Hydrocarbon and Hydrographic Data from Southern Hecate Strait: Water and Sediment Samples Collected in September, 2003

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by

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ABSTRACT

McLaughlin, F. A., Yunker, M. B., Whitney, F. A., Lee, K., Fowler, B. R., Fowler, M. G. and Robinson, R. 2008. Hydrocarbon and hydrographic data from southern Hecate Strait: Water and sediment samples collected in September, 2003. Can. Data Rep. Hydrogr. Ocean. Sci. 168: vi + 118 p**.**

This program had two scientific objectives. First, a west coast protocol for the analysis of hydrocarbon parameters in sediment and water samples was developed based on previous work in organic geochemistry and environmental fate and effects studies of oil in marine environments. Second, a small pilot study was conducted during an oceanographic expedition in Hecate Strait aboard the *CCGS John P. Tully* from September 15-21, 2003 to determine the natural background hydrocarbon concentrations in both the sediment and overlying water column prior to any offshore oil and gas development in the Hecate Strait region. On this expedition water column samples and sediment cores were collected along an east-west section across southern Hecate Strait by hydrographic casts using a conductivity-temperature-depth (CTD)/ rosette and a sediment box core. Water samples from ten sites were analysed for salinity, dissolved oxygen, orthophosphate, reactive silicate, nitrate, methane, ethane, ethylene and propane, while sediment samples from three sites were analysed for moisture content, organic carbon, organic nitrogen, opal, ^{210}Pb, *n*-alkanes and isoprenoids, parent and alkyl polycyclic aromatic hydrocarbons (PAHs), and terpane, hopane and sterane petroleum biomarkers.

Résumé

McLaughlin, F. A., Yunker, M. B., Whitney, F. A., Lee, K., Fowler, B. R., Fowler, M. G. and Robinson, R. 2008. Hydrocarbon and hydrographic data from southern Hecate Strait: Water and sediment samples collected in September, 2003. Can. Data Rep. Hydrogr. Ocean. Sci. 168: vi + 118 p**.**

Ce programme avait deux objectifs scientifiques.En premier lieu, nous avons mis au point un protocole propre à la côte Ouest pour l'analyse des paramètres des hydrocarbures dans les échantillons d'eau et de sédiments d'après des travaux antérieurs sur la géochimie organique et des études sur le devenir du pétrole dans l'environnement et sur ses effets dans les milieux marins. En deuxième lieu, nous avons réalisé une petite étude pilote au cours d'une expédition océanographique dans le détroit d'Hecate à bord du *NGCC John P. Tully*, du 15 au 21 septembre 2003, afin de déterminer les concentrations naturelles d'hydrocarbures dans les sédiments et la colonne d'eau avant toute activité de prospection pétrolière et gazière dans la zone extracôtière du détroit d'Hecate. Durant cette expédition, des palanquées munies d'un capteur CTP (conductivité-température-profondeur)/rosette et d'un carottier à boîte ont prélevé des échantillons dans la colonne d'eau et des carottes de sédiments le long d'un axe est-ouest dans le sud du détroit. Les échantillons d'eau prélevés à dix endroits ont été analysés aux fins de la détermination de la salinité et de la teneur en oxygène dissous, orthophosphate, silicate réactif, nitrate,

méthane, éthane, éthylène et propane. Les échantillons de sédiments recueillis à trois endroits ont été analysés aux fins de la détermination de la teneur en eau, carbone organique, azote organique, opale, ^{210}Pb, *n*-alcanes et isoprénoïdes, dérivés alkylés et apparentés d'hydrocarbures aromatiques polycycliques (HAP) et biomarqueurs (terpanes, hopanes et stéranes) du pétrole.

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The success of this program has been due to collaboration between researchers at Fisheries and Oceans Canada's Institute of Ocean Sciences and Bedford Institute of Oceanography, the assistance of the ship's captain and crew and the oceanographic sampling team. Valuable guidance about station location was provided by Vaughn Barrie from the Pacific branch of National Resources Canada. Collaboration with researchers from the National Resources Canada's Organic Chemistry laboratory in Calgary provided additional hydrocarbon mass spectrometry data. Kalai Pillay of Axys Analytical Services Ltd. analysed the PAH authentic standards.

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1. INTRODUCTION

The continental shelf adjacent of British Columbia is believed to contain significant reserves of oil and gas. The first offshore test wells were drilled in 1969 in a region stretching from Barkley Sound to Hecate Strait and non-commercial levels of oil were found in Hecate Strait. A federal moratorium on offshore exploration was declared in 1989 by Canada; a moratorium will only be lifted upon the request of the province of British Columbia. In 2001 British Columbia appointed an independent scientific panel to report whether offshore oil and gas could be extracted in a scientifically sound and environmentally responsible manner. In response to the panel's 2002 report the province subsequently asked the University of Northern British Columbia (UNBC) to carry out scientific research and develop a work plan in response to the report's recommendations.

A West Coast Offshore Oil and Gas Workshop was held at the Institute of Ocean Sciences (IOS) January 8-10, 2003 to review relevant research activities. This meeting provided the catalyst for scientists from IOS and Bedford Institute of Oceanography (BIO) to collaborate and initiate a small program that would establish a west coast protocol for sample analysis, and conduct a small survey to collect and analyze samples to provide data for an unstudied region of the North Pacific coast. Accordingly, this program has two scientific objectives: 1) to develop a west coast protocol for the analysis of hydrocarbon concentrations in samples, and 2) to conduct a small pilot study in Hecate Strait to determine the natural background hydrocarbon concentrations in both the sediment and overlying water column in a region identified as an area for future offshore oil and gas development.

The west coast hydrocarbon analysis protocol was developed under contract by Mark Yunker and identifies a specific and detailed number of *n*-alkanes, polycyclic aromatic hydrocarbons (PAHs) and petroleum biomarker compounds to be analyzed in sediment or biological samples. Analysis of compounds on this list, developed particularly for offshore west coast samples, will provide the necessary baseline pre-development data for comparison in the future if there is contamination from petroleum exploration, production or transport. These data also will establish the natural petroleum fingerprint of west coast sediments and provide a benchmark or baseline and thus enable fate and effects studies.

The field program was carried out aboard the *CCGS John P. Tully* (cruise #2003-27) on the return journey from Station Papa by researchers from the Institute of Ocean Sciences (IOS), Fisheries & Oceans Canada. The field work was conducted from September 15 -21, 2003 in the southern Hecate Strait, working from Juan Perez Sound in the west to Milbank Sound in the east.

Data assembled in the present report include the standard supporting oceanographic determinations of conductivity-temperature-depth (CTD) and rosette bottle measurements for salinity, nutrients, dissolved oxygen and low molecular weight hydrocarbons including methane, ethane, ethylene and propane. Sediment analyses from box core sections include alkanes, parent and alkyl PAHs, and terpane, hopane and sterane biomarkers plus ancillary analyses for carbon, nitrogen, opal and lead-210 (^{210}Pb).

2. DEVELOPMENT OF A PROTOCOL FOR BASELINE STUDIES PRIOR TO OFFSHORE OIL AND GAS EXPLORATION

2.1 BACKGROUND

In the past decade, organic geochemistry has played a major role in assessments of the impact of the *Exxon Valdez* oil spill on the environment of Prince William Sound, Alaska, through the identification and quantification of the multiple petroleum sources in the spill area (Bence et al., 1996). Oil seeps in the eastern Gulf of Alaska were first thought to be responsible for the petroleum background in Prince William Sound (Bence et al., 1996), but coal has subsequently been championed as the major source by one group (Short et al., 1999; 2000) and oil seepage and eroded shales by another (Page et al., 1996, 1999; Boehm et al., 2000; 2001). Multivariate statistical analyses of the data have concluded that five principal petroleum sources contribute to sediments collected in the Gulf of Alaska and Prince William Sound (Mudge, 2002; Burns et al., 2006), although the source proportions are dependent on the program and the method used to constrain results.

For Prince William Sound the environmental significance of source stems from whether the PAHs in the background come from coal, and thus may be of limited bioavailability, or from oil seepage and eroded shales and, therefore, may have greater bioavailability (Short et al., 1999; Boehm et al., 2001; Burns et al., 2006). A comprehensive understanding of the bioavailability of petroleum in the background of the area is necessary for an accurate assessment of the environmental impact of the *Exxon Valdez* oil spill. The question remains unresolved as this extended debate continues in the scientific literature.

The *Exxon Valdez* spill provides the most relevant case study of how the problems of source identification can confound, or at least complicate, a study of the fate and effects of an oil spill when a benchmark does not exist. Identification and quantification of baseline petroleum hydrocarbons in the proposed Hecate Strait and Tofino basin exploration areas are essential to the evaluation of the fate, effects and weathering of oil in the event of a blow out or oil spill (cf. Bence et al., 1996). Because these areas have a similar coal- and oil-rich geology to coastal southern Alaska, multiple natural sources of hydrocarbons can potentially contribute to the petroleum background through oil seeps and erosion of carbon-rich rock formations.

When the potential for chronic anthropogenic petroleum discharges is added to the mix, many of the same compounds expected in possible Coastal B.C. oils also will be present in contemporary sediments from Hecate Strait and offshore Vancouver Island. Accordingly, methods that utilise a variety of molecular and isotopic techniques will be required. The hydrocarbon benchmark will have to include both sediments and potential petroleum source rocks from the area, although water and tissues from sessile and benthic animals (e.g., mussels and flatfish) also will be required for a full assessment. This benchmark needs to be established before exploratory drilling begins.

2.2 PETROLEUM BIOMARKERS

A large number of different hopane and sterane biomarker parameters have been developed by petroleum organic geochemists to correlate different oils, and determine their source, original depositional environment, maturation and amount of biodegradation (Peters and Moldowan, 1993). In the last two decades many of these techniques have been utilised to identify the origins and degree of biodegradation of oils spilled in the marine environment (e.g., Volkman et al., 1992; Wang and Fingas, 1994; Wang et al., 1995; Bence et al., 1996; Barakat et al., 1999; Zakaria et al., 2000).

Fingerprinting methods, utilising multiple parameters sensitive to both source composition and degree of weathering, can be used to distinguish oil-spill hydrocarbons from petroleum sources unrelated to a spill in shoreline, subtidal sediment, and biological samples (e.g., Bence et al., 1996). Methods used in such studies include measurements of total hydrocarbons and carbon isotopic compositions ($\delta^{13}C$) of sample extracts, and chromatographic and mass spectrometric analyses of aliphatic (the non-aromatic alkanes, tricyclic and tetracyclic terpanes, hopanes and steranes) and aromatic (benzene derivatives, PAHs and mono- and triaromatic steranes) biomarkers.

The presence or absence of selected hopane biomarkers and characteristic ratios of different hopanes and steranes also can be invaluable for distinguishing oils from different sources (Volkman et al., 1992; Peters and Moldowan, 1993; Barakat et al., 1999; Zakaria et al., 2000; Yunker and Macdonald, 2003b). Distributions of 2- to 6-ring polycyclic aromatic hydrocarbons, dibenzothiophenes and aromatic steranes have proved to be particularly effective for distinguishing *Exxon Valdez* oil and its weathered residues from oil seep or coal hydrocarbons in the modern sediments of Prince William Sound (Bence et al., 1996; Douglas et al., 1996; Short and Heintz, 1997; Short et al., 1999; Boehm et al., 2001). The single-ring aromatics (benzene, toluene, ethylbenzene, xylene), which are of significant environmental concern, are highly volatile, dissipate rapidly, and are of little value in the identification of hydrocarbon sources (Bence et al., 1996).

Because no real knowledge exists about the composition of Queen Charlotte or Tofino Basin oils, should there be any, benchmark studies should consist of detailed examinations of the concentrations and carbon isotopic compositions of alkane and PAH biomarkers in representative samples from Hecate Strait and the surrounding shoreline. The identification and quantification of the background hydrocarbons with both natural and anthropogenic sources is necessary to make meaningful fate and effects assessments, should there be an oil spill during drilling or production. A more detailed description of the parameters that should be measured and what they mean in terms of identifying spilled oil against a pre-existing hydrocarbon background follows.

2.2.1 Alkanes and cycloalkanes

Petroleum-derived alicyclic alkanes in marine environmental samples are frequently degraded to the point where they are not discernible from the biogenic background (e.g., Wang and Fingas, 1994; Bence et al., 1996), although petroleum can be remarkably persistent when buried in suboxic sediments (Reddy et al., 2002; White et al., 2005). Accordingly, the measurement of

total petroleum hydrocarbons normally is valuable only in the initial stages following an oil spill and usually is of little value for long term fate and effects studies. In contrast, the tricyclic terpane, hopane and sterane biomarkers are refractory enough to persist in the environment for extended periods of time.

Hopanes and steranes are stable 5- and 4-ring hydrocarbons whose respective precursors in living organisms are the hopanols produced by bacteria and the sterols produced by algal and terrestrial plants (Ourisson et al., 1979; Mackenzie et al., 1982; Ourisson et al., 1987). The precursors of the tri- and tetracyclic terpanes are less well established but bacteria or primitive alga are likely possibilities (Ourisson et al., 1982; Simoneit et al., 1990; Peters and Moldowan, 1993). Heat and pressure diagenetically modify all these compounds from the "biological" configuration into forms with higher thermodynamic stability as organic matter is converted into petroleum or coal over geological time scales. The modifications occur in predictable ways resulting in well defined and characteristic series of the rearranged, diagenetic isomers of these hopane and sterane biomarkers in organic rich sediments and sedimentary rocks, petroleum source rocks, crude oils, coals, etc. (Peters and Moldowan, 1993; Farrimond et al., 1998). Because these biomarkers are more stable than other petroleum components such as the resolved alkanes, the hopanes and steranes serve as conservative indicators (and tracers) of petroleum that has entered the marine environment *via* oil seeps or the erosion of bitumens, organic-rich rocks or coals (e.g., Volkman et al., 1992; Yunker et al., 1993; Prince et al., 1994; Bieger et al., 1996; Hostettler et al., 1999).

The tri- and tetracyclic terpanes, hopanes and steranes are absent from refined products such as gasoline, but they are present in crude and heavy oils, motor oils, asphalt and coal (e.g., Barrick et al., 1984; Peters and Moldowan, 1993; Rogge et al., 1993; Bieger et al., 1996; Faure et al., 2000). Because the bioavailability of contaminants such as the PAHs differs dramatically between these various matrices, the exact petroleum source(s) must be established to predict the impact of this petroleum on biota (e.g., Short et al., 1999). The polycyclic biomarkers are more resistant to weathering than are the alkanes and 2- and 3-ring PAH.

The triterpanes 18α(H)-oleanane and 17α(H),18α(H),21β(H)-28,30-bisnorhopane hold special interest for the fate and effects studies of *Exxon Valdez* oil (Bence et al., 1996). These compounds also promise to be valuable biomarkers for the Queen Charlotte Basin. Oleanane is an angiosperm (flowering plant) biomarker whose presence generally indicates Cretaceous (105-65 Ma) or younger petroleum reservoirs (Creaney and Allan, 1992; Creaney et al., 1994). Oleanane is absent in oils from Cook Inlet (Bence et al., 1996), Western Canada (Creaney and Allan, 1992; Creaney et al., 1994) and the Alaska North Slope (Bence et al., 1996). Oleanane does occur in Tertiary oil shows and bitumen samples from the Queen Charlotte Islands and seep oils from the eastern Gulf of Alaska (Fowler et al., 1988). 28,30-Bisnorhopane also does not occur at detectable levels in oils from the Alaska North Slope, but it is present in some Western Canada oils including the heavy oils from the Athabasca tar sands (Brooks et al., 1988). Bisnorhopane is present in non-Tertiary (likely Jurassic) samples from the Queen Charlotte Islands (Fowler et al., 1988).

2.2.2 Polycyclic aromatic hydrocarbons and aromatic steranes

PAHs can induce biological effects (Canadian Council of the Ministers of the Environment, 1998). Accordingly, PAHs of concern as environmental contaminants should be measured along with PAHs with potential utility as source indicators.

The dibenzothiophene content of crude oils varies from trace levels to more than 30% of the alkyl PAH total (Requejo et al., 1996) and is not always correlated with the sulphur content (Hughes et al., 1995). It has been established that the ratio of the dibenzothiophenes to the phenanthrenes is characteristic of the depositional environment where a crude oil was formed (Hughes et al., 1995; Requejo et al., 1996) and can be used to distinguish petroleum sources in the environment (Hughes et al., 1995; Douglas et al., 1996). Ratios can be based either on the totals for all homologues (e.g., C_0 - C_2 sum), and thereby improve the detectability of the ratio (Requejo et al., 1996), or on the ratios of specific homologues (e.g., C_2), and reduce the sensitivity of the ratio to petroleum weathering (Douglas et al., 1996).

PAH ratios of C_2-dibenzothiophene/C_2-phenanthrene (D2/P2) and C_3-dibenzothiophene/C_3-phenanthrene (D3/P3) are particularly useful for distinguishing oils (Bence et al., 1996). These ratios, which vary among oils having different sulphur contents, remain relatively constant as spilled oil weathers and may be used to identify oil sources when the residues are heavily degraded (Douglas et al., 1996). Biodegradation experiments using *Exxon Valdez* crude oil in soil (Douglas et al., 1996) show that the D2/P2 and D3/P3 ratios remain relatively unchanged even when the individual components have been degraded by more than 95% and total PAH has been reduced by more than 98%. In contrast, the C_3-chrysenes exhibit little depletion even in the advanced stages of crude oil weathering and the ratio of C_3-dibenzothiophene/C_3-chrysene (D3/C3) provides a measure the degree of weathering for crude oil in the aquatic environment (Douglas et al., 1996).

Combustion products are distinguished from all oils by the dominance of 4- to 6-ring PAH over the lower molecular weight 2- to 3-ring PAH and by the dominance of the unsubstituted compound over the alkylated homologues particularly for the four-ring and higher homologous PAH series. PAH alkyl homologue series maxima at C_1 and higher usually can be taken as a sign of mature organic matter or petroleum, whereas a maximum at C_0 usually indicates combustion (Laflamme and Hites, 1978; Wakeham et al., 1980; Sporstøl et al., 1983). For example, the alkyl phenanthrene/anthracene (P) series for petroleum has an essentially linear concentration increase to higher homologues, whereas wood, brown coal and coal combustion maxima generally are at C_0 for the alkyl P plus the naphthalenes (N), fluoranthene/pyrenes (FP) and benz[*a*]anthracene/chrysenes (C)(Grimmer et al., 1983; Grimmer et al., 1985; Simoneit, 1985; Schauer et al., 2001). The interpretation of combustion PAH distributions for sediments from B.C. has been described by Yunker et al. (1999; 2002; 2003a).

The benzonaphthothiophenes are PAHs characteristic of diesel and coal combustion sources (Grimmer et al., 1983; Wise et al., 1988; Tolosa et al., 1996). These sulphur-containing PAHs have been found to be more abundant than dibenzothiophene in sediments from large areas of the NW Mediterranean Sea (Tolosa et al., 1996; Salau et al., 1997). The main constituents usually are benzo[*b*]naphtho[2,1-*d*]thiophene, benzo[*b*]naphtho[1,2-*d*]thiophene and benzo[*b*]naphtho[2,3-*d*]thiophene (Salau et al., 1997).

The mono- and triaromatic steranes are produced by the aromatization of steranes as petroleum matures (Peters and Moldowan, 1993). The aromatic steranes are highly resistant to degradation and these compounds will preserve oil source profiles even in heavily biodegraded samples (Peters and Moldowan, 1993; Short et al., 1999; Boehm et al., 2001). A ratio of two refractory constituents of crude oils, the triaromatic steroids to the methylchrysenes, can be used to distinguish crude oils from coals in Prince William Sound (Short et al., 1999; Boehm et al., 2001).

2.3 RECOMMENDED PARAMETERS FOR BASELINE STUDIES

Sediments and potential petroleum source rocks from land masses adjacent to Hecate Strait and offshore Vancouver Island should be analyzed for the terpanes and biogenic and diagenic hopanes listed in Table 1 and the steranes and diasteranes listed in Table 2. Table 3 lists parent and alkyl PAHs that are valuable for both distinguishing combustion and petroleum sources and fingerprinting petroleum (Yunker et al., 2002).

Based on present knowledge, any oils are likely to be either Jurassic or Tertiary in origin (Fowler et al., 1988). The natural hydrocarbon background is likely to arise from coals (likely Tertiary) and oil seeps. Accordingly, the presence or absence of biomarkers such as oleanane (Tertiary) or 28,30-bisnorhopane (not Tertiary, likely Jurassic) will be important for distinguishing these petrogenic groups (Fowler et al., 1988).

Recent work suggests that lupane could be a valuable diagnostic biomarker particularly for Tertiary oils (Nytoft et al., 2002). Under normal chromatographic conditions lupane coelutes with oleanane, and the separation of the two biomarkers requires a polar column (Nytoft et al., 2002). Initially a subset of samples should be analyzed for lupane to see if its analysis in all samples is warranted. Unusual PAHs from the partial aromatization of triterpanes are proving to be valuable diagnostic source indicators for some oils (Li et al., 1997) and are worth investigating further in Hecate Strait – Tofino Basin samples.

Table 1. Terpanes and biogenic and diagenic hopanes recommended for analysis

Name	Ion	Abbreviation
$C_{19}H_{34}$ tricyclic terpane	191	19/3
$C_{20}H_{36}$ tricyclic terpane	191	20/3
$C_{21}H_{38}$ tricyclic terpane	191	21/3
$C_{22}H_{40}$ tricyclic terpane	191	22/3
$C_{23}H_{42}$ tricyclic terpane	191	23/3
$C_{24}H_{44}$ tricyclic terpane	191	24/3
$C_{25}H_{46}$ tricyclic terpane	191	25/3 (R and S)
$C_{24}H_{42}$ tetracyclic terpane	191	24/4
$C_{26}H_{48}$ tricyclic terpane	191	26/3 (R and S)
$C_{28}H_{52}$ tricyclic terpane	191	28/3 (R and S)
$C_{29}H_{54}$ tricyclic terpane	191	29/3 (R and S)
18α(H)-22,29,30-trisnorneohopane	191	27Ts
17α(H),21β(H)-25,28,30-trisnorhopane	177	25nor28αβ
22,29,30-Trisnorhop-17(21)-ene	191	30D17
17α(H)-22,29,30-trisnorhopane	191	27Tm (27α)
$C_{30}H_{56}$ tricyclic terpane	191	30/3 (R and S)
17β(H)-22,29,30-trisnorhopane	191	27β
17α(H),21β(H)-28,30-bisnorhopane	191	28αβ
17α(H),21β(H)-25-norhopane	191	25nor30αβ
17α(H),21β(H)-30-norhopane	191	29αβ
17α(H),21β(H)-25-norhopane	177	25nor30αβ
18α(H)-30-norneohopane	191	29Ts
15α-methyl-17α(H)-27-norhopane (diahopane)	191	30D
17β(H),21α(H)-30-norhopane (normoretane)	191	29βα
18α(H)-oleanane	191	30O
17α(H),21β(H),22(R)-25-norhomohopane	177	25nor31αβR
17α(H),21β(H)-hopane	191	30αβ
Neohop-13(18)-ene	191	30D13
17β(H),21β(H)-30-Norhopane	191	29ββ
17β(H),21α(H)-hopane (moretane)	191	30βα
17α(H),21β(H),22(S)-homohopane	191	31αβS
17α(H),21β(H),22(R)-homohopane	191	31αβR
Gammacerane	191	30G
17β(H),21β(H)-hopane	191	30ββ
17β(H),21α(H)-homohopane	191	31βα
Diploptene (hop-22(29)-ene)	191	D
17α(H),21β(H),22(S)-bishomohopane	191	32αβS
17α(H),21β(H),22(R)-bishomohopane	191	32αβR
17α(H),21β(H),22(S)-trishomohopane	191	33αβS
17α(H),21β(H),22(R)-trishomohopane	191	33αβR
17α(H),21β(H),22(S)-tetrakishomohopane	191	34αβS
17α(H),21β(H),22(R)-tetrakishomohopane	191	34αβR
17α(H),21β(H),22(S)-pentakishomohopane	191	35αβS
17α(H),21β(H),22(R)-pentakishomohopane	191	35αβR

Table adapted from Weiss et al. (2000), with the addition of biogenic hopanes.

Table 2. Steranes and diasteranes recommended for analysis

Name	Abbreviation
m/z 217 Steranes	
13β(H),17α(H),20(S)-cholestane (diasterane)	27dβS
13β(H),17α(H),20(R)-cholestane (diasterane)	27dβR
13α(H),17β(H),20(R)-cholestane (diasterane)	27dαR
13α(H),17β(H),20(S)-cholestane (diasterane)	27dαS
5α(H),14α(H),17α(H),20(S)-cholestane	27αααS
5α(H),14β(H),17β(H),20(R)-cholestane	27αββR
5α(H),14β(H),17β(H),20(S)-cholestane	27αββS
5α(H),14α(H),17α(H),20(R)-cholestane	27αααR
24-methyl-13β(H),17α(H),20(S)-cholestane (diasterane)	28dβS
24-methyl-13β(H),17α(H),20(R)-cholestane (diasterane)	28dβR
24-methyl-13α(H),17β(H),20(R)-cholestane (diasterane)	28dαR
24-methyl-13α(H),17β(H),20(S)-cholestane (diasterane)	28dαS
24-methyl-5α(H),14α(H),17α(H),20(S)-cholestane	28αααS
24-methyl-5α(H),14β(H),17β(H),20(R)-cholestane	28αββR
24-methyl-5α(H),14β(H),17β(H),20(S)-cholestane	28αββS
24-methyl-5α(H),14α(H),17α(H),20(R)-cholestane	28αααR
24-ethyl-13β(H),17α(H),20(S)-cholestane (diasterane)	29dβS
24-ethyl-13β(H),17α(H),20(R)-cholestane (diasterane)	29dβR
24-ethyl-13α(H),17β(H),20(R)-cholestane (diasterane)	29dαR
24-ethyl-13α(H),17β(H),20(S)-cholestane (diasterane)	29dαS
24-ethyl-5α(H),14α(H),17α(H),20(S)-cholestane	29αααS
24-ethyl-5α(H),14β(H),17β(H),20(R)-cholestane	29αββR
24-ethyl-5α(H),14β(H),17β(H),20(S)-cholestane	29αββS
24-ethyl-5α(H),14α(H),17α(H),20(R)-cholestane	29αααR
24-propyl-5α(H),14α(H),17α(H),20(S)-cholestane	30αααS
24-propyl-5α(H),14β(H),17β(H),20(R)-cholestane	30αββR
24-propyl-5α(H),14β(H),17β(H),20(S)-cholestane	30αββS
24-propyl-5α(H),14α(H),17α(H),20(R)-cholestane	30αααR
4-methyl-14α(H),17α(H)-cholestanes	M28αα
4,24-dimethyl-14α(H),17α(H)-cholestanes	M29αα
4-methyl-24-ethyl-14α(H),17α(H)-cholestanes	M30αα
4,23,24-trimethyl-14α(H),17α(H)-cholestanes (dinosteranes)	M30D
m/z 218 Steranes	
5α(H),14β(H),17β(H),20(R)-cholestane	27ββR
5α(H),14β(H),17β(H),20(S)-cholestane	27ββS
24-methyl-5α(H),14β(H),17β(H),20(R)-cholestane	28ββR
24-methyl-5α(H),14β(H),17β(H),20(S)-cholestane	28ββS
24-ethyl-5α(H),14β(H),17β(H),20(R)-cholestane	29ββR
24-ethyl-5α(H),14β(H),17β(H),20(S)-cholestane	29ββS
24-propyl-5α(H),14β(H),17β(H),20(R)-cholestane	30ββR
24-propyl-5α(H),14β(H),17β(H),20(S)-cholestane	30ββS

Table 3. Parent and alkyl PAH parameters recommended for analysis

PAH	Molecular-Mass	PAH	Molecular-Mass
Naphthalene	128	2,6-dimethylphenanthrene	206
C1-Naphthalenes	142	C3-Phenanthrene/anthracenes	220
2-Methylnaphthalene	142	C4-Phenanthrene/anthracenes	234
1-Methylnaphthalene	142	Retene	234
C2-Naphthalenes	156	Fluoranthene	202
C3-Naphthalenes	170	Pyrene	202
C4-Naphthalenes	184	C1-Fluoranthene/pyrenes	216
Biphenyl	154	C2-Fluoranthene/pyrenes	230
Acenaphthylene	152	C3-Fluoranthene/pyrenes	244
Acenaphthene	154	Benz[*a*]anthracene	228
Fluorene	166	Chrysene/triphenylene	228
C1-Fluorenes	180	C1-Benz[*a*]anthracene/chrysenes	242
C2-Fluorenes	194	C2-Benz[*a*]anthracene/chrysenes	256
C3-Fluorenes	208	C3-Benz[*a*]anthracene/chrysenes	270
Dibenzothiophene	184	Benzo[*b*]naphtho[2,1-*d*]thiophene	234
C1-Dibenzothiophenes	198	Benzo[*b*]naphtho[1,2-*d*]thiophene	234
C2-Dibenzothiophenes	212	Benzo[*b*]naphtho[2,3-*d*]thiophene	234
C3-Dibenzothiophenes	226	Benzo[*b/j/k*]fluoranthene	252
Phenanthrene	178	Benzo[*e*]pyrene	252
Anthracene	178	Benzo[*a*]pyrene	252
C1-Phenanthrene/anthracenes	192	Perylene	252
3-Methylphenanthrene	192	Dibenz[*a,j*]anthracene	278
2-Methylphenanthrene	192	Dibenz[*a,h*]anthracene	278
9/4-Methylphenanthrene	192	Picene	278
1-Methylphenanthrene	192	Indeno[7,1,2,3-*cdef*]chrysene	276
C2-Phenanthrene/anthracenes	206	Indeno[1,2,3-*cd*]pyrene	276
1,7-dimethylphenanthrene	206	Benzo[*ghi*]perylene	276

3. FIELD SAMPLING AND METHODS OF ANALYSIS

The sampling program for mission #2003-27 included an extensive oceanographic survey of the Northeast Pacific Ocean, and conducted the following in support of a hydrocarbon survey in Hecate Strait:

- A ten station CTD survey across Hecate Strait
- A five station water column survey across Hecate Strait
- Three box cores were collected from the centre of Hecate Strait, Juan Perez Sound and Milbank Sound.

Analytical methods and resulting data are reported here.

3.1 STATION LOCATIONS AND SAMPLING PROTOCOL

A chronological list of the activities conducted at each station and the location at the start of the cast is provided in Table 4. Station positions were obtained from the ship's navigation system on the bridge and the station locations are illustrated in Figure 1.

Table 4. Mission 2003-27 CTD/Rosette Cast Locations

Station	CTD Cast #	Date	Latitude ºN	Longitude ºW	Water Depth, m	Activity
JP1	107	2003/9/16	52.6493	130.2102	254	Rosette cast, box core
JP2	110	2003/9/16	52.6307	130.4668		CTD cast
JP3	111	2003/9/17	52.6132	130.6843	137	Rosette cast
JP4	115	2003/9/17	52.5688	130.9668		CTD cast
JP5	118	2003/9/17	52.5278	131.2063	157	Rosette cast
JP6	120	2003/9/17	52.5240	131.2728		CTD cast
JP7	123	2003/9/17	52.5203	131.3998		CTD cast
JP8	125	2003/9/17	52.5535	131.4980	333	Rosette cast, box core
JP9	127	2003/9/17	52.6033	131.5317		CTD cast
MS1	133	2003/9/18	52.3820	128.5497	241	Rosette cast, box core

Rosette casts were carried out using a rosette outfitted with 24 10-litre Niskin bottles, a Seabird Electronics SBE 911+ CTD (Conductivity-Temperature-Depth instrument), Benthos altimeter, SBE 43 oxygen probe, Seapoint fluorometer and WET Labs transmissometer. CTD casts were carried out using the rosette package without collecting water samples.

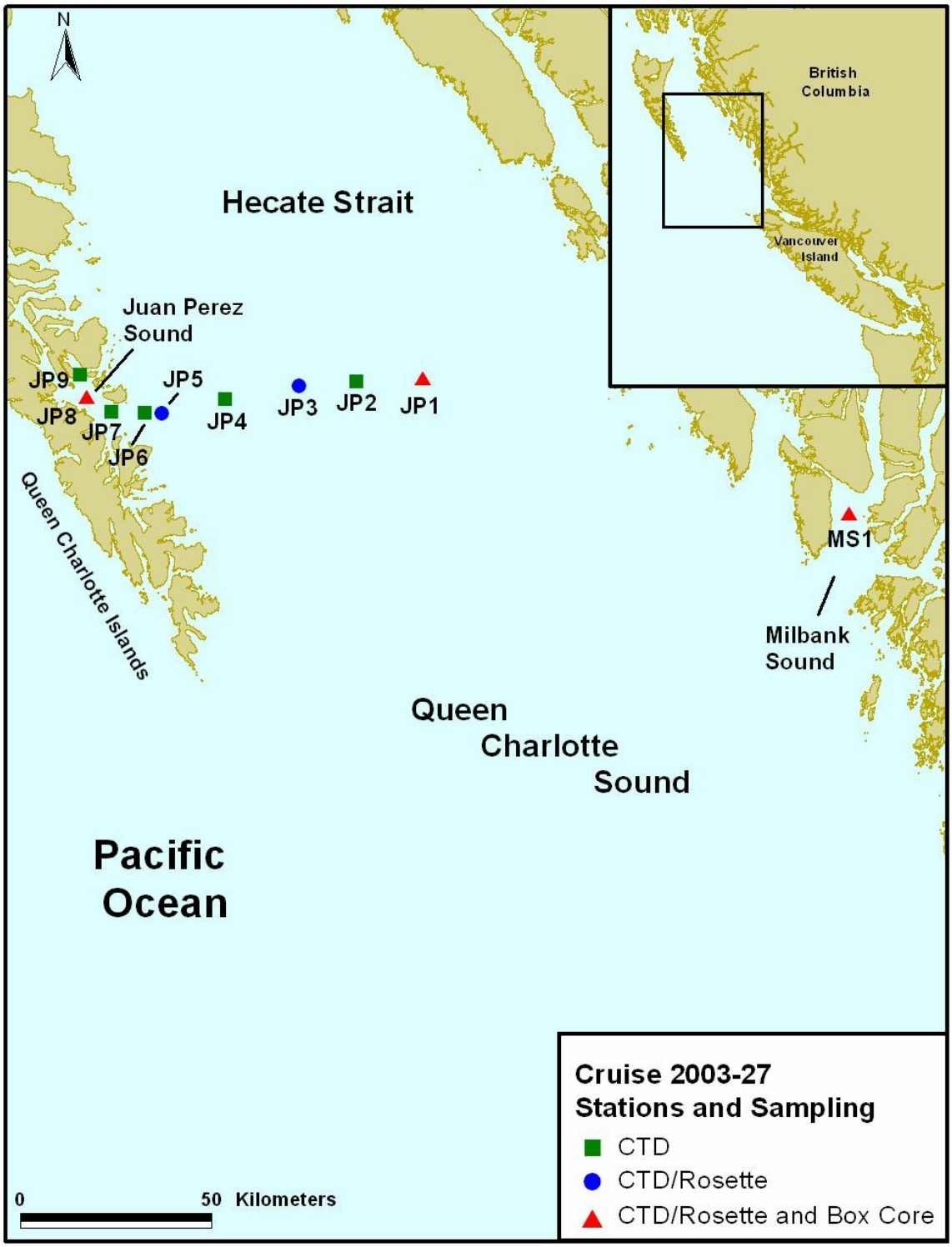


Figure 1. Mission 2003-27 station locations.

The CTD/rosette was deployed from the aft deck of the *CCGS John P. Tully*, using an A-frame and winch. Profile data were taken with the Seabird 911+ CTD (S/N 0550), installed with a conducting sea cable for real-time data acquisition. The CTD was mounted to a custom built aluminum rosette frame holding 24 Niskin bottles. Additional data were collected from a WET Labs transmissometer (light attenuation), Seapoint fluorometer (*in vivo* chlorophyll) and SBE 43 oxygen sensor mounted on the CTD. On each rosette cast, water column CTD profiling was uninterrupted on the down cast. Water samples were collected near bottom and at standard depths on the up cast. The rosette was halted for 30 seconds at depth before the Niskin bottles were closed. A Benthos sonar altimeter was used to detect distance to the bottom from the rosette. This allowed sampling within a few meters of the bottom. GPS data were logged continuously throughout rosette casts to provide location information. Bottom depth was tracked using a Simrad EA500 sounder and 12 kHz transducer.

Sediment sampling was conducted using a Pouliot box corer (0.06 m^2, 50-55 cm deep) with a stainless steel liner. The box core was also deployed from the aft deck of the *CCGS John P. Tully* using an A-frame and winch. Sediment box cores were sectioned in a sheltered area on the aft deck (partially under the stairs to the deck above) on the starboard side of the main door to the laboratory. A plastic tarp was fastened above the core-sectioning table to ensure that foreign material did not fall into the sediment samples.

3.2 PROCESSING AND VALIDATION OF THE CTD DATA

3.2.1 General CTD Processing Steps

- verification of calibration coefficients for all sensors;
- verification of data files produced by acquisition programs with log sheets;
- checking and editing header information;
- conversion of CTD data files into IOS HEADER format;
- application of sensor calibrations to the “raw” data;
- removal of data spikes and corrupted data;
- correction for differences in temperature and conductivity time responses;
- deletion of swells, upcast and unwanted surface records;
- manual editing where required;
- reduction of the data to one meter averaged values;
- production of final test plots;
- creation of overlay plots to compare CTD data with bottle data;
- adjustment of the processed CTD data to agree with reference data and historical data;
- preparation of bottle files.

3.2.2 Pressure

Pressure values were corrected by applying an offset of +2db.

3.2.3 Salinity

Dual conductivity sensors, calibrated in April 2003 by Sea-Bird Electronics, were mounted on the CTD. Post cruise corrections were made to CTD salinity data based on comparison with salinity samples collected during rosette casts and analysed on a Portasal. Data from the primary sensor was selected for archival and corrected by subtracting 0.004psu. After recalibration COMPARE was rerun on the primary salinity and the results were satisfactory.

3.2.4 Temperature

Dual SBE temperature sensors, also calibrated in April 2003 by Sea-Bird Electronics, were mounted on the CTD.

3.2.5 Oxygen Calibration

The CTD sensor and bottle data were compared and the fit that gave the best agreement was:

$$\text{Titrated DOX} = 1.1362 \times \text{SBE\_DOX} - 0.0143.$$

The SBE dissolved oxygen sensor data could require calibration for time-response due to flow configuration transit time and sensor response times. Upcast and downcast traces in casts with few bottle stops were compared (casts 144 and 139) to determine the transit time. Based on these traces and data from previous cruises a shift of 9 s was applied. No correction was required to correct for the sensor response-time because the sample bottles were tripped while the CTD was stopped.

3.2.6 Fluorescence

Upcast and downcast profiles were examined to determine the vertical offset of the temperature and fluorescence traces and a shift of +24 records was applied (+1 s), the same shift that had been applied to recent data sets. A median filter, fixed size = 11, was applied to reduce spikiness.

3.2.7 CTD Data at Bottle Depths for Water Chemistry File

The CTD pressure, temperature and salinity associated with the water samples in the water chemistry file were obtained from the CTD downcast.

See Appendix 6.1 for data tables and plots of the CTD data.

3.3 WATER COLUMN SAMPLING AND ANALYSIS

Niskin rosette bottles (10L) were sampled on the upcast, stopping at the selected depth for 30 seconds before the bottle was tripped. Samples were drawn from bottles in the following order: dissolved oxygen, low molecular weight hydrocarbons (LMW-HC), nutrients and salinity.

CTD data at bottle trip depths and water chemistry data are reported in Appendix 6.2. Water column chemistry profile plots and section plots along the cruise transect are provided in Appendix 6.3.

3.3.1 Sampling and Laboratory Methods

The precision of the methods used was estimated by analyzing replicates and expressed as the pooled standard deviation s_p using the equation:

$$s_p = \sqrt{\frac{\sum \ (c(1)-c(2))^2}{2n}}$$

where c(1) and c(2) were the concentrations of duplicate samples and n refers to the number of pairs.

3.3.1.1 Salinity

Samples were drawn from the Niskin bottle into 300 mL glass salinity bottles. Bottles were rinsed three times before filling to the shoulder and capped tightly. Analysis was performed at sea using a Model 8410 Guildline Portasal in a thermostated but not air-conditioned room. The salinometer was standardized against IAPSO standard seawater (batch P141).

3.3.1.2 Dissolved Oxygen

Dissolved oxygen samples were collected into a 125 mL glass bottle with a ground glass joint and stopper. The sample was transferred from the Niskin *via* latex tubing to avoid aeration. The sampling tube was connected to the spigot of the Niskin bottle and, holding the tube up, rinsed by flowing sample water through the tube to remove any trapped air bubbles. The tube was then placed at the bottom of the flask and the flask was filled smoothly from the bottom and overflowed by two times its volume. The sample was “pickled" immediately by the addition of 1 mL magnesium chloride and 1 mL of alkaline iodide solutions and analyzed on board within 24 hours of collection (Carpenter, 1965) using an automated version of the Micro-Winkler Technique (methodology described in an internal DFO/IOS document: Dissolved Oxygen Determination Methods and Procedures by Bernard Minkley and George Chase). The titration was performed with a Metrohn Dosimat 665 and the end point was detected using a Brinkmann probe colorimeter PC900.

3.3.1.3 Nutrients

Water samples for nutrient analysis were collected into 16 mL polystyrene test tubes. Each tube was rinsed three times before filling two/thirds full. Nutrients were analyzed on board ship using a Technicon Autoanalyzer II. Reactive silicate, nitrate plus nitrite and soluble orthophosphate were determined using methods as described in Barwell-Clarke and Whitney (1996). Nutrient standards (nitrate and silicate) were compared against Sagami standards (Waco Chemical) to confirm there were no errors in preparation (Sagami phosphate standards have not

been found reliable). It was not necessary to apply any correction to the standards as a result of this comparison.

3.3.1.4 Methane

Seawater samples were collected into 100 mL glass bottles using a piece of Tygon tubing, by filling from the bottom and overflowing the bottle volume three times. The sample was preserved by the addition of 100 µL $HgCl_2$ solution (saturated, or saturated at 4°C) and sealed by a septum capped by an aluminum seal and crimped. Samples were stored at 4 ^{o}C until analyzed at IOS.

Samples were analyzed at IOS using a custom-built purge and trap system connected to an Agilent 6890 gas chromatograph with an FID detector (GC-FID). To transfer the sample from the bottle to the extraction system two needles were inserted into the rubber septa bottle closure: one long needle that extended to the bottom of the bottle; and one short needle that just entered the water sample. Helium (UHP grade; 60 mL/min) was used to pressurize the bottle via the short needle and ~80 mL of sample was transferred via the long needle through a 16.5 mL standard volume on the extraction board. Using valves to control the helium flow, the sample was transferred into a purging chamber and the helium bubbled through the sample at 60 mL/min for 5 minutes. Methane and other light hydrocarbons were stripped out of the water by the helium, carried through a 5 cm $Mg(ClO_4)_2$ drying column and then trapped in a 15 cm column packed with Porasil B adsorbent in liquid nitrogen (-195°C). The trap was then isolated and heated to 40 ^{o}C for 1 min and transferred by helium flow at 18 mL/min, either directly or split, onto a GS GasPro 60 m column in the GC-FID. The following temperature program allowed the column to separate the hydrocarbons so that they could be detected individually at the FID: hold at 40 ^{o}C for 3.5 min, ramp to 150 ^{o}C at 20 ^{o}C/min, and hold for 2 min. The FID detector temperature was 200 ^{o}C. Individual hydrocarbons were identified by peak retention time and quantitated by peak area and comparison with a BOC certified calibration gas mixture containing methane, ethane, ethylene, propane and propylene. Standard volumes of the BOC standard were injected in the same way as the samples and peak areas were used to create individual calibration curves for methane, ethane, ethylene, propane and propylene.

On each analysis day, blanks were run until the system was stable and then a series of standards were analyzed to construct a 5 point calibration curve for each component. Then a method blank was run by filling the standard volume with UHP He. All samples were corrected using this blank value. About 10 samples were analyzed each day, after which a midlevel standard was analyzed. If the standard concentration differed by more than 12%, the analysis was not used or a correction factor was used to account for the calibration drift.

The samples collected from this cruise contained a compound that coeluted with propylene and therefore propylene was not quantified. Although approximately 90% of the samples had a small bubble in them, <3mm in diameter, less than 0.8 % (mol) of the methane would be lost from the water to the bubble. If the bubble were air, the methane concentration in the water would increase by about 0.4%.

3.3.1.5 Sampling precision

Precision data for the water column sampling have been provided in Table 5.

Table 5. Summary of water column sampling precision

Analysis	Precision (Standard Deviation)	Number of Duplicate Pairs	Minimum Range	Maximum Range
Salinity	0.0009	16	31.3	34.6
Dissolved oxygen	4.3 umol/kg	16	1	174
Nitrate + nitrite	0.11 uM	16	0	45.6
Silicate	0.37 uM	16	36	174
Orthophosphate	0.005 uM	16	1.9	5.4
Methane	1.6%	3	0.1 nM	1100 nM
Ethane	3% rsd	7	0.1 nM	1100 nM
Ethylene	3% rsd	7	0.1 nM	1100 nM
Propane	3% rsd	7	0.1 nM	1100 nM

3.4 SEDIMENT BOX CORE SAMPLING AND ANALYSIS

3.4.1 Box Core Sampling

One wall of the removable stainless steel liner was lowered to allow subsampling of the core with minimal disturbance. Prior to sectioning one or two plastic tubes (~ 5 cm i.d.) were pushed into the sediment to obtain intact sub-cores for future analysis. Sediment from the outer ~5 cm of the box was discarded. For each interval a portion of the sediment was transferred to a 500 mL glass jar and mixed. This material was subsampled for CHN and ^{210}Pb (plastic bags) and hydrocarbon (100 mL baked glass jars) analysis. The homogenate and the remaining sediment from the interval were placed in a large plastic bag. Between samples the tools (scoopula and flat stainless steel spatula) and mixing jar were washed with tap water, deionized water and pesticide grade acetone. The mixing jar was rinsed again with deionized water to ensure that all acetone was removed before contact with sediment samples. The same sampling procedure was used for all three cores.

3.4.1.1 Core JP1

September 16, 2003. Station JP1, 52.6255º N, 130.2925º W; 240 m

The surface of the box core from station JP1 was composed of olive brown mud with small bivalves and brittle stars. The core surface was slanted from the upper left to the lower right of the box, for a drop of 3-4 cm. One large rock and several smaller rocks were present on the right side. The large rock had disturbed the sediment on the right side and the initial samples were taken only from the left side of the core. A single sub-core was taken from the back left

corner; a considerable amount of force was necessary to push this core to the bottom of the box. The resulting sub-core was compressed to 32 cm.

Core JP1 was sectioned immediately after sampling (see Table 6 for the core record). Because the surface of the core appeared to be disturbed the subsamples in the upper core were collected at 2 cm intervals.

The box corer apparently went in on an angle for this core sample. From the presence of brachiopods and surface slime on only a portion of the large rock, the rock was inferred to be partially exposed above the sediment surface on the sea floor. It was likely that the side of the corer hit this rock, driving it into the sediment and mixing the sample on the right side (the right side was disturbed down to ~20 cm). This also likely prevented the right side of the corer from penetrating as deeply as the left side.

Below 25 cm depth in the front left half of the box core there were obvious extrusions in places of the brown mud from the upper sections into the grey mud of the lower sections. Evidently the insertion of the core barrel into the back left side of the core produced large disturbances in the front half of the box core. To obtain an undisturbed sample, sampling had to be shifted to the right below 25 cm depth.

Core JP1 should provide a reasonable stratigraphy for the sediments at the sampling site, but an exact chronology may be problematic below 25 cm.

3.4.1.2 Core JP8

September 17, 2003. Station JP8, 52.5545º N, 131.1649º W; 325 m

Core JP8 was collected at 1750 GMT on September 17, just prior to crossing Hecate Strait under storm conditions. The core was stored upright at 4 ºC until sectioning began at 1635 GMT on September 19. At this point the core was ~2 cm higher in the right front corner. A 5 cm × 1 cm worm and a 5 cm diameter copepod were dug into the mud on the right side. Two core tubes were inserted side-by-side into the back left with one core in the back left corner and the other on the back left side. The cores were ~1 cm apart and ~1-2 cm from the walls of the core. Cores were inserted a little at a time to avoid disturbing or displacing the deeper sediments.

The full core from the back left corner measured 35 cm after compression during sampling. The middle, partial core that was removed when the sediment was in the box core was at –20-22 cm measured 20 cm in the core tube.

Core JP8 was composed of brown mud throughout (see Table 7 for the core record).

3.4.1.3 Core MS1

September 18, 2003. Station MS1, 52.3817º N, 128.5502º W; 245 m

Benthic animals and sediment disturbances were absent from the surface of the core from station MS1. The box core sleeve was full right to the top with sediment when the sample was brought on board, hence there may have been some loss of sediment from the core surface.

Two core tubes were inserted into the back left and back right corners at a distance of ~1-2 cm from the walls of the core. Cores were inserted a little at a time to avoid disturbing or displacing the deeper sediments. Both sub-cores measured 50 cm after removal.

Core MS1 was composed of soft brown mud throughout (see Table 8 for the core record). This core was sectioned immediately after sampling.

3.4.2 Sediment bulk parameters

3.4.2.1 Total organic carbon and nitrogen

The organic carbon and nitrogen method was adapted from Van Iperen and Helder (1985). Utensils and equipment were solvent cleaned or combusted according to the Control Equipment Corporation (CEC) 440 Elemental Analyser operation manual.

Each marine sediment sample was homogenized with a clean mortar and pestle to a fine textured mixture. One subsample was oven dried at 50 ºC overnight to determine moisture content. Another subsample of approximately 500 mg was weighed into a clean pre-weighed crucible to determine the initial sample weight (W_i). Carbonates were removed by adding 10 mL of 1 M HCl and the sample was stirred gently until effervescence stopped. Samples were then dried on a hot plate overnight at 70 ºC to evaporate water and excess HCl, and then oven dried for another 2 hours at 105 ºC. Open samples were allowed to equilibrate at room temperature and humidity for 2 hours then re-weighed to determine the final weight (W_f). The analyzed sample weight was corrected for conversion of $CaCO_3$ to $CaCl_2$. The decalcified samples were re-homogenized using a clean glass rod and an 8 – 12 mg sub-sample was weighed into clean tin cups for analysis with the CEC 440 Elemental Analyzer. In the analyser organic carbon was converted to CO_2 and nitrogen oxides were reduced to N_2 gas: both CO_2 gas and N_2 gas were measured by thermal conductivity.

A set of acetanilide standards (71.09% carbon and 10.36% nitrogen) was run at the start of each day to determine the K factors used to calculate the concentration of carbon and nitrogen. Tin cup and nickel sleeve blanks were analysed to determine blank readings. Acetanilide was run as an unknown every 10 samples and at the end of each day.

The organic carbon content (%w/w) for the initial sample (OC_i) was calculated from the organic carbon content of the acidified sample (OC_f) as follows:

$$OC_i = OC_f \times (W_f/W_i)$$

The pooled standard deviation for the samples (n = 7 replicates) and reference standard (acetanilide) analyses are:

OC s_p= 0.25, range of 0.28 - 6.08%;

ON s_p = 0.02, range of 0.05 – 0.76%;

Carbon s_p = 0.25

Nitrogen s_p =0.08

and the coefficient of variance is 0.36% for Carbon and 0.83% for Nitrogen. The detection limit for the CEC Elemental Analyser, determined as 3 times the standard deviation of the blanks for n=7 replicate blanks, is:

Carbon = 0.62 µg carbon

Nitrogen = 0.16 µg nitrogen.

3.4.2.2 Biogenic silica

The biogenic silica analysis follows the method reported by DeMasters (1981). Approximately 5 - 10 mg of oven dried and homogenised marine sediments were weighed into 50 mL polypropylene centrifuge tubes and 40 mL of 1% Na_2CO_3 (w/v in double deionised water, pH 11.2) were added. The tube was capped tightly and the contents digested at 85 °C for 2 hours in a Digi-prep Jr. Digestion System. The samples were shaken to disperse the particles after one hour. After cooling a 0.5 mL aliquot was taken and diluted 20 times with double deionised water. This subsample was then analysed with a Technicon AutoAnalyzer II using the dissolved silicate method (Barwell-Clarke and Whitney, 1996). An aliquot of Station Papa Reference Material (SPRM-1) and blanks were analysed with each batch of samples. The pooled standard deviation for n=10 sample replicates was:

s_p = 0.52; range: 2.58% - 24.84%.

3.4.2.3 Lead-210

These analyses were conducted under contract by Flett Research Ltd., Winnipeg in 2004 and based upon the method of Eakins and Morrison (1978) where ^{210}Po (the granddaughter of ^{210}Pb) has been distilled out of sediments at high temperature, acid digested and finally plated onto silver disks for analysis by alpha spectrometry.

A 0.1 - 0.5 g sample of dry sediment (or wet sample providing the equivalent amount of dry sediment) was put into a test tube, treated with hydrochloric acid and spiked with a precisely known aliquot (10 - 20 DPM) of Po-209 tracer (NIST SRM 4326). The sample was dried overnight in a heating block at about 120 ºC. A small Pyrex wool plug was pushed down the test tube on top of the sample and a second Pyrex plug, dampened with water, was inserted in the top most portion of the test tube. The tube was then placed horizontally in a tube furnace at about 500 ºC for 1 hour (only the bottom half of the tube was actually in the furnace). Under these conditions the volatile chloride form of polonium distilled out of the sediment and condensed on the cooler Pyrex plug in the portion of the tube not in the furnace.

After cooling, each tube was etched 5 cm from the bottom and the lower section, which contains the sediment, was broken off and discarded. The upper section was placed into a 400 mL tall form beaker, the Pyrex wool forced out of the tube onto the floor of the beaker with a clean glass rod, and 25 mL of conc. HNO_3 was added to the beaker. The beaker was covered with a watch glass and heated on a hotplate at gentle reflux for about 3 hours, or until all brown colouration had disappeared. When cool, the HNO_3 and Pyrex wool was poured through a funnel into a 200 mL beaker. The 400 mL beaker was rinsed 3 times with ~ 5 mL of 1.5 M HNO_3 and the rinses were poured over the Pyrex wool in the funnel so that any polonium absorbed to the wool was washed into the beaker. The wool in the funnel, following several more rinses with 1.5 M HNO_3, was then squeezed mostly dry with a glass stirring rod, the funnel removed and the wool discarded.

The acidic polonium solution was evaporated to dryness, made up to 20 mL with 1.5 M HCl and heated gently until any precipitate was dissolved. The warm solution was poured into a 25 mL beaker containing a silver disk, the 200 mL beaker was rinsed with 3 × 2 mL of ascorbic acid solution and the combined solution in the 25 mL beaker heated just to boiling for a period of 3 hours. After cooling, the fluid was poured out of the beaker, and the disks were rinsed with distilled water and then methanol, and then placed on a paper towel and oven dried for 1 hour at 60 ºC.

The silver disks were placed into an Ortec 'Octet' alpha spectrometer (one silver disk in an evacuated chamber at a time) for a 30,000 second counting period. The samples were monitored for ^{210}Po and ^{209}Po isotopes with a 300 mm^2 PIPS or surface barrier detectors. The ^{209}Po counts allowed precise measurement of the overall chemical yield and thereby permitted calculation of the specific activity of the ^{210}Po in the original sediment sample.

The minimum detection limit (MDL) for a 0.5 g dry sample was ~ 0.2 DPM ^{210}Po /g dry sample at a 95 % confidence level for a 30,000 sec counting time. This could vary slightly, depending upon the system blanks, and the detector and the recovery efficiency of each sample. A duplicate was run every tenth sample (provided sufficient material was available) and a blank was run every twentieth sample. Detector blanks were run every 90 days. All data were reviewed by the Flett Research chief scientist before release.

Sediment bulk properties data and downcore profiles have been provided in Appendix 6.4.

3.4.3 Sediment hydrocarbon analysis

3.4.3.1 Analyses by Axys Analytical

Samples were extracted and analyzed for alkanes and PAHs by Axys Analytical Services Ltd. Samples were analyzed in two batches (samples L7581-1 to -8 in batch 1 and L7581-9 to -15 in batch 2) along with one sample blank and a sediment sample spiked with a known quantity of the even *n*-alkanes from *n*-C_{12} to *n*-C_{36} plus pristane or the parent PAHs from naphthalene to benzo[*ghi*]perylene (as appropriate).

All samples were spiked with a suite of perdeuterated surrogate standards (listed in Table 9), dried with sodium sulphate and soxhlet extracted overnight with dichloromethane. The extract volume was reduced to 1 mL using Kuderna-Danish concentration apparatus, solvent exchanged into hexane and allowed to stand over activated copper to remove sulphur. The extract was quantitatively loaded onto a silica gel column (10 g, deactivated 5% with water) and eluted with 25 mL pentane (alkane fraction, F1) followed by 100 mL dichloromethane (PAH fraction, F2). Each fraction was reduced to a small volume (0.5 mL) using Kuderna-Danish apparatus, transferred to an autosampler vial, and blown down with dry nitrogen to 100 µL. In preparation for GC/MS analysis, a 5 µL aliquot of the F1 recovery standard (perdeuterated fluoranthene) was added to each alkane fraction and 50 µL of PAH recovery standard (perdeuterated acenaphthene, pyrene, and benzo[*e*]pyrene) to the PAH fraction, in similar quantity to the surrogates. The volumes of each fraction were adjusted to 100 µL before injection.

Alkane and PAH analyses were performed using selective ion monitoring high resolution gas chromatography coupled with low resolution quadrupole mass spectrometry (HRGC/LRMS) using a minimum of two ions per analyte. Analyses used EI mode (70 eV) with multiple ion detection (MID) in an Agilent 6890 GC with 5973 MSD low-resolution mass spectrometer (MS) and CTC GC PAL autosampler, a 30 m capillary column (Restek 0.25 mm id, 0.25 µm film Rtx-5) and helium carrier gas. Separate instrument sequences with appropriate calibration standards, GC programs and MS scan descriptors were used for alkanes and PAHs. The temperature program for alkanes was: split/splitless injection at 60 °C, hold 3 min., ramp at 10 °C/min. to 110 °C, hold for 2 min., ramp at 7.5 °C/min. to 320 °C and hold for 8 min. The temperature program for PAHs was: split/splitless injection at 60 °C, hold 2 min., ramp at 40 °C/min. to 100 °C, hold for 2 min., ramp at 10 °C/min. to 265 °C, hold 7 min., ramp at 10 °C/min. to 300 °C, ramp at 3 °C/min. to 325 °C and hold for 3 min.

Analyte concentrations were determined with respect to the labelled surrogate standards added at the beginning of analysis, where the surrogate employed was the one judged to be chemically most similar to the target analyte. Mean relative response factors (RRF) determined from the initial calibration runs were used to convert raw peak areas in sample chromatograms to final concentrations (the surrogate and basis for RRF for each PAH have been provided in Table 10). Data were not blank corrected.

3.4.3.2 Additional PAH Quantified

The GC/MS chromatograms produced by Axys Analytical were used to obtain concentration data for eight additional parent PAHs and 45 individual alkyl PAH isomers in seven of the major alkyl PAH series (Table 11; Appendix 6.5). These concentrations were calculated relative to PAHs reported by Axys Analytical using peak areas from electronic chromatograms measured using the same HP Chem Station software used by Axys.

For the parent PAHs, ion chromatograms were used to obtain concentration data for acephenanthrylene, the molecular mass 276 PAHs indeno[1,2,3-*cd*]fluoranthene, indeno[7,1,2,3-*cdef*]chrysene and anthanthrene, and the mass 278 PAHs dibenz[*a*,*j*]anthracene, benzo[*b*]chrysene, pentaphene and picene (Yunker et al., 1999; Yunker et al., 2002). Indeno[7,1,2,3-*cdef*]chrysene, has been referred to by the synonyms indeno[4,3,2,1-

cdef]chrysene and dibenzo[*b,ghi*]fluoranthene)(Sander and Wise, 1997), but the name indeno[7,1,2,3-*cdef*]chrysene would be most correct based on the numbering for indene and a parent component with a higher order of preference (chrysene rather than fluoranthene)(Moss, 1998). Authentic standards were available previously (Yunker et al., 1999) for all mass 276 and 278 PAHs except indeno[1,2,3-*cd*]fluoranthene, indeno[7,1,2,3-*cdef*]chrysene and pentaphene.

The peak assignment of indeno[1,2,3-*cd*]fluoranthene for this work, and the previous assignments of pentaphene and indeno[7,1,2,3-*cdef*]chrysene by Yunker et al. (1999) were based on published identifications (Wise et al., 1986; Wise et al., 1988) and, for the latter two PAHs, retention indices in NIST SRMs 1597, 1648 and 1649. For this work additional authentic standards were obtained for pentaphene and indeno[7,1,2,3-*cdef*]chrysene (Chiron Inc., Norway), and used to prepare a mixture with other mass 276 and 278 authentic standards (chromatograms are shown in Figure 2). This standard mixture confirmed the previous assignments of indeno[7,1,2,3-*cdef*]chrysene and pentaphene by Yunker et al. (1999). This means that assignments of all the additional molecular mass 276 and 278 PAHs except indeno[1,2,3-*cd*]fluoranthene are now based on authentic standards.

Allen (1997) has reported a PAH retention index (RI) of 485.35 for an authentic standard of indeno[1,2,3-*cd*]fluoranthene (where chrysene is 400 and picene is 500; Lee et al., 1979). (Retention indices of other PAHs have been shown in Figure 2; note that perdeuterated surrogate standards shift RI values for closely eluting native PAHs.) The peak assigned as indeno[1,2,3-*cd*]fluoranthene had retention indices of 485.38, 485.48 and 485.23 in surface sediment from cores JP1, JP8 and MS1, respectively, which agreed very well with the value reported by Allen (1997). Several recent papers from the atmospheric contaminant literature have identified the mass 276 peak eluting just before indeno[1,2,3-*cd*]pyrene as indeno[1,2,3-*cd*]fluoranthene, not indeno[7,1,2,3-*cdef*]chrysene (Hedberg et al., 2002; Hays et al., 2005; Simoneit et al., 2005). Based on the indeno[1,2,3-*cd*]fluoranthene retention provided by Allen (1997) and the elution sequence of authentic indeno[7,1,2,3-*cdef*]chrysene observed here, the identification of this peak as indeno[1,2,3-*cd*]fluoranthene is likely to be incorrect.

The large M-2 ion for the mass 278 PAHs and [$^{2}H_{14}$]dibenz[*a,h*]anthracene (average 24.31% of the molecular ion; Figure 2) can affect quantification for PAHs with molecular masses two mass units smaller. For this data set, the M-2 ion for dibenz[*a,j*]anthracene (23.27% of the peak area) does interfere with indeno[7,1,2,3-*cdef*]chrysene due to the near coelution (retention difference of 0.01 minute), and 23.27% of the dibenz[*a,j*]anthracene peak area has been subtracted from the 276 area when calculating indeno[7,1,2,3-*cdef*]chrysene concentrations for Appendix 6.6.

Peak assignments for the individual di- and trimethylnaphthalenes, methylphenanthrenes and methyldibenzothiophenes were based on labelled chromatograms provided by Yawanarajah and Kruge (1994) and Weiss et al. (2000). Assignments for the dimethylphenanthrenes also largely followed these authors, although the authentic standards for 2,6- and 3,6-dimethylphenanthrene used by Axys indicated that the elution order of 2,6-dimethylphenanthrene under the Axys GC conditions conformed to the order given by Yawanarajah and Kruge (1994) and Benner et al. (1995), but not by Weiss et al. (2000). The 1- and 2-methylfluorenes were assigned using the relative retention time positions relative to fluorene and phenanthrene given by Wang et al. (2000). Peak assignments were unavailable for other trimethylnaphthalenes and

methylfluorenes as well as for the methylfluoranthene/pyrenes, and peaks in the chromatograms for these alkyl PAHs have been arbitrarily assigned letters. Labelled chromatograms for all the alkyl PAH series examined have been provided in Appendix 6.5.

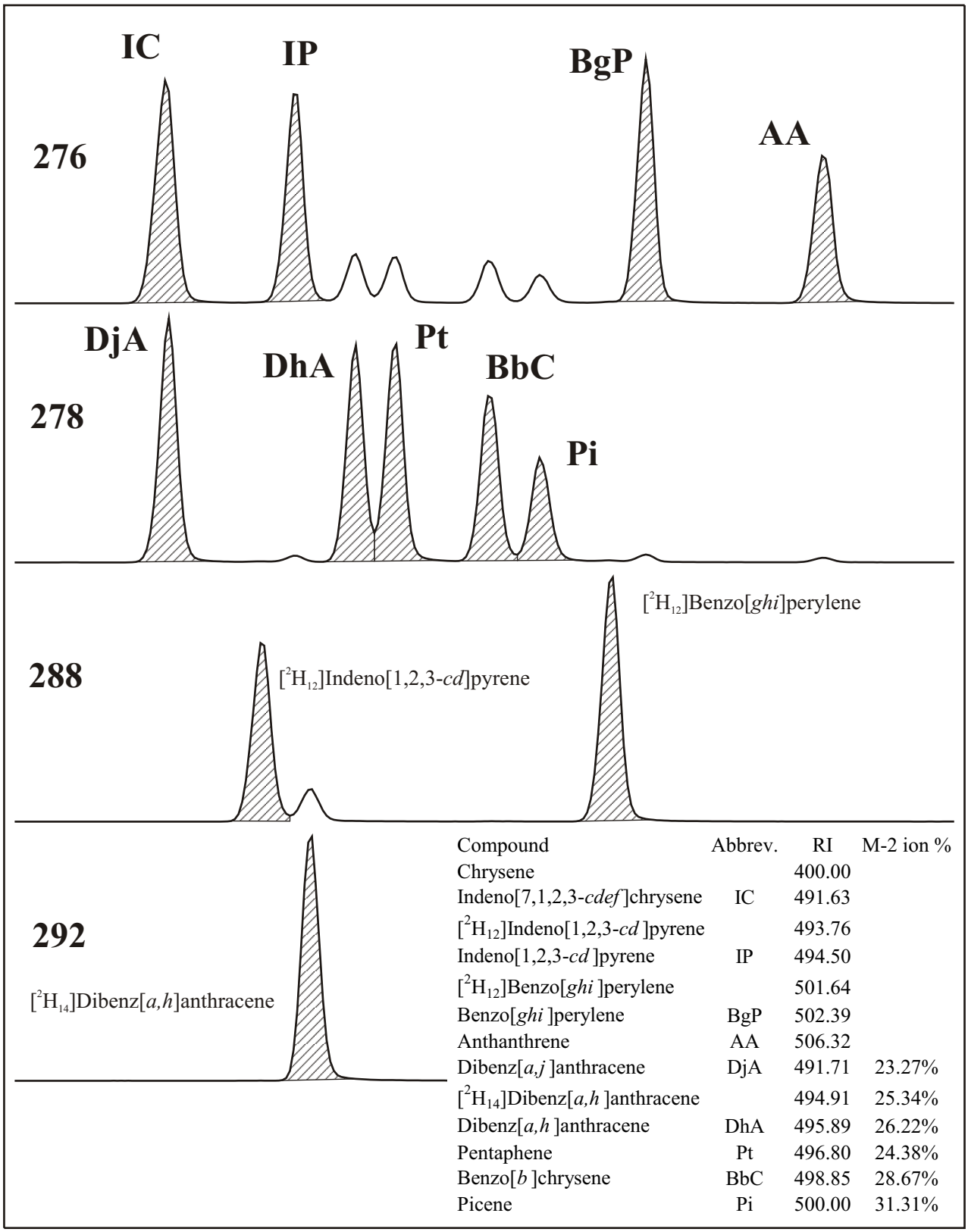
3.4.3.3 Hopane, Sterane and Terpane Analyses

Alkane extracts were analyzed further for hopanes, tri- and tetracyclic terpanes and steranes by full scan GC/MS at the Institute of Sedimentary and Petroleum Geology in Calgary. The analysis was carried out using an Agilent 6890 GC coupled to a Waters Autospec Magnetic Sector Mass Spectrometer. The GC was fitted with a 30 m DB5ms capillary column (0.25 μm film thickness × 0.32 mm i.d.) and a split/splitless injector operated in split mode with an injector temp of 280 ºC. Helium was used as the carrier gas and the CG temperature program was: 80 ºC for 2 min., ramped at 40 ºC/min. to 180 ºC for 0 min., then ramped at 4 ºC/min to 320 ºC, and then held for 7 min. The Mass Spectrometer was operated in full scan mode from m/z 50 – 450, with a scan rate of 1.5 seconds/scan and positive ion electron ionization.

Preliminary CC/MS/MS analysis also has been carried out for five core sections using a Varian 1200L GC/MS Triple Quadrupole. The capillary column and GC conditions were the same as for the GC/MS analyses, except that the injector was operated in splitless mode. The Mass Spectrometer was operated in Multiple Reaction Monitoring mode, using positive ion electron impact for ionization, argon collision gas, and collision energy of 10 eV.

The target lists of tricyclic terpanes, biogenic and diagenic hopanes, steranes and diasteranes have been provided in Table 1 and Table 2. Representative chromatograms for the full scan GC/MS analyses of the alkane fraction for hopanes, steranes and terpanes have been provided in Appendix 6.7.

Peak heights and selected biomarker proportions for the five core sections analyzed by GC/MS/MS (JP8 18-20 cm, MS1 5-6, 10-12, 25-30, 50-55 cm) have been provided in Appendix 6.8. These samples yielded chromatograms with considerable baseline noise. The analyses of additional samples and reanalyses of these samples to reduce noise have not been completed in time for this report.



Compound	Abbrev.	RI	M-2 ion %
Chrysene		400.00	
Indeno[7,1,2,3-*cdef*]chrysene	IC	491.63	
[$^2H_{12}$]Indeno[1,2,3-*cd*]pyrene		493.76	
Indeno[1,2,3-*cd*]pyrene	IP	494.50	
[$^2H_{12}$]Benzo[*ghi*]perylene		501.64	
Benzo[*ghi*]perylene	BgP	502.39	
Anthanthrene	AA	506.32	
Dibenz[*a,j*]anthracene	DjA	491.71	23.27%
[$^2H_{14}$]Dibenz[*a,h*]anthracene		494.91	25.34%
Dibenz[*a,h*]anthracene	DhA	495.89	26.22%
Pentaphene	Pt	496.80	24.38%
Benzo[*b*]chrysene	BbC	498.85	28.67%
Picene	Pi	500.00	31.31%

Figure 2. Mass 276 and 278 authentic standards and perdeuterated surrogates, their observed retention indices, and M-2 ion percentages for mass 278 PAHs and [$^2H_{14}$]dibenz[*a,h*]anthracene.

Table 6. Core record for station JP1

Sample	Measurement	Interval	Comment
1	147-145 cm	0-2 cm	
2	145-143 cm	2-4 cm	Large rock on right side began at ~3 cm.
3	143-141 cm	4-6 cm	
4	141-139 cm	6-8 cm	Sample more cohesive; some grey clay visible.
5	139-137 cm	8-10 cm	Grey striations present.
6	137-135 cm	10-12 cm	
7	135-133 cm	12-14 cm	Bottom of large rock on right side; mixed grey and brown sediment indicated substantial disturbance.
8	133-131 cm	14-16 cm	
9	131-129 cm	16-18 cm	Still olive brown mud, but more grey mud occlusions were evident
10	129-127 cm	18-20 cm	Transition between olive brown and grey mud. The top of the layer of grey mud could be seen after removing the sample.
11	127-125 cm	20-22 cm	First grey mud layer; some olive brown mud mixed into sample.
12	125-123 cm	22-24 cm	Grey mud layer. Sediment was very stiff and difficult to mix. Subsamples taken without mixing.
13	123-118 cm	24-29 cm	Grey mud. Undisturbed section on right front taken; subsample for CHN, ^{210}Pb and hydrocarbon, rest in bag.
14	118-113 cm	29-34 cm	Grey mud taken from centre-right of core to avoid disturbance from insertion of the core barrel.
15	113-98 cm	34-39 cm	Grey mud. Core finished 2-3 cm from bottom plate.

Table 7. Core record for station JP8

Sample	Measurement	Interval	Comment
1	151-150 cm	0-1 cm	For this section the undisturbed sediment primarily from the centre-right was collected. The sample was ~2 cm deep on the right and tapered to ~0.5 cm deep on the left side.
2	150-149 cm	1-2 cm	The centre-front and right side of the core were sampled to the 20 cm depth.
3	149-148 cm	2-3 cm	
4	148-147 cm	3-4 cm	
5	147-146 cm	4-5 cm	
6	146-145 cm	5-6 cm	
7	145-144 cm	6-7 cm	
8	144-143 cm	7-8 cm	
9	143-142 cm	8-9 cm	
10	142-141 cm	9-10 cm	
11	141-139 cm	10-12 cm	
12	139-137 cm	12-14 cm	
13	137-135 cm	14-16 cm	
14	135-133 cm	16-18 cm	
15	133-131 cm	18-20 cm	
16	131-126 cm	20-25 cm	A 5 cm section from centre two-thirds of the core (~1 cm in from the front of the box, 5-10 cm in from the sides) was sampled and homogenised.
17	126-121 cm	25-30 cm	
18	121-116 cm	30-35 cm	
19	116-111 cm	35-40 cm	
20	111-106 cm	40-45 cm	

Table 8. Core record for station MS1

Sample	Measurement	Interval	Comment
1	64.5- ~63.5 cm	0-1 cm	The top of the core was composed of very soft, unconsolidated, soupy mud. The top ~1 cm was removed before moving the front panel of the core sleeve.
2	62.0-60.5 cm	1-2.5 cm	The core slumped ~1.5 cm when the front panel of the core sleeve was loosened. Soft brown mud.
3	60.5-60 cm	2.5-3 cm	
4	60-59 cm	3-4 cm	
5	59-58 cm	4-5 cm	
6	58-57 cm	5-6 cm	More cohesive
7	57-56 cm	6-7 cm	
8	56-55 cm	7-8 cm	Occasional black streaks in sample.
9	55-54 cm	8-9 cm	
10	54-53 cm	9-10 cm	Front plate shifted. Sample was a little less than 1 cm.
11	53-51 cm	10-12 cm	
12	51-49 cm	12-14 cm	
13	49-47 cm	14-16 cm	
14	47-45 cm	16-18 cm	
15	45-43 cm	18-20 cm	
16	43-38 cm	20-25 cm	
17	38-33 cm	25-30 cm	
18	33-28 cm	30-35 cm	
19	28-23 cm	35-40 cm	
20	23-18 cm	40-45 cm	H_2S more apparent.
21	18-13 cm	45-50 cm	
22	13-08 cm	50-55 cm	

Table 9. Perdeuterated surrogate and recovery standards used for alkane and PAH analysis

Labelled surrogate standards	Recovery calculated against
$^{2}H_{22}$-Decane (*n*-C_{10})	$^{2}H_{10}$-Fluoranthene
$^{2}H_{26}$-Dodecane (*n*-C_{12})	$^{2}H_{10}$-Fluoranthene
$^{2}H_{34}$-Hexadecane (*n*-C_{16})	$^{2}H_{10}$-Fluoranthene
$^{2}H_{50}$-Tetracosane (*n*-C_{24})	$^{2}H_{10}$-Fluoranthene
$^{2}H_{74}$-Hexatriacontane (*n*-C_{36})	$^{2}H_{10}$-Fluoranthene
$^{2}H_{8}$-Naphthalene	$^{2}H_{10}$-Acenaphthene
$^{2}H_{10}$-Biphenyl	$^{2}H_{10}$-Acenaphthene
$^{2}H_{10}$-2-Methylnaphthalene	$^{2}H_{10}$-Acenaphthene
$^{2}H_{8}$-Acenaphthylene	$^{2}H_{10}$-Acenaphthene
$^{2}H_{10}$-Phenanthrene	$^{2}H_{10}$-Pyrene
$^{2}H_{10}$-Fluoranthene	$^{2}H_{10}$-Pyrene
$^{2}H_{12}$-Benz[*a*]anthracene	$^{2}H_{10}$-Pyrene
$^{2}H_{12}$-Chrysene	$^{2}H_{10}$-Pyrene
$^{2}H_{12}$-2,6 Dimethylnaphthalene	$^{2}H_{10}$-Acenaphthene
$^{2}H_{12}$-Benzo[*b/k*]fluoranthene	$^{2}H_{12}$-Benzo[*e*]pyrene
$^{2}H_{12}$-Benzo[*a*]pyrene	$^{2}H_{12}$-Benzo[*e*]pyrene
$^{2}H_{12}$-Perylene	$^{2}H_{12}$-Benzo[*e*]pyrene
$^{2}H_{12}$-Indeno[1,2,3,*cd*]pyrene	$^{2}H_{12}$-Benzo[*e*]pyrene
$^{2}H_{14}$-Dibenzo[*a,h*]anthracene	$^{2}H_{12}$-Benzo[*e*]pyrene
$^{2}H_{12}$-Benzo[*ghi*]perylene	$^{2}H_{12}$-Benzo[*e*]pyrene

Table 10. PAHs reported by Axys Analytical, with the surrogate used for quantification and the standard used to obtain a relative response factor

Compound	Surrogate	RRF determined from
Naphthalene	$^{2}H_{8}$-Naphthalene	Naphthalene
Biphenyl	$^{2}H_{10}$-2-Methylnaphthalene	Biphenyl
Acenaphthylene	$^{2}H_{8}$-Acenaphthylene	Acenaphthylene
Acenaphthene	$^{2}H_{8}$-Acenaphthylene	Acenaphthene
Fluorene	$^{2}H_{10}$-Phenanthrene	Fluorene
Phenanthrene	$^{2}H_{10}$-Phenanthrene	Phenanthrene
Anthracene	$^{2}H_{10}$-Phenanthrene	Anthracene
Fluoranthene	$^{2}H_{10}$-Fluoranthene	Fluoranthene
Pyrene	$^{2}H_{10}$-Fluoranthene	Pyrene
Benz[*a*]anthracene	$^{2}H_{12}$-Benz[*a*]anthracene	Benz[*a*]anthracene
Chrysene/triphenylene	$^{2}H_{12}$-Chrysene	Chrysene
Benzo[*b/j/k*]fluoranthene	$^{2}H_{12}$-Benzo[*b/k*]fluoranthene	Benzo[*b/k*]fluoranthene
Benzo[*e*]pyrene	$^{2}H_{12}$-Benzo[*a*]pyrene	Benzo[*e*]pyrene
Benzo[*a*]pyrene	$^{2}H_{12}$-Benzo[*a*]pyrene	Benzo[*a*]pyrene
Perylene	$^{2}H_{12}$-Perylene	Perylene
Dibenzo[*a,c/a,h*]anthracene	$^{2}H_{14}$-Dibenzo[*a,h*]anthracene	Dibenz[*a,h*]anthracene
Indeno[1,2,3-*cd*]pyrene	$^{2}H_{12}$-Indeno[1,2,3,*cd*]pyrene	Indeno[1,2,3-*cd*]pyrene
Benzo[*ghi*]perylene	$^{2}H_{12}$-Benzo[*ghi*]perylene	Benzo[*ghi*]perylene
C1 Naphthalenes	$^{2}H_{10}$-2-Methylnaphthalene	1- / 2-Methylnaphthalene
1-Methylnaphthalene	$^{2}H_{10}$-2-Methylnaphthalene	1-Methylnaphthalene
2-Methylnaphthalene	$^{2}H_{10}$-2-Methylnaphthalene	2-Methylnaphthalene
C2 Naphthalenes	$^{2}H_{12}$-2,6-Dimethylnaphthalene	2,6-Dimethylnaphthalene
C3 Naphthalenes	$^{2}H_{12}$-2,6-Dimethylnaphthalene	2,3,5-Trimethylnaphthalene
C4 Naphthalenes	$^{2}H_{12}$-2,6-Dimethylnaphthalene	2,3,5-Trimethylnaphthalene
C1 Fluorenes	$^{2}H_{8}$-Acenaphthylene	Acenaphthylene
C2 Fluorenes	$^{2}H_{8}$-Acenaphthylene	Acenaphthylene
C3 Fluorenes	$^{2}H_{8}$-Acenaphthylene	Acenaphthylene
Dibenzothiophene	$^{2}H_{10}$-Phenanthrene	Dibenzothiophene
C1 Dibenzothiophenes	$^{2}H_{10}$-Phenanthrene	2-Methyldibenzothiophene
C2 Dibenzothiophenes	$^{2}H_{10}$-Phenanthrene	2,4-Dimethyldibenzothiophene
C3 Dibenzothiophenes	$^{2}H_{10}$-Phenanthrene	2,4-Dimethyldibenzothiophene
C1 Phenanthrenes/anthracenes	$^{2}H_{10}$-Phenanthrene	1-Methylphenanthrene
3-Methylphenanthrene	$^{2}H_{10}$-Phenanthrene	1-Methylphenanthrene
2-Methylphenanthrene	$^{2}H_{10}$-Phenanthrene	1-Methylphenanthrene
9/4-Methylphenanthrene	$^{2}H_{10}$-Phenanthrene	1-Methylphenanthrene
1-Methylphenanthrene	$^{2}H_{10}$-Phenanthrene	1-Methylphenanthrene
C2 Phenanthrenes/anthracenes	$^{2}H_{10}$-Phenanthrene	3,6-Dimethylphenanthrene
C3 Phenanthrenes/anthracenes	$^{2}H_{10}$-Phenanthrene	1,2,6-Trimethylphenanthrene
C4 Phenanthrenes/anthracenes	$^{2}H_{10}$-Phenanthrene	1,2,6-Trimethylphenanthrene
Retene	$^{2}H_{10}$-Fluoranthene	Retene
C1 Fluoranthene/pyrenes	$^{2}H_{10}$-Fluoranthene	3-Methylfluoranthene
C2 Fluoranthene/pyrenes	$^{2}H_{10}$-Fluoranthene	3-Methylfluoranthene
C3 Fluoranthene/pyrenes	$^{2}H_{10}$-Fluoranthene	3-Methylfluoranthene
C1 Benz[*a*]anthracene/chrysenes	$^{2}H_{12}$-Chrysene	5-Methylchrysene
C2 Benz[*a*]anthracene/chrysenes	$^{2}H_{12}$-Chrysene	7,12-Dimethylbenz[*a*]anthracene
C3 Benz[*a*]anthracene/chrysenes	$^{2}H_{12}$-Chrysene	7,12-Dimethylbenz[*a*]anthracene
Benzo[*b*]naphtho[1,2-*d*]thiophene	$^{2}H_{12}$-Chrysene	Benzo[*b*]naphtho[1,2-*d*]thiophene
Benzo[*b*]naphtho[2,1-*d*]thiophene	$^{2}H_{12}$-Chrysene	Benzo[*b*]naphtho[1,2-*d*]thiophene
Benzo[*b*]naphtho[2,3-*d*]thiophene	$^{2}H_{12}$-Chrysene	Benzo[*b*]naphtho[1,2-*d*]thiophene

Table 11. Additional PAHs determined from GC/MS chromatograms

Compound	Concentration determined from
Acephenanthrylene	Pyrene
Dibenz[*a,j*]anthracene	Dibenz[*a,h*]anthracene
Pentaphene	Dibenz[*a,h*]anthracene
Benzo[*b*]chrysene	Dibenz[*a,h*]anthracene
Picene	Dibenz[*a,h*]anthracene
Indeno[1,2,3-*cd*]fluoranthene	Indeno[1,2,3-*cd*]pyrene
Indeno[7,1,2,3-*cdef*]chrysene	Indeno[1,2,3-*cd*]pyrene
Anthanthrene	Benzo[*ghi*]perylene
2-Ethylnaphthalene	C2 Naphthalenes
1-Ethylnaphthalene	C2 Naphthalenes
2,6/2,7-Dimethylnaphthalene	C2 Naphthalenes
1,3/1,7-Dimethylnaphthalene	C2 Naphthalenes
1,6-Dimethylnaphthalene	C2 Naphthalenes
2,3/1,4-Dimethylnaphthalene	C2 Naphthalenes
1,5-Dimethylnaphthalene	C2 Naphthalenes
1,2-Dimethylnaphthalene	C2 Naphthalenes
C3 Naphthalene A	C3 Naphthalenes
1,3,7-Trimethylnaphthalene	C3 Naphthalenes
1,3,6-Trimethylnaphthalene	C3 Naphthalenes
1,3,5/1,4,6-Trimethylnaphthalene	C3 Naphthalenes
2,3,6-Trimethylnaphthalene	C3 Naphthalenes
1,2,7/1,6,7/1,2,6-Trimethylnaphthalene	C3 Naphthalenes
1,2,4-Trimethylnaphthalene	C3 Naphthalenes
1,2,5-Trimethylnaphthalene	C3 Naphthalenes
C3 Naphthalene B	C3 Naphthalenes
Methylfluorene A	C1 Fluorenes
2-Methylfluorene	C1 Fluorenes
1-Methylfluorene	C1 Fluorenes
Methylfluorene B	C1 Fluorenes
Methylfluorene C	C1 Fluorenes
4-Methyldibenzothiophene	C1 Dibenzothiophenes
2/3-Methyldibenzothiophene	C1 Dibenzothiophenes
1-Methyldibenzothiophene	C1 Dibenzothiophenes
2-Methylanthracene	C1 Phenanthrenes/anthracenes
Ethylphenanthrene	C2 Phenanthrene/anthracenes
3,6-Dimethylphenanthrene/Ethylphenanthrene	C2 Phenanthrene/anthracenes
2,6-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
2,7-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
1,3/2,10/3,9/3,10-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
1,6/2,9-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
1,5/1,7-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
2,3-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
1,9/4,9-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
1,8-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
1,2-Dimethylphenanthrene	C2 Phenanthrene/anthracenes
Other C4 Phenanthrene/anthracenes	C4 Phenanthrene/anthracenes - Retene
Methylfluoranthene/pyrene A	C1 Fluoranthene/pyrenes
Methylfluoranthene/pyrene B	C1 Fluoranthene/pyrenes
Methylfluoranthene/pyrene C	C1 Fluoranthene/pyrenes
Methylfluoranthene/pyrene D	C1 Fluoranthene/pyrenes
Methylfluoranthene/pyrene E	C1 Fluoranthene/pyrenes
Methylfluoranthene/pyrene F	C1 Fluoranthene/pyrenes
Other C1 Fluoranthene/pyrenes	C1 Fluoranthene/pyrenes

4. RESULTS AND DISCUSSION

4.1 HYDROGRAPHY

A hydrographic section across Hecate Strait has been surveyed from Juan Perez Sound on the west to Milbank Sound on the east (Appendix 6.1 to 6.3). This section crosses a ~ 400 m deep trough that lies between Station MS1 and JP1 (center of Hecate Strait). West of the trough the water column shallows to ~150 m near Station JP7 and in Juan Perez Sound there is a basin ~350 m deep located between Stations JP7 and JP8.

Surface temperatures across Hecate Strait during the mid-September 2003 sampling increase from 11 to 13 °C in an eastward direction across the transect whereas surface salinities decline from ~ 31.5 to 30 ‰ (Appendix 6.3). The presence of warmer, fresher and lower density waters at the surface on the eastern half of Hecate Strait is the result of the Coriolis force in the northern hemisphere directing riverine inflow from along the coast of British Columbia northward. The trough waters below ~ 150 m are more saline and cold at 33.5 ‰ and 6°C whereas in Juan Perez Sound the salinity and temperature of waters below 150 m are 33 ‰ and > 7°C.

Nutrient depth profiles of silicate, nitrate and phosphate show relatively constant surface concentrations with a small east-west gradient in nutrient distributions, where concentrations are slightly higher on the eastern side of the section. Here concentrations in the upper 40 m are 20 µmol/L silicate, 10 µmol/L nitrate and 0.8 µmol/L phosphate and in the west concentrations are 10 µmol/L silicate, 5 µmol/L nitrate and 0.6 µmol/L phosphate. Such levels indicate that these nutrients do not limit productivity. Concentrations generally increase uniformly with depth in all three nutrients in the eastern part of the Strait. Concentrations in the deep trough are greater than 70 µmol/L silicate, 35 µmol/L nitrate and 2.8 µmol/L phosphate. In Juan Perez Sound there is some nutrient depletion at depth relative to the eastern side, with concentrations below 200 m > 50 µmol/L silicate, 25 µmol/L nitrate and 2.2 µmol/L phosphate.

Oxygen concentrations in surface waters are higher on the western side of the section, due to the slightly colder temperatures. Oxygen concentrations in the upper 40 m are 275 mmol/L on the west and 250 mmol/L on the east and decrease with depth. In the trough oxygen concentrations are hypoxic at 75 mmol/L. In Juan Perez Sound waters below 200 m oxygen concentrations are not hypoxic at 125 mmol/L.

There is no east-west methane gradient across Hecate Strait and concentrations are less than 10 nmol/L in the upper 40 m and at depth in the trough. In Juan Perez Sound concentrations increase slightly with depth to 22 nmol/L below 200 m. These concentrations are similar to those found in the open ocean and do not indicate seepage of low molecular weight hydrocarbons from the sediment into the overlying water column.

4.2 SEDIMENT BULK PROPERTIES

Subsamples from each core section have been analysed for total organic carbon, nitrogen and silica. Concentrations of carbon, nitrogen and silica are similar in sediment cores from the ends of the transect (JP8 range: POC 3.7-4.2, PON 0.47-0.53, silica 16.8-18.7% and MS1: POC 4.8-6.1, PON 0.58-0.76, silica 20.3-24.8%), and exhibit little change with depth in both cores (Appendix 6.4). In contrast, concentrations of all parameters are much lower at station JP1 in the centre of Hecate Strait (POC 0.28-2.6, PON 0.03-0.34, silica 1.9-8.9%). The highest silica concentrations are found in the 8-20 cm region of the JP1 core, whereas the POC and PON concentrations in the core decline substantially below 20 cm. The silica data, when presented in percent composition, show that sediments at stations MS1 and JP8 have a biogenic signature (i.e. silica ~ 20 % or more) that is not evident at JP1. The decrease in carbon and nitrogen below 20 cm in core JP1 coincides with the abrupt transition from olive brown to grey sediment. The decline in the C/N ratio with core depth in the grey sediment zone is due to a more rapid decrease in POC than PON.

4.3 LEAD-210 CHRONOLOGY

The ^{210}Pb-based sedimentation rates at stations JP8 and MS1 also are comparable (0.51 and 0.39 cm/yr, respectively), and profiles suggest a relatively uniform sedimentation regimes throughout the cores (Appendix 6.4). In contrast, the sedimentation rate is much lower at station JP1 (0.1 cm/yr), where the ^{210}Pb profile suggests a decline in the accumulation rate around ~1925 and the presence of much older sediments (with no detectable ^{210}Pb) below the transition from olive brown to grey sediment. Accordingly, the grey sediment can only be dated to pre-1800 using ^{210}Pb, and this part of the core could be much older.

4.4 HYDROCARBON ANALYSES

4.4.1 Quality Assurance/Quality Control Results

4.4.1.1 n-Alkanes

Procedural blanks demonstrate no hydrocarbon interferences and recoveries from spiked samples are within the QA/QC criteria of 70-130%.

4.4.1.2 Polycyclic aromatic hydrocarbons

Procedural blanks demonstrate no hydrocarbon interferences and recoveries from spiked samples are within the QA/QC criteria of 70-130% with two exceptions. The recoveries of the fluorene and dibenzothiophene native analytes are below method specifications in the spiked matrix for Batch 1 (all samples from core JP1 and the upper three sections analyzed from core JP8). Fluorene and dibenzothiophene data in all sediment samples may be similarly affected.

The recoveries of the labelled naphthalene and 2-methylnaphthalene surrogates are slightly below the method control limit in samples from the 0-2 cm section at station JP1 and the 5-6 cm section at station JP8. To meet the established acceptance limits, percent recoveries of surrogate

compounds must fall within the range of 15 - 120% for naphthalene, 20 - 120% for acenaphthylene, and methylnaphthalene and 30 - 120% for all other surrogates. Since the isotope dilution method of quantification produces data that are recovery corrected, these slight variances from the method acceptance criteria have been deemed not to affect analyte quantification by Axys.

The baselines for the monomethylphenanthrenes have been affected by the presence of sulphur in some samples (particularly the top three sections analyzed from station JP8). Nevertheless, integrations of the monomethylphenanthrene chromatograms for these samples are still satisfactory, and samples have not been not reanalysed.

4.4.2 Alkane and PAH Results

Alkane and PAH concentrations in sediment are given in Appendix 6.6. PAH concentrations reported by Axys have the compound name in normal type, while additional PAH concentrations determined from the GC/MS chromatograms have the name in italics.

Resolved *n*-alkane (nC_{12} – nC_{36}) concentrations range between 320 – 570 ng/g at station JP1, 620 – 1400 ng/g at JP8 and 910 – 1800 ng/g at MS1. There are no systematic trends with core depth for any of the cores, and a large fraction of the concentration variation is due to the nC_{27} – nC_{31} alkanes with a well defined odd-even predominance (C_{29} OEP at JP1 4.31 – 5.75; JP8 5.70 – 6.13; MS1 5.08 – 6.91). These *n*-alkanes have a predominant source in leaf waxes from vascular plants (Meyers and Ishiwatari, 1993), suggesting that the concentration variations are largely due to variations in the inputs of leaf litter and other plant debris.

In most core sections concentrations of the 3- to 6-ring parent PAHs (molecular mass 178 – 278) are lowest in core JP1 (range 17 – 28 ng/g), intermediate at JP8 (64 – 130 ng/g), and only a little higher at MS1 (133 – 182 ng/g). The exceptions from station MS1 are the core bottom section (~ 1870) with a concentration of only 24 ng/g and the 5-6 cm section (~ 1985) with a concentration of 550 ng/g. Similarly, totals of the C1-C4 alkyl naphthalenes, fluorenes, dibenzothiophenes, phenanthrene/anthracenes, fluoranthene/pyrenes and benz[*a*]anthracene/chrysenes are lowest in core JP1 (range 110 – 200 ng/g), intermediate at JP8 (220 – 480 ng/g), and highest at MS1 (450 - 1970 ng/g). Once again the MS1 core bottom section has a low concentration (380 ng/g) and the 5-6 cm section has a very high concentration (14,500 ng/g). The difference in concentration between the 5-6 cm section from core MS1 and other MS1 sections is primarily due to the 3-ring and higher alkyl PAHs. The parent and alkyl PAH profiles in these two MS1 sections do not differ substantially from those of other core sections from the three cores (Appendix 6.5), hence the elevated and depleted PAH concentrations appear to reflect more or less of the same PAH input, rather than the input of PAHs with a substantially different source.

Nevertheless, differences in the relative amounts of the mass 276 and 278 parent PAHs are observed both between cores and with sediment depth (Appendix 6.5 and 6.6). Differences between cores and sediment depths also are apparent for the alkyl PAH series. For the di-and trimethylnaphthalenes, methylfluorenes, methyldibenzothiophenes and methylphenanthrene/anthracenes the differences are relatively subtle, and primarily manifest as

changes in the relative proportion of closely eluting peaks/isomers. The changes in the alkyl PAH patterns are much more evident for the dimethylphenanthrene/anthracenes and methylfluoranthene/pyrenes.

4.4.3 Hopane and Sterane Results

4.4.3.1 Full scan GC/MS

Representative chromatograms for the full scan GC/MS analyses of the alkane fraction for hopanes, steranes and terpanes are given in Appendix 6.7. The first page in the appendix is an annotated chromatogram with the major peaks identified (see Tables 1 and 2 for abbreviations). Selected ion chromatograms for each core section follow (5 pages per core with pages in order of increasing core depth). The bottom two traces (m/z 217 and 191) on each page are for the oil standard.

Most of the hydrocarbons in the hopane and sterane chromatograms are biogenic. In addition to the biogenic/early diagenetic hopanes with 17β(H),21α(H) and 17β(H),21β(H) configurations, there are large numbers of mono-unsaturated terpenes of molecular weight 410, 396 and 368 ($C_{30}H_{50}$, $C_{29}H_{48}$ and $C_{27}H_{44}$, respectively). These terpenes are present throughout the three cores — their relative proportions do change with core depth, but the diagenetic hopanes and steranes are no better resolved at the base of the cores than they are at the core surface.

Even with the assistance of the oil standard it is difficult to pick out the diagenetic hopanes and steranes from the 191 and 217 traces. The compounds are much easier to pick out using the molecular ions (traces for the C_{31} and C_{30} hopanes and the C_{29} and C_{27} steranes are shown).

There are peaks in the m/z 191 traces with the correct retention time for the 30αβ and 31αβ hopanes. However, the mass spectra for these peaks show other molecular ions, indicating that ratios based on the 191 traces may not be very meaningful. Much better ratios could be obtained using the molecular ions, but all the literature guidelines for interpretation are based on m/z 191 (e.g., Peters and Moldowan, 1993), hence this is not satisfactory solution.

The steranes have a similar problem with biogenic interferences. Peaks are evident in the 217 chromatograms for the C_{27} diasteranes and 27αααR sterane but the fine structure of the diagenetic steranes is difficult to pick out with confidence. The αββ steranes in the 218 chromatograms are down in the baseline noise. Better results could be obtained with the molecular ions, but again all the literature is based on m/z 217 or 218 (Peters and Moldowan, 1993). Given that biogenic 27αααR likely contributes (Yunker and Macdonald, 2003a) and interference from C_{29} diasteranes is likely, choosing a sterane peak for comparison to the diasteranes also would be problematic.

4.4.3.2 GC/MS/MS analyses

The initial round of GC/MS/MS analyses for characterization of the petrogenic baseline of selected samples yielded chromatograms with considerable baseline noise. Peak heights and

selected biomarker proportions for the five core sections analyzed by GC/MS/MS (JP8 18-20 cm, MS1 5-6, 10-12, 25-30, 50-55 cm) have been provided in Appendix 6.8. Additional analyses and reanalyses have not been completed in time for this report.

In all samples, the diasteranes predominate over steranes, 17α(H),21β(H)-30-norhopane is less abundant than 17α(H),21β(H)-hopane, and both 18α(H)-oleanane and 17α(H),21β(H)-28,30-bisnorhopane are present. The latter two biomarkers have been attributed to Tertiary and Late Triassic/Early Jurassic sources, respectively, in the Queen Charlotte Island/Hecate Strait region (Fowler et al., 1988; Bustin and Mastalerz, 1995). The high fraction of diasteranes is accompanied by values in some samples of the C_{29} sterane maturity parameters 29ααα 20S/(20S + 20R) and 29ββ/(29ββ + 29αα) that are less than the values of 0.50 and 0.70, respectively, typical of a mature sample (Peters and Moldowan, 1993). These preliminary data suggest that sediment samples contain mixtures of petrogenic material from different geological periods and likely different maturities. Additional analyses from all three cores with reduced baseline noise are needed for a more definitive discussion.

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6. APPENDICES

6.1 CTD DATA TABLES AND PLOTS

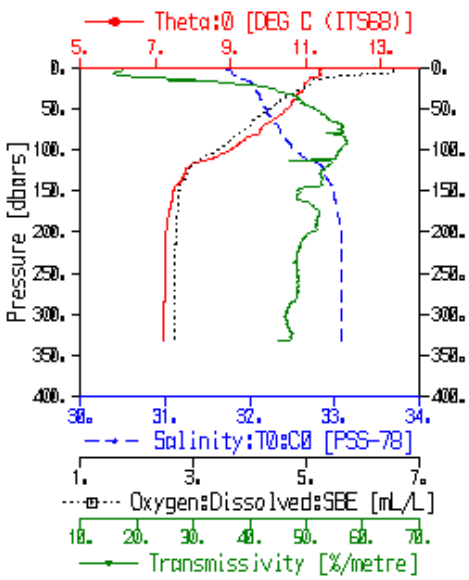
The following appendix contains data plots for each CTD cast. Stations are ordered from west to east along the transect from JP8 to MS1.

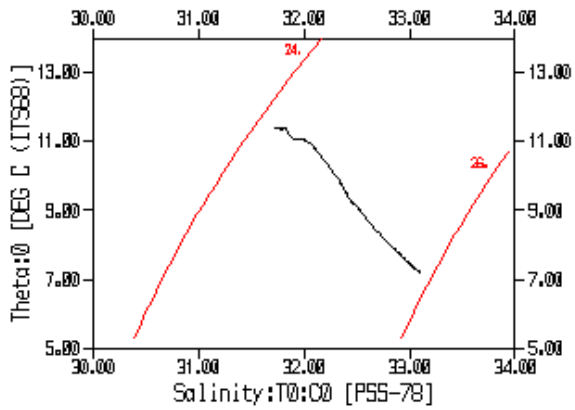
Data Table: In the upper right quadrant of each plot is a data table showing various measured and derived properties at selected standard depths. Units and abbreviations used in the data table are summarized in the following:

Quantity	Abbreviation	Units
Pressure	Pres	DBAR
Temperature	Temp	Deg C
Potential Temperature	Theta	Deg C
Salinity	Sal	PSS-78
% Transmissivity	% Tr	%/ metre

Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 8
Mission-Event : 2003-27-125
Start Time : UTC 2003/09/17 12:29:53
Position : 52 33.230 N 131 29.850 W
Water Depth : 330

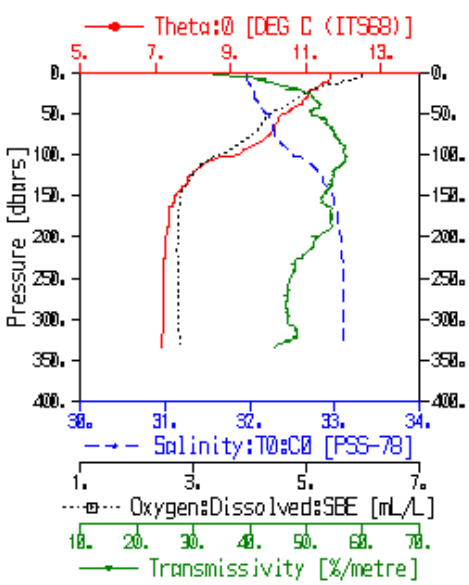
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-78	Theta DEG C (ITS68)
10.10	18.4	5.62	31.8306	11.3002
20.00	31.9	5.08	32.0403	10.9461
30.00	45.0	4.80	32.0893	10.8514
50.00	51.6	4.36	32.1859	10.4007
75.00	55.5	3.92	32.3530	9.7070
100.00	56.2	3.43	32.5300	8.9645
125.00	52.6	2.92	32.8060	7.7930
150.00	48.5	2.15	32.9963	7.4702
200.00	51.0	1.69	33.0831	7.2431
250.00	48.5	1.60	33.0891	7.2302
300.00	46.4	1.60	33.0919	7.2216

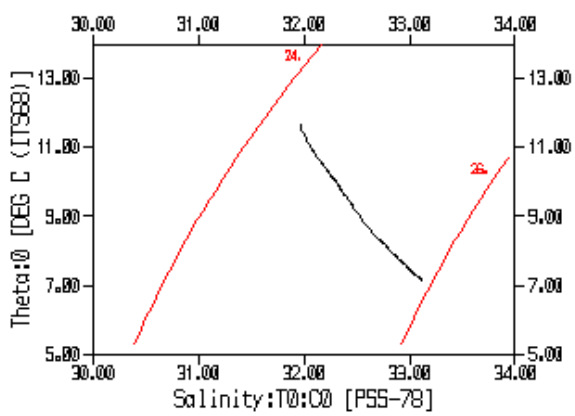




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 7
Mission-Event : 2003-27-123
Start Time : UTC 2003/09/17 10:41:55
Position : 52 31.200 N 131 23.990 W
Water Depth : 330

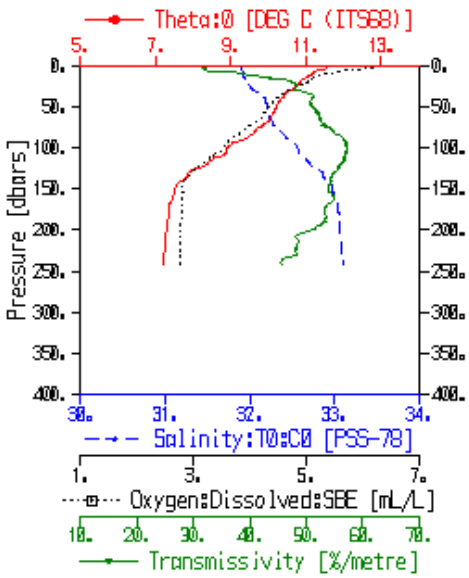
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-78	Theta DEG C (ITS68)
10.00	41.6	5.69	31.9765	11.5904
20.00	48.7	5.12	32.0705	11.3046
30.00	51.4	4.80	32.0500	11.0361
50.00	50.9	4.31	32.1903	10.4631
75.00	55.2	4.05	32.2953	10.0519
100.00	57.0	3.44	32.4099	9.1690
125.00	54.1	2.91	32.8543	7.8091
150.00	53.0	2.11	32.9030	7.5141
200.00	52.0	2.12	33.0704	7.2590
250.00	47.2	2.12	33.1015	7.2025
300.00	46.0	2.13	33.1025	7.1992

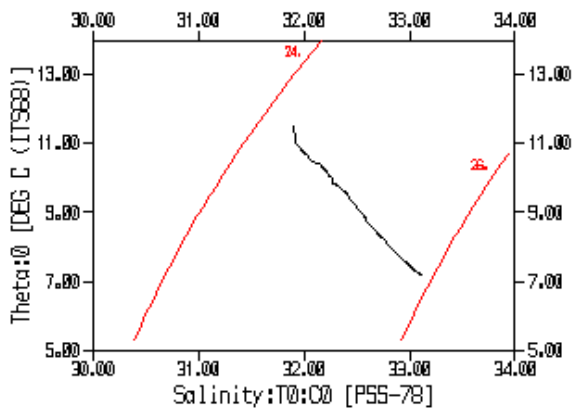




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 6
Mission-Event : 2003-27-120
Start Time : UTC 2003/09/17 09:04:04
Position : 52 31.450 N 131 16.360 W
Water Depth : 290

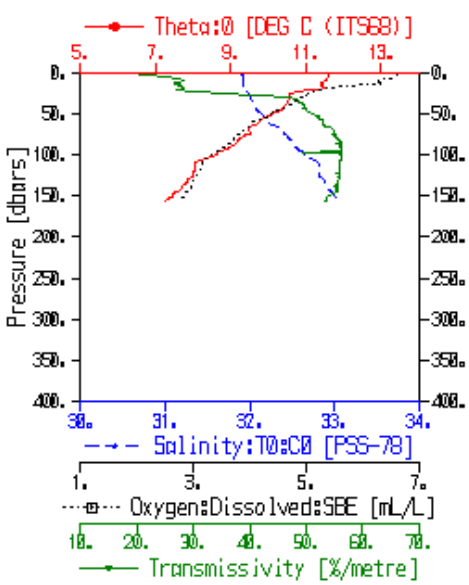
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1[illegible]	Theta [ITS68] C
10.00	39.2	5.39	31.9141	11.1635
20.00	41.3	5.02	31.9694	10.8356
30.00	40.6	4.70	32.0442	10.5021
50.00	51.4	4.34	32.2045	10.2193
75.00	53.9	3.96	32.3340	9.7149
100.00	51.2	3.55	32.5601	8.9022
125.00	55.0	3.03	32.7993	8.0511
150.00	53.9	2.00	32.9109	7.5153
200.00	51.4	2.16	33.0654	7.2903

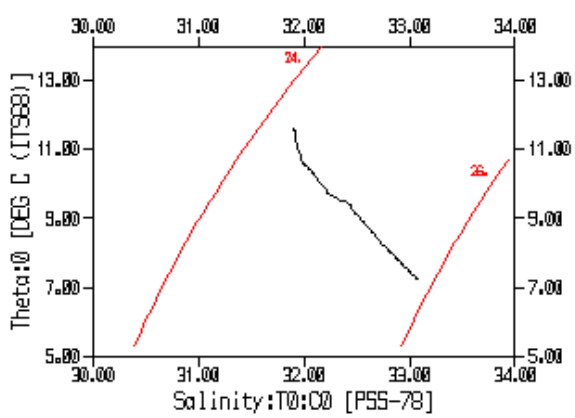




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 5
Mission-Event : 2003-27-118
Start Time : UTC 2003/09/17 07:16:45
Position : 52 31.690 N 131 12.370 W
Water Depth : 156

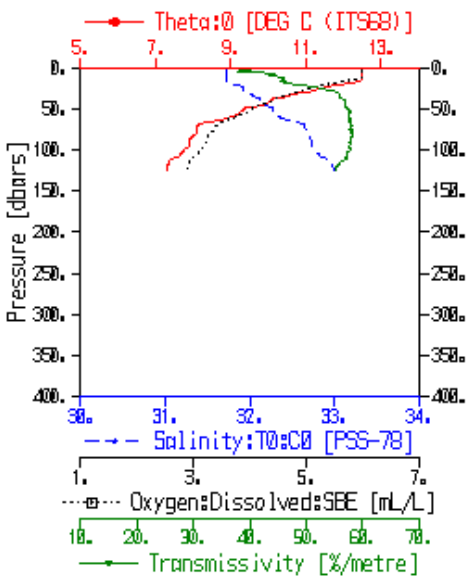
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1[illegible]	Theta [ITS68] C
10.00	20.0	6.29	31.9120	11.5430
20.00	21.1	5.29	31.9232	11.4160
30.00	45.9	4.93	32.0422	10.5629
50.00	51.2	4.31	32.2340	10.2302
75.00	55.2	3.19	32.4130	9.4191
100.00	55.9	3.31	32.6530	8.5442
125.00	55.9	3.06	32.8291	7.9909
150.00	54.0	2.03	33.0051	7.4431

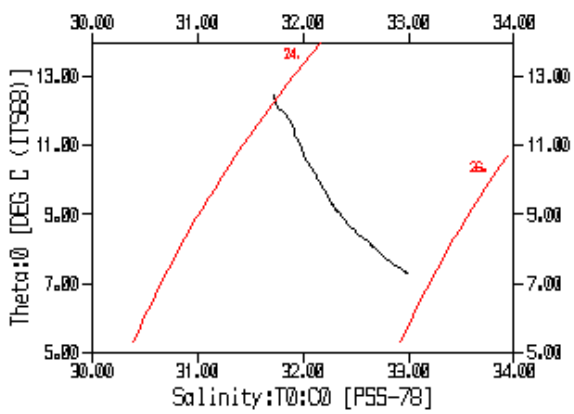




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 4
Mission-Event : 2003-27-115
Start Time : UTC 2003/09/17 05:10:33
Position : 52 34.120 N 130 57.990 W
Water Depth : 124

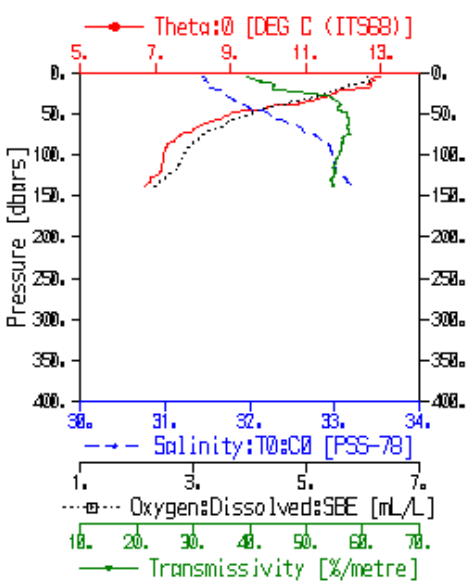
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1978	Theta C [ITS68]
10.00	44.4	5.99	31.1334	12.4035
20.00	48.0	5.39	31.0324	11.9913
30.00	55.6	4.03	31.9145	11.0552
50.00	51.2	4.03	32.2639	9.3649
75.00	50.0	3.31	32.6653	8.0000
100.00	51.0	3.13	32.7104	7.7405

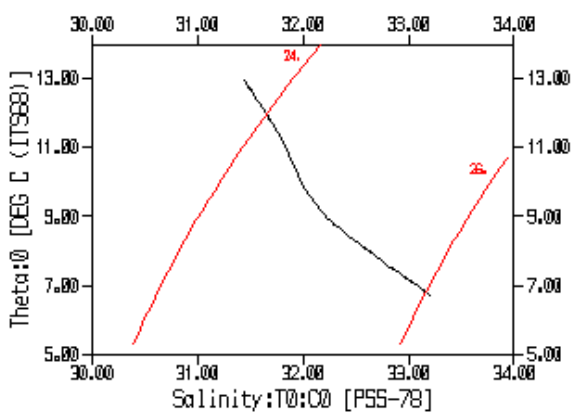




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 3
Mission-Event : 2003-27-111
Start Time : UTC 2003/09/17 00:39:42
Position : 52 36.830 N 130 41.080 W
Water Depth : 135

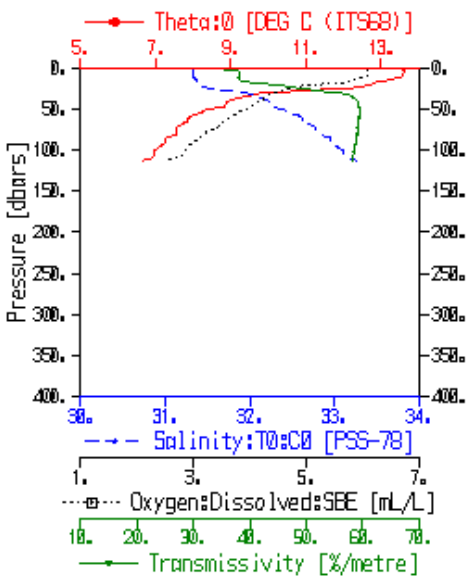
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1978	Theta C [ITS68]
10.00	42.3	6.32	31.4135	12.0443
20.00	44.0	5.56	31.6324	12.3543
30.00	54.5	5.35	31.7545	11.5021
50.00	51.3	4.02	32.2199	8.9905
75.00	51.1	3.39	32.7131	7.6421
100.00	55.9	2.03	32.9194	7.2405
125.00	55.0	1.53	33.0612	7.0399

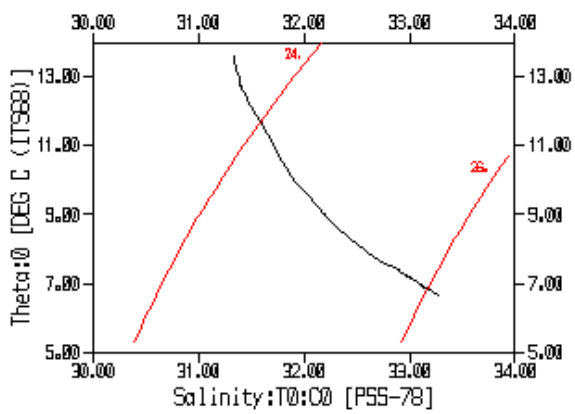




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 2
Mission-Event : 2003-27-110
Start Time : UTC 2003/09/16 22:06:02
Position : 52 37.870 N 130 28.010 W
Water Depth : 110

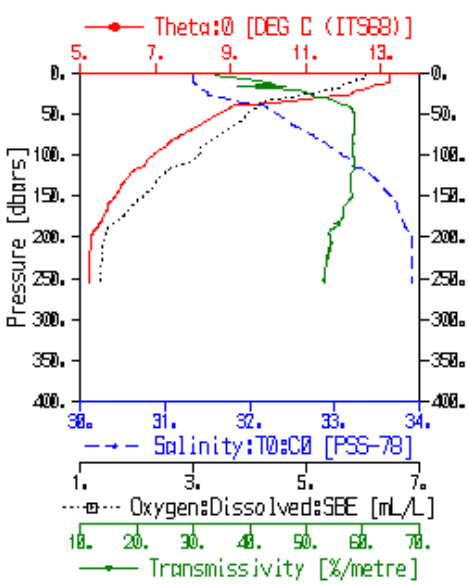
Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1DDS C	Theta [ITS68]
10.00	30.2	6.05	31.3313	13.5623
20.00	43.0	5.25	31.4454	12.1463
30.00	55.0	4.43	31.9212	9.9602
50.00	59.4	3.93	32.3301	8.5560
75.00	59.1	3.33	32.7034	7.5531
100.00	58.6	2.46	33.2004	6.9136

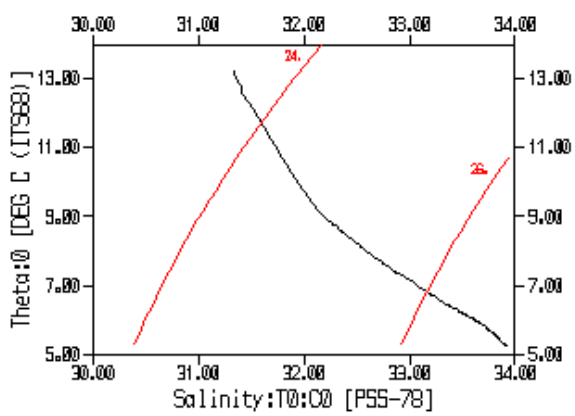




Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 1
Mission-Event : 2003-27-107
Start Time : UTC 2003/09/16 15:14:55
Position : 52 38.960 N 130 12.590 W
Water Depth : 164

Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1DDS C	Theta [ITS68]
10.00	43.0	5.04	31.3314	13.2234
20.00	48.3	5.44	31.4324	12.5400
30.00	53.5	4.60	31.6423	11.3156
50.00	56.5	3.96	32.3160	8.6919
75.00	56.4	3.47	32.7392	7.6160
100.00	56.4	3.00	33.0924	6.9403
125.00	57.9	2.45	33.4309	6.3016
150.00	58.3	2.32	33.6660	5.9719
200.00	56.4	1.42	33.9496	5.2170
250.00	53.2	1.35	33.9246	5.2430





Cruise 2003-27 CCGS John P. Tully

Line P

Station : MS 1

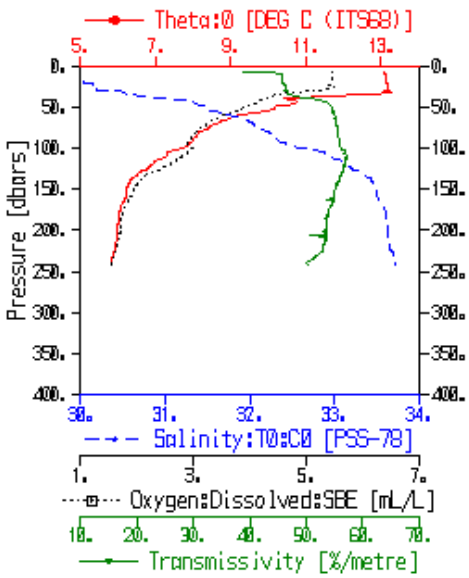
Mission-Event : 2003-27-133

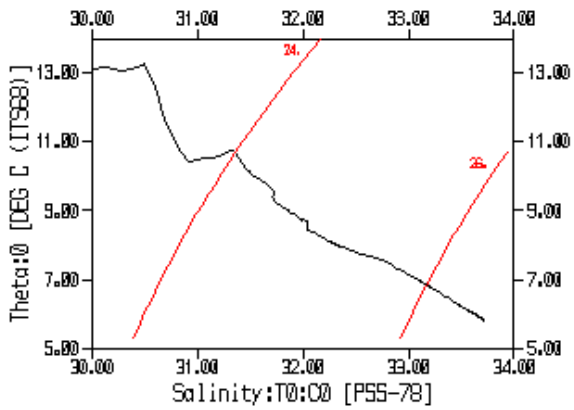
Start Time : UTC 2003/09/18 14:43:46

Position : 52 22.890 N 128 32.960 W

Water Depth : 197

Pressure dbars	Transmissiv %/metre	Oxygen mL/L	Salinity PSS-1978	Theta [ITS68] C
10.00	45.6	5.41	29.9046	13.1115
20.00	45.0	5.45	30.0260	13.1033
30.00	46.5	5.32	30.2190	13.0096
50.00	54.5	3.92	31.4162	10.1611
75.00	55.5	3.14	32.0199	8.3960
100.00	56.3	2.96	32.6415	7.6543
125.00	56.7	2.43	33.2133	6.7631
150.00	55.2	1.94	33.4960	6.2219
200.00	53.5	1.70	33.6340	5.9022





6.2 WATER COLUMN CHEMISTRY DATA TABLES

The following appendix contains water column chemistry data. Stations are ordered from west to east along the transect from JP8 to MS1.

Tables include station positions, dates and times recorded at the beginning of the cast, water depth and the following parameters:

- Sample Number
- Pressure
- CTD Temperature
- CTD Transmissivity
- CTD Oxygen
- CTD Salinity
- Rosette Bottle #
- Salinity
- Oxygen
- Nitrate + Nitrite
- Silicate
- Phosphate
- Methane
- Ethane
- Ethylene
- Propane

Station	Sample Number	Pressure dbars	CTD Temperature °C	CTD Transmissivity %/m	CTD Oxygen mL/L	CTD Salinity	Rosette Bottle #	Salinity	Oxygen mL/L	Nitrate + Nitrite µmol/L	Silicate µmol/L	Phosphate µmol/L	Methane nmol/L	Ethane nmol/L	Ethylene nmol/L	Propane nmol/L
	Station: JP 8															
	Start Time: UTC 2003/09/17 12:29:53															
	Position: 52 33.230 N, 131 29.850 W															
	Water Depth: 330 m															
JP 8	517	6.1	11.4311	16.3	6.75	31.7748	17	31.8327	6.382	4.6	5.8	0.9	11.9	0	0.1	0
JP 8	516	12.4	11.0755	36.9	5.14	31.9416	16	31.9507	5.245	10.4	14.0	1.2	12.8	0	0.2	0
JP 8	515	22.1	10.9592	42.8	4.92	32.0466	15	32.0669	4.835	12.9	19.7	1.4	9.5	0	0.1	0
JP 8	514	31.8	10.8053	49.5	4.75	32.1074	13	32.1166	4.716	13.7	22.5	1.4	8.7	0	0.2	0
JP 8	513	52.2	10.4467	52.7	4.36	32.1988	12	32.2303	4.302	16.4	27.4	1.6	9.7	0	0.1	0
JP 8	512	76.8	9.7540	57.0	3.93	32.3625	11	32.3708	3.920	19.2	32.9	1.7	9.4	0	0.1	0
JP 8	511	102.1	8.8342	54.7	3.37	32.5758	10	32.5989	3.366	23.4	42.9	2.0	15.9	0	0	0
JP 8	510	127.1	7.7388	53.0	2.85	32.9070	9	32.9208	2.900	27.4	52.2	2.3	17.4	0	0	0
JP 8	509	152.1	7.4737	50.0	2.74	32.9991	8	33.0009	2.708	28.4	54.6	2.3	16.9	0	0.1	0
JP 8	508	202.0	7.2632	50.7	2.74	33.0819	7	33.0845	2.690	28.9	54.9	2.4	21.0	0	0	0
JP 8	507	302.1	7.2516	48.5	2.73	33.0901	6	33.0916	2.882	29.1	55.1	2.4	23.0	0	0	0
JP 8	506	320.2	7.2509	48.0	2.73	33.0911	5	33.0922	2.697	29.0	55.6	2.4	22.5	0	0	0
JP 8	505	325.1	7.2516	48.1	2.74	33.0910	4	33.0923	2.686	29.1	55.3	2.4	22.1	0	0	0
JP 8	504	329.1	7.2525	48.1	2.74	33.0909	3	33.0923	2.677	28.9	55.3	2.4	21.9	0	0	0
JP 8	503	331.0	7.2526	47.9	2.74	33.0911	2	33.0920	2.854	29.1	55.6	2.4	22.4	0	0	0
JP 8	502	333.4	7.2524	46.2	2.73	33.0914	1	33.0926	2.724	28.9	55.4	2.4	22.4	0	0	0
	Station: JP 5															
	Start Time: UTC 2003/09/17 07:16:45															
	Position: 52 31.690 N, 131 12.370 W															
	Water Depth: 156 m															
JP 5	499	6.2	11.4859	24.0	6.28	31.9159	13	31.9210	6.325	6.5	6.1	0.9				
JP 5	498	12.2	11.2890	31.0	5.97	31.9256	12	31.9310	6.170	8.0	9.0	1.0	6.6	0	0.1	0
JP 5	497	22.3	10.5557	48.5	4.86	32.0080	11	32.0088	5.195	13.5	22.2	1.4	7.3	0	0.1	0
JP 5	496	32.3	10.5198	50.0	4.78	32.0218	10	32.0264	5.048	13.9	23.0	1.4	7.7	0	0.1	0
JP 5	495	51.9	9.7570	53.5	4.19	32.2310	9	32.2373	4.225	18.0	30.8	1.7	7.6	0	0	0
JP 5	494	77.0	9.2144	56.5	3.68	32.4793	8	32.4805	3.690	21.2	37.2	1.9	8.5	0	0	0
JP 5	493	102.5	8.5831	56.4	3.39	32.6579	7	32.6661	3.329	23.8	42.4	2.0	10.2	0	0	0
JP 5	492	127.4	7.8786	56.0	3.05	32.8678	6	32.8715	3.124	26.6	48.0	2.2	11.8	0	0	0
JP 5	491	144.3	7.5110	55.0	2.92	32.9847	5	32.9895	2.874	28.1	50.8	2.3	12.9	0	0	0
JP 5	490	149.1	7.4509	53.6	2.83	33.0078	4	33.0190	2.851	28.4	52.2	2.3	13.0	0	0	0
JP 5	489	153.0	7.3490	53.9	2.85	33.0461	3	33.0529	2.890	28.7	52.2	2.3	11.5	0	0.1	0
JP 5	488	155.2	7.2916	53.6	2.86	33.0685	2	33.0600	2.820	28.6	52.3	2.3	10.7	0	0.1	0
JP 5	487	156.8	7.2882	53.2	2.87	33.0703	1	33.0481	2.880	28.6	52.1	2.3	11.0	0	0.1	0

Station	Sample Number	Pressure dbars	CTD Temperature °C	CTD Transmissivity %/m	CTD Oxygen mL/L	CTD Salinity	Rosette Bottle #	Salinity	Oxygen mL/L	Nitrate + Nitrite µmol/L	Silicate µmol/L	Phosphate µmol/L	Methane nmol/L	Ethane nmol/L	Ethylene nmol/L	Propane nmol/L
	Station: JP 3															
	Start Time: UTC 2003/09/17 00:39:42															
	Position: 52 36.830 N, 130 41.080 W															
	Water Depth: 135 m															
JP 3	485	5.3	12.9635	35.4	6.20	31.4533	12	31.4163	6.198	4.2	9.8	0.6	5.5	0	0	0
JP 3	484	11.4	12.6903	45.1	6.14	31.5102	11	31.5233	6.212	4.8	9.2	0.7	5.4	0	0	0
JP 3	483	21.6	11.8865	52.4	5.54	31.6787	10	31.7039	5.480	7.9	13.2	1.0	5.9	0	0.1	0
JP 3	482	31.6	11.1715	56.5	5.05	31.8182	9	31.8406	4.980	11.2	18.6	1.2	5.8	0	0	0
JP 3	481	51.9	8.7284	57.9	3.82	32.3201	8	32.3496	3.798	22.6	38.6	1.9	6.1	0	0	0
JP 3	480	77.2	7.6095	57.0	3.14	32.7960	7	32.8296	3.060	27.3	50.4	2.2	6.3	0	0	0
JP 3	479	101.4	7.2209	55.7	2.81	32.9749	6	32.9806	2.891	29.0	54.5	2.3	6.3	0	0	0
JP 3	478	121.7	7.0892	55.3	2.68	33.0365	5	33.0426	2.647	29.8	56.3	2.4	6.3	0	0	0
JP 3	477	128.2	6.8848	54.8	2.49	33.1351	4	33.1369	2.437	30.9	59.2	2.5	6.5	0	0	0
JP 3	476	132.1	6.8391	55.1	2.46	33.1580	3	33.1562	2.465	31.0	59.5	2.5	5.7	0	0	0
JP 3	475	134.0	6.8196	55.2	2.43	33.1679	2	33.1783	2.525	31.3	59.5	2.5	6.3	0	0	0
JP 3	474	137.2	6.7415	54.7	2.35	33.2073	1	33.1732	2.436	31.2	59.1	2.5	5.8	0	0	0
	Station: JP 1															
	Start Time: UTC 2003/09/16 15:14:55															
	Position: 52 38.960 N, 130 12.590 W															
	Water Depth: 164 m															
JP 1	472	5.8	13.2422	42.5	6.17	31.3347	18	31.3438	6.147	3.9	10.7	0.5	4.6	0	0	0
JP 1	471	12.0	13.2357	43.8	6.14	31.3351	17	31.3666	6.003	4.5	10.8	0.6	4.9	0	0.1	0
JP 1	470	22.2	12.1286	51.8	5.36	31.5199	16	31.5605	5.264	9.5	14.9	1.0	4.8	0	0	0
JP 1	469	31.5	10.6242	56.1	4.54	31.8343	15	31.8718	4.467	15.8	22.9	1.5				
JP 1	468	51.5	8.2812	58.7	3.80	32.4790	14	32.4802	3.772	22.7	36.7	1.9				
JP 1	467	51.5	8.2773	58.7	3.80	32.4804	13	32.4802	3.770	22.8	37.0	1.9	6.9	0	0	0
JP 1	466	76.6	7.4775	58.6	3.35	32.8294	12	32.8296	3.464	26.4	44.7	2.2				
JP 1	465	101.9	6.9149	58.9	3.07	33.1088	11	33.1437	3.078	29.1	49.3	2.3	5.5	0	0	0
JP 1	464	126.9	6.2747	58.3	2.38	33.4588	10	33.4694	2.348	33.2	60.3	2.5				
JP 1	463	152.6	5.8701	57.0	2.00	33.6881	9	33.6875	1.997	35.5	64.8	2.7				
JP 1	462	176.9	5.6139	56.2	1.72	33.7959	8	33.7978	1.750	37.3	70.6	2.8				
JP 1	461	201.2	5.2824	54.7	1.40	33.9125	7	33.9146	1.418	38.9	78.5	2.9	4.7	0	0	0
JP 1	460	226.8	5.2638	53.9	1.40	33.9206	6	33.9231	1.364	39.1	78.7	2.9	6.5	0	0	0
JP 1	459	239.3	5.2629	53.8	1.39	33.9212	5	33.9229	1.354	38.9	78.6	2.9	5.6	0	0	0
JP 1	458	244.5	5.2621	53.8	1.40	33.9217	4	33.9236	1.348	39.0	78.4	2.9	4.7	0	0	0
JP 1	457	248.2	5.2603	53.6	1.40	33.9226	3	33.9246	1.384	38.9	78.3	2.9	4.7	0	0	0
JP 1	456	251.1	5.2598	53.5	1.40	33.9232	2	33.9243	1.372	39.1	78.3	2.9	4.8	0	0	0
JP 1	455	254.0	5.2586	53.4	1.40	33.9243	1	33.9255	1.376	38.8	77.6	2.9	4.3	0	0	0

Station	Sample Number	Pressure dbars	CTD Temperature °C	CTD Transmissivity %/m	CTD Oxygen mL/L	CTD Salinity	Rosette Bottle #	Salinity	Oxygen mL/L	Nitrate + Nitrite µmol/L	Silicate µmol/L	Phosphate µmol/L	Methane nmol/L	Ethane nmol/L	Ethylene nmol/L	Propane nmol/L
	Station: MS 1															
	Start Time: UTC 2003/09/18 14:43:46															
	Position: 52 22.890 N, 128 32.960 W															
	Water Depth: 197 m															
MS 1	536	7.1	13.0538	45.0	5.58	29.6901	17	29.5718	5.620	6.3	18.6	0.7	5.5	0	0.1	0
MS 1	535	12.2	13.2015	46.1	5.55	30.1775	16	30.1747	5.833	6.0	17.7	0.8	5.4	0	0.1	0
MS 1	534	21.8	13.1888	46.7	5.49	30.2149	15	30.2214	5.602	6.3	18.0	0.8	5.7	0	0.1	0
MS 1	533	32.7	13.4098	46.3	5.55	30.5171	13	30.4568	5.691	5.5	16.1	0.8				
MS 1	532	51.6	10.1776	55.0	3.89	31.4968	12	31.4869	3.928	19.0	35.6	1.6				
MS 1	531	76.2	8.2051	55.9	3.05	32.2023	11	32.1727	3.069	26.7	49.4	2.2				
MS 1	530	101.9	7.6117	57.1	2.90	32.6665	10	32.6723	2.972	28.3	50.2	2.3	7.0	0	0	0
MS 1	529	126.0	6.6728	56.6	2.35	33.2678	9	33.2538	2.500	31.9	57.1	2.5				
MS 1	528	151.6	6.2436	55.3	1.91	33.4916	8	33.4912	1.867	34.7	65.6	2.7				
MS 1	527	176.7	6.0750	54.4	1.78	33.5883	7	33.5812	1.796	35.5	67.7	2.7				
MS 1	526	201.8	5.9959	53.8	1.72	33.6332	6	33.6323	1.729	35.9	69.7	2.8	12.7	0	0	0
MS 1	525	225.8	5.8875	52.6	1.65	33.6900	5	33.6814	1.683	36.4	70.4	2.8	12.7	0	0	0
MS 1	524	229.9	5.8616	51.6	1.62	33.7032	4	33.7022	1.798	36.5	71.1	2.8	14.5	0	0.1	0
MS 1	523	237.6	5.8455	50.4	1.60	33.7121	3	33.7103	1.559	36.6	71.8	2.8	15.5	0	0	0
MS 1	522	238.9	5.8431	50.3	1.60	33.7136	2	33.7109	1.736	36.6	71.8	2.8	15.5	0	0.1	0
MS 1	521	241.0	5.8420	50.1	1.60	33.7149	1	33.7141	1.675	36.9	72.0	2.8	16.4	0	0	0

6.3 WATER COLUMN PROFILE PLOTS AND SECTION PLOTS

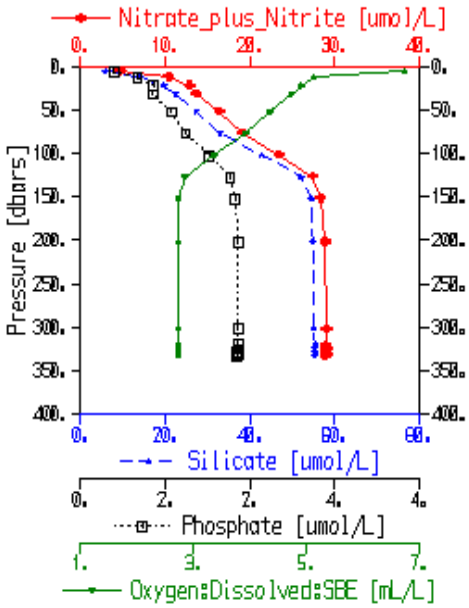
The following Appendix contains profile plots with stations ordered from west to east along the transect. The following parameters are shown for each station:

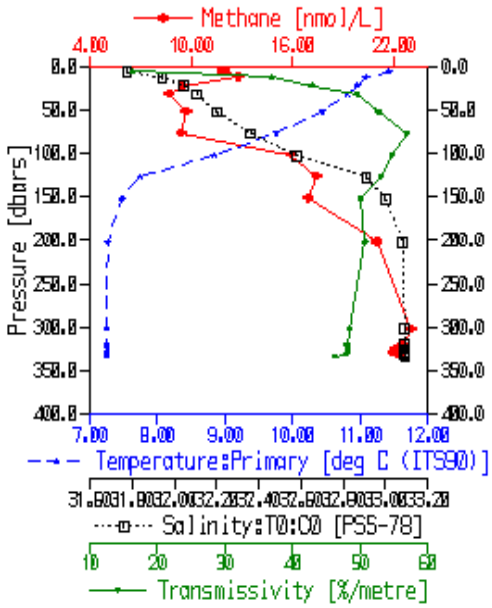
- Temperature
- Bottle salinity
- Dissolved oxygen
- Silicate
- Orthophosphate
- Nitrate
- Methane

Section plots along the cruise transect also are provided for:

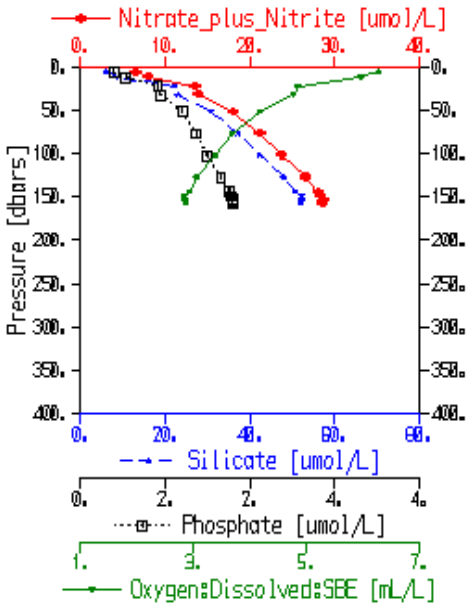
- Temperature
- Salinity
- Density
- Silicate
- Nitrate
- Phosphate
- Oxygen
- Methane

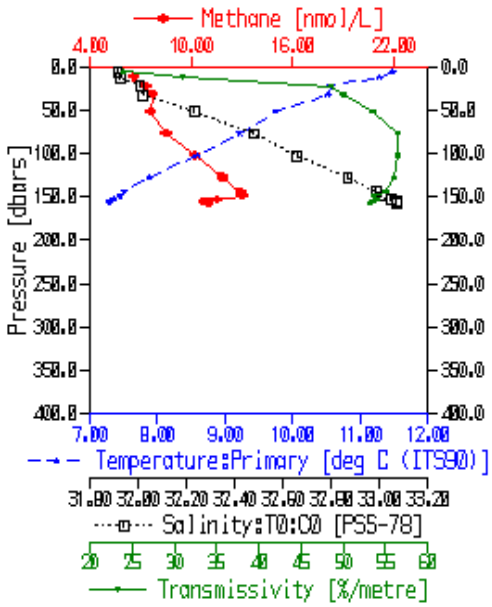
Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 8
Mission-Event : 2003-27-125
Start Time : UTC 2003/09/17 12:29:53
Position : 52 33.230 N 131 29.850 W
Water Depth : 330



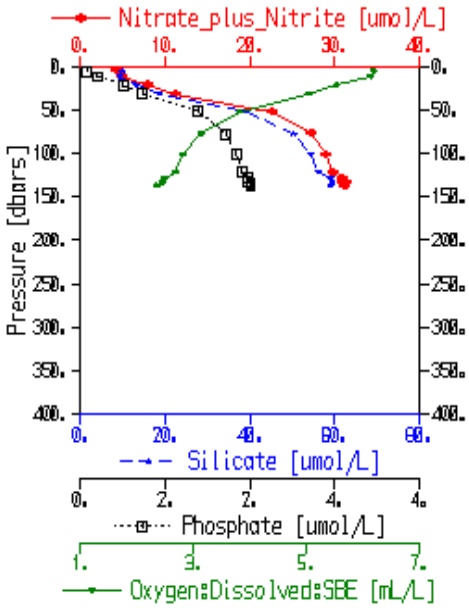


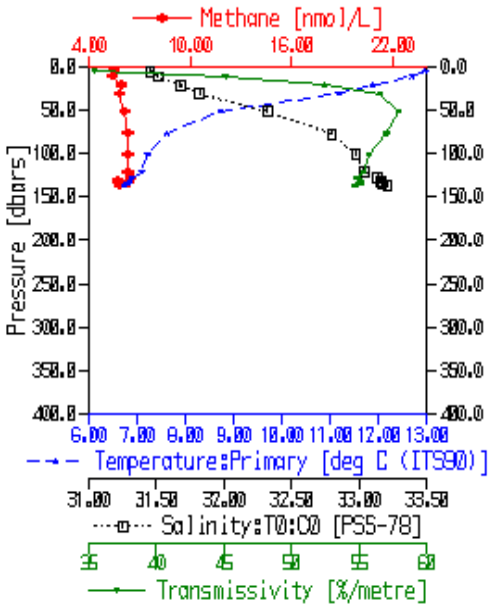
Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 5
Mission-Event : 2003-27-118
Start Time : UTC 2003/09/17 07:16:45
Position : 52 31.690 N 131 12.370 W
Water Depth : 156



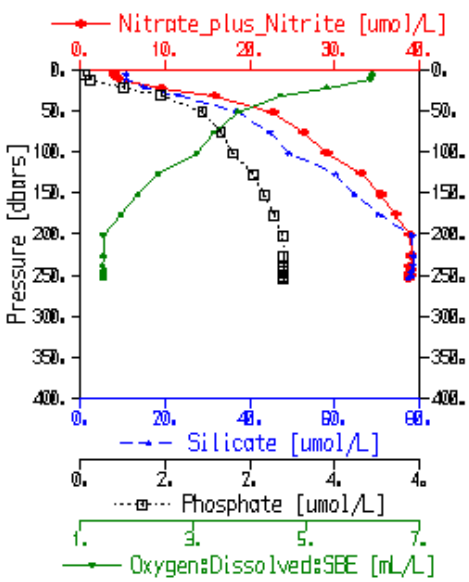


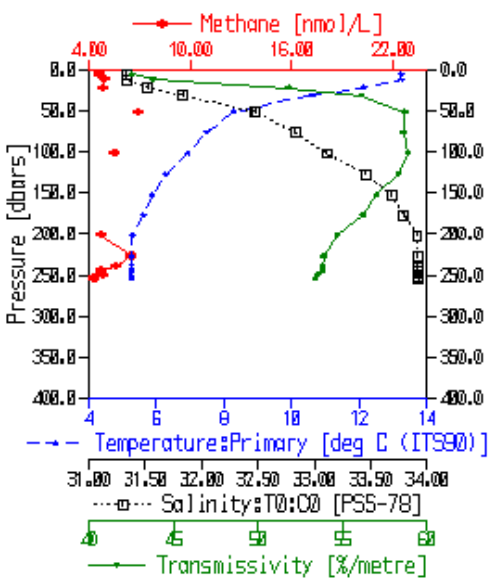
Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 3
Mission-Event : 2003-27-111
Start Time : UTC 2003/09/17 00:39:42
Position : 52 36.830 N 130 41.080 W
Water Depth : 135



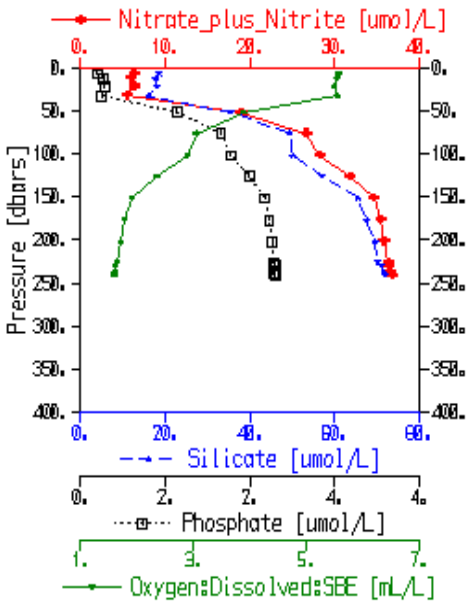


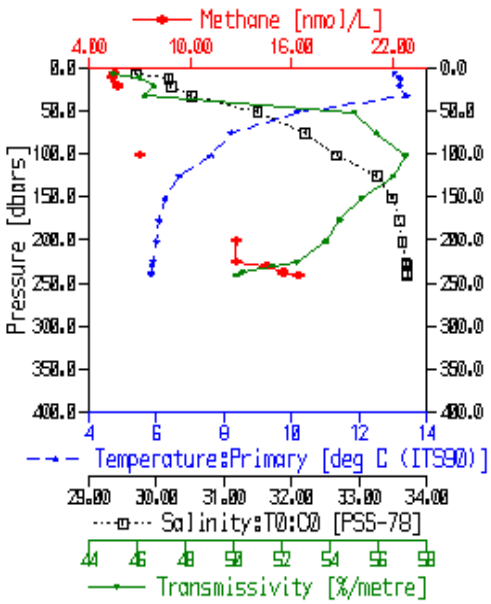
Cruise 2003-27 CCGS John P. Tully
Line P
Station : JP 1
Mission-Event : 2003-27-107
Start Time : UTC 2003/09/16 15:14:55
Position : 52 38.960 N 130 12.590 W
Water Depth : 164

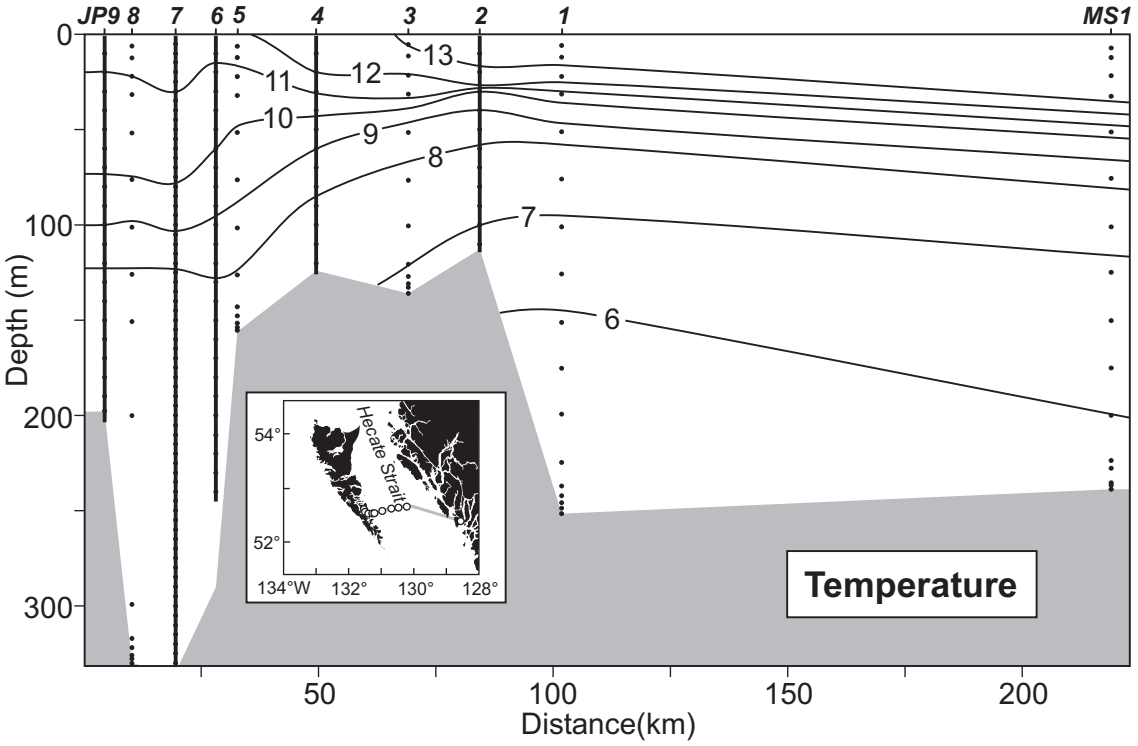


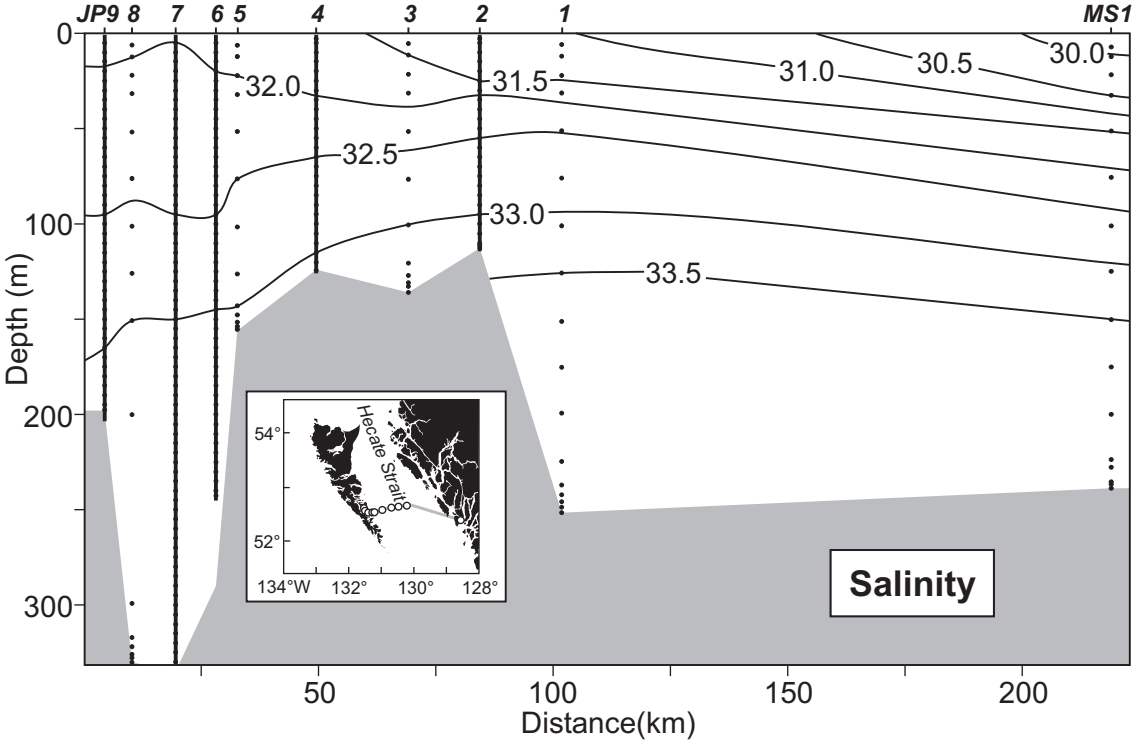


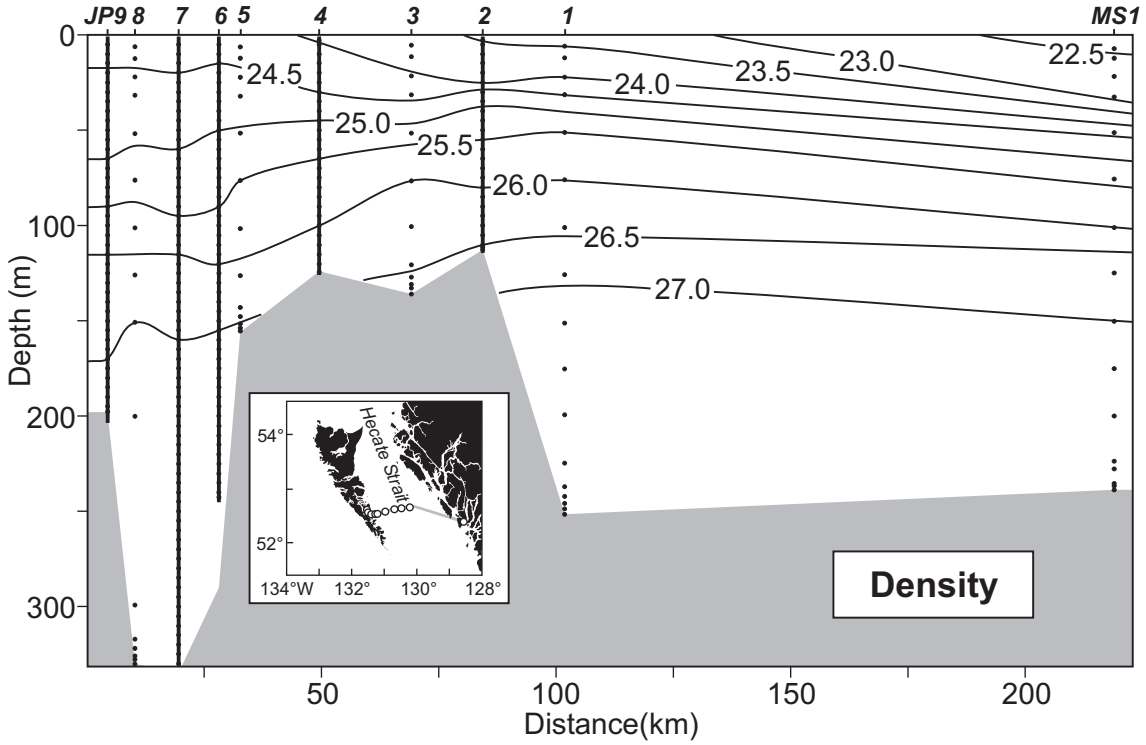
Cruise 2003-27 CCGS John P. Tully
Line P
Station : MS 1
Mission-Event : 2003-27-133
Start Time : UTC 2003/09/18 14:43:46
Position : 52 22.890 N 128 32.960 W
Water Depth : 197

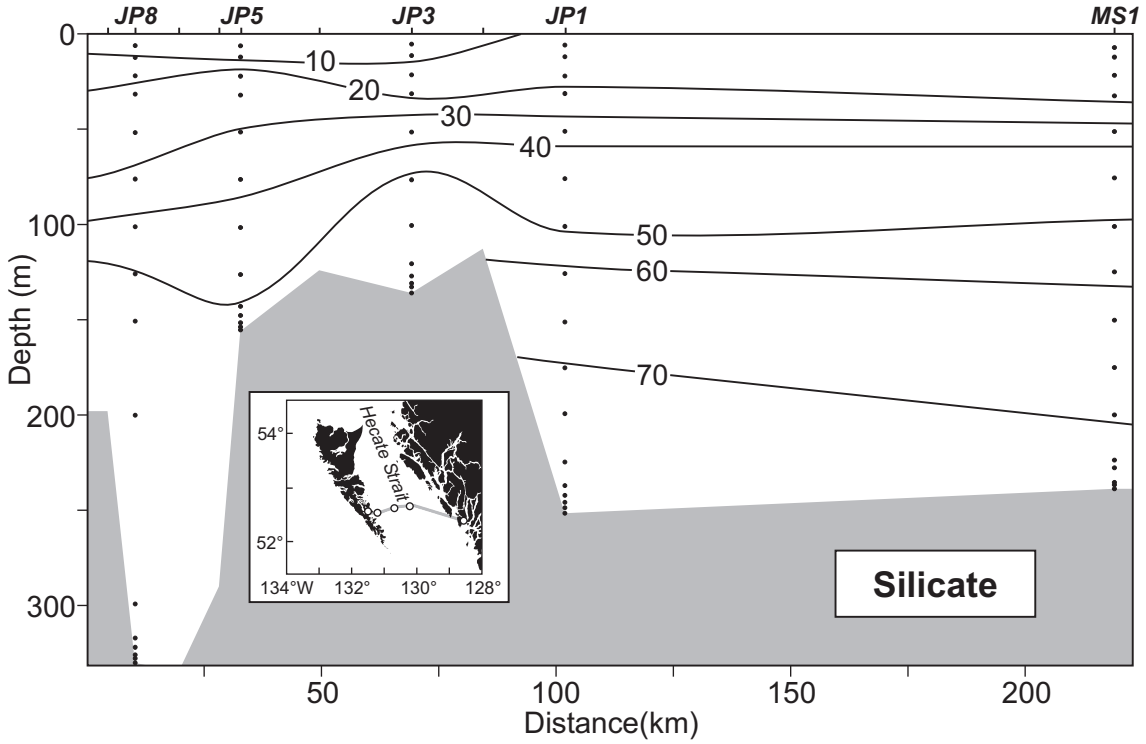


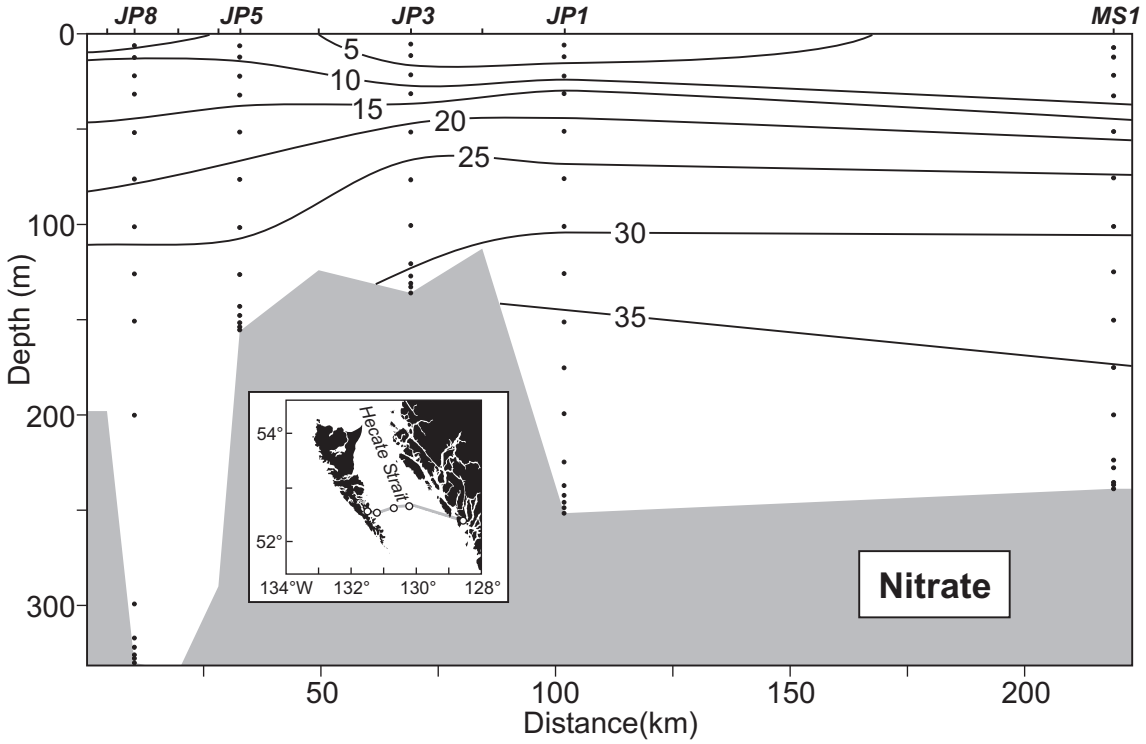


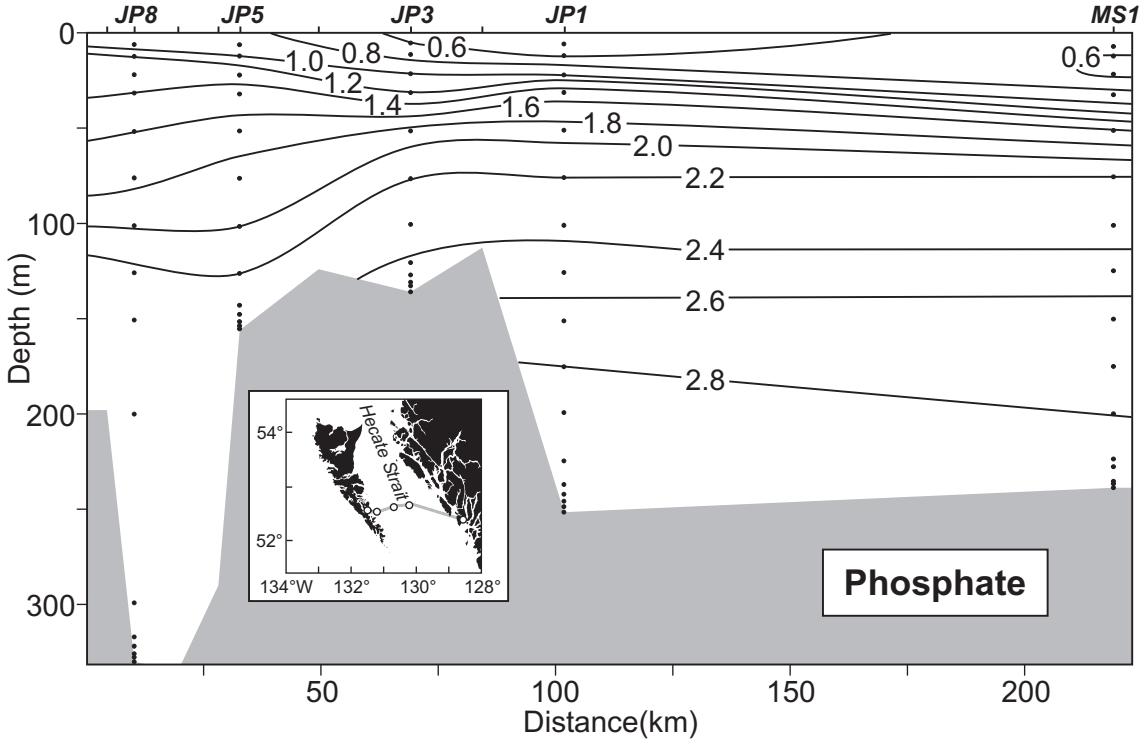

JP9 8 7 6 5 4 3 2 1 MS1
0
100
200
300
Depth (m)
13
12
11
10
9
8
7
6
Hecate Strait
54°
52°
134°W 132° 130° 128°
Temperature
50 100 150 200
Distance(km)

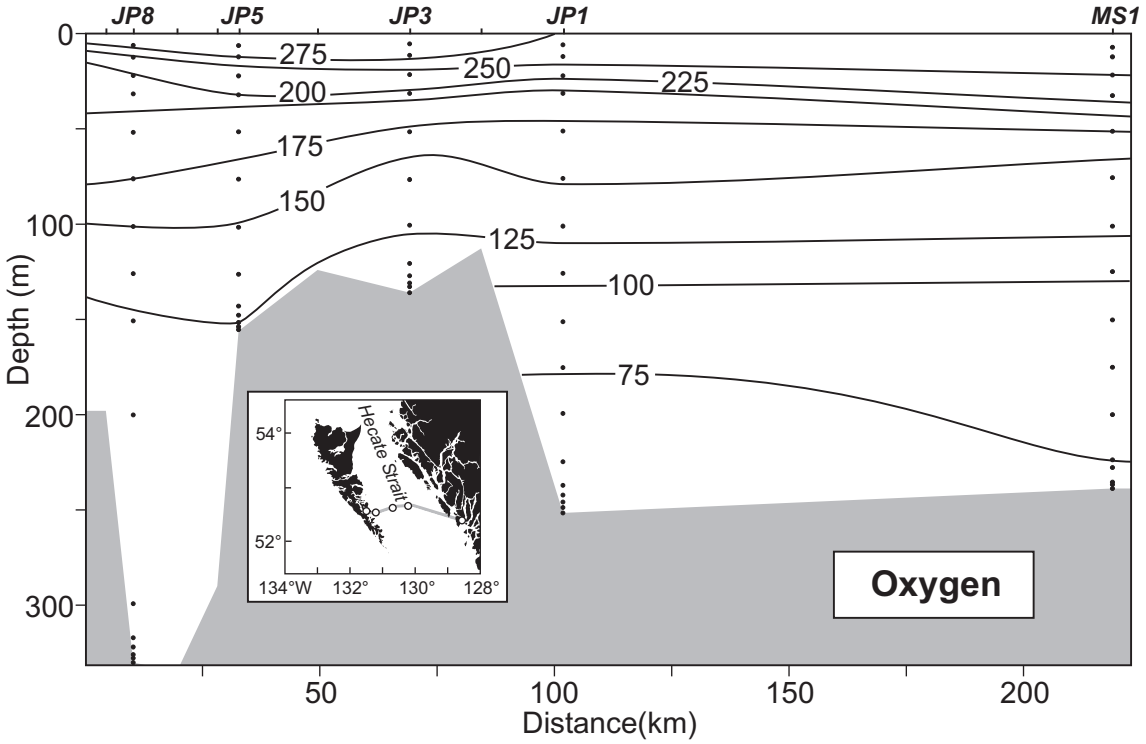

JP9 8 7 6 5 4 3 2 1 MS1
0
100
200
300
Depth (m)
32.0
31.5
31.0
30.5
30.0
32.5
33.0
33.5
Hecate Strait
54°
52°
134°W 132° 130° 128°
Salinity
50 100 150 200
Distance(km)

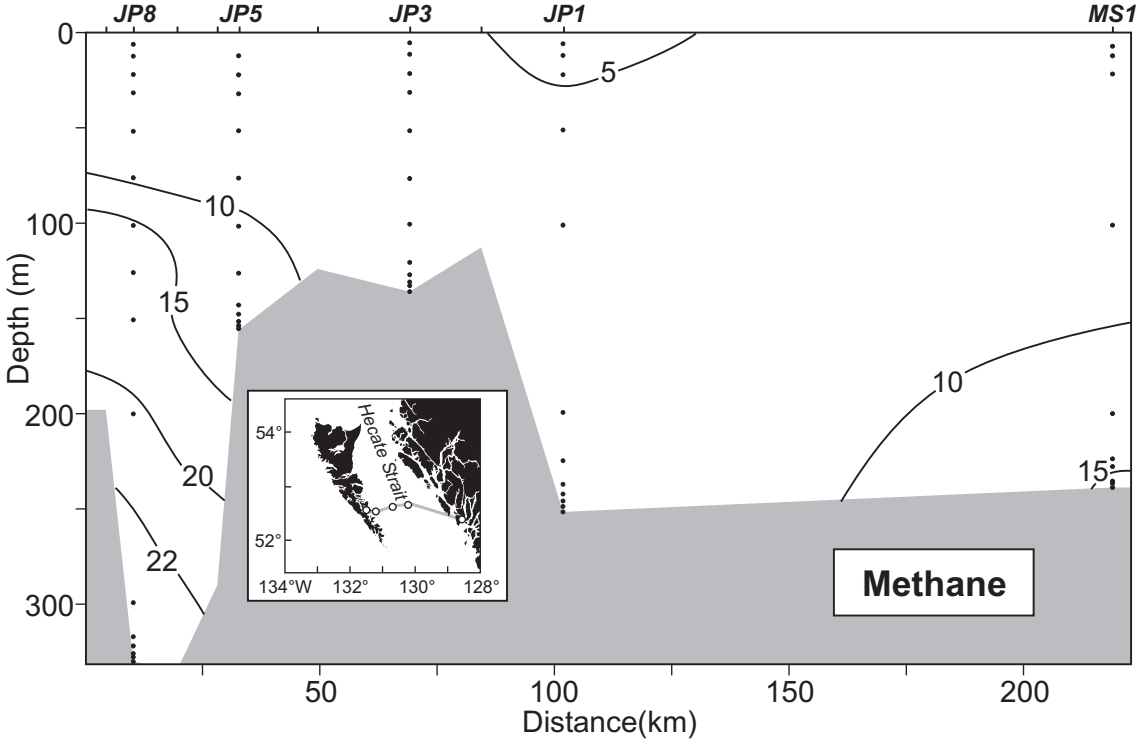

JP9 8 7 6 5 4 3 2 1 MS1
0
100
200
300
Depth (m)
24.5
25.0
25.5
26.0
26.5
27.0
24.0
23.5
23.0
22.5
Hecate Strait
54°
52°
134°W 132° 130° 128°
Density
50 100 150 200
Distance(km)


JP8 JP5 JP3 JP1 MS1
0
100
200
300
Depth (m)
10
20
30
40
50
60
70
Hecate Strait
54°
52°
134°W 132° 130° 128°
Silicate
50 100 150 200
Distance(km)


JP8
JP5
JP3
JP1
MS1
0
100
200
300
Depth (m)
5
10
15
20
25
30
35
Hecate Strait
54°
52°
134°W
132°
130°
128°
Nitrate
50
100
150
200
Distance(km)


JP8
JP5
JP3
JP1
MS1
0
100
200
300
Depth (m)
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
Hecate Strait
54°
52°
134°W
132°
130°
128°
Phosphate
50
100
150
200
Distance(km)


JP8
JP5
JP3
JP1
MS1
275
250
225
200
175
150
125
100
75
Depth (m)
0
100
200
300
50
100
150
200
Distance(km)
Hecate Strait
54°
52°
134°W
132°
130°
128°
Oxygen


JP8
JP5
JP3
JP1
MS1
5
10
15
20
22
10
15
Depth (m)
0
100
200
300
50
100
150
200
Distance(km)
Hecate Strait
54°
52°
134°W
132°
130°
128°
Methane

6.4 SEDIMENT BULK PROPERTIES

This appendix contains sediment bulk properties data for stations JP8, JP1 and MS1. Parameters shown for each station are:

- Moisture
- Total organic carbon (TOC)
- Total nitrogen (TN)
- Carbon/nitrogen (C/N) ratio
- Biogenic silica ($SiO_2.4H_2O$)
- ^{210}Pb

Downcore profiles are presented as bar plots for TOC, TN and Opal (biogenic silica) and as line plots for C/N ratio, percent silica, excess ^{210}Pb and porosity, and excess ^{210}Pb showing both core depth and year scales.

Stn	Sample #	Interval	Moisture %	TOC %	TN %	C/N ratio	Silica %
JP8	1	0-1 cm	0.687	4.052	0.531	7.63	18.55
JP8	2	1-2 cm	0.678	4.122	0.516	7.99	17.38
JP8	3	2-3 cm	0.677	4.002	0.517	7.75	17.77
JP8	4	3-4 cm	0.680	4.121	0.506	8.15	17.21
JP8	5	4-5 cm	0.685	3.845	0.498	7.72	17.08
JP8	6	5-6 cm	0.684	3.875	0.498	7.78	17.40
JP8	7	6-7 cm	0.690	4.185	0.529	7.91	17.64
JP8	8	7-8 cm	0.680	3.987	0.506	7.88	17.50
JP8	9	8-9 cm	0.679	4.166	0.532	7.84	17.13
JP8	10	9-10 cm	0.669	3.870	0.490	7.90	16.76
JP8	11	10-12 cm	0.672	4.069	0.509	7.99	16.97
JP8	12	12-14 cm	0.651	3.844	0.484	7.94	16.79
JP8	13	14-16 cm	0.682	3.880	0.490	7.92	16.98
JP8	14	16-18 cm	0.642	4.108	0.509	8.07	16.90
JP8	15	18-20 cm	0.630	4.071	0.523	7.79	17.85
JP8	16	20-25 cm	0.646	3.942	0.495	7.96	18.71
JP8	17	25-30 cm	0.655	3.918	0.483	8.10	18.55
JP8	18	30-35 cm	0.645	3.902	0.496	7.86	18.38
JP8	19	35-40 cm	0.641	3.721	0.476	7.82	18.09
JP8	20	40-55 cm	0.656	3.690	0.473	7.80	18.54
JP1	1	0-2 cm	0.343	0.608	0.078	7.80	1.91
JP1	2	2-4 cm	0.317	0.769	0.097	7.91	2.37
JP1	3	4-6 cm	0.352	1.235	0.152	8.10	2.74
JP1	4	6-8 cm	0.391	1.730	0.210	8.23	5.10
JP1	5	8-10 cm	0.413	1.903	0.228	8.35	6.77
JP1	6	10-12 cm	0.437	1.800	0.230	7.83	7.57
JP1	7	12-14 cm	0.423	1.928	0.252	7.66	7.00
JP1	8	14-16 cm	0.410	2.591	0.342	7.58	8.01
JP1	9	16-18 cm	0.425	1.641	0.216	7.60	8.77
JP1	10	18-20 cm	0.397	1.563	0.207	7.54	7.86
JP1	11	20-22 cm	0.292	0.480	0.066	7.24	2.98
JP1	12	22-24 cm	0.328	0.277	0.037	7.53	3.34
JP1	13	24-29 cm	0.356	0.307	0.029	10.73	2.58
JP1	14	29-34 cm	0.383	0.297	0.045	6.56	2.39
JP1	15	34-39 cm	0.381	0.303	0.049	6.23	2.73
MS1	1	0-1 cm	0.813	5.864	0.761	7.71	20.28
MS1	2	1-2.5 cm	0.794	5.806	0.736	7.89	20.59
MS1	3	2.5-3 cm	0.789	6.077	0.756	8.04	21.01
MS1	4	3-4 cm	0.782	5.975	0.743	8.04	21.08
MS1	5	4-5 cm	0.771	5.723	0.718	7.97	20.74
MS1	6	5-6 cm	0.776	5.120	0.659	7.77	21.14
MS1	7	6-7 cm	0.757	5.786	0.732	7.90	20.67
MS1	8	7-8 cm	0.756	5.846	0.746	7.84	20.81
MS1	9	8-9 cm	0.757	5.905	0.745	7.93	21.88
MS1	10	9-10 cm	0.757	5.463	0.716	7.63	20.91
MS1	11	10-12 cm	0.769	5.385	0.688	7.82	20.76
MS1	12	12-14 cm	0.757	5.859	0.749	7.83	20.90
MS1	13	14-16 cm	0.755	5.833	0.745	7.83	22.00
MS1	14	16-18 cm	0.757	5.501	0.667	8.24	20.94
MS1	15	18-20 cm	0.760	5.427	0.666	8.15	20.42
MS1	16	20-25 cm	0.760	5.263	0.642	8.20	21.03
MS1	17	25-30 cm	0.754	5.358	0.683	7.85	20.86
MS1	18	30-35 cm	0.731	5.120	0.627	8.17	21.76
MS1	19	35-40 cm	0.741	4.970	0.652	7.62	21.75
MS1	20	40-45 cm	0.748	5.094	0.645	7.90	22.82
MS1	21	45-50 cm	0.747	5.164	0.659	7.83	23.47
MS1	22	50-55 cm	0.733	4.845	0.580	8.35	24.84

Station: JP8
Water depth: 331 m
Bottom water temperature: 7.3
Bottom water salinity: 33.1
Bottom water density: 27.9

Interval top cm	bottom cm	mid cm	Vw vol water	Vs vol solids	phi porosity	Mid Pt g/cm2	Total ^{210}Pb dpm/g	Excess ^{210}Pb dpm/g	Ln($^{210}Pb_{ex}$) dpm/g	^{210}Pb dpm/cm3	^{226}Ra dpm/g
0	1	0.5	0.687	0.110	0.862	0.182	30.76	30.16	3.41	11.00	
1	2	1.5	0.678	0.113	0.857	0.554					
2	3	2.5	0.677	0.114	0.856	0.934	34.10	33.50	3.51	12.76	0.53
3	4	3.5	0.680	0.112	0.858	1.313					
4	5	4.5	0.685	0.110	0.861	1.684	28.03	27.43	3.31	10.08	
5	6	5.5	0.684	0.111	0.860	2.053					
6	7	6.5	0.690	0.108	0.864	2.418	25.65	25.05	3.22	9.00	
7	8	7.5	0.680	0.112	0.859	2.785					
8	9	8.5	0.679	0.113	0.857	3.161	25.84	25.24	3.23	9.54	
9	10	9.5	0.669	0.117	0.852	3.547					
10	12	11.0	0.672	0.116	0.853	4.132	22.97	22.37	3.11	8.70	
12	14	13.0	0.651	0.123	0.841	4.944					
14	16	15.0	0.682	0.112	0.859	5.739	16.48	15.88	2.77	5.92	0.68
16	18	17.0	0.642	0.127	0.835	6.549					
18	20	19.0	0.630	0.132	0.827	7.445	13.31	12.71	2.54	5.82	
20	25	22.5	0.646	0.125	0.837	8.980					
25	30	27.5	0.655	0.122	0.843	11.098	7.78	7.18	1.97	2.99	
30	35	32.5	0.645	0.126	0.837	13.219					
35	40	37.5	0.641	0.128	0.834	15.400	8.38	7.71	2.04	3.40	
40	55	47.5	0.656	0.122	0.843	19.612	5.78	5.18	1.64	2.15	0.67

Station: JP1
Water depth: 252 m
Bottom water temperature: 5.3
Bottom water salinity: 33.9
Bottom water density: 28.9

Interval top cm	bottom cm	mid cm	Vw vol water	Vs vol solids	phi porosity	Mid Pt g/cm2	Total ^{210}Pb dpm/g	Excess ^{210}Pb dpm/g	Ln($^{210}Pb_{ex}$) dpm/g	^{210}Pb dpm/cm3	^{226}Ra dpm/g
0	2	1.0	0.343	0.244	0.585	1.101	14.22	13.62	2.61	14.99	
2	4	3.0	0.317	0.254	0.555	3.381	9.31	8.71	2.16	10.26	
4	6	5.0	0.352	0.240	0.594	5.634	3.88	3.28	1.19	3.53	0.70
6	8	7.0	0.391	0.225	0.635	7.675	1.38	0.78	-0.24	0.76	
8	10	9.0	0.413	0.216	0.657	9.552	1.15	0.55	-0.59	0.50	
10	12	11.0	0.437	0.207	0.679	11.313	1.17	0.57	-0.56	0.49	
12	14	13.0	0.423	0.212	0.666	13.051	1.49	0.89	-0.12	0.79	
14	16	15.0	0.410	0.218	0.653	14.857	1.82	1.22	0.20	1.12	
16	18	17.0	0.425	0.211	0.668	16.655	2.15	1.55	0.44	1.36	0.86
18	20	19.0	0.397	0.223	0.640	18.488	0.96	0.36	-1.03	0.34	
20	22	21.0	0.292	0.263	0.526	20.696	0.74	0.14	-1.99	0.17	
22	24	23.0	0.328	0.249	0.568	23.096					
24	29	26.5	0.356	0.239	0.598	26.902	0.51	-0.09			
29	34	31.5	0.383	0.228	0.627	32.031	0.72	0.12	-2.12	0.12	0.80
34	39	36.5	0.381	0.229	0.625	36.982					

Station: MS1

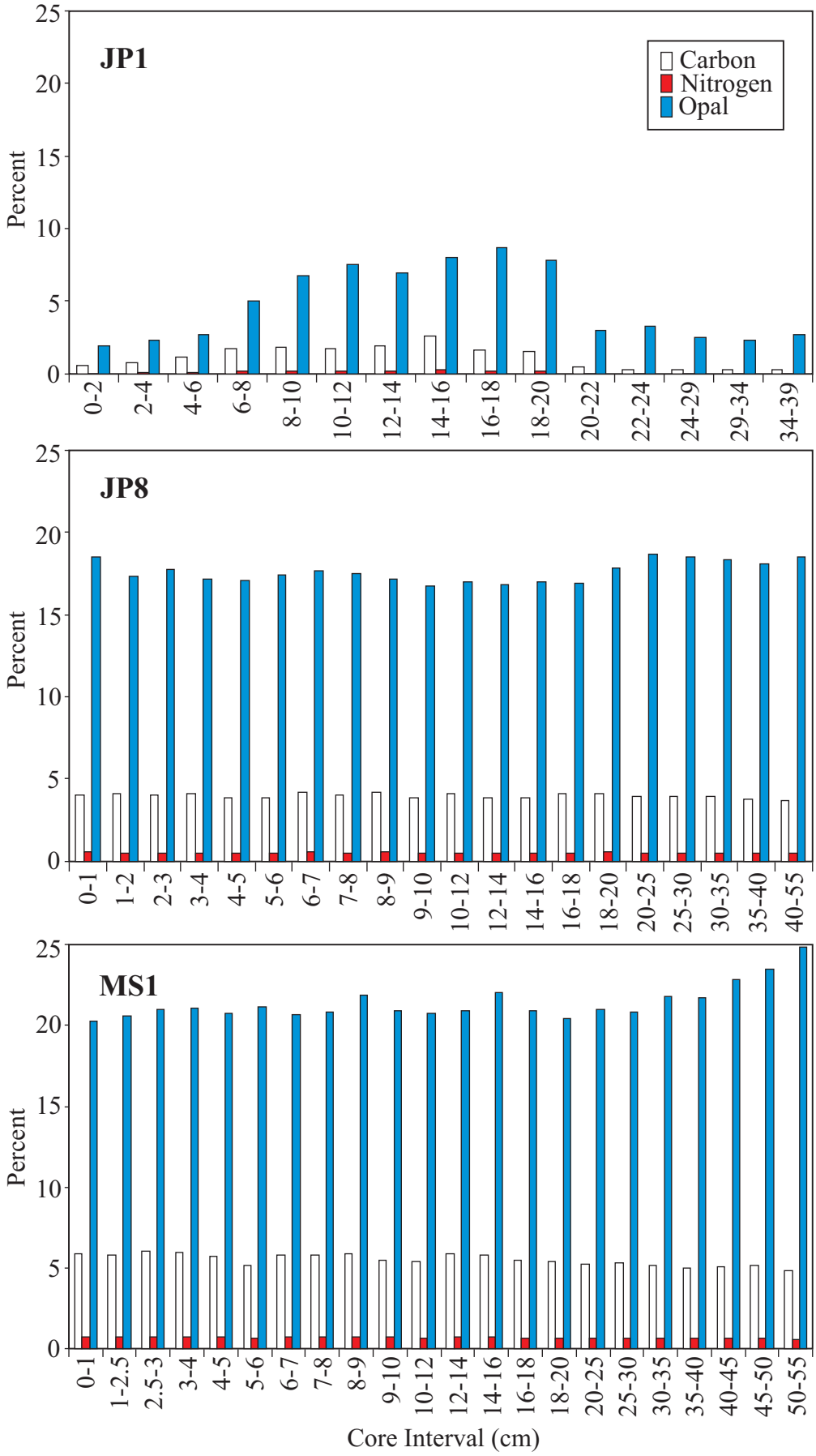
Water depth: 239 m

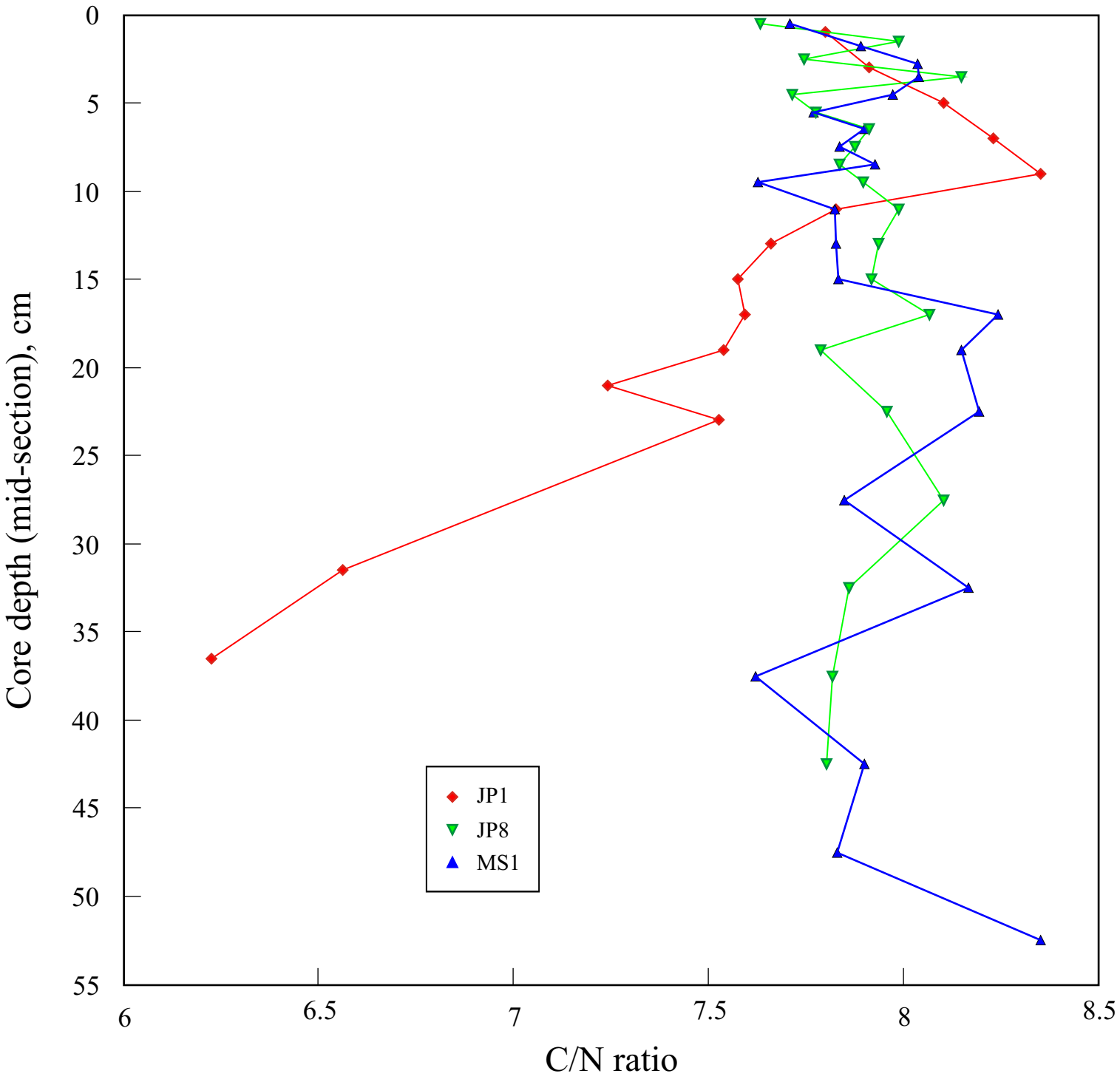
Bottom water temperature: 5.8

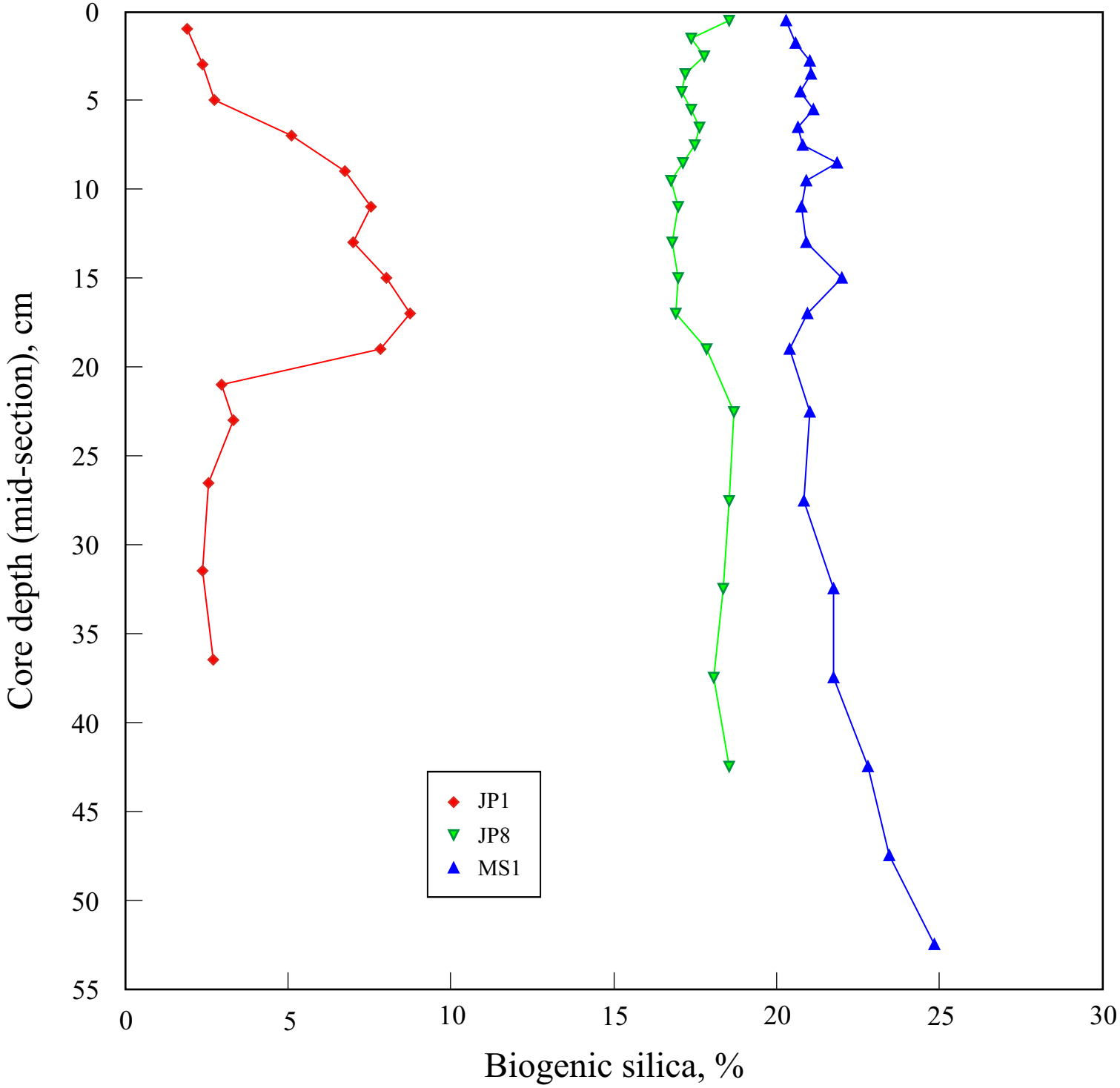
Bottom water salinity: 33.7

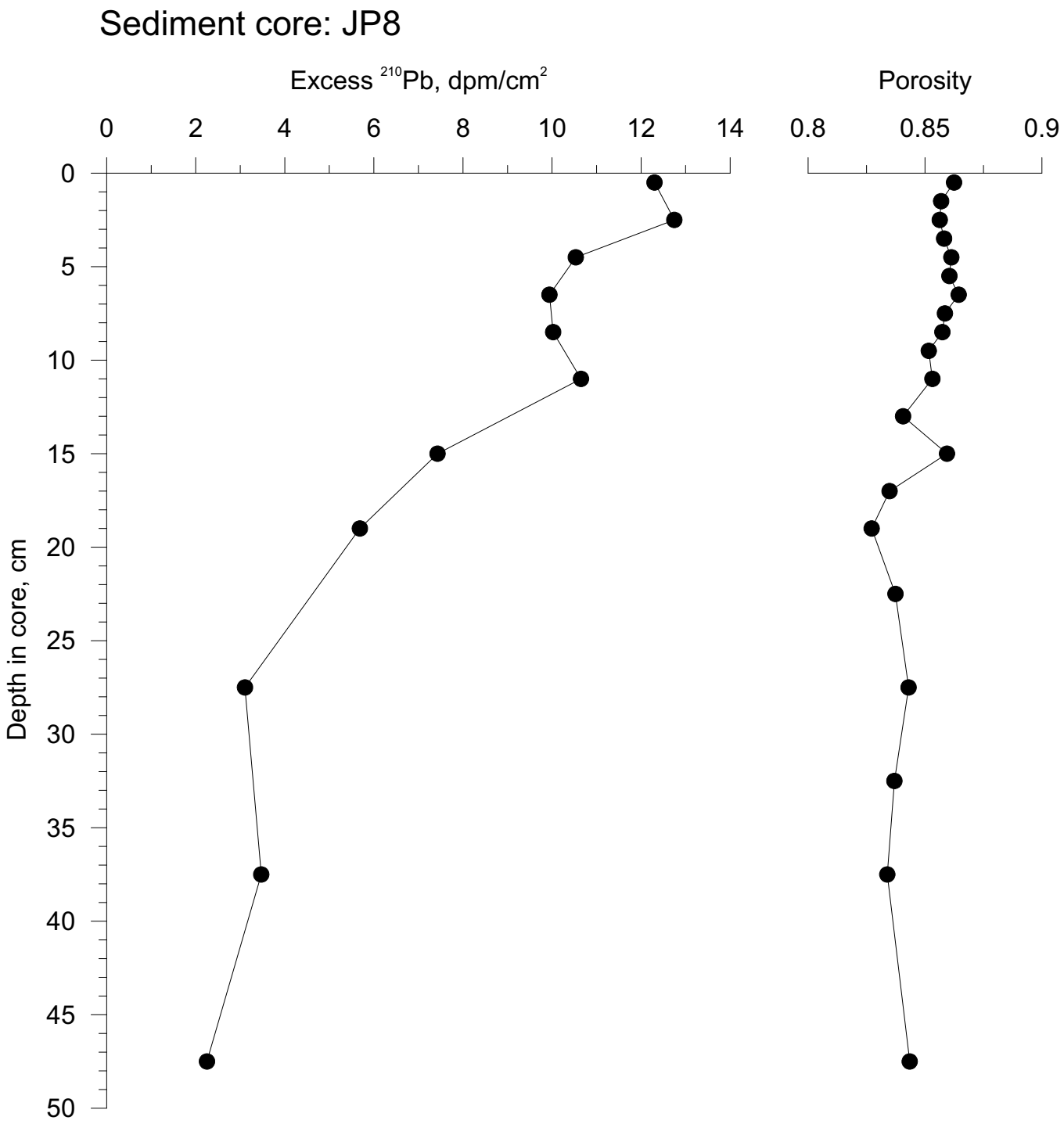
Bottom water density: 28.6

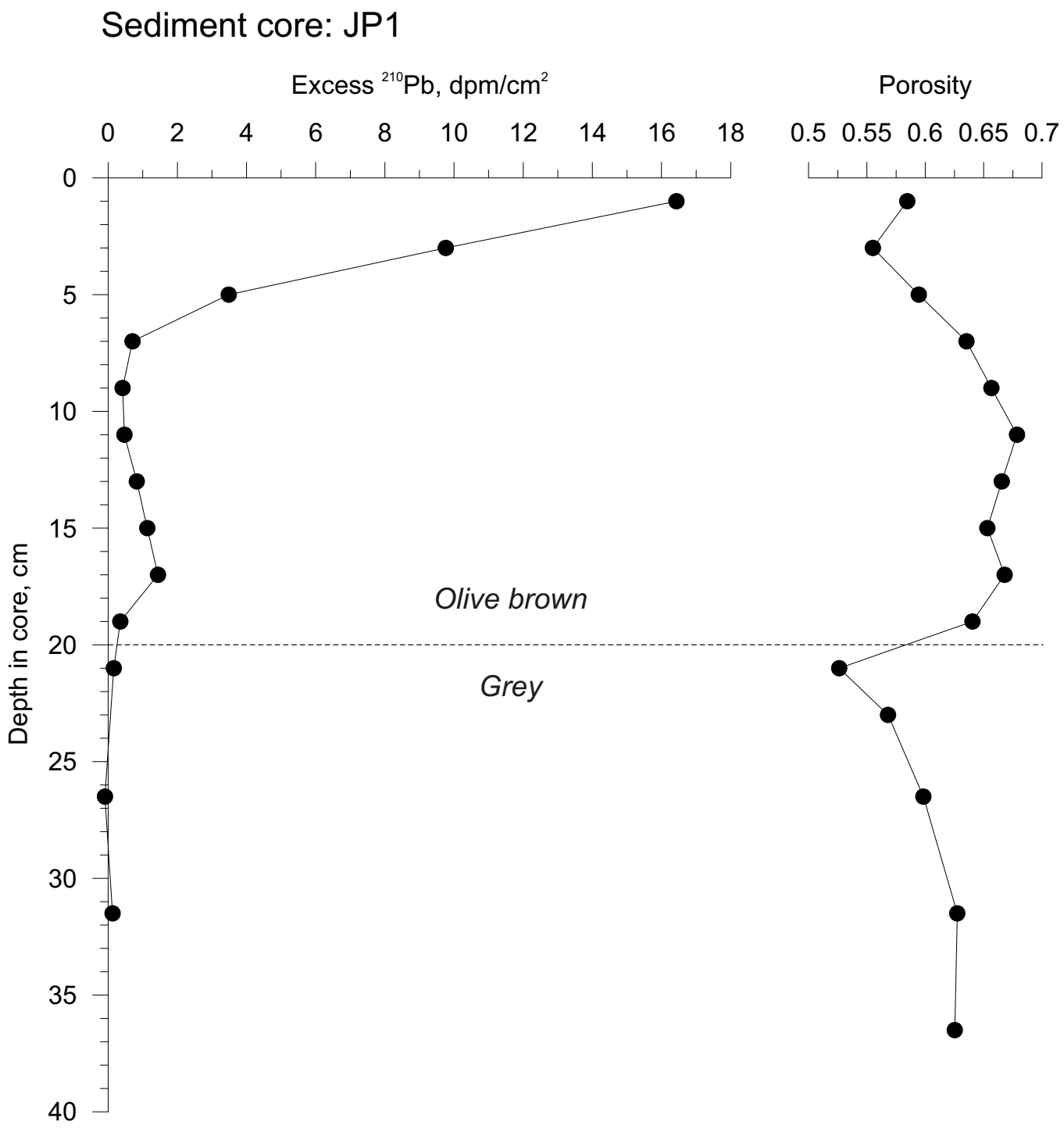
Interval top	bottom	mid	V_w	V_s	phi	Mid Pt	Total ^{210}Pb	Excess ^{210}Pb	$Ln(^{210}Pb_{ex})$	^{210}Pb	^{226}Ra
cm	cm	cm	vol water	vol solids	porosity	g/cm^2	dpm/g	dpm/g	dpm/g	dpm/cm^3	dpm/g
0.0	1.0	0.50	0.813	0.060	0.931	0.091	50.78	49.98	3.91	10.86	
1.0	2.5	1.75	0.794	0.068	0.921	0.339					
2.5	3.0	2.75	0.789	0.069	0.919	0.548					
3.0	4.0	3.50	0.782	0.072	0.915	0.714	31.18	30.38	3.41	7.08	1.62
4.0	5.0	4.50	0.771	0.077	0.910	0.946					
5.0	6.0	5.50	0.776	0.075	0.912	1.182	49.31	48.51	3.88	12.08	
6.0	7.0	6.50	0.757	0.082	0.902	1.427					
7.0	8.0	7.50	0.756	0.082	0.902	1.687	46.14	45.34	3.81	12.00	
8.0	9.0	8.50	0.757	0.082	0.902	1.947					
9.0	10.0	9.50	0.757	0.082	0.902	2.206					
10.0	12.0	11.00	0.769	0.077	0.909	2.578	41.37	40.57	3.70	10.94	
12.0	14.0	13.00	0.757	0.082	0.902	3.080					
14.0	16.0	15.00	0.755	0.083	0.901	3.602	29.45	28.65	3.36	7.63	1.35
16.0	18.0	17.00	0.757	0.082	0.902	4.124					
18.0	20.0	19.00	0.760	0.081	0.904	4.639	20.51	19.71	2.98	5.17	
20.0	25.0	22.50	0.760	0.081	0.904	5.532					
25.0	30.0	27.50	0.754	0.083	0.901	6.827	11.73	10.93	2.39	2.83	
30.0	35.0	32.50	0.731	0.092	0.888	8.227					
35.0	40.0	37.50	0.741	0.088	0.894	9.674	5.37	4.57	1.52	1.29	
40.0	45.0	42.50	0.748	0.086	0.897	11.060					
45.0	50.0	47.50	0.747	0.086	0.897	12.423	2.92	2.12	0.75	0.62	
50.0	55.0	52.50	0.733	0.092	0.889	13.842	1.92	1.12	0.11	0.37	0.84

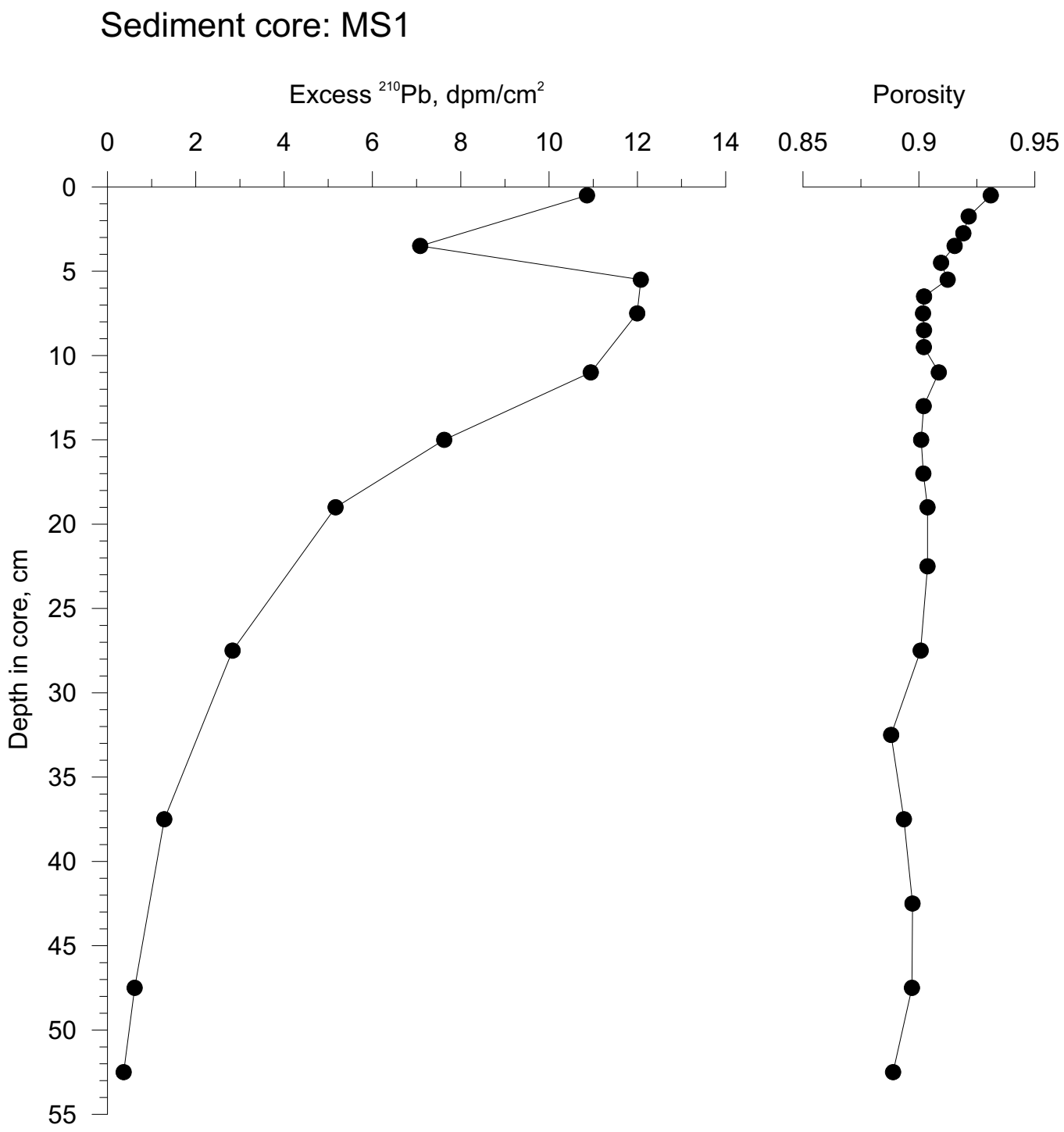

JP1
Carbon
Nitrogen
Opal
Percent
0
5
10
15
20
25
0-2
2-4
4-6
6-8
8-10
10-12
12-14
14-16
16-18
18-20
20-22
22-24
24-29
29-34
34-39
JP8
Percent
0-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-12
12-14
14-16
16-18
18-20
20-25
25-30
30-35
35-40
40-55
MS1
Percent
0-1
1-2.5
2.5-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-12
12-14
14-16
16-18
18-20
20-25
25-30
30-35
35-40
40-45
45-50
50-55
Core Interval (cm)

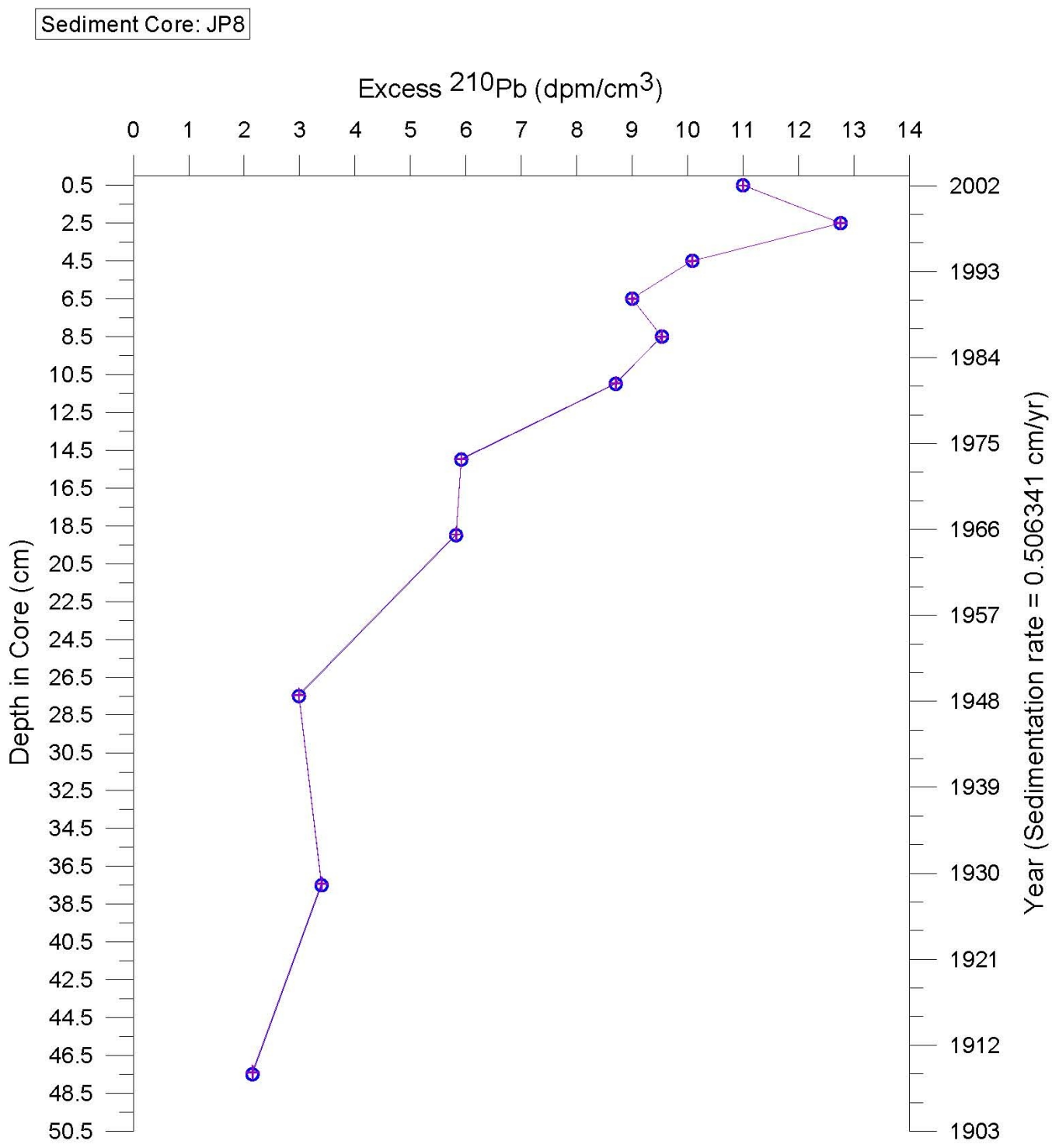

Core depth (mid-section), cm
0
5
10
15
20
25
30
35
40
45
50
55
6
6.5
7
7.5
8
8.5
C/N ratio
JP1
JP8
MS1

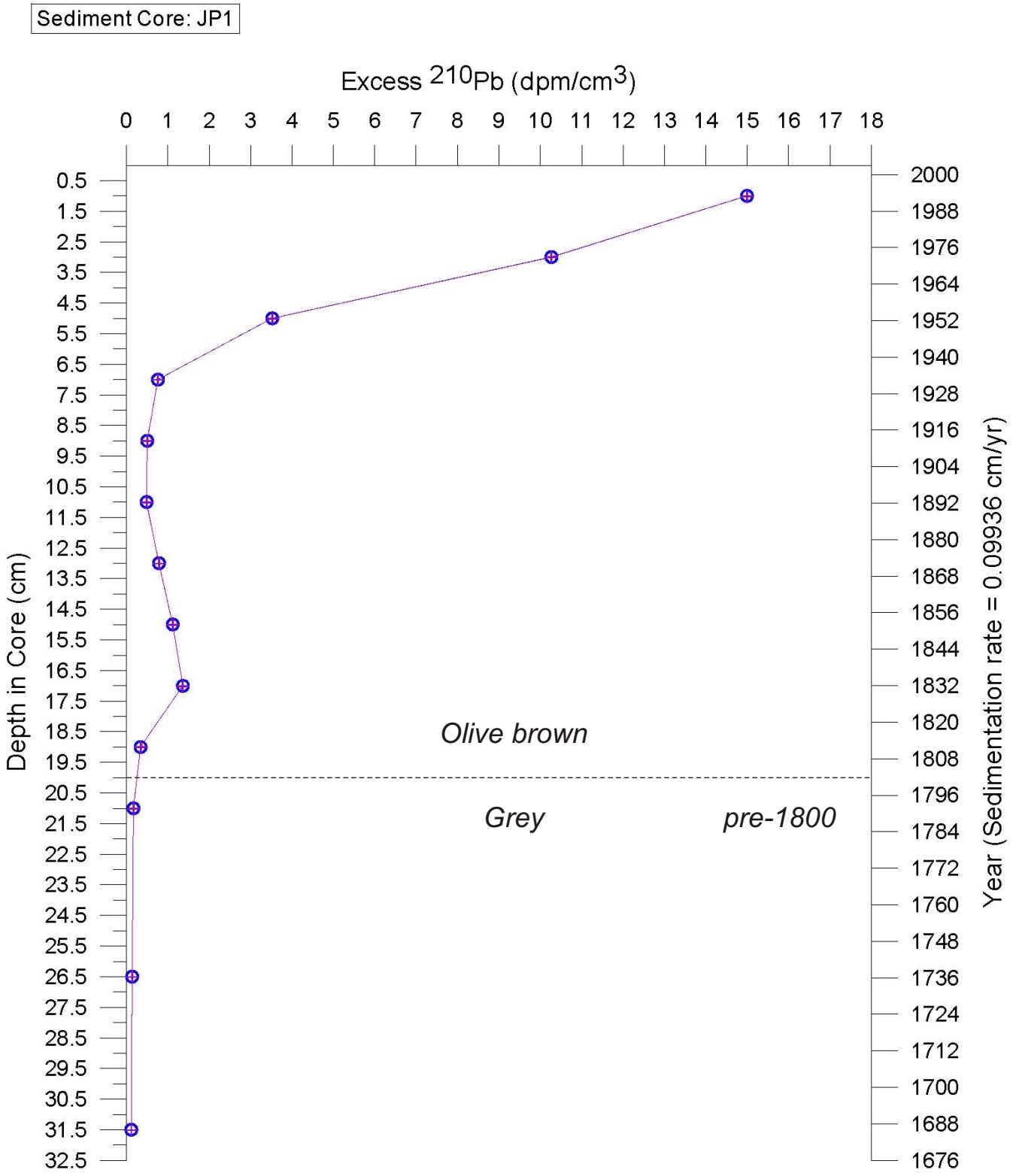

Core depth (mid-section), cm
0
5
10
15
20
25
30
35
40
45
50
55
0
5
10
15
20
25
30
Biogenic silica, %
JP1
JP8
MS1

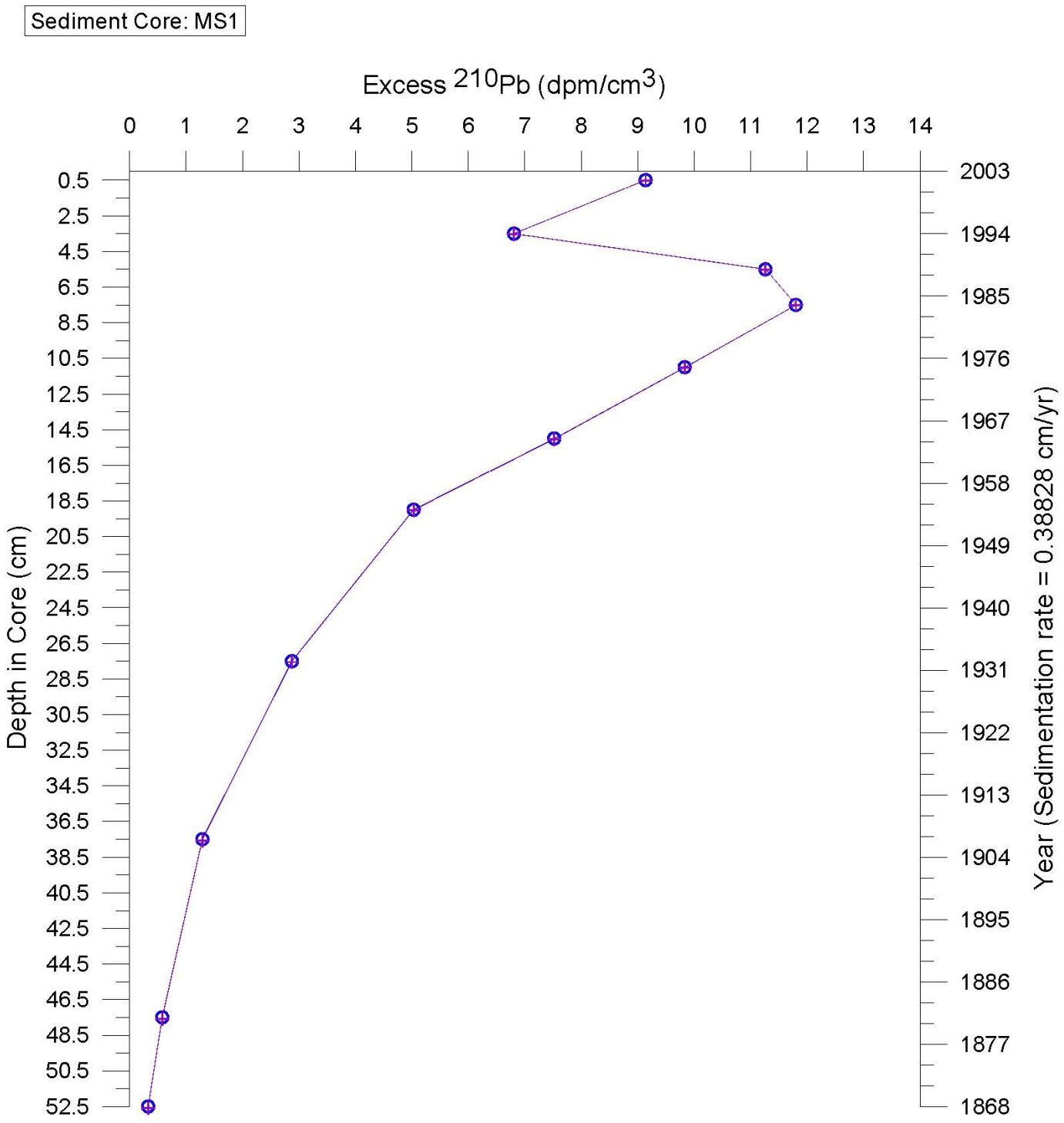

Sediment core: JP8
Excess 210Pb, dpm/cm2
0
2
4
6
8
10
12
14
Porosity
0.8
0.85
0.9
Depth in core, cm
0
5
10
15
20
25
30
35
40
45
50


Sediment core: JP1
Excess 210Pb, dpm/cm2
0 2 4 6 8 10 12 14 16 18
Porosity
0.5 0.55 0.6 0.65 0.7
Depth in core, cm
0 5 10 15 20 25 30 35 40
Olive brown
Grey


Sediment core: MS1
Excess 210Pb, dpm/cm2
0
2
4
6
8
10
12
14
Porosity
0.85
0.9
0.95
Depth in core, cm
0
5
10
15
20
25
30
35
40
45
50
55


Sediment Core: JP8
Excess 210Pb (dpm/cm3)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Depth in Core (cm)
0.5 2.5 4.5 6.5 8.5 10.5 12.5 14.5 16.5 18.5 20.5 22.5 24.5 26.5 28.5 30.5 32.5 34.5 36.5 38.5 40.5 42.5 44.5 46.5 48.5 50.5
Year (Sedimentation rate = 0.506341 cm/yr)
2002 1993 1984 1975 1966 1957 1948 1939 1930 1921 1912 1903


Sediment Core: JP1
Excess 210Pb (dpm/cm3)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Depth in Core (cm)
0.5 1.5 2.5 3.5 4.5 5.5 6.5 7.5 8.5 9.5 10.5 11.5 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.5 20.5 21.5 22.5 23.5 24.5 25.5 26.5 27.5 28.5 29.5 30.5 31.5 32.5
Year (Sedimentation rate = 0.09936 cm/yr)
2000 1988 1976 1964 1952 1940 1928 1916 1904 1892 1880 1868 1856 1844 1832 1820 1808 1796 1784 1772 1760 1748 1736 1724 1712 1700 1688 1676
Olive brown
Grey
pre-1800


Sediment Core: MS1
Excess 210Pb (dpm/cm3)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Depth in Core (cm)
0.5 2.5 4.5 6.5 8.5 10.5 12.5 14.5 16.5 18.5 20.5 22.5 24.5 26.5 28.5 30.5 32.5 34.5 36.5 38.5 40.5 42.5 44.5 46.5 48.5 50.5 52.5
Year (Sedimentation rate = 0.38828 cm/yr)
2003 1994 1985 1976 1967 1958 1949 1940 1931 1922 1913 1904 1895 1886 1877 1868

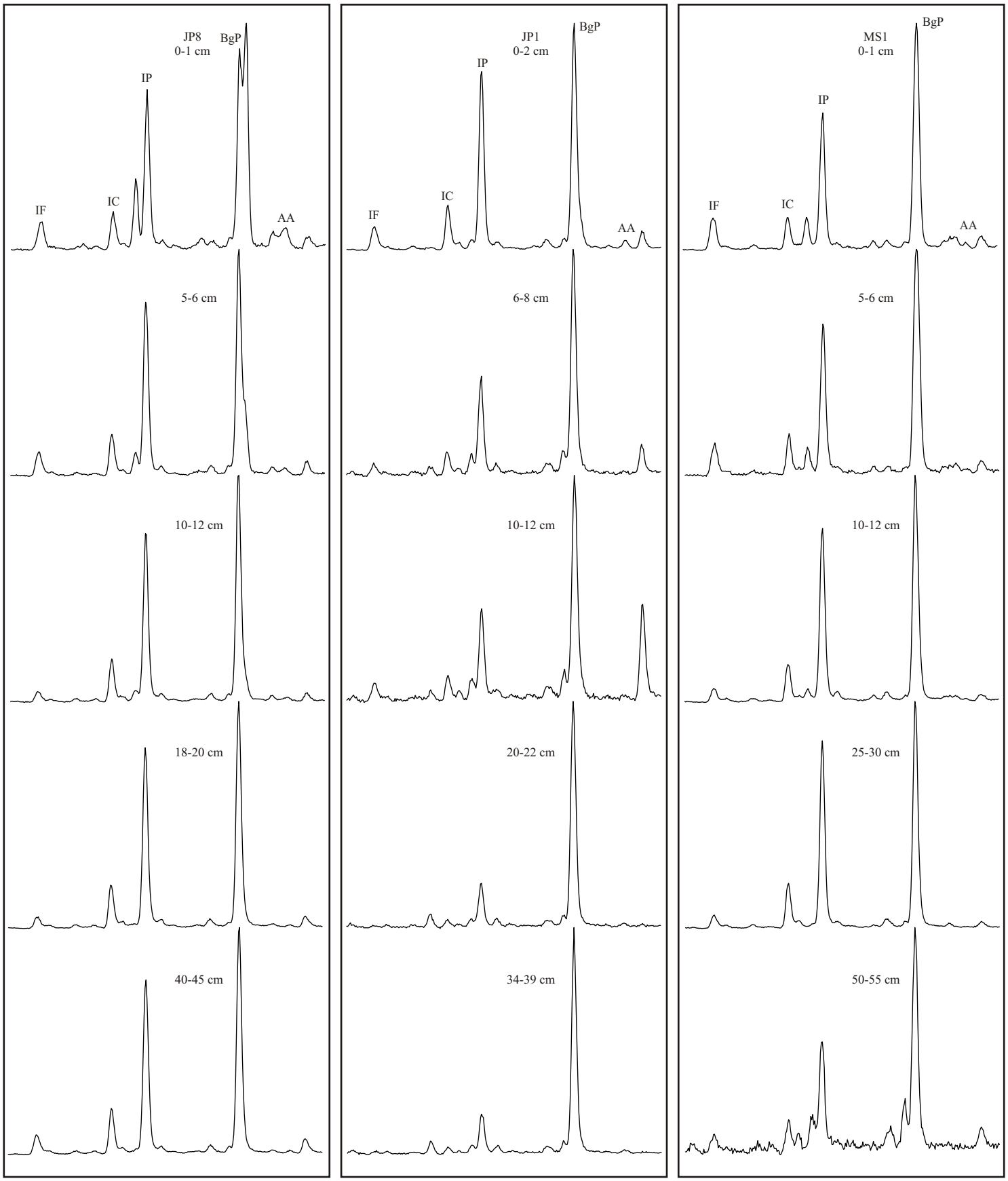
6.5 PAH CHROMATOGRAMS

Compounds and abbreviations for the PAH chromatograms in this appendix are listed in the following tables. The two pages of parent PAH chromatograms and the seven pages of alkyl PAH chromatograms all utilise the same horizontal scale (2.2 cm/minute of retention time) except for the dimethylphenanthrene/anthracenes (m/z 206), which utilise an expanded scale to simplify peak labelling (3.2 cm/minute).

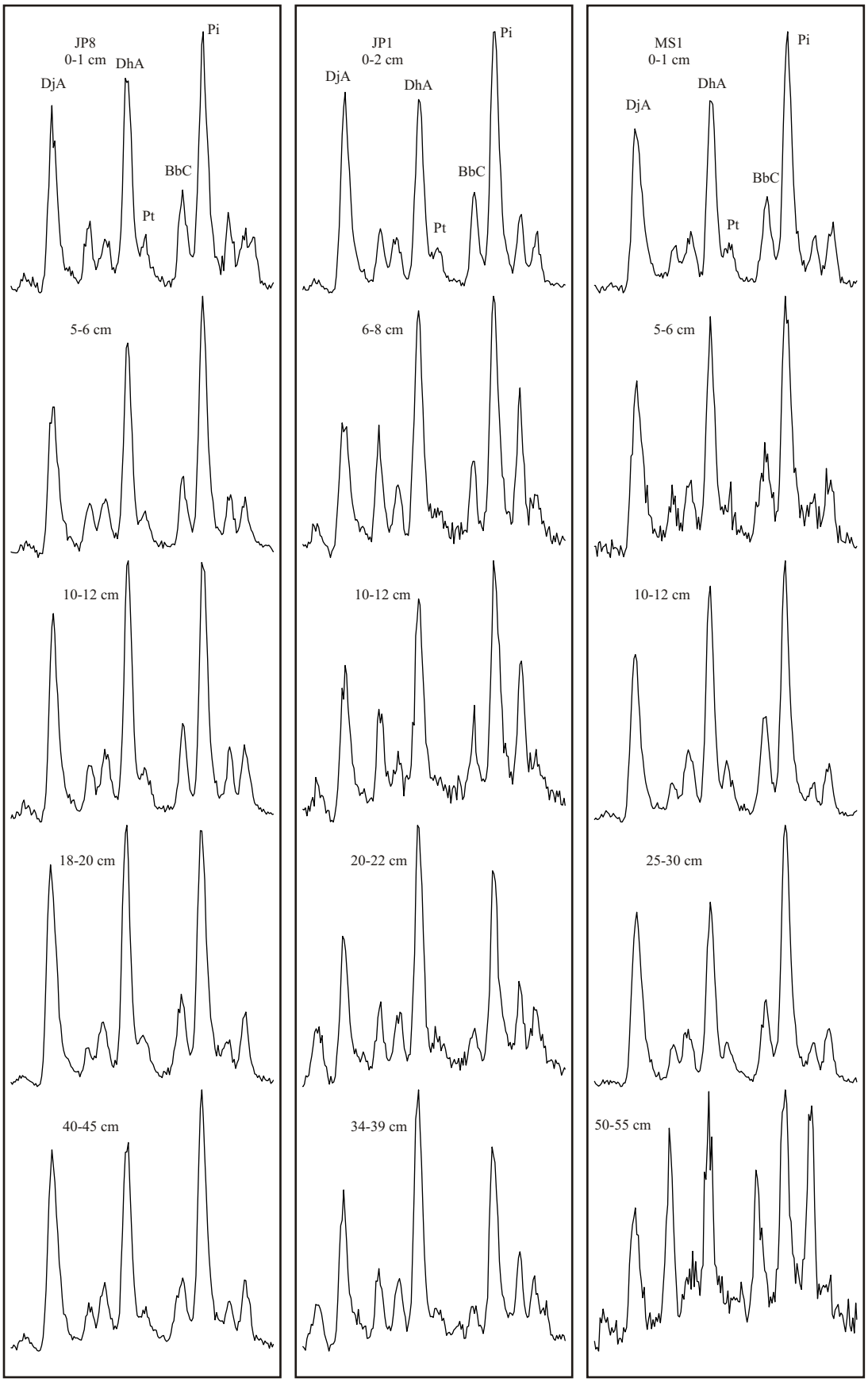
Compound	Abbreviation
$C_{22}H_{12}$ Parent PAH (m/z 276)	
Indeno[1,2,3-*cd*]fluoranthene	IF
Indeno[7,1,2,3-*cdef*]chrysene	IC
Indeno[1,2,3-*cd*]pyrene	IP
Benzo[*ghi*]perylene	BgP
Anthanthrene	AA
$C_{22}H_{14}$ Parent PAH (m/z 278)	
Dibenz[*a*,*j*]anthracene	DjA
Dibenzo[*a*,*c*/*a*,*h*]anthracene	DhA
Pentaphene	Pt
Benzo[*b*]chrysene	BbC
Picene	Pi
Dimethylnaphthalenes (m/z 156)	
2-Ethylnaphthalene	2Et
1-Ethylnaphthalene	1Et
2,6/2,7-Dimethylnaphthalene	2,6/2,7
1,3/1,7-Dimethylnaphthalene	1,3/1,7
1,6-Dimethylnaphthalene	1,6
2,3/1,4-Dimethylnaphthalene	2,3/1,4
1,5-Dimethylnaphthalene	1,5
1,2-Dimethylnaphthalene	1,2
Trimethylnaphthalenes (m/z 170)	
C3 Naphthalene A	A
1,3,7-Trimethylnaphthalene	1,3,7
1,3,6-Trimethylnaphthalene	1,3,6
1,3,5/1,4,6-Trimethylnaphthalene	1,3,5/1,4,6
2,3,6-Trimethylnaphthalene	2,3,6
1,2,7/1,6,7/1,2,6-Trimethylnaphthalene	1,2,7/1,6,7/1,2,6
1,2,4-Trimethylnaphthalene	1,2,4
1,2,5-Trimethylnaphthalene	1,2,5
C3 Naphthalene B	B

Compound	Abbreviation
Methylfluorenes (m/z 180)	
Methylfluorene A	A
2-Methylfluorene	2
1-Methylfluorene	1
Methylfluorene B	B
Methylfluorene C	C
Methyldibenzothiophenes (m/z 198)	
4-Methyldibenzothiophene	4
2/3-Methyldibenzothiophene	2/3
1-Methyldibenzothiophene	1
Methylphenanthrene/anthracenes (m/z 192)	
3-Methylphenanthrene	3
2-Methylphenanthrene	2
2-Methylanthracene	2MA
9/4-Methylphenanthrene	9/4
1-Methylphenanthrene	1
Dimethylphenanthrene/anthracenes (m/z 206)	
Ethylphenanthrene	EP
3,6-Dimethylphenanthrene/Ethylphenanthrene	3,6/EP
2,6-Dimethylphenanthrene	2,6
2,7-Dimethylphenanthrene	2,7
1,3/2,10/3,9/3,10-Dimethylphenanthrene	1,3/2,10/3,9/3,10
1,6/2,9-Dimethylphenanthrene	1,6/2,9
1,5/1,7-Dimethylphenanthrene	1,5/1,7
2,3-Dimethylphenanthrene	2,3
1,9/4,9-Dimethylphenanthrene	1,9/4,9
1,8-Dimethylphenanthrene	1,8
1,2-Dimethylphenanthrene	1,2
Methylfluoranthene/pyrenes (m/z 216)	
Methylfluoranthene/pyrene A	A
Methylfluoranthene/pyrene B	B
Methylfluoranthene/pyrene C	C
Methylfluoranthene/pyrene D	D
Methylfluoranthene/pyrene E	E
Methylfluoranthene/pyrene F	F

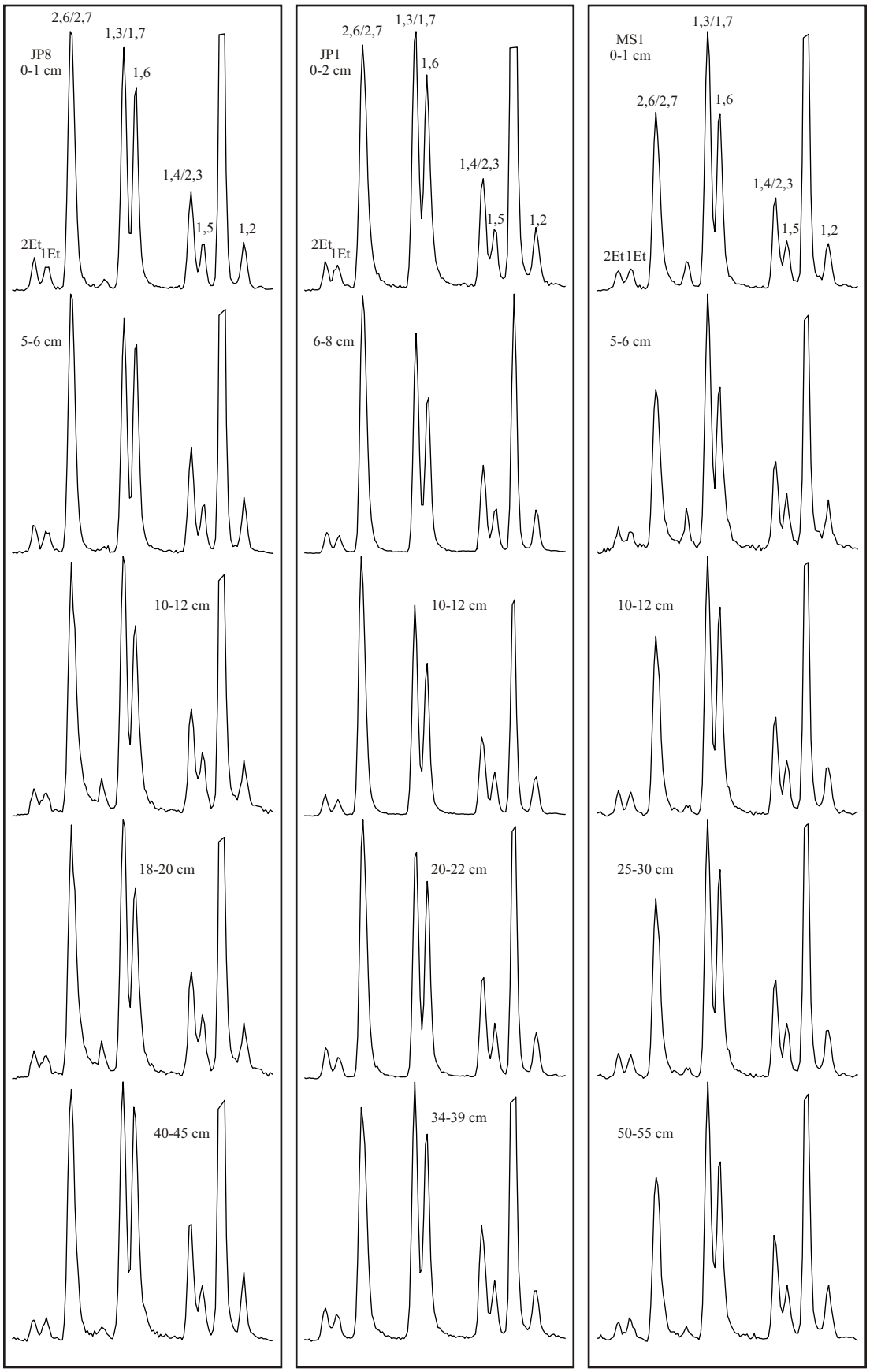
$C_{22}H_{12}$ Parent PAH (m/z 276)



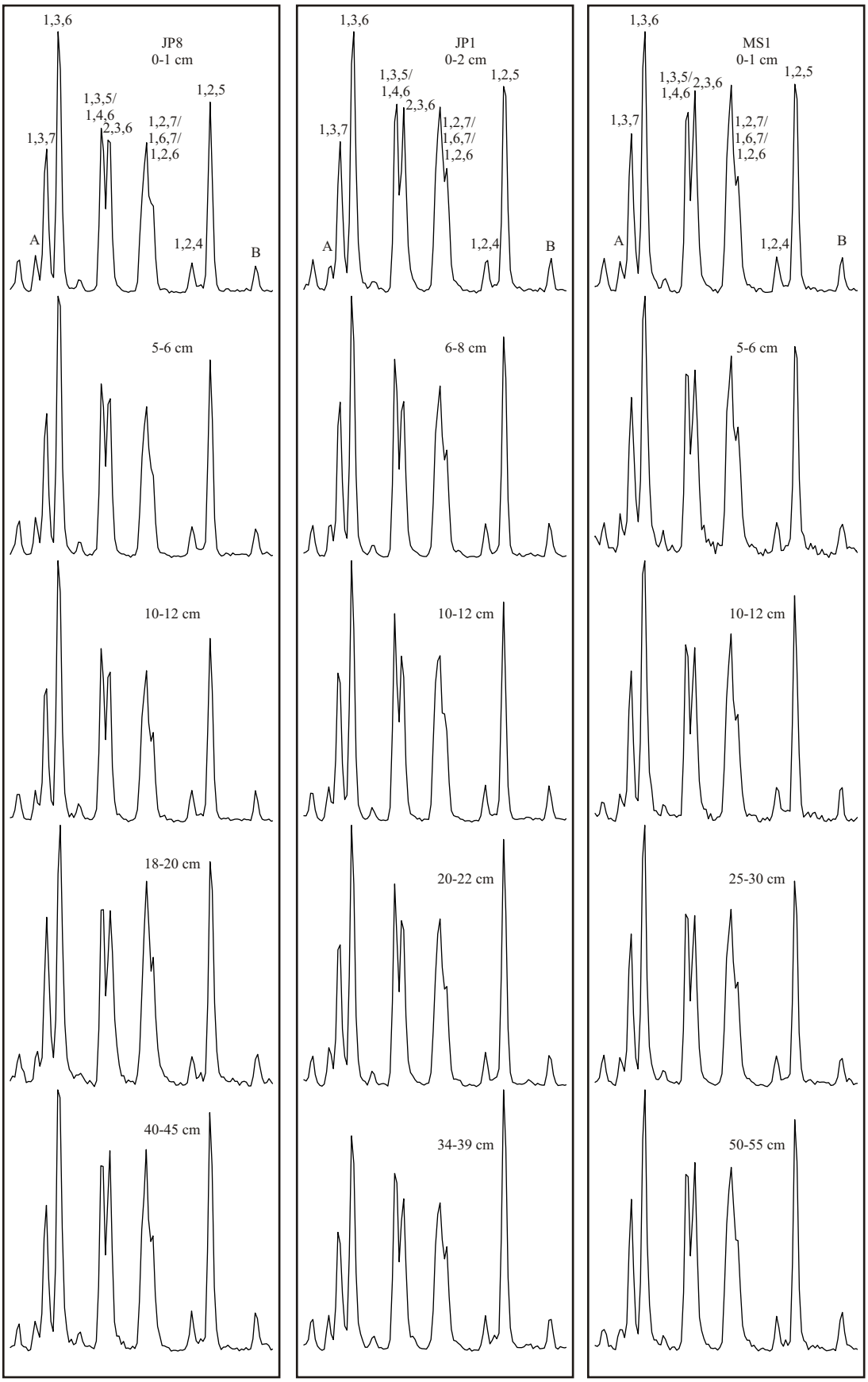
$C_{22}H_{14}$ Parent PAH (m/z 278)



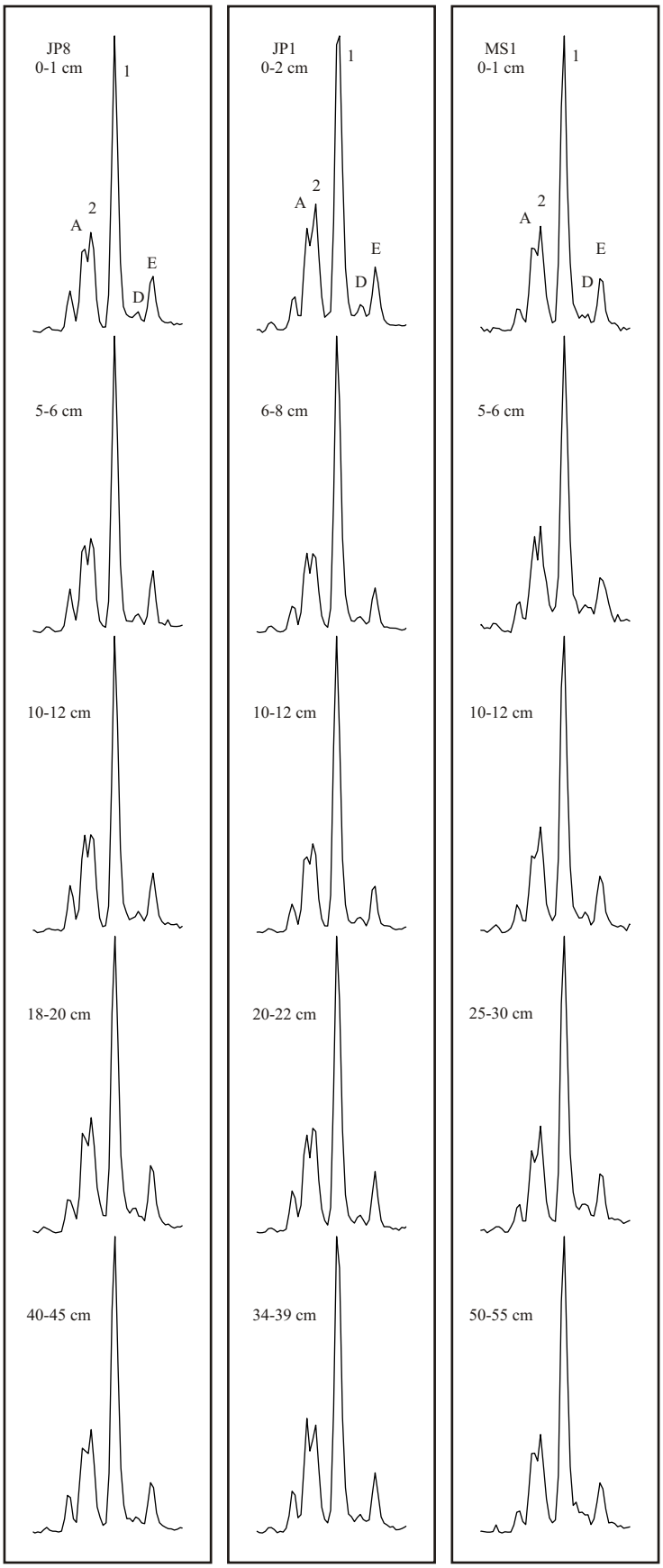
Dimethylnaphthalenes (m/z 156)



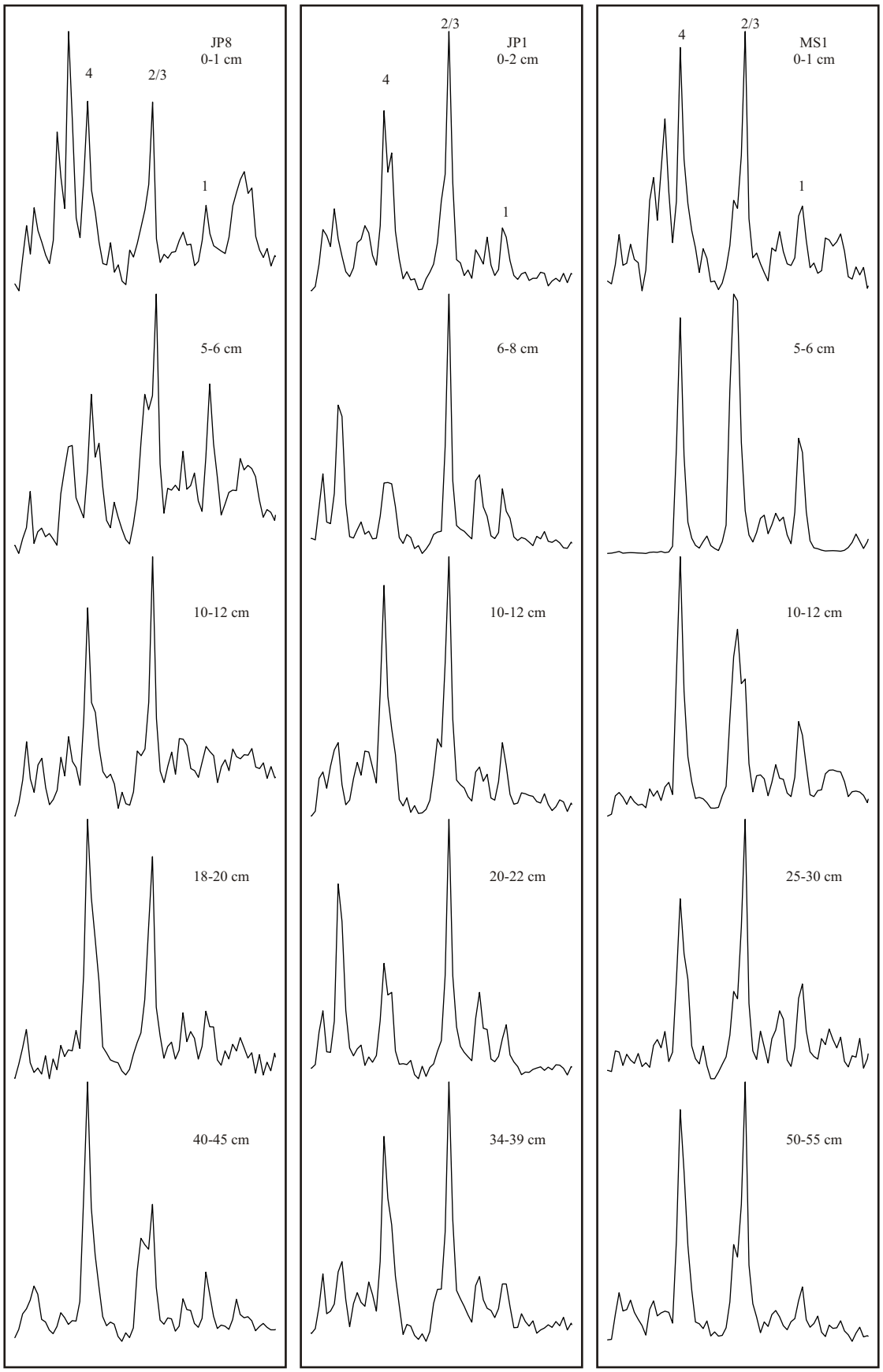
Trimethylnaphthalenes (m/z 170)



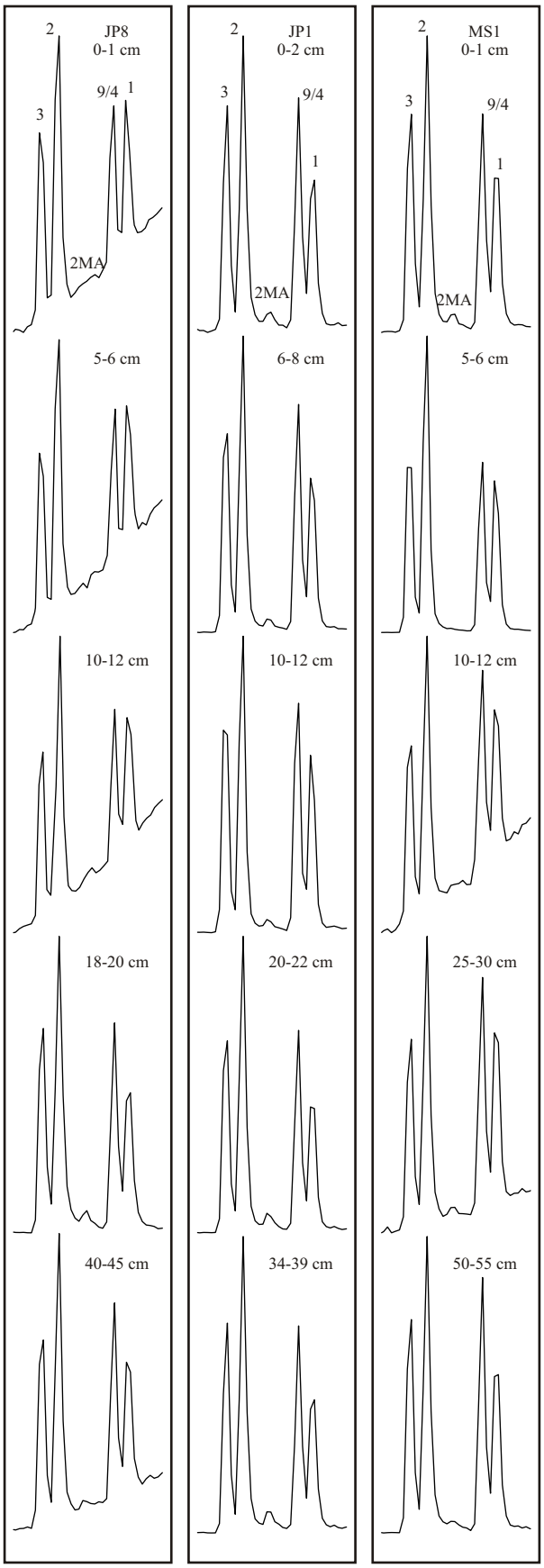
Methylfluorenes (m/z 180)



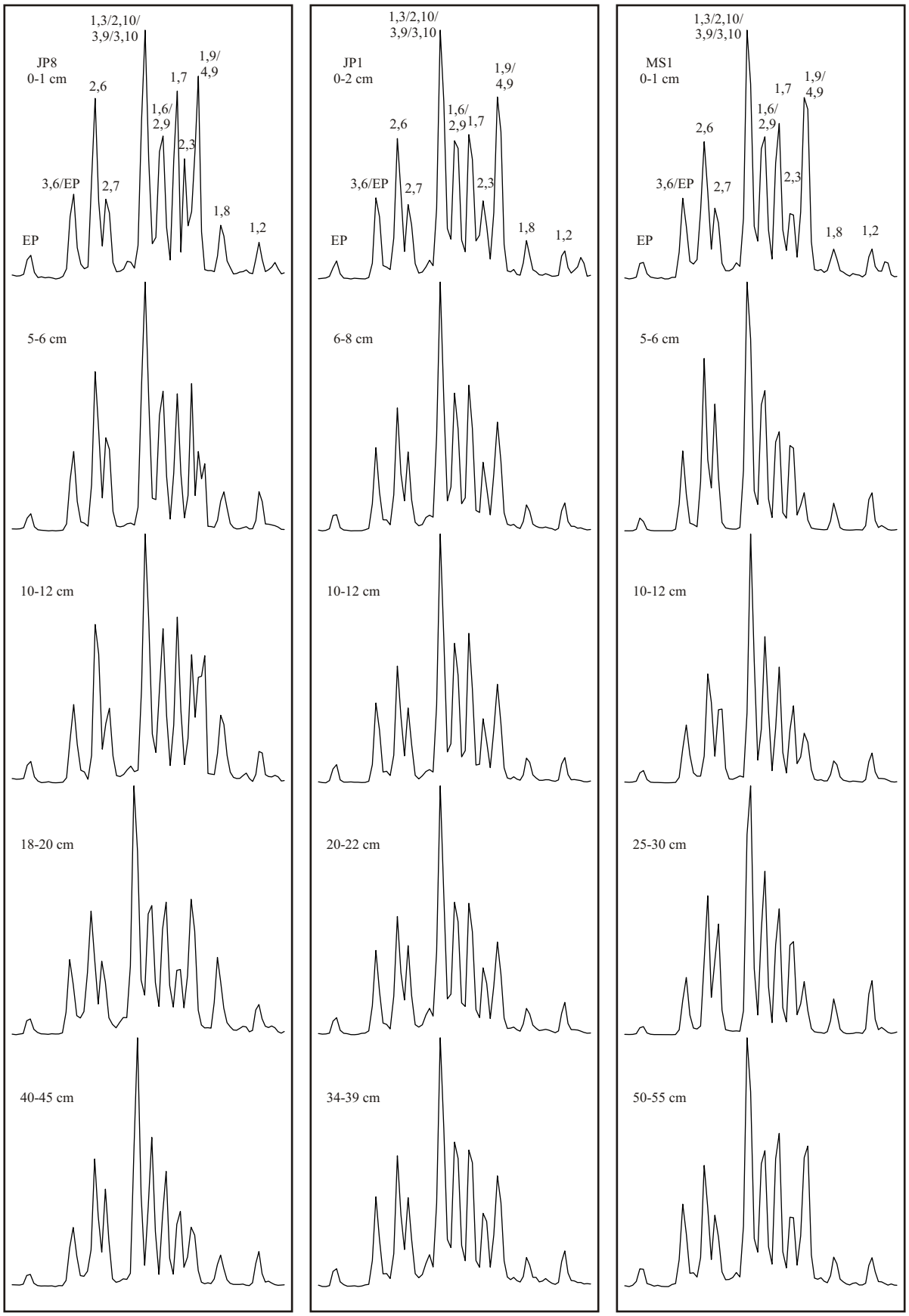
Methyldibenzothiophenes (m/z 198)



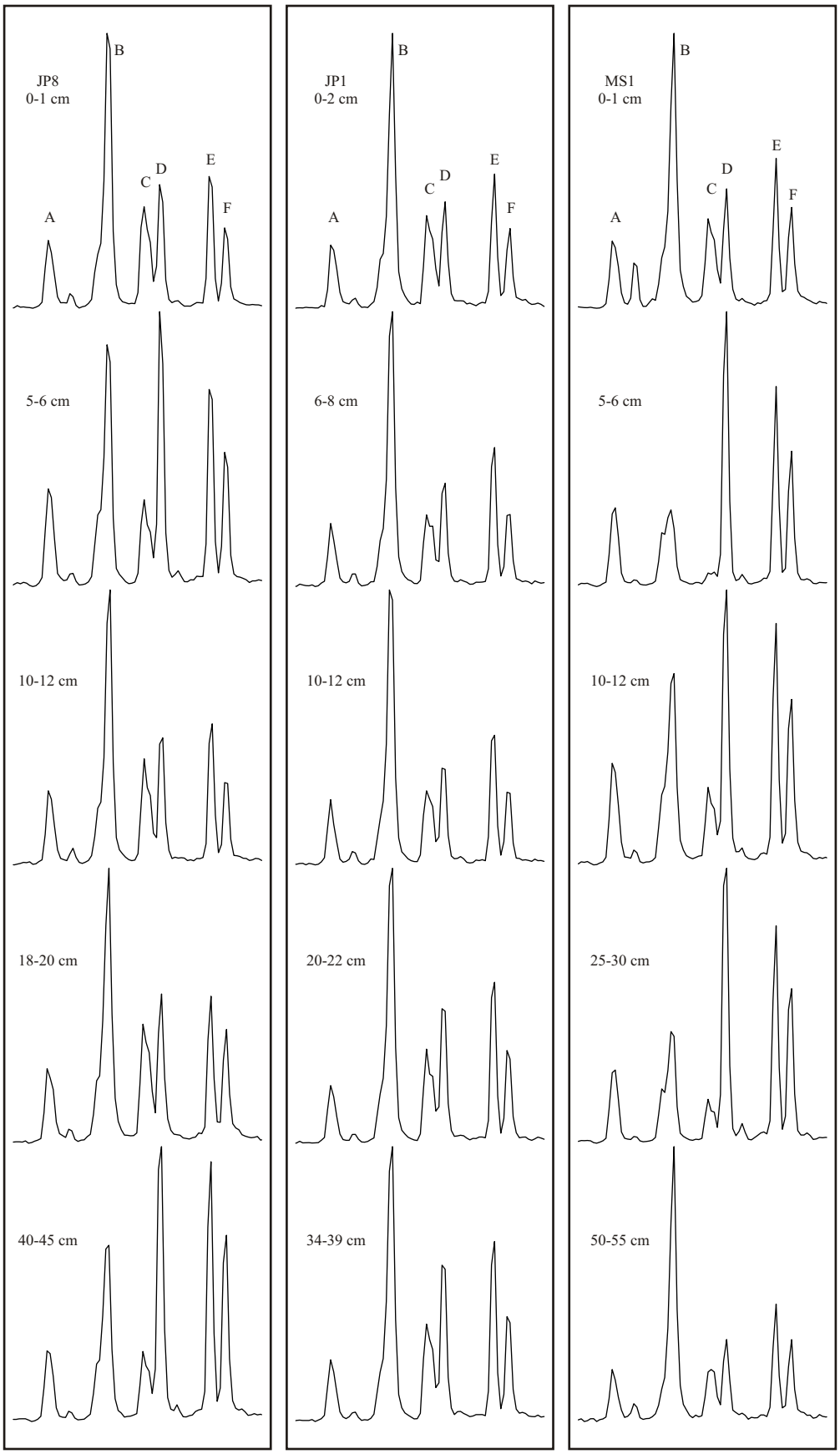
Methylphenanthrene/anthracenes (m/z 192)



Dimethylphenanthrene/anthracenes (m/z 206)



Methylfluoranthene/pyrenes (m/z 216)



6.6 SEDIMENT ALKANE AND PAH CONCENTRATIONS

This Appendix contains Alkane and PAH concentrations in sediment for stations JP8, JP1 and MS1.

Alkane concentration data are as reported by Axys Analytical.

PAH concentration data are distinguished using the compound name:

- PAH concentrations reported by Axys Analytical (Table 10) have the compound name shown in normal type;
- Additional PAH concentrations determined from the GC/MS chromatograms (Table 11Table 11) have the compound name shown in italics.

Location	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd
Sample	JP8 #1	JP8 #6	JP8 #11	JP8 #15	JP8 #20
Latitude	52.5545º N	52.5545º N	52.5545º N	52.5545º N	52.5545º N
Longitude	131.1649º W	131.1649º W	131.1649º W	131.1649º W	131.1649º W
Depth, m	325 m	325 m	325 m	325 m	325 m
Collection Date	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003
Section	0-1 cm	5-6 cm	10-12 cm	18-20 cm	40-45 cm
Weight (g dry)	3.25 g (dry)	3.34 g (dry)	3.50 g (dry)	3.62 g (dry)	3.54 g (dry)
Organic Carbon %	4.05	3.87	4.08	4.07	3.69
Organic Nitrogen %	0.53	0.50	0.52	0.52	0.47
C/N ratio	7.63	7.78	7.85	7.79	7.80
Core Depth (mid-section), cm	0.5	5.5	11.0	19.0	42.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (Alkanes)	L7581-6	L7581-7	L7581-8	L7581-9	L7581-10
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14961	WG14961
Dodecane (nC12)	4.66	3.22	2.04	5.07	3.95
2,6-Dimethyl Undecane	1.50	0.85	0.71	1.83	1.60
Norfarnesane	1.63	1.03	0.89	2.48	1.59
Tridecane (nC13)	6.96	4.56	3.98	6.25	5.50
Farnesane	2.78	2.21	1.82	2.50	2.39
Tetradecane (nC14)	9.35	7.92	6.30	6.99	7.32
2,6,10-Trimethyl Tridecane	4.54	3.97	3.35	3.53	3.22
Pentadecane (nC15)	18.30	15.60	11.60	11.40	12.00
Hexadecane (nC16)	12.60	13.50	10.60	9.39	10.00
Norpristane	3.97	4.37	3.58	3.37	3.34
Heptadecane (nC17)	30.30	30.80	24.90	20.40	21.10
Pristane	29.40	21.50	17.30	12.40	13.00
Octadecane (nC18)	16.00	16.90	14.40	11.10	11.60
Phytane	5.49	5.94	4.80	3.56	3.62
Nonadecane (nC19)	27.60	27.50	22.60	17.70	18.10
Eicosane (nC20)	18.90	19.30	16.70	14.10	14.30
Heneicosane (nC21)	93.60	81.30	71.40	55.50	65.00
Docosane (nC22)	18.70	18.50	18.10	17.00	24.20
Tricosane (nC23)	37.90	34.90	38.20	44.40	54.80
Tetracosane (nC24)	16.90	15.50	18.80	20.40	51.80
Pentacosane (nC25)	47.30	41.60	54.80	62.70	97.40
Hexacosane (nC26)	16.70	14.70	22.80	21.50	50.70
Heptacosane (nC27)	73.60	67.20	107.00	106.00	132.00
Octacosane (nC28)	13.80	12.30	24.30	20.20	31.30
Nonacosane (nC29)	64.70	59.00	127.00	107.00	170.00
Triacontane (nC30)	7.95	6.90	18.20	13.20	25.70
Untriacontane (nC31)	40.00	33.60	107.00	70.30	148.00
Dotriacontane (nC32)	4.57	3.95	14.10	8.07	17.20
Tritriacontane (nC33)	52.10	45.30	172.00	91.90	203.00
Tetratriacontane (nC34)	3.98	3.38	16.90	6.68	17.00
Pentatriacontane (nC35)	42.60	36.50	193.00	68.60	203.00
Hexatriacontane (nC36)	1.14	1.11	7.36	2.09	7.21
Surrogate Standard Recovery (%)					
Decane (nC10)-D22	5.5	5.1	1.1	12.6	9.0
Dodecane (nC12)-D24	12.3	8.4	3.9	21.5	18.0
Hexadecane (nC16)-D34	45.5	46.4	28.2	40.3	49.4
Tetracosane (nC24)-D50	65.1	61.5	50.7	87.9	96.8
Hexatriacontane (nC36)-D74	18.5	17.2	50.2	36.2	120.0

Location	Hecate Str	Hecate Str	Hecate Str	Hecate Str	Hecate Str
Sample	JP1 #1	JP1 #4	JP1 #6	JP1 #11	JP1 #15
Latitude	52.6255º N	52.6255º N	52.6255º N	52.6255º N	52.6255º N
Longitude	130.2925º W	130.2925º W	130.2925º W	130.2925º W	130.2925º W
Depth, m	240 m	240 m	240 m	240 m	240 m
Collection Date	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003
Section	0-2 cm	6-8 cm	10-12 cm	20-22 cm	34-39 cm
Weight (g dry)	6.76 g (dry)	6.07 g (dry)	5.79 g (dry)	7.98 g (dry)	7.02 g (dry)
Organic Carbon %	0.61	1.73	1.80	0.48	0.30
Organic Nitrogen %	0.08	0.21	0.23	0.07	0.05
C/N ratio	7.80	8.23	7.83	7.24	6.23
Core Depth (mid-section), cm	1.0	7.0	11.0	21.0	36.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (Alkanes)	L7581-1	L7581-2	L7581-3	L7581-4	L7581-5
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14933	WG14933
Dodecane (nC12)	1.67	2.26	4.83	6.23	6.07
2,6-Dimethyl Undecane	0.71	1.01	2.34	2.36	2.44
Norfarnesane	0.78	0.90	3.10	2.45	1.93
Tridecane (nC13)	2.03	2.55	6.39	7.72	6.91
Farnesane	1.08	1.47	3.89	2.83	2.36
Tetradecane (nC14)	2.38	3.25	7.60	8.68	7.51
2,6,10-Trimethyl Tridecane	1.50	1.92	5.09	4.76	4.21
Pentadecane (nC15)	3.89	5.53	12.90	12.80	11.20
Hexadecane (nC16)	2.94	5.23	10.90	9.72	8.49
Norpristane	1.20	2.38	4.93	3.78	3.42
Heptadecane (nC17)	5.31	10.30	19.90	22.80	20.10
Pristane	7.77	11.20	22.50	17.30	16.30
Octadecane (nC18)	3.77	7.49	14.00	11.30	9.83
Phytane	1.20	2.69	4.89	4.62	4.44
Nonadecane (nC19)	5.24	10.00	17.50	13.60	11.70
Eicosane (nC20)	4.78	9.75	16.40	13.00	11.10
Heneicosane (nC21)	25.10	37.90	66.20	22.60	16.20
Docosane (nC22)	6.06	12.20	17.20	14.00	12.30
Tricosane (nC23)	10.70	22.50	28.20	22.90	19.70
Tetracosane (nC24)	7.29	13.80	15.20	13.10	11.70
Pentacosane (nC25)	15.80	31.50	32.30	27.40	24.40
Hexacosane (nC26)	9.09	16.20	14.40	12.80	11.20
Heptacosane (nC27)	30.50	60.70	49.30	42.20	34.40
Octacosane (nC28)	10.90	17.00	11.90	11.70	9.32
Nonacosane (nC29)	46.20	85.70	57.20	54.30	38.60
Triacontane (nC30)	9.35	11.80	6.92	8.03	5.70
Untriacontane (nC31)	41.40	73.30	40.40	49.20	30.30
Dotriacontane (nC32)	7.00	7.17	3.38	4.49	2.67
Tritriacontane (nC33)	37.60	61.20	29.00	23.10	10.10
Tetratriacontane (nC34)	5.37	5.66	2.36	2.22	0.81
Pentatriacontane (nC35)	34.90	54.60	24.20	10.70	2.54
Hexatriacontane (nC36)	3.12	1.92	<0.558	0.74	0.38
Surrogate Standard Recovery (%)					
Decane (nC10)-D22	6.7	5.5	13.1	13.0	16.5
Dodecane (nC12)-D24	8.7	9.9	24.0	22.1	28.2
Hexadecane (nC16)-D34	19.1	28.1	54.3	36.9	56.7
Tetracosane (nC24)-D50	38.6	62.0	61.7	46.1	73.4
Hexatriacontane (nC36)-D74	30.4	60.2	21.2	30.0	27.3

Location	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd
Sample	MS1 #1	MS1 #6	MS1 #11	MS1 #17	MS1 #22
Latitude	52.3817º N	52.3817º N	52.3817º N	52.3817º N	52.3817º N
Longitude	128.5502º W	128.5502º W	128.5502º W	128.5502º W	128.5502º W
Depth, m	245 m	245 m	245 m	245 m	245 m
Collection Date	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003
Section	0-1 cm	5-6 cm	10-12 cm	25-30 cm	50-55 cm
Weight (g dry)	1.91 g (dry)	2.25 g (dry)	2.45 g (dry)	2.51 g (dry)	2.72 g (dry)
Organic Carbon %	5.86	5.21	5.57	5.36	4.84
Organic Nitrogen %	0.76	0.68	0.72	0.68	0.58
C/N ratio	7.71	7.71	7.80	7.85	8.35
Core Depth (mid-section), cm	0.5	5.5	11.0	27.5	52.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (Alkanes)	L7581-11	L7581-12	L7581-13	L7581-14	L7581-15
Batch (Workgroup)	WG14961	WG14961	WG14961	WG14961	WG14961
Dodecane (nC12)	2.17	9.47	5.36	4.65	6.62
2,6-Dimethyl Undecane	1.08	4.87	2.64	2.25	4.10
Norfarnesane	1.34	6.18	2.85	3.08	4.13
Tridecane (nC13)	3.41	12.20	6.62	5.87	8.48
Farnesane	2.37	7.38	4.18	4.06	6.37
Tetradecane (nC14)	5.30	15.10	8.48	7.58	10.60
2,6,10-Trimethyl Tridecane	3.80	10.20	5.61	4.36	5.93
Pentadecane (nC15)	13.60	24.80	13.10	11.20	15.60
Hexadecane (nC16)	9.31	19.20	11.10	9.49	12.20
Norpristane	3.92	8.45	4.96	4.32	5.55
Heptadecane (nC17)	22.20	44.10	24.30	19.60	25.50
Pristane	24.40	41.30	23.90	19.20	25.40
Octadecane (nC18)	13.00	25.00	15.40	12.70	15.00
Phytane	4.77	8.64	5.74	4.30	5.00
Nonadecane (nC19)	22.60	41.00	26.90	20.70	23.20
Eicosane (nC20)	16.90	30.10	21.10	18.30	19.90
Heneicosane (nC21)	87.50	164.00	97.70	93.20	129.00
Docosane (nC22)	21.90	34.30	29.20	72.50	26.00
Tricosane (nC23)	52.40	70.00	56.50	130.00	54.50
Tetracosane (nC24)	28.70	36.00	32.00	149.00	26.90
Pentacosane (nC25)	80.10	83.40	64.70	171.00	66.20
Hexacosane (nC26)	34.20	30.90	26.00	58.10	23.70
Heptacosane (nC27)	163.00	126.00	89.00	100.00	105.00
Octacosane (nC28)	41.50	27.90	19.40	21.90	20.80
Nonacosane (nC29)	223.00	144.00	87.40	92.90	121.00
Triacontane (nC30)	36.10	20.20	13.70	13.40	12.40
Untriacontane (nC31)	190.00	106.00	59.30	64.90	86.60
Dotriacontane (nC32)	29.60	14.40	9.97	7.75	7.11
Tritriacontane (nC33)	302.00	149.00	81.30	81.30	115.00
Tetratriacontane (nC34)	37.90	15.90	10.90	8.46	8.39
Pentatriacontane (nC35)	388.00	173.00	97.40	89.10	127.00
Hexatriacontane (nC36)	17.30	7.31	5.66	2.80	2.48
Surrogate Standard Recovery (%)					
Decane (nC10)-D22	4.0	18.7	9.5	10.4	15.1
Dodecane (nC12)-D24	9.3	31.4	18.6	17.3	25.9
Hexadecane (nC16)-D34	37.5	59.5	48.3	36.8	49.5
Tetracosane (nC24)-D50	86.9	63.1	78.7	67.3	68.9
Hexatriacontane (nC36)-D74	106.0	25.6	25.0	23.4	32.1

Location	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd
Sample	JP8 #1	JP8 #6	JP8 #11	JP8 #15	JP8 #20
Latitude	52.5545º N	52.5545º N	52.5545º N	52.5545º N	52.5545º N
Longitude	131.1649º W	131.1649º W	131.1649º W	131.1649º W	131.1649º W
Depth, m	325 m	325 m	325 m	325 m	325 m
Collection Date	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003
Section	0-1 cm	5-6 cm	10-12 cm	18-20 cm	40-45 cm
Weight (g dry)	3.25 g (dry)	3.34 g (dry)	3.50 g (dry)	3.62 g (dry)	3.54 g (dry)
Organic Carbon %	4.05	3.87	4.08	4.07	3.69
Organic Nitrogen %	0.53	0.50	0.52	0.52	0.47
C/N ratio	7.63	7.78	7.85	7.79	7.80
Core Depth (mid-section), cm	0.5	5.5	11.0	19.0	42.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-6	L7581-7	L7581-8	L7581-9 L	L7581-10 L
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14961	WG14961
Naphthalene	10.50	11.30	7.90	5.61	5.79
Biphenyl	4.08	3.77	3.71	3.65	3.67
Acenaphthylene	0.45	0.45	0.52	1.65	0.53
Acenaphthene	0.47	0.51	0.57	0.67	0.50
Fluorene	2.98	2.90	3.40	2.52	2.93
Phenanthrene	11.10	9.95	11.70	15.50	11.80
Anthracene	0.88	0.64	0.82	1.69	0.85
Fluoranthene	5.95	5.83	7.60	14.70	8.26
Acephenanthrylene	0.44	0.39	0.51	1.21	0.71
Pyrene	4.74	6.66	5.65	12.40	9.97
Benz[a]anthracene	2.77	2.27	3.02	5.71	2.60
Chrysene	5.98	5.19	6.66	9.26	5.94
Benzo[b/j/k]fluoranthene	10.60	11.00	14.00	21.70	14.80
Benzo[e]pyrene	6.65	8.68	10.00	14.60	9.58
Benzo[a]pyrene	3.50	3.11	4.15	7.17	4.02
Perylene	46.40	56.70	65.60	61.00	52.30
Dibenz[a,j]anthracene	0.83	0.85	1.27	1.81	1.50
Dibenz[a,c/a,h]anthracene	NDR 1.00	NDR 1.00	NDR 1.37	1.85	NDR 1.25
Pentaphene	0.15	0.17	0.22	0.37	0.20
Benzo[b]chrysene	0.37	0.33	0.43	0.72	0.40
Picene	1.16	1.25	1.42	2.15	1.63
Indeno[1,2,3-cd]fluoranthene	1.15	0.94	0.54	0.99	1.37
Indeno[7,1,2,3-cdef]chrysene	1.12	1.19	1.55	2.61	2.11
Indeno[1,2,3-cd]pyrene	4.96	5.30	7.00	11.70	9.28
Benzo[ghi]perylene	NDR 6.10	7.02	8.78	13.90	11.20
Anthanthrene	1.05	0.31	0.18	0.11	0.11
C1 Naphthalenes	14.70	13.40	13.40	11.90	10.90
2-Methylnaphthalene	8.07	7.38	7.06	6.64	5.94
1-Methylnaphthalene	6.66	5.98	6.30	5.21	4.92
C2 Naphthalenes	27.50	25.40	27.40	36.50	35.40
2-Ethylnaphthalene	0.81	0.71	0.79	0.94	0.72
1-Ethylnaphthalene	0.77	0.66	0.70	0.85	0.79
2,6/2,7-Dimethylnaphthalene	8.73	7.72	8.51	11.40	9.91
1,3/1,7-Dimethylnaphthalene	6.72	5.56	6.39	8.94	8.01
1,6-Dimethylnaphthalene	5.41	5.65	5.68	6.84	8.63
2,3/1,4-Dimethylnaphthalene	2.58	2.49	2.67	3.47	3.64
1,5-Dimethylnaphthalene	1.19	1.20	1.11	1.87	1.55
1,2-Dimethylnaphthalene	1.28	1.40	1.55	2.19	2.14
C3 Naphthalenes	20.30	22.50	23.00	27.00	26.30
C3 Naphthalene A	0.53	0.71	0.62	0.55	0.57
1,3,7-Trimethylnaphthalene	2.18	2.38	2.47	2.71	2.45
1,3,6-Trimethylnaphthalene	3.82	4.39	4.61	4.52	4.69
1,3,5/1,4,6-Trimethylnaphthalene	2.69	2.95	3.01	2.84	3.11
2,3,6-Trimethylnaphthalene	2.26	2.49	2.46	3.43	3.15
1,2,7/1,6,7/1,2,6-Trimethylnaphthalene	4.34	4.53	4.82	6.33	5.85
1,2,4-Trimethylnaphthalene	0.47	0.58	0.53	0.68	0.72
1,2,5-Trimethylnaphthalene	2.53	2.84	2.82	4.02	3.84
C3 Naphthalene B	0.55	0.50	0.54	0.69	0.73
Other C3 Naphthalenes	0.93	1.14	1.13	1.23	1.19
C4 Naphthalenes	10.40	11.00	11.70	15.40	15.10

Location	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd
Sample	JP8 #1	JP8 #6	JP8 #11	JP8 #15	JP8 #20
Latitude	52.5545º N	52.5545º N	52.5545º N	52.5545º N	52.5545º N
Longitude	131.1649º W	131.1649º W	131.1649º W	131.1649º W	131.1649º W
Depth, m	325 m	325 m	325 m	325 m	325 m
Collection Date	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003
Section	0-1 cm	5-6 cm	10-12 cm	18-20 cm	40-45 cm
Weight (g dry)	3.25 g (dry)	3.34 g (dry)	3.50 g (dry)	3.62 g (dry)	3.54 g (dry)
Organic Carbon %	4.05	3.87	4.08	4.07	3.69
Organic Nitrogen %	0.53	0.50	0.52	0.52	0.47
C/N ratio	7.63	7.78	7.85	7.79	7.80
Core Depth (mid-section), cm	0.5	5.5	11.0	19.0	42.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-6	L7581-7	L7581-8	L7581-9 L	L7581-10 L
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14961	WG14961
C1 Fluorenes	5.80	6.65	6.82	9.48	8.52
Methylfluorene A	1.00	1.21	1.17	1.63	1.58
2-Methylfluorene	0.84	0.98	1.06	1.59	1.14
1-Methylfluorene	3.12	3.63	3.55	4.80	4.74
Methylfluorene B	0.17	0.17	0.23	0.40	0.23
Methylfluorene C	0.68	0.67	0.80	1.06	0.83
C2 Fluorenes	7.07	5.68	7.57	19.00	18.20
C3 Fluorenes	8.13	13.30	10.90	21.70	24.20
Dibenzothiophene	NDR 0.293	NDR 0.175	NDR 0.359	NDR 0.502	NDR 0.714
C1 Dibenzothiophenes	0.54	0.57	0.63	0.87	1.13
4-Methyldibenzothiophene	0.17	1.21	0.27	0.53	1.94
2/3-Methyldibenzothiophene	0.18	2.04	0.33	0.35	1.10
1-Methyldibenzothiophene	0.07	1.21	0.08	0.10	0.41
C2 Dibenzothiophenes	0.42	4.46	0.69	0.99	3.45
C3 Dibenzothiophenes	0.19	8.84	0.39	0.71	4.12
C1 Phenanthrene/anthracenes	22.00	25.60	25.40	29.40	26.20
3-Methylphenanthrene	NDR 5.79	NDR 6.20	NDR 6.77	NDR 6.88	NDR 6.86
2-Methylphenanthrene	6.17	7.46	6.93	8.50	7.60
2-Methylanthracene	0.63	0.73	1.30	0.81	0.57
9/4-Methylphenanthrene	NDR 5.45	NDR 5.59	NDR 6.57	NDR 6.54	NDR 6.09
1-Methylphenanthrene	3.64	4.50	4.63	5.17	4.51
C2 Phenanthrene/anthracenes	15.40	33.20	18.60	22.60	41.10
Ethylphenanthrene	0.35	0.56	0.35	0.36	0.65
3,6-Dimethylphenanthrene/Ethylphenanthrene	1.17	2.54	1.33	1.62	3.14
2,6-Dimethylphenanthrene	2.08	4.52	2.32	2.71	5.63
2,7-Dimethylphenanthrene	0.87	2.69	1.06	1.34	3.06
1,3/2,10/3,9/3,10-Dimethylphenanthrene	3.36	8.50	4.30	5.50	10.49
1,6/2,9-Dimethylphenanthrene	1.98	4.27	2.22	2.82	5.86
1,5/1,7-Dimethylphenanthrene	1.75	3.51	2.10	2.67	4.46
2,3-Dimethylphenanthrene	0.90	2.92	1.59	1.30	3.08
1,9/4,9-Dimethylphenanthrene	2.24	2.42	2.17	2.73	3.05
1,8-Dimethylphenanthrene	0.71	1.29	1.15	1.56	1.68
1,2-Dimethylphenanthrene	0.38	1.27	0.58	0.75	1.47
C3 Phenanthrene/anthracenes	5.82	29.00	6.82	8.90	39.90
C4 Phenanthrene/anthracenes	7.77	36.60	10.50	15.60	73.70
Retene	3.17	3.90	4.64	5.16	4.95
Other C4 Phenanthrene/anthracenes	4.60	32.70	5.86	10.44	68.75
C1 Fluoranthene/pyrenes	6.89	10.40	8.49	15.20	27.80
Methylfluoranthene/pyrene A	0.74	1.17	0.91	1.59	2.42
Methylfluoranthene/pyrene B	2.56	2.95	3.06	5.46	6.63
Methylfluoranthene/pyrene C	0.99	0.99	1.21	2.43	2.18
Methylfluoranthene/pyrene D	0.86	1.99	1.07	1.98	6.49
Methylfluoranthene/pyrene E	0.83	1.59	1.09	1.95	5.40
Methylfluoranthene/pyrene F	0.52	1.07	0.70	1.60	4.14
Other C1 Fluoranthene/pyrenes	0.39	0.64	0.45	0.19	0.54
C2 Fluoranthene/pyrenes	5.65	6.64	8.39	12.20	16.00
C3 Fluoranthene/pyrenes	1.76	1.87	3.01	5.56	4.88
C1 Benz[a]anthracene/chrysenes	22.40	20.50	29.00	35.50	28.00
C2 Benz[a]anthracene/chrysenes	3.43	3.32	5.69	6.45	5.13
C3 Benz[a]anthracene/chrysenes	0.53	0.46	0.82	0.82	0.64

Location	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd	Juan Perez Snd
Sample	JP8 #1	JP8 #6	JP8 #11	JP8 #15	JP8 #20
Latitude	52.5545º N	52.5545º N	52.5545º N	52.5545º N	52.5545º N
Longitude	131.1649º W	131.1649º W	131.1649º W	131.1649º W	131.1649º W
Depth, m	325 m	325 m	325 m	325 m	325 m
Collection Date	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003	Sep 17, 2003
Section	0-1 cm	5-6 cm	10-12 cm	18-20 cm	40-45 cm
Weight (g dry)	3.25 g (dry)	3.34 g (dry)	3.50 g (dry)	3.62 g (dry)	3.54 g (dry)
Organic Carbon %	4.05	3.87	4.08	4.07	3.69
Organic Nitrogen %	0.53	0.50	0.52	0.52	0.47
C/N ratio	7.63	7.78	7.85	7.79	7.80
Core Depth (mid-section), cm	0.5	5.5	11.0	19.0	42.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-6	L7581-7	L7581-8	L7581-9 L	L7581-10 L
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14961	WG14961
Benzo[b]naphtho[1,2-d]thiophene	0.23	0.14	0.25	0.44	0.68
Benzo[b]naphtho[2,1-d]thiophene	<0.0696	<0.0761	<0.0603	0.12	0.13
Benzo[b]naphtho[2,3-d]thiophene	<0.0696	<0.0761	<0.0603	<0.0976	<0.0865
Surrogate Standard Recovery (%)					
Naphthalene-D8	16.2	8.0	20.9	13.1	15.0
Biphenyl-D10	32.1	21.8	47.7	20.5	35.8
Acenaphthylene-D8	36.6	26.7	51.7	24.1	40.5
Phenanthrene-D10	63.1	56.3	85.4	43.8	71.4
Fluoranthene-D10	71.0	67.9	106.0	55.5	86.2
Benz[a]anthracene-D12	39.4	39.3	81.2	49.7	79.2
Chrysene-D12	40.1	43.0	85.6	53.5	83.4
Benzo[b/k]fluoranthene-D12	63.5	61.6	97.3	57.1	90.8
Benzo[a]pyrene-D12	45.1	34.9	62.8	38.9	65.0
Perylene-D12	55.1	44.6	82.9	48.9	84.3
Dibenz[ah]anthracene-D14	51.1	51.6	70.5	57.8	94.8
Indeno[1,2,3-cd]pyrene-D12	54.2	55.0	82.5	60.2	97.4
Benzo[ghi]perylene-D12	56.4	56.4	94.5	65.5	105.0
2-Methylnaphthalene-D10	26.9	15.0	36.9	18.5	25.3
2,6-Dimethylnaphthalene-D12	34.5	24.1	50.7	22.3	34.2

Location	Hecate Str	Hecate Str	Hecate Str	Hecate Str	Hecate Str
Sample	JP1 #1	JP1 #4	JP1 #6	JP1 #11	JP1 #15
Latitude	52.6255º N	52.6255º N	52.6255º N	52.6255º N	52.6255º N
Longitude	130.2925º W	130.2925º W	130.2925º W	130.2925º W	130.2925º W
Depth, m	240 m	240 m	240 m	240 m	240 m
Collection Date	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003
Section	0-2 cm	6-8 cm	10-12 cm	20-22 cm	34-39 cm
Weight (g dry)	6.76 g (dry)	6.07 g (dry)	5.79 g (dry)	7.98 g (dry)	7.02 g (dry)
Organic Carbon %	0.61	1.73	1.80	0.48	0.30
Organic Nitrogen %	0.08	0.21	0.23	0.07	0.05
C/N ratio	7.80	8.23	7.83	7.24	6.23
Core Depth (mid-section), cm	1.0	7.0	11.0	21.0	36.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-1 i	L7581-2 i	L7581-3	L7581-4	L7581-5
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14933	WG14933
Naphthalene	2.52	3.74	3.45	3.38	6.97
Biphenyl	0.92	1.72	1.64	2.14	2.24
Acenaphthylene	0.33	0.09	0.09	0.05	0.06
Acenaphthene	NDR 0.138	0.23	0.27	0.23	0.28
Fluorene	0.69	1.21	1.48	2.00	1.28
Phenanthrene	4.08	5.52	6.38	5.62	5.48
Anthracene	0.39	0.20	0.21	0.20	0.30
Fluoranthene	2.95	1.02	1.02	1.00	0.91
Acephenanthrylene	0.31	0.17	0.17	0.13	0.11
Pyrene	2.38	1.34	1.38	2.16	2.00
Benz[a]anthracene	1.23	0.50	0.51	0.62	0.60
Chrysene	2.41	2.11	2.34	3.08	2.87
Benzo[b/j/k]fluoranthene	4.12	1.72	1.76	2.60	2.45
Benzo[e]pyrene	2.20	1.41	1.47	2.52	2.27
Benzo[a]pyrene	1.65	0.45	0.45	0.59	0.53
Perylene	7.00	18.30	17.30	60.40	57.90
Dibenz[a,j]anthracene	0.50	0.20	0.18	0.24	0.28
Dibenz[a,c/a,h]anthracene	NDR 0.425	NDR 0.267	NDR 0.230	NDR 0.396	0.39
Pentaphene	0.09	0.03	0.03	0.05	0.03
Benzo[b]chrysene	0.20	0.08	0.07	0.08	0.06
Picene	0.62	0.30	0.27	0.35	0.33
Indeno[1,2,3-cd]fluoranthene	0.46	0.09	0.17	<0.0525	<0.0581
Indeno[7,1,2,3-cdef]chrysene	0.56	0.13	0.14	0.08	<0.0581
Indeno[1,2,3-cd]pyrene	2.58	0.62	0.55	0.54	0.50
Benzo[ghi]perylene	3.24	1.42	1.42	2.56	2.44
Anthanthrene	0.12	<0.0377	<0.0485	<0.0477	<0.055
C1 Naphthalenes	5.36	8.59	9.23	7.76	8.43
2-Methylnaphthalene	2.81	4.19	4.48	4.43	5.03
1-Methylnaphthalene	2.55	4.40	4.75	3.33	3.40
C2 Naphthalenes	11.20	20.60	24.70	14.10	13.40
2-Ethylnaphthalene	0.28	0.51	0.58	0.45	0.42
1-Ethylnaphthalene	0.31	0.41	0.48	0.32	0.37
2,6/2,7-Dimethylnaphthalene	3.24	7.16	8.86	4.56	3.90
1,3/1,7-Dimethylnaphthalene	2.71	5.01	5.99	3.24	3.03
1,6-Dimethylnaphthalene	2.36	3.58	4.27	2.78	2.85
2,3/1,4-Dimethylnaphthalene	1.09	1.84	2.27	1.45	1.42
1,5-Dimethylnaphthalene	0.56	0.98	1.09	0.67	0.62
1,2-Dimethylnaphthalene	0.65	1.11	1.18	0.62	0.78
C3 Naphthalenes	12.30	17.10	20.30	11.30	13.30
C3 Naphthalene A	0.25	0.41	0.58	0.32	0.35
1,3,7-Trimethylnaphthalene	1.24	1.89	2.27	1.20	1.18
1,3,6-Trimethylnaphthalene	2.15	2.97	2.94	1.88	1.95
1,3,5/1,4,6-Trimethylnaphthalene	1.42	2.24	2.88	1.48	1.61
2,3,6-Trimethylnaphthalene	1.49	1.89	2.16	1.27	1.51
1,2,7/1,6,7/1,2,6-Trimethylnaphthalene	2.90	3.90	4.91	2.45	2.83
1,2,4-Trimethylnaphthalene	0.31	0.37	0.52	0.25	0.38
1,2,5-Trimethylnaphthalene	1.60	2.38	2.73	1.74	2.34
C3 Naphthalene B	0.35	0.37	0.54	0.21	0.46
Other C3 Naphthalenes	0.58	0.69	0.76	0.49	0.68
C4 Naphthalenes	7.02	11.70	10.70	8.44	11.80

Location	Hecate Str	Hecate Str	Hecate Str	Hecate Str	Hecate Str
Sample	JP1 #1	JP1 #4	JP1 #6	JP1 #11	JP1 #15
Latitude	52.6255º N	52.6255º N	52.6255º N	52.6255º N	52.6255º N
Longitude	130.2925º W	130.2925º W	130.2925º W	130.2925º W	130.2925º W
Depth, m	240 m	240 m	240 m	240 m	240 m
Collection Date	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003
Section	0-2 cm	6-8 cm	10-12 cm	20-22 cm	34-39 cm
Weight (g dry)	6.76 g (dry)	6.07 g (dry)	5.79 g (dry)	7.98 g (dry)	7.02 g (dry)
Organic Carbon %	0.61	1.73	1.80	0.48	0.30
Organic Nitrogen %	0.08	0.21	0.23	0.07	0.05
C/N ratio	7.80	8.23	7.83	7.24	6.23
Core Depth (mid-section), cm	1.0	7.0	11.0	21.0	36.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-1 i	L7581-2 i	L7581-3	L7581-4	L7581-5
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14933	WG14933
C1 Fluorenes	3.00	4.33	4.67	3.21	4.71
Methylfluorene A	0.41	0.60	0.76	0.54	0.78
2-Methylfluorene	0.57	0.61	0.69	0.58	0.85
1-Methylfluorene	1.63	2.62	2.65	1.69	2.49
Methylfluorene B	0.10	0.10	0.14	0.08	0.13
Methylfluorene C	0.29	0.40	0.42	0.32	0.46
C2 Fluorenes	6.97	7.48	9.14	5.49	8.25
C3 Fluorenes	5.13	6.71	8.16	4.56	8.89
Dibenzothiophene	NDR 0.120	NDR 0.127	NDR 0.247	NDR 0.166	NDR 0.227
C1 Dibenzothiophenes	0.28	0.40	0.62	0.46	0.58
4-Methyldibenzothiophene	0.07	0.05	0.18	0.09	0.20
2/3-Methyldibenzothiophene	0.08	0.13	0.18	0.16	0.24
1-Methyldibenzothiophene	0.03	0.03	0.05	0.04	0.07
C2 Dibenzothiophenes	0.19	0.20	0.41	0.29	0.51
C3 Dibenzothiophenes	<0.0397	0.09	0.27	0.19	0.43
C1 Phenanthrene/anthracenes	6.25	15.40	17.60	13.70	13.50
3-Methylphenanthrene	NDR 2.14	NDR 3.71	NDR 4.35	NDR 3.31	NDR 3.15
2-Methylphenanthrene	2.34	4.19	4.59	3.92	3.83
2-Methylanthracene	0.26	0.27	0.34	0.39	0.42
9/4-Methylphenanthrene	NDR 2.15	NDR 3.86	NDR 4.52	NDR 3.15	NDR 3.04
1-Methylphenanthrene	1.53	2.72	3.03	2.26	2.32
C2 Phenanthrene/anthracenes	6.25	11.60	13.40	10.90	9.69
Ethylphenanthrene	0.10	0.20	0.24	0.19	0.16
3,6-Dimethylphenanthrene/Ethylphenanthrene	0.47	0.95	1.13	0.93	0.79
2,6-Dimethylphenanthrene	0.70	1.29	1.49	1.23	1.07
2,7-Dimethylphenanthrene	0.35	0.64	0.78	0.70	0.61
1,3/2,10/3,9/3,10-Dimethylphenanthrene	1.51	2.89	3.40	2.81	2.59
1,6/2,9-Dimethylphenanthrene	0.79	1.62	1.95	1.67	1.33
1,5/1,7-Dimethylphenanthrene	0.81	1.67	1.94	1.33	1.19
2,3-Dimethylphenanthrene	0.35	0.66	0.74	0.64	0.61
1,9/4,9-Dimethylphenanthrene	0.99	1.33	1.37	1.08	1.08
1,8-Dimethylphenanthrene	0.18	0.35	0.37	0.32	0.27
1,2-Dimethylphenanthrene	0.13	0.33	0.33	0.33	0.29
C3 Phenanthrene/anthracenes	2.77	5.20	6.14	5.17	5.70
C4 Phenanthrene/anthracenes	4.90	8.83	10.80	11.30	12.90
Retene	2.12	4.65	5.42	6.69	6.38
Other C4 Phenanthrene/anthracenes	2.78	4.18	5.38	4.61	6.52
C1 Fluoranthene/pyrenes	3.45	5.14	5.54	6.29	6.19
Methylfluoranthene/pyrene A	0.36	0.49	0.51	0.55	0.53
Methylfluoranthene/pyrene B	1.30	2.10	2.29	2.33	2.20
Methylfluoranthene/pyrene C	0.50	0.64	0.65	0.77	0.80
Methylfluoranthene/pyrene D	0.41	0.54	0.65	0.93	0.98
Methylfluoranthene/pyrene E	0.43	0.73	0.77	0.95	0.98
Methylfluoranthene/pyrene F	0.32	0.43	0.44	0.58	0.61
Other C1 Fluoranthene/pyrenes	0.13	0.20	0.22	0.17	0.10
C2 Fluoranthene/pyrenes	3.32	6.48	7.18	7.65	7.71
C3 Fluoranthene/pyrenes	2.23	1.79	1.77	1.96	1.73
C1 Benz[a]anthracene/chrysenes	9.45	15.00	16.80	21.10	19.60
C2 Benz[a]anthracene/chrysenes	1.74	3.25	4.20	4.29	3.63
C3 Benz[a]anthracene/chrysenes	0.22	0.22	0.20	0.41	0.22

Location	Hecate Str	Hecate Str	Hecate Str	Hecate Str	Hecate Str
Sample	JP1 #1	JP1 #4	JP1 #6	JP1 #11	JP1 #15
Latitude	52.6255º N	52.6255º N	52.6255º N	52.6255º N	52.6255º N
Longitude	130.2925º W	130.2925º W	130.2925º W	130.2925º W	130.2925º W
Depth, m	240 m	240 m	240 m	240 m	240 m
Collection Date	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003	Sep 16, 2003
Section	0-2 cm	6-8 cm	10-12 cm	20-22 cm	34-39 cm
Weight (g dry)	6.76 g (dry)	6.07 g (dry)	5.79 g (dry)	7.98 g (dry)	7.02 g (dry)
Organic Carbon %	0.61	1.73	1.80	0.48	0.30
Organic Nitrogen %	0.08	0.21	0.23	0.07	0.05
C/N ratio	7.80	8.23	7.83	7.24	6.23
Core Depth (mid-section), cm	1.0	7.0	11.0	21.0	36.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-1 i	L7581-2 i	L7581-3	L7581-4	L7581-5
Batch (Workgroup)	WG14933	WG14933	WG14933	WG14933	WG14933
Benzo[b]naphtho[1,2-d]thiophene	0.11	0.06	0.21	0.13	0.22
Benzo[b]naphtho[2,1-d]thiophene	<0.0280	<0.0339	<0.0302	<0.0439	<0.0352
Benzo[b]naphtho[2,3-d]thiophene	<0.0280	<0.0339	<0.0302	<0.0439	<0.0352
Surrogate Standard Recovery (%)					
Naphthalene-D8	13.8	27.8	26.2	42.6	22.7
Biphenyl-D10	22.6	40.6	38.6	55.8	31.9
Acenaphthylene-D8	29.3	43.3	43.0	56.8	35.5
Phenanthrene-D10	65.0	66.0	66.0	70.5	71.8
Fluoranthene-D10	76.1	74.2	71.9	73.7	87.1
Benz[a]anthracene-D12	71.8	69.0	63.5	64.5	80.6
Chrysene-D12	70.8	69.6	63.7	64.1	81.2
Benzo[b/k]fluoranthene-D12	80.9	78.6	74.4	73.2	90.3
Benzo[a]pyrene-D12	68.4	63.1	59.8	59.8	76.6
Perylene-D12	84.0	78.7	75.1	77.4	95.7
Dibenz[ah]anthracene-D14	71.9	69.9	62.6	54.0	74.5
Indeno[1,2,3-cd]pyrene-D12	77.4	75.0	66.9	62.2	82.2
Benzo[ghi]perylene-D12	86.1	82.6	76.1	72.6	92.1
2-Methylnaphthalene-D10	18.7	36.4	35.0	53.5	30.0
2,6-Dimethylnaphthalene-D12	25.4	43.4	41.3	59.5	34.4

Location	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd
Sample	MS1 #1	MS1 #6	MS1 #11	MS1 #17	MS1 #22
Latitude	52.3817º N	52.3817º N	52.3817º N	52.3817º N	52.3817º N
Longitude	128.5502º W	128.5502º W	128.5502º W	128.5502º W	128.5502º W
Depth, m	245 m	245 m	245 m	245 m	245 m
Collection Date	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003
Section	0-1 cm	5-6 cm	10-12 cm	25-30 cm	50-55 cm
Weight (g dry)	1.91 g (dry)	2.25 g (dry)	2.45 g (dry)	2.51 g (dry)	2.72 g (dry)
Organic Carbon %	5.86	5.21	5.57	5.36	4.84
Organic Nitrogen %	0.76	0.68	0.72	0.68	0.58
C/N ratio	7.71	7.71	7.80	7.85	8.35
Core Depth (mid-section), cm	0.5	5.5	11.0	27.5	52.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-11 L	L7581-12 LW	L7581-13 L	L7581-14 L	L7581-15 i
Batch (Workgroup)	WG14961	WG14961	WG14961	WG14961	WG14961
Naphthalene	10.90	7.55	9.54	8.04	4.18
Biphenyl	3.46	3.15	3.79	2.82	2.06
Acenaphthylene	1.59	1.32	2.72	1.58	<0.131
Acenaphthene	0.62	NDR 0.777	0.94	0.71	0.41
Fluorene	3.26	2.74	2.18	2.78	1.58
Phenanthrene	16.70	34.20	16.20	13.90	9.53
Anthracene	1.75	2.57	2.25	1.34	0.37
Fluoranthene	13.00	55.60	17.30	17.60	1.61
Acephenanthrylene	1.15	15.59	1.29	2.73	0.25
Pyrene	11.20	357.00	22.90	66.10	1.74
Benz[a]anthracene	5.34	6.14	8.47	4.53	0.66
Chrysene	8.84	12.00	11.30	7.01	2.62
Benzo[b/j/k]fluoranthene	19.80	21.20	29.20	18.60	2.10
Benzo[e]pyrene	11.90	13.30	18.90	11.80	1.78
Benzo[a]pyrene	8.42	8.21	14.50	7.85	NDR 0.612
Perylene	54.40	74.50	67.20	27.80	24.10
Dibenz[a,j]anthracene	2.27	1.72	2.72	2.00	0.18
Dibenz[a,c/a,h]anthracene	NDR 2.02	NDR 1.82	NDR 2.83	NDR 1.68	NDR 0.239
Pentaphene	0.41	0.36	0.59	0.34	<0.144
Benzo[b]chrysene	0.85	0.85	1.48	0.73	0.20
Picene	2.69	2.26	3.48	2.74	0.31
Indeno[1,2,3-cd]fluoranthene	3.69	3.35	1.63	1.26	0.08
Indeno[7,1,2,3-cdef]chrysene	2.45	2.70	3.01	3.02	0.20
Indeno[1,2,3-cd]pyrene	12.10	13.00	16.20	13.70	NDR 0.758
Benzo[ghi]perylene	21.90	NDR 22.2	21.70	16.60	1.55
Anthanthrene	1.01	0.71	0.18	<0.184	<0.123
C1 Naphthalenes	21.10	19.80	17.50	16.90	14.20
2-Methylnaphthalene	10.90	9.98	8.58	8.16	6.34
1-Methylnaphthalene	10.20	9.81	8.92	8.74	7.84
C2 Naphthalenes	69.10	65.70	65.30	51.30	47.40
2-Ethylnaphthalene	1.80	1.76	1.55	1.25	1.16
1-Ethylnaphthalene	2.00	1.72	2.22	1.37	1.27
2,6/2,7-Dimethylnaphthalene	17.47	16.30	15.09	12.51	11.64
1,3/1,7-Dimethylnaphthalene	20.40	18.41	17.84	13.94	13.43
1,6-Dimethylnaphthalene	13.91	13.28	15.85	11.81	9.27
2,3/1,4-Dimethylnaphthalene	6.80	6.40	6.80	4.94	5.20
1,5-Dimethylnaphthalene	3.48	3.84	3.21	2.65	2.60
1,2-Dimethylnaphthalene	3.24	3.99	2.73	2.83	2.83
C3 Naphthalenes	40.70	47.80	53.60	37.90	41.50
C3 Naphthalene A	0.81	1.03	1.01	0.73	0.71
1,3,7-Trimethylnaphthalene	4.19	4.64	5.08	3.92	3.93
1,3,6-Trimethylnaphthalene	7.09	7.99	10.20	6.89	7.23
1,3,5/1,4,6-Trimethylnaphthalene	4.64	5.09	6.08	4.43	4.96
2,3,6-Trimethylnaphthalene	5.15	6.25	6.05	4.35	4.90
1,2,7/1,6,7/1,2,6-Trimethylnaphthalene	9.80	11.58	12.82	9.12	10.22
1,2,4-Trimethylnaphthalene	1.02	1.34	2.07	0.95	0.96
1,2,5-Trimethylnaphthalene	5.57	6.47	7.19	5.24	6.13
C3 Naphthalene B	0.76	1.49	1.15	0.81	1.27
Other C3 Naphthalenes	1.66	1.92	1.95	1.45	1.18
C4 Naphthalenes	20.40	26.90	31.50	19.60	27.60

Location	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd
Sample	MS1 #1	MS1 #6	MS1 #11	MS1 #17	MS1 #22
Latitude	52.3817º N	52.3817º N	52.3817º N	52.3817º N	52.3817º N
Longitude	128.5502º W	128.5502º W	128.5502º W	128.5502º W	128.5502º W
Depth, m	245 m	245 m	245 m	245 m	245 m
Collection Date	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003
Section	0-1 cm	5-6 cm	10-12 cm	25-30 cm	50-55 cm
Weight (g dry)	1.91 g (dry)	2.25 g (dry)	2.45 g (dry)	2.51 g (dry)	2.72 g (dry)
Organic Carbon %	5.86	5.21	5.57	5.36	4.84
Organic Nitrogen %	0.76	0.68	0.72	0.68	0.58
C/N ratio	7.71	7.71	7.80	7.85	8.35
Core Depth (mid-section), cm	0.5	5.5	11.0	27.5	52.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-11 L	L7581-12 LW	L7581-13 L	L7581-14 L	L7581-15 i
Batch (Workgroup)	WG14961	WG14961	WG14961	WG14961	WG14961
C1 Fluorenes	7.85	10.70	12.90	9.49	12.30
Methylfluorene A	1.34	1.71	2.17	1.10	2.15
2-Methylfluorene	1.15	1.61	1.79	1.70	1.72
1-Methylfluorene	4.26	5.76	7.30	5.23	6.85
Methylfluorene B	0.25	0.51	0.29	0.54	0.40
Methylfluorene C	0.85	1.12	1.35	0.92	1.18
C2 Fluorenes	15.60	49.30	33.20	23.90	26.80
C3 Fluorenes	15.20	298.00	46.10	40.10	27.00
Dibenzothiophene	NDR 0.499	NDR 1.83	NDR 0.559	NDR 0.475	NDR 0.352
C1 Dibenzothiophenes	1.39	86.40	2.81	1.18	1.26
4-Methyldibenzothiophene	0.63	206.46	7.35	5.36	0.68
2/3-Methyldibenzothiophene	0.52	359.20	6.68	6.11	0.52
1-Methyldibenzothiophene	0.24	128.34	2.87	2.73	0.13
C2 Dibenzothiophenes	1.39	694.00	16.90	14.20	1.32
C3 Dibenzothiophenes	1.21	1150.00	27.30	33.80	0.90
C1 Phenanthrene/anthracenes	34.10	764.00	48.80	39.20	29.10
3-Methylphenanthrene	NDR 8.28	NDR 181	11.40	NDR 9.13	NDR 6.78
2-Methylphenanthrene	9.16	239.00	14.10	10.80	7.79
2-Methylanthracene	0.76	4.66	0.99	0.62	0.46
9/4-Methylphenanthrene	NDR 7.86	NDR 163	NDR 13.4	NDR 10.3	NDR 7.30
1-Methylphenanthrene	6.32	140.00	9.69	8.15	5.41
C2 Phenanthrene/anthracenes	31.00	2380.00	84.70	237.00	21.20
Ethylphenanthrene	0.52	29.28	1.30	2.10	0.41
3,6-Dimethylphenanthrene/Ethylphenanthrene	2.27	182.37	6.38	14.21	1.73
2,6-Dimethylphenanthrene	3.89	375.33	11.16	28.64	2.15
2,7-Dimethylphenanthrene	1.80	217.17	7.52	24.16	1.27
1,3/2,10/3,9/3,10-Dimethylphenanthrene	7.17	639.79	21.52	62.18	5.22
1,6/2,9-Dimethylphenanthrene	3.85	347.90	12.69	35.98	2.70
1,5/1,7-Dimethylphenanthrene	3.93	243.75	9.38	27.91	2.82
2,3-Dimethylphenanthrene	1.66	204.33	7.78	25.45	1.34
1,9/4,9-Dimethylphenanthrene	5.11	84.07	4.68	8.87	3.02
1,8-Dimethylphenanthrene	0.79	56.01	2.29	7.50	0.55
1,2-Dimethylphenanthrene	0.75	94.17	3.02	12.81	0.57
C3 Phenanthrene/anthracenes	12.20	2730.00	80.00	443.00	8.43
C4 Phenanthrene/anthracenes	20.90	3570.00	110.00	402.00	15.90
Retene	8.79	NDR 80.3	7.86	8.39	6.75
Other C4 Phenanthrene/anthracenes	12.11	3489.70	102.14	393.61	9.15
C1 Fluoranthene/pyrenes	16.00	765.00	38.90	216.00	8.51
Methylfluoranthene/pyrene A	1.62	99.61	4.62	22.53	0.80
Methylfluoranthene/pyrene B	5.92	138.88	9.95	42.53	3.63
Methylfluoranthene/pyrene C	2.18	18.91	3.35	12.86	0.96
Methylfluoranthene/pyrene D	1.75	223.97	8.50	57.99	0.92
Methylfluoranthene/pyrene E	1.96	154.86	6.55	42.19	1.10
Methylfluoranthene/pyrene F	1.56	115.08	5.06	32.71	0.83
Other C1 Fluoranthene/pyrenes	0.99	13.68	0.87	5.19	0.27
C2 Fluoranthene/pyrenes	23.10	202.00	20.90	59.50	9.14
C3 Fluoranthene/pyrenes	13.30	39.60	9.02	9.30	3.12
C1 Benz[a]anthracene/chrysenes	35.70	39.90	42.60	28.10	20.00
C2 Benz[a]anthracene/chrysenes	8.15	9.10	11.20	6.81	4.69
C3 Benz[a]anthracene/chrysenes	0.96	1.69	2.08	0.71	0.53

Location	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd
Sample	MS1 #1	MS1 #6	MS1 #11	MS1 #17	MS1 #22
Latitude	52.3817º N	52.3817º N	52.3817º N	52.3817º N	52.3817º N
Longitude	128.5502º W	128.5502º W	128.5502º W	128.5502º W	128.5502º W
Depth, m	245 m	245 m	245 m	245 m	245 m
Collection Date	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003	Sep 18, 2003
Section	0-1 cm	5-6 cm	10-12 cm	25-30 cm	50-55 cm
Weight (g dry)	1.91 g (dry)	2.25 g (dry)	2.45 g (dry)	2.51 g (dry)	2.72 g (dry)
Organic Carbon %	5.86	5.21	5.57	5.36	4.84
Organic Nitrogen %	0.76	0.68	0.72	0.68	0.58
C/N ratio	7.71	7.71	7.80	7.85	8.35
Core Depth (mid-section), cm	0.5	5.5	11.0	27.5	52.5
Units	ng/g	ng/g	ng/g	ng/g	ng/g
Axys ID (PAHs)	L7581-11 L	L7581-12 LW	L7581-13 L	L7581-14 L	L7581-15 i
Batch (Workgroup)	WG14961	WG14961	WG14961	WG14961	WG14961
Benzo[b]naphtho[1,2-d]thiophene	0.55	9.40	0.91	1.72	0.37
Benzo[b]naphtho[2,1-d]thiophene	0.11	2.36	0.19	0.45	0.05
Benzo[b]naphtho[2,3-d]thiophene	<0.0792	0.88	<0.109	<0.0941	<0.0518
Surrogate Standard Recovery (%)					
Naphthalene-D8	18.8	16.5	9.9	28.4	10.0
Biphenyl-D10	32.5	32.0	19.8	43.0	20.2
Acenaphthylene-D8	37.8	37.7	25.8	43.5	19.3
Phenanthrene-D10	45.2	52.2	47.7	68.8	59.0
Fluoranthene-D10	51.4	69.8	63.5	81.6	80.7
Benz[a]anthracene-D12	44.7	56.1	57.4	75.1	73.4
Chrysene-D12	47.0	58.4	62.1	79.3	76.3
Benzo[b/k]fluoranthene-D12	48.9	68.3	64.5	84.1	82.1
Benzo[a]pyrene-D12	37.0	47.9	45.5	56.3	58.4
Perylene-D12	46.4	60.1	57.7	73.5	77.4
Dibenz[ah]anthracene-D14	49.3	64.4	65.3	86.8	82.0
Indeno[1,2,3-cd]pyrene-D12	51.0	68.0	66.0	87.7	83.4
Benzo[ghi]perylene-D12	53.0	73.2	69.6	91.9	89.2
2-Methylnaphthalene-D10	27.8	24.8	15.2	40.0	15.0
2,6-Dimethylnaphthalene-D12	29.9	33.5	21.9	45.1	19.1

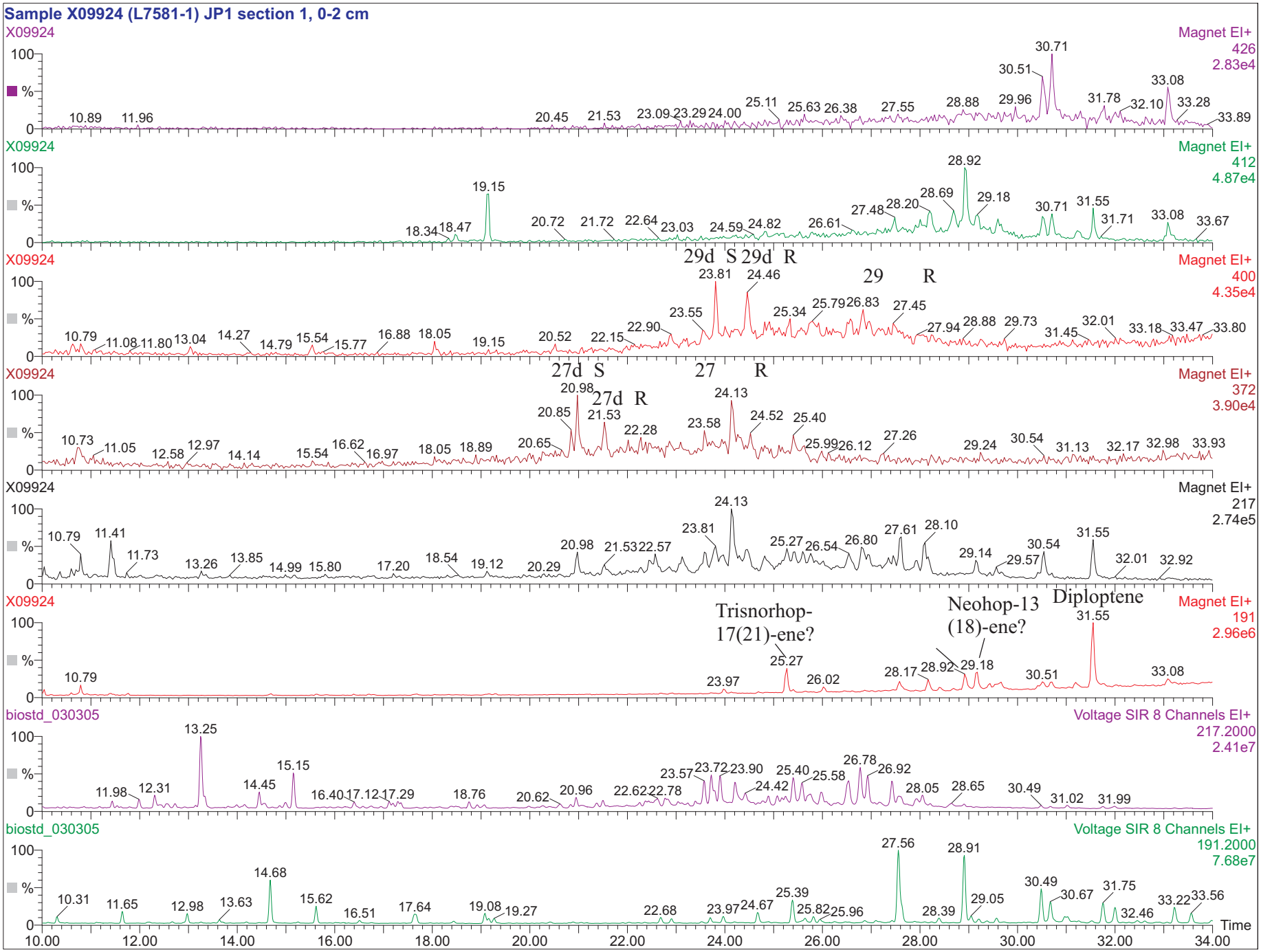
6.7 REPRESENTATIVE HOPANE, STERANE, AND TERPANE CHROMATOGRAMS

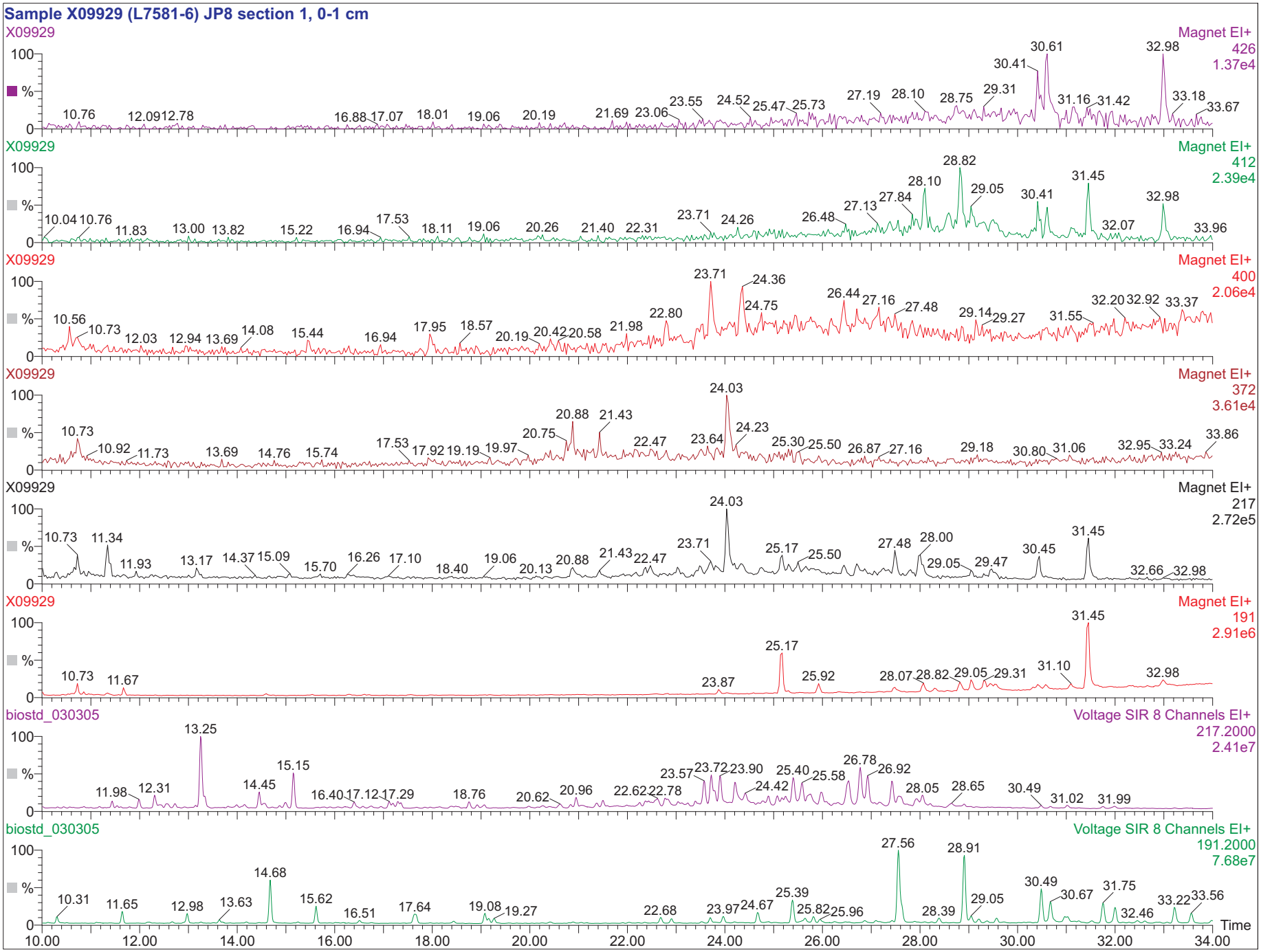
Representative chromatograms for the full scan GC/MS analyses of the alkane fraction for hopanes, steranes and terpanes are given in this Appendix.

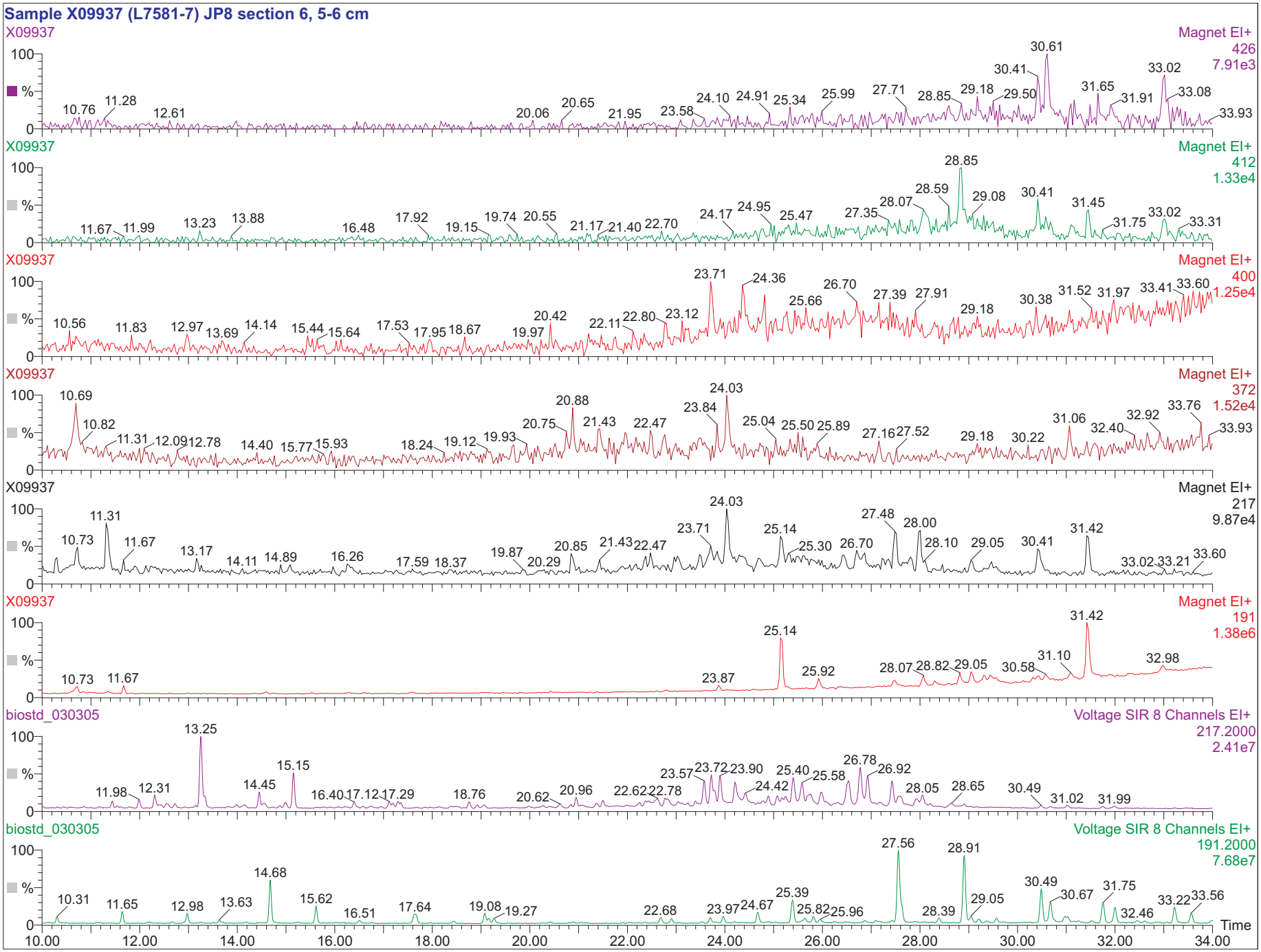
The first page in the appendix is an annotated chromatogram with the major peaks identified (see Tables 1 and 2 for abbreviations).

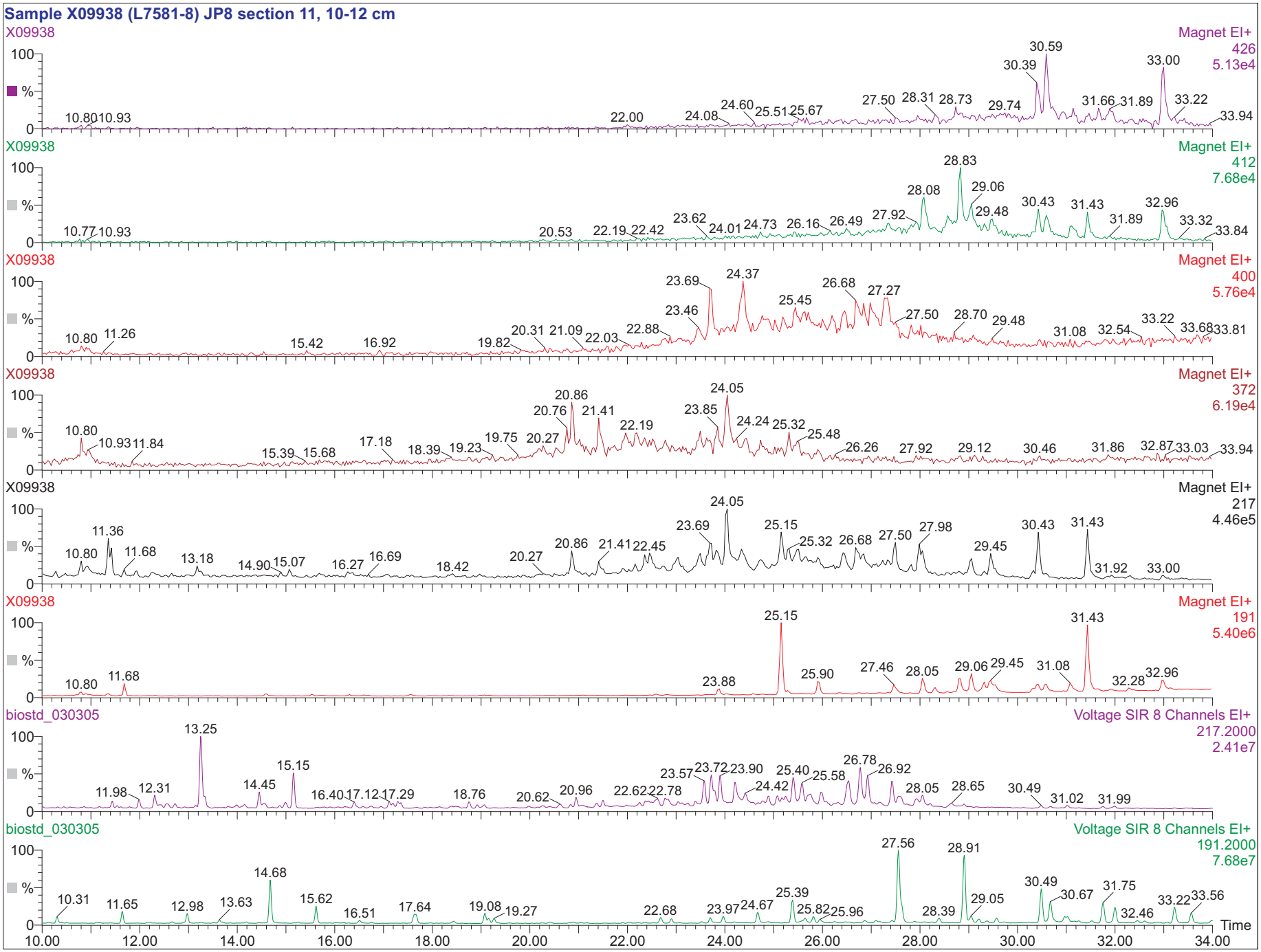
Selected ion chromatograms for each core section follow (5 pages per core with pages in order of increasing core depth).

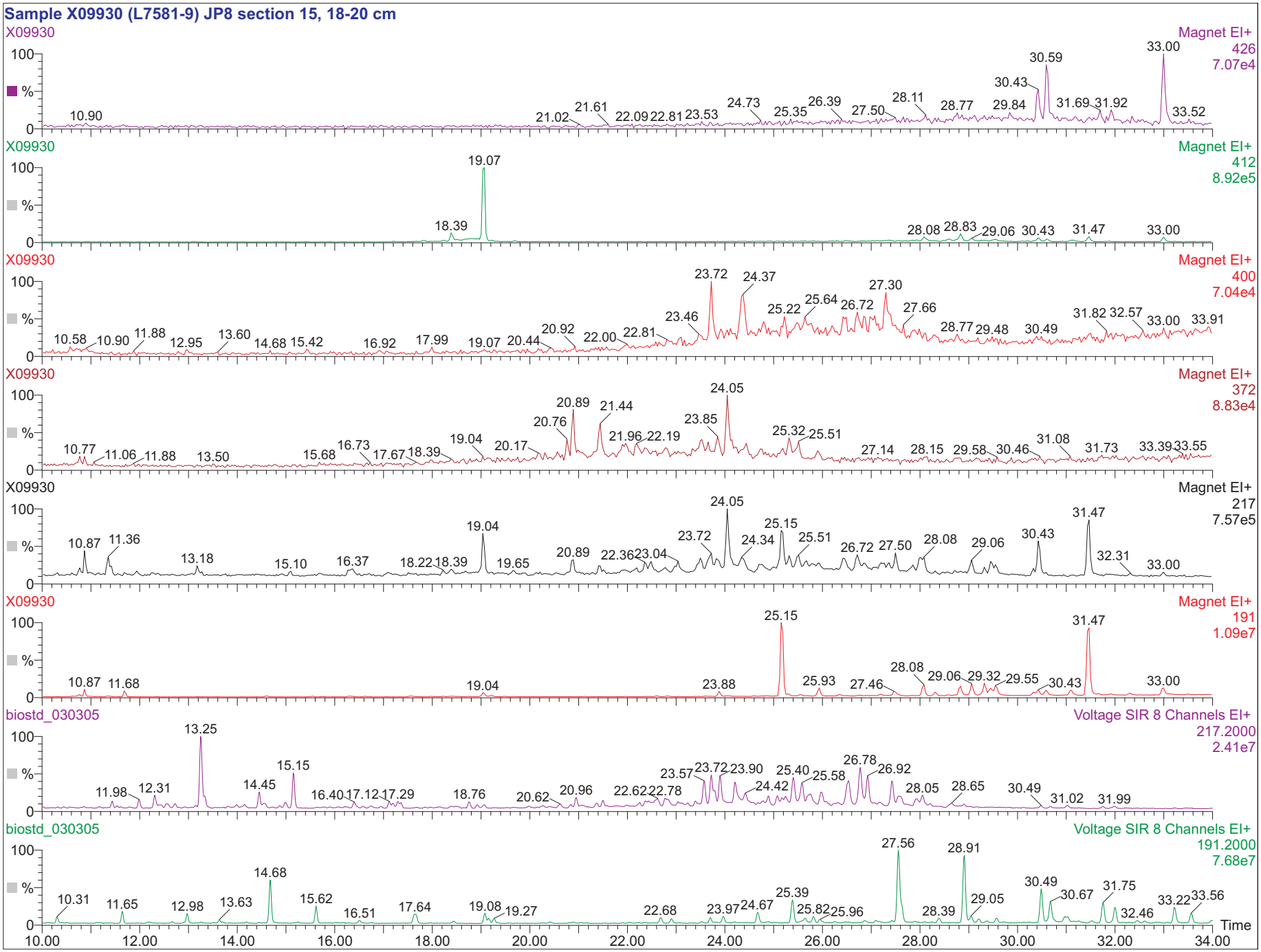
The bottom two traces (m/z 217 and 191) on each page are for the oil standard (biostd 030305).

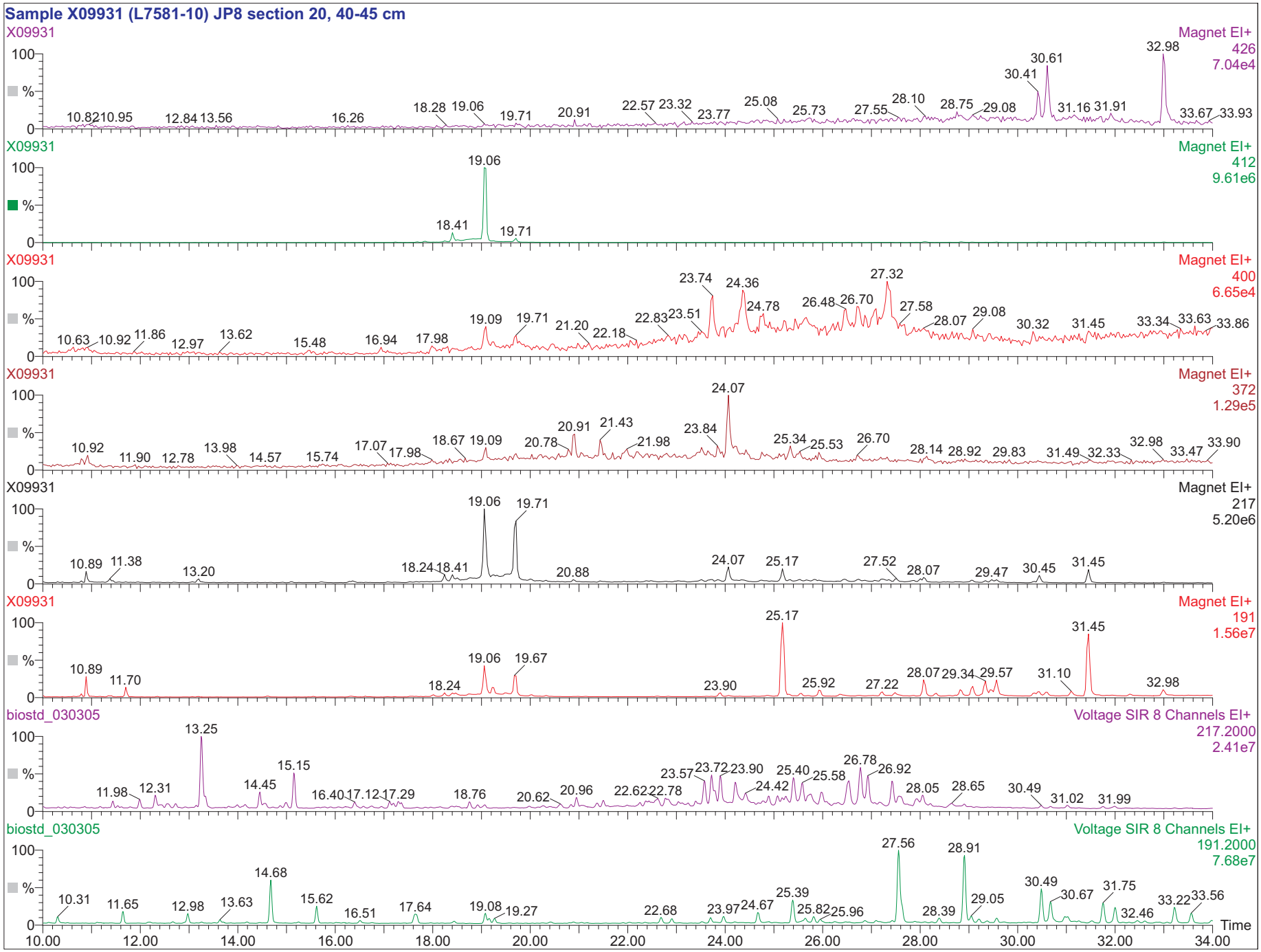

Sample X09924 (L7581-1) JP1 section 1, 0-2 cm
X09924
Magnet EI+
426
2.83e4
X09924
Magnet EI+
412
4.87e4
X09924
Magnet EI+
400
4.35e4
29d S 29d R
29 R
X09924
Magnet EI+
372
3.90e4
27d S
27 R
27d R
X09924
Magnet EI+
217
2.74e5
X09924
Magnet EI+
191
2.96e6
Trisnorhop-17(21)-ene?
Neohop-13 (18)-ene?
Diploptene
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

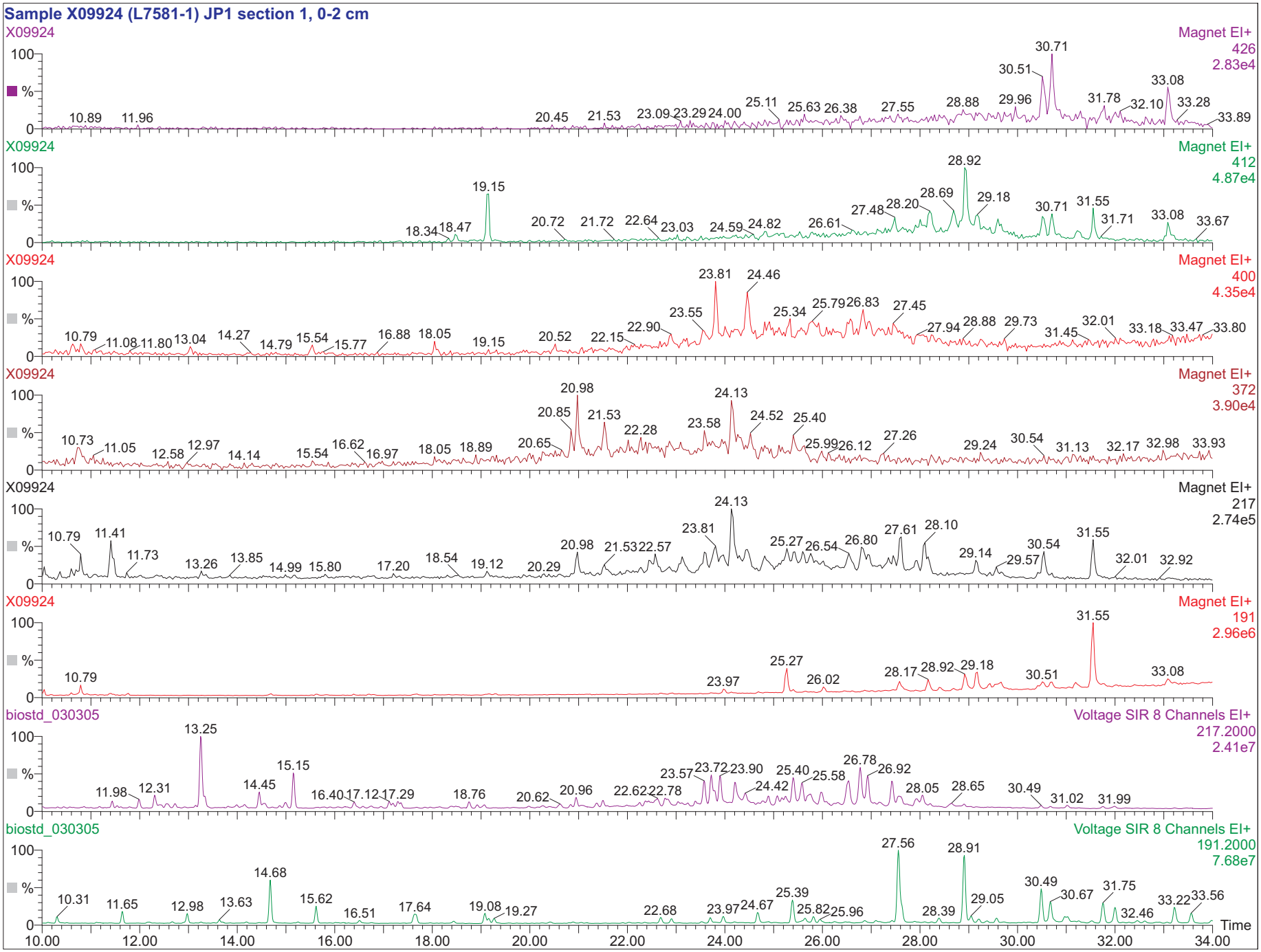

Sample X09929 (L7581-6) JP8 section 1, 0-1 cm
X09929
Magnet EI+
426
1.37e4
X09929
Magnet EI+
412
2.39e4
X09929
Magnet EI+
400
2.06e4
X09929
Magnet EI+
372
3.61e4
X09929
Magnet EI+
217
2.72e5
X09929
Magnet EI+
191
2.91e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

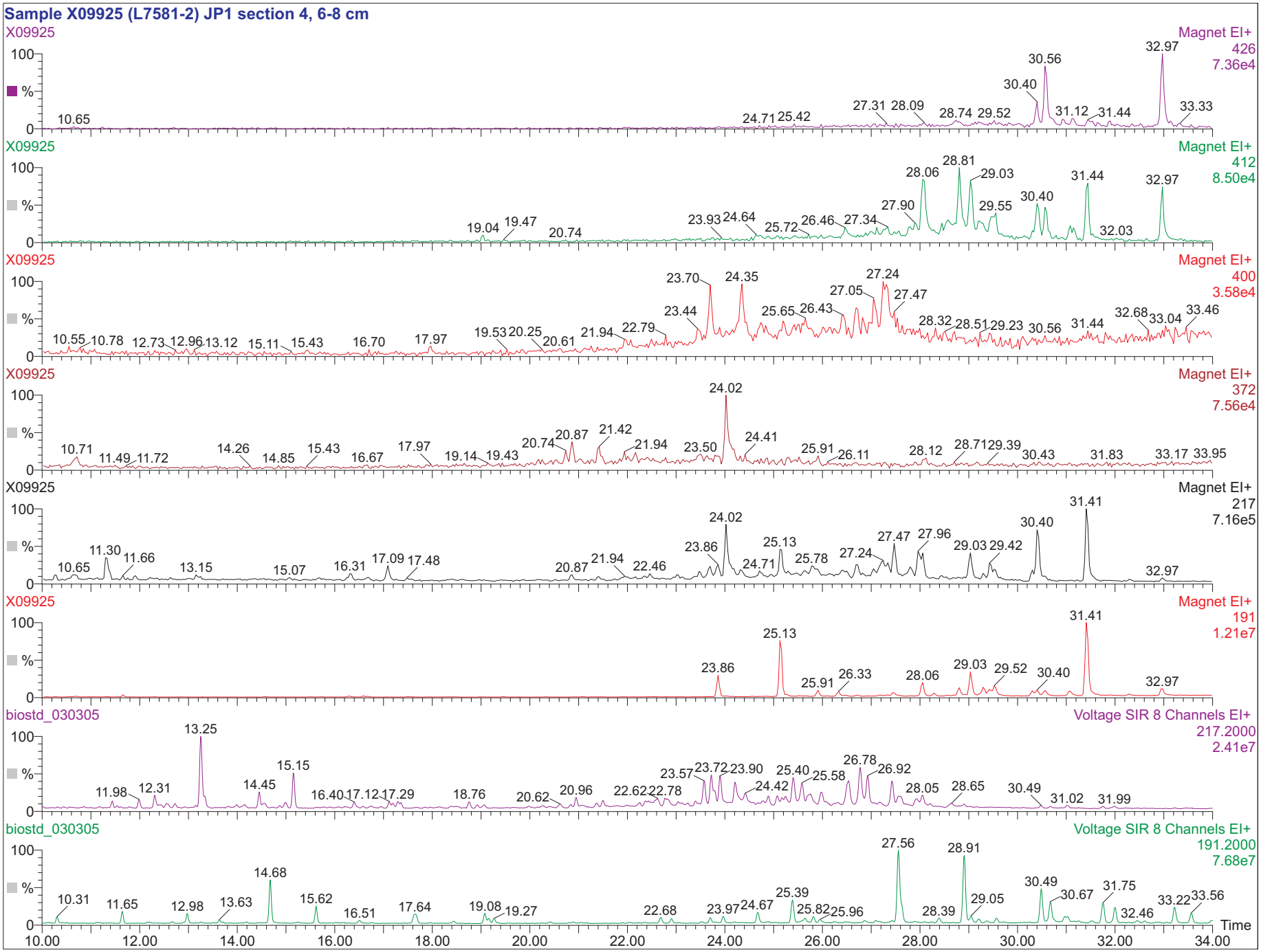

Sample X09937 (L7581-7) JP8 section 6, 5-6 cm
X09937
Magnet EI+
426
7.91e3
X09937
Magnet EI+
412
1.33e4
X09937
Magnet EI+
400
1.25e4
X09937
Magnet EI+
372
1.52e4
X09937
Magnet EI+
217
9.87e4
X09937
Magnet EI+
191
1.38e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

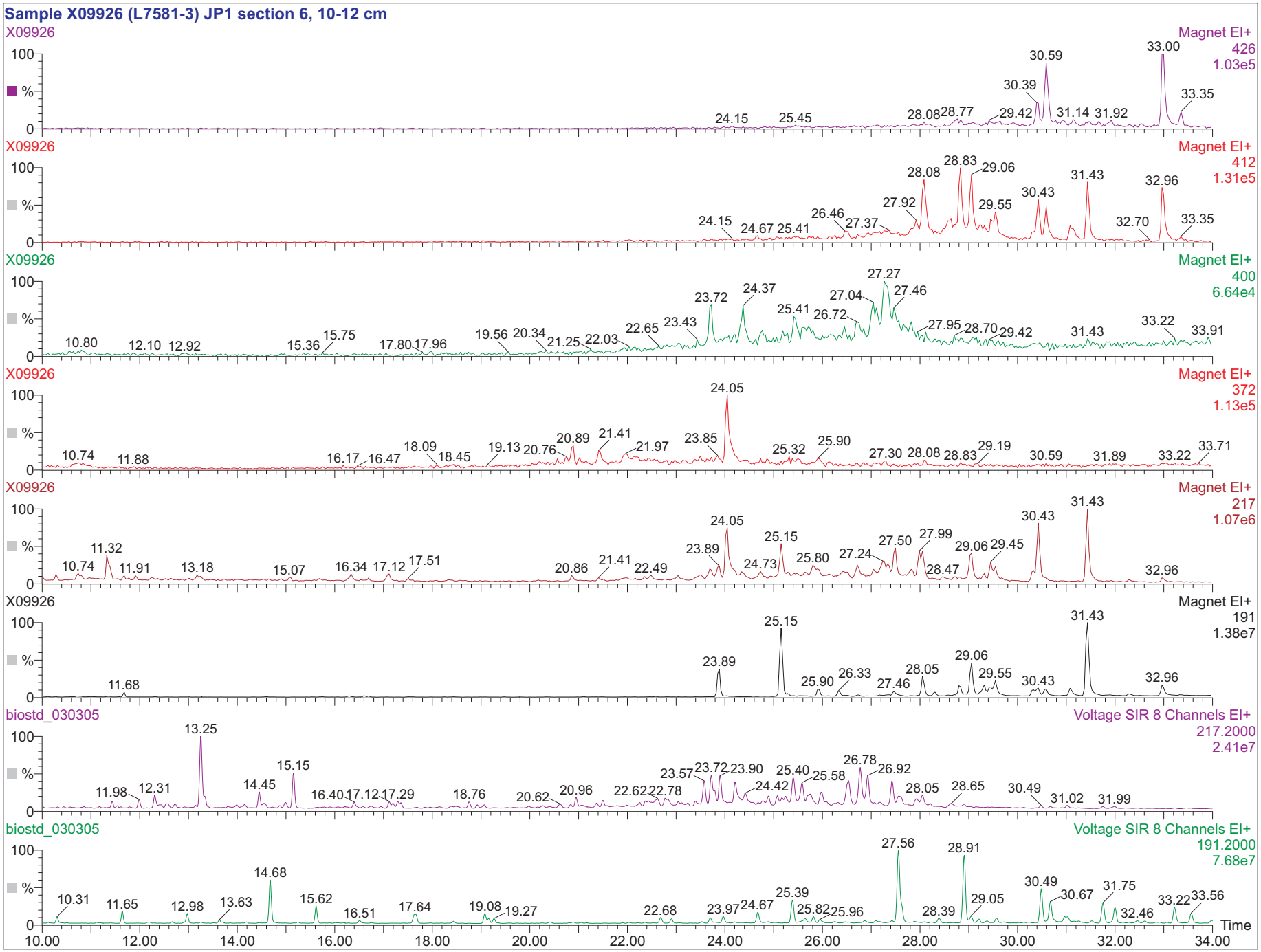

Sample X09938 (L7581-8) JP8 section 11, 10-12 cm
X09938
Magnet EI+
426
5.13e4
X09938
Magnet EI+
412
7.68e4
X09938
Magnet EI+
400
5.76e4
X09938
Magnet EI+
372
6.19e4
X09938
Magnet EI+
217
4.46e5
X09938
Magnet EI+
191
5.40e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

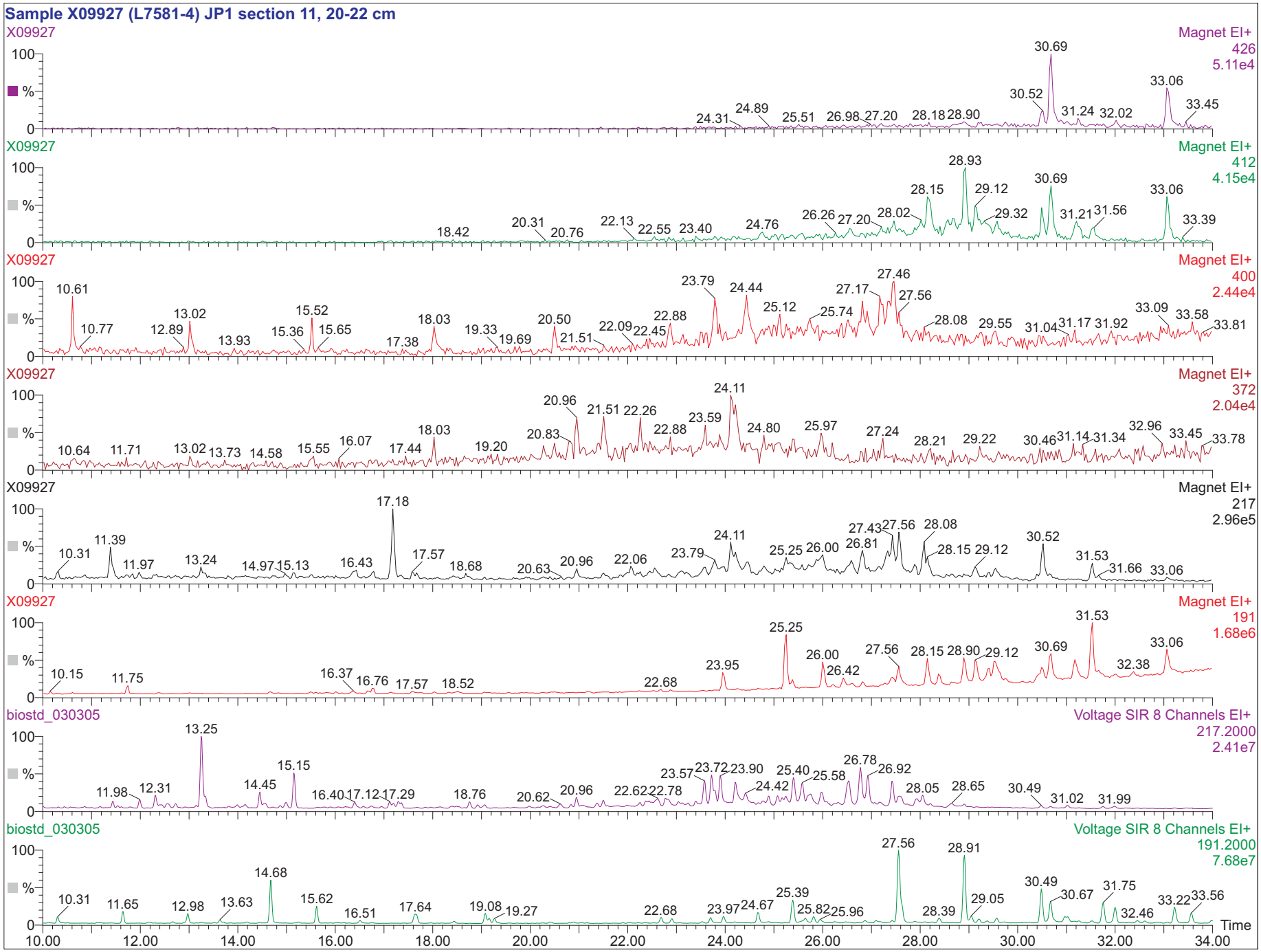

Sample X09930 (L7581-9) JP8 section 15, 18-20 cm
X09930
Magnet EI+
426
7.07e4
10.90 21.02 21.61 22.09 22.81 23.53 24.73 25.35 26.39 27.50 28.11 28.77 29.84 30.43 30.59 31.69 31.92 33.00 33.52
X09930
Magnet EI+
412
8.92e5
18.39 19.07 28.08 28.83 29.06 30.43 31.47 33.00
X09930
Magnet EI+
400
7.04e4
10.58 10.90 11.88 12.95 13.60 14.68 15.42 16.92 17.99 19.07 20.44 20.92 22.00 22.81 23.46 23.72 24.37 25.22 25.64 26.72 27.30 27.66 28.77 29.48 30.49 31.82 32.57 33.00 33.91
X09930
Magnet EI+
372
8.83e4
10.77 11.06 11.88 13.50 15.68 16.73 17.67 18.39 19.04 20.17 20.76 20.89 21.44 21.96 22.19 23.85 24.05 25.32 25.51 27.14 28.15 29.58 30.46 31.08 31.73 33.39 33.55
X09930
Magnet EI+
217
7.57e5
10.87 11.36 13.18 15.10 16.37 18.22 18.39 19.04 19.65 20.89 22.36 23.04 23.72 24.05 24.34 25.15 25.51 26.72 27.50 28.08 29.06 30.43 31.47 32.31 33.00
X09930
Magnet EI+
191
1.09e7
10.87 11.68 19.04 23.88 25.15 25.93 27.46 28.08 29.06 29.32 29.55 30.43 31.47 33.00
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
11.98 12.31 13.25 14.45 15.15 16.40 17.12 17.29 18.76 20.62 20.96 22.62 22.78 23.57 23.72 23.90 24.42 25.40 25.58 26.78 26.92 28.05 28.65 30.49 31.02 31.99
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
10.31 11.65 12.98 13.63 14.68 15.62 16.51 17.64 19.08 19.27 22.68 23.97 24.67 25.39 25.82 25.96 27.56 28.39 28.91 29.05 30.49 30.67 31.75 32.46 33.22 33.56
Time
10.00 12.00 14.00 16.00 18.00 20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00

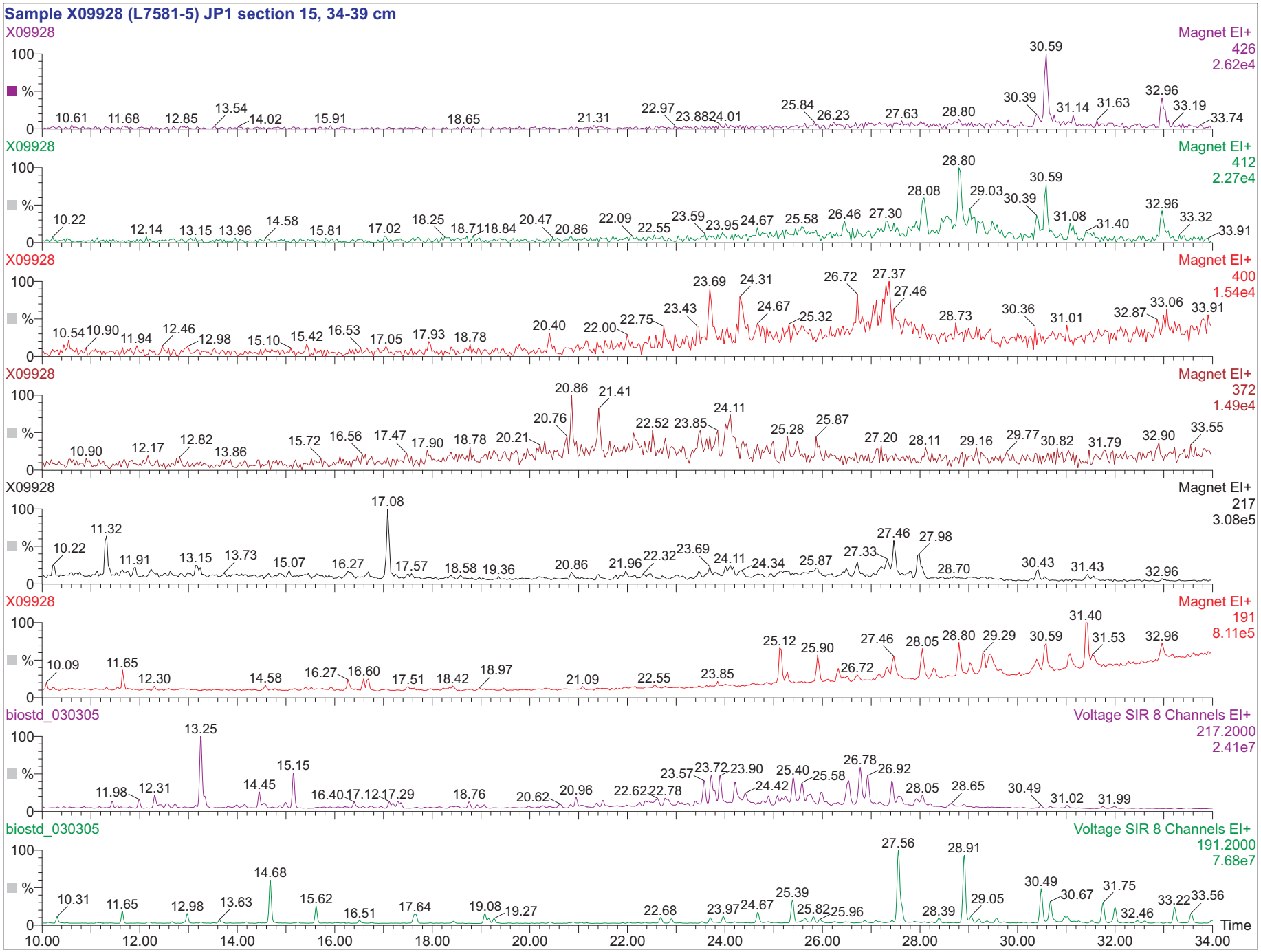

Sample X09931 (L7581-10) JP8 section 20, 40-45 cm
X09931
Magnet EI+
426
7.04e4
X09931
Magnet EI+
412
9.61e6
X09931
Magnet EI+
400
6.65e4
X09931
Magnet EI+
372
1.29e5
X09931
Magnet EI+
217
5.20e6
X09931
Magnet EI+
191
1.56e7
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

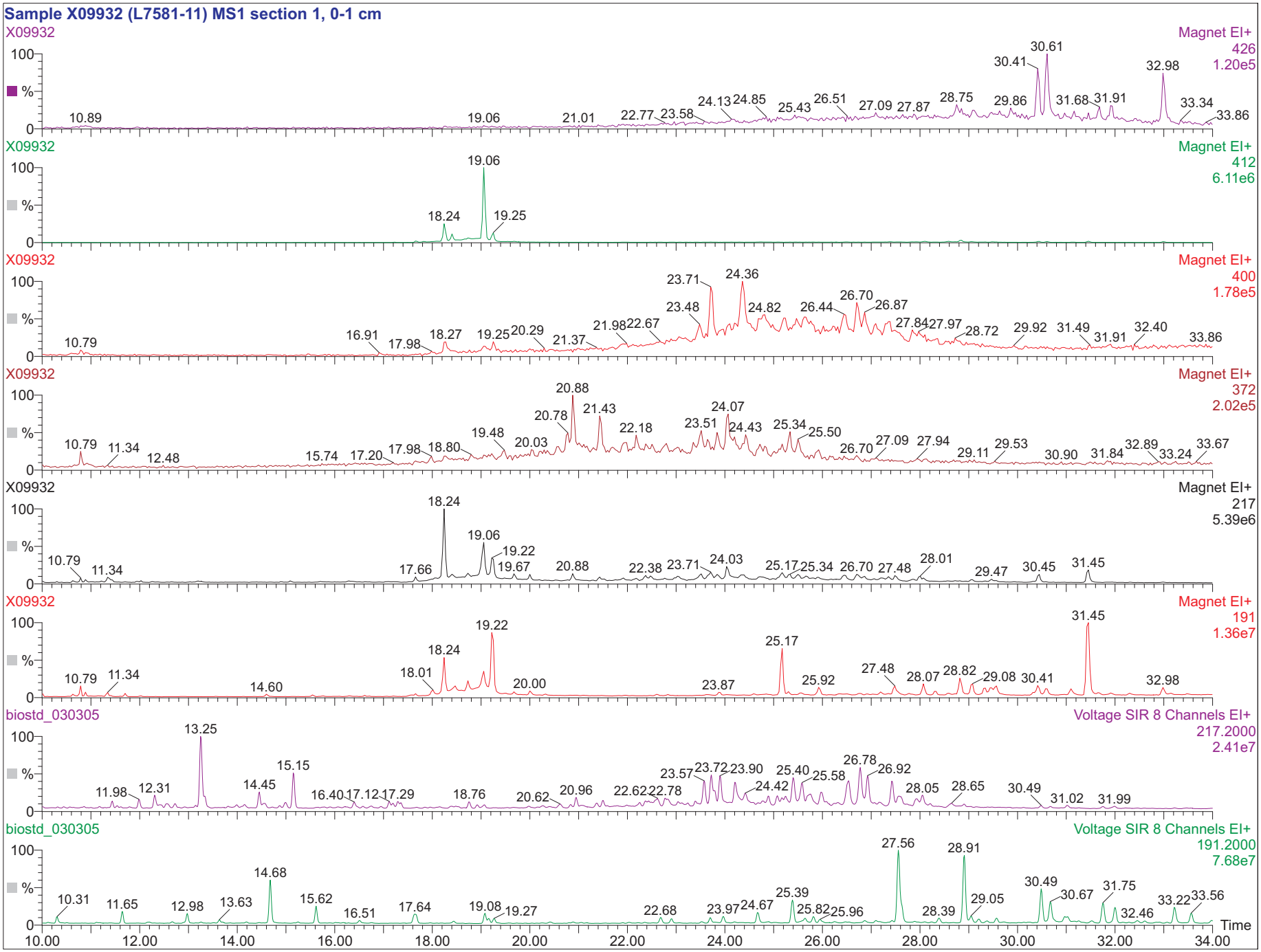

Sample X09924 (L7581-1) JP1 section 1, 0-2 cm
X09924
Magnet EI+
426
2.83e4
X09924
Magnet EI+
412
4.87e4
X09924
Magnet EI+
400
4.35e4
X09924
Magnet EI+
372
3.90e4
X09924
Magnet EI+
217
2.74e5
X09924
Magnet EI+
191
2.96e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

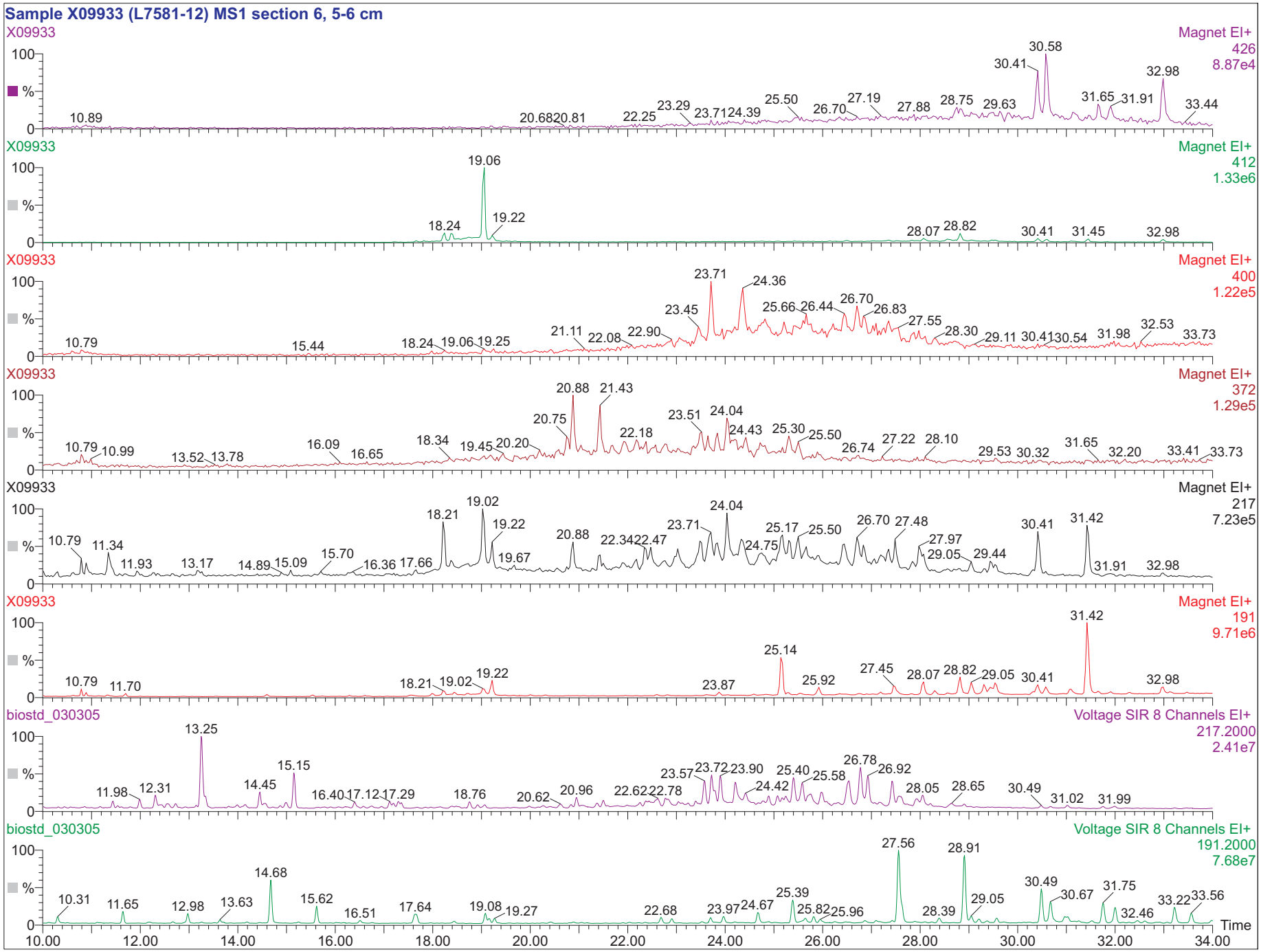

Sample X09925 (L7581-2) JP1 section 4, 6-8 cm
X09925
Magnet EI+
426
7.36e4
10.65 24.71 25.42 27.31 28.09 28.74 29.52 30.40 30.56 31.12 31.44 32.97 33.33
X09925
Magnet EI+
412
8.50e4
19.04 19.47 20.74 23.93 24.64 25.72 26.46 27.34 27.90 28.06 28.81 29.03 29.55 30.40 31.44 32.03 32.97
X09925
Magnet EI+
400
3.58e4
10.55 10.78 12.73 12.96 13.12 15.11 15.43 16.70 17.97 19.53 20.25 20.61 21.94 22.79 23.44 23.70 24.35 25.65 26.43 27.05 27.24 27.47 28.32 28.51 29.23 30.56 31.44 32.68 33.04 33.46
X09925
Magnet EI+
372
7.56e4
10.71 11.49 11.72 14.26 14.85 15.43 16.67 17.97 19.14 19.43 20.74 20.87 21.42 21.94 23.50 24.02 24.41 25.91 26.11 28.12 28.71 29.39 30.43 31.83 33.17 33.95
X09925
Magnet EI+
217
7.16e5
10.65 11.30 11.66 13.15 15.07 16.31 17.09 17.48 20.87 21.94 22.46 23.86 24.02 24.71 25.13 25.78 27.24 27.47 27.96 29.03 29.42 30.40 31.41 32.97
X09925
Magnet EI+
191
1.21e7
23.86 25.13 25.91 26.33 28.06 29.03 29.52 30.40 31.41 32.97
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
11.98 12.31 13.25 14.45 15.15 16.40 17.12 17.29 18.76 20.62 20.96 22.62 22.78 23.57 23.72 23.90 24.42 25.40 25.58 26.78 26.92 28.05 28.65 30.49 31.02 31.99
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
10.31 11.65 12.98 13.63 14.68 15.62 16.51 17.64 19.08 19.27 22.68 23.97 24.67 25.39 25.82 25.96 27.56 28.39 28.91 29.05 30.49 30.67 31.75 32.46 33.22 33.56
Time
10.00 12.00 14.00 16.00 18.00 20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00

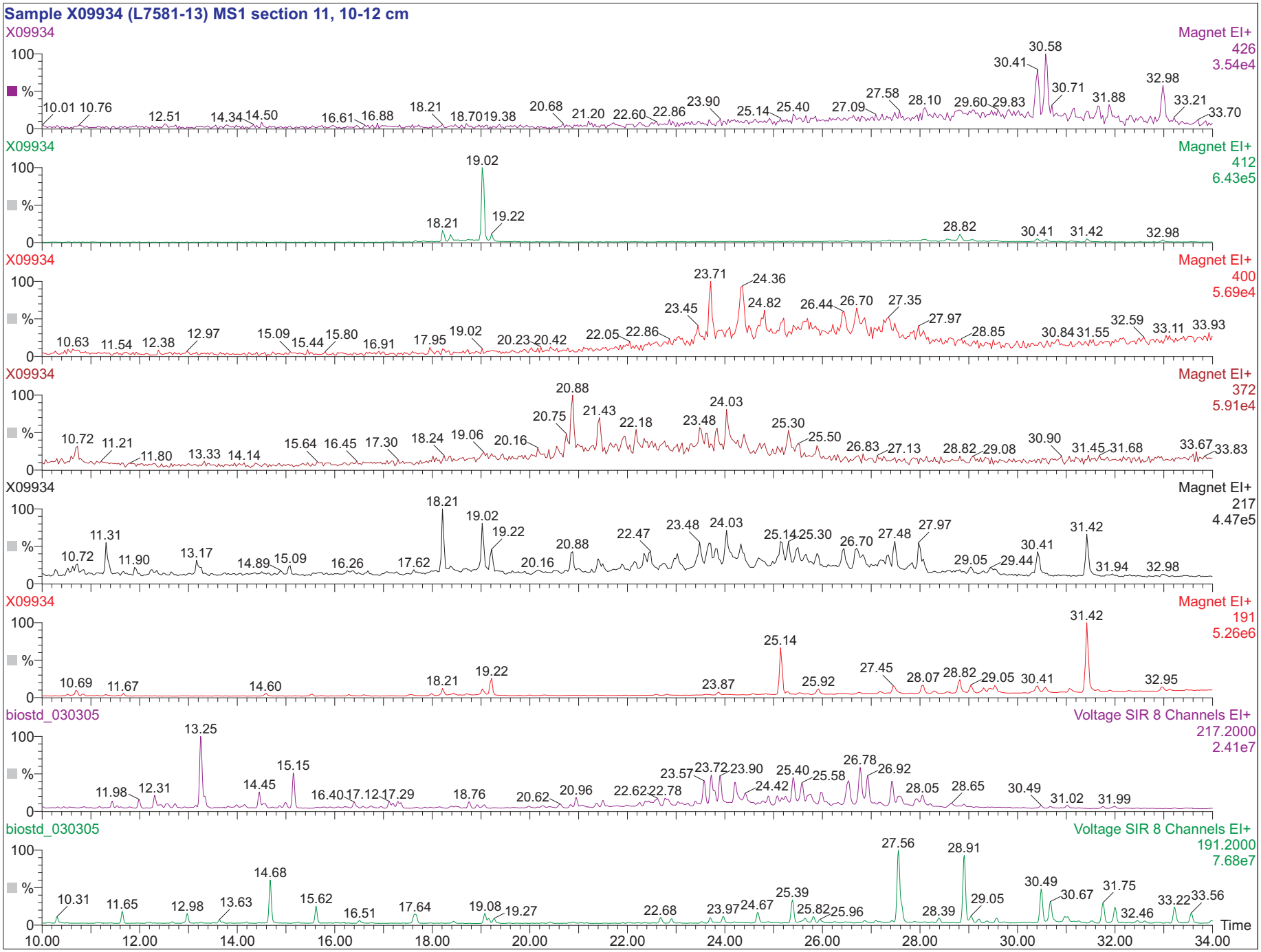

Sample X09926 (L7581-3) JP1 section 6, 10-12 cm
X09926
Magnet EI+
426
1.03e5
X09926
Magnet EI+
412
1.31e5
X09926
Magnet EI+
400
6.64e4
X09926
Magnet EI+
372
1.13e5
X09926
Magnet EI+
217
1.07e6
X09926
Magnet EI+
191
1.38e7
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

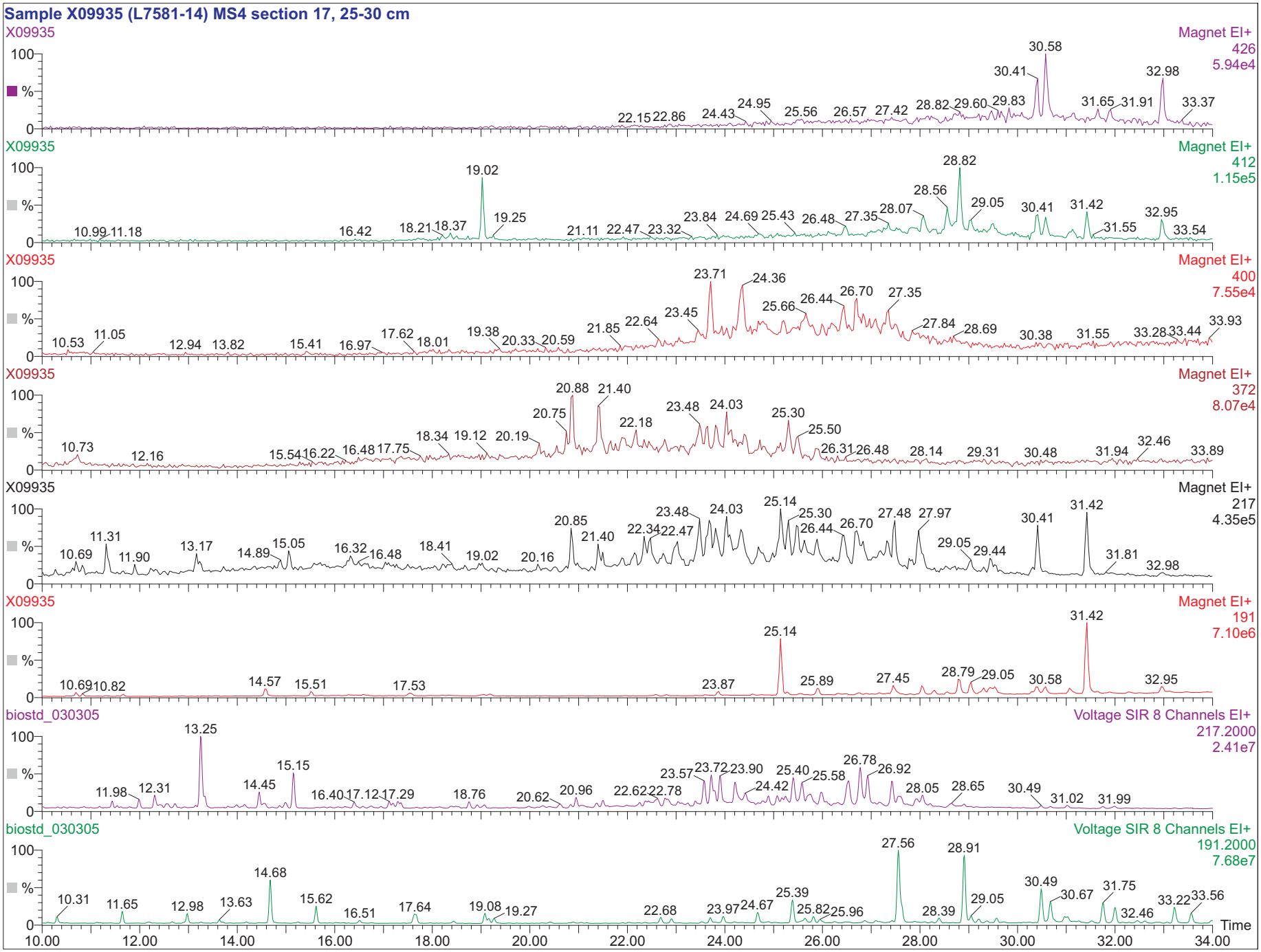

Sample X09927 (L7581-4) JP1 section 11, 20-22 cm
X09927
Magnet EI+
426
5.11e4
X09927
Magnet EI+
412
4.15e4
X09927
Magnet EI+
400
2.44e4
X09927
Magnet EI+
372
2.04e4
X09927
Magnet EI+
217
2.96e5
X09927
Magnet EI+
191
1.68e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

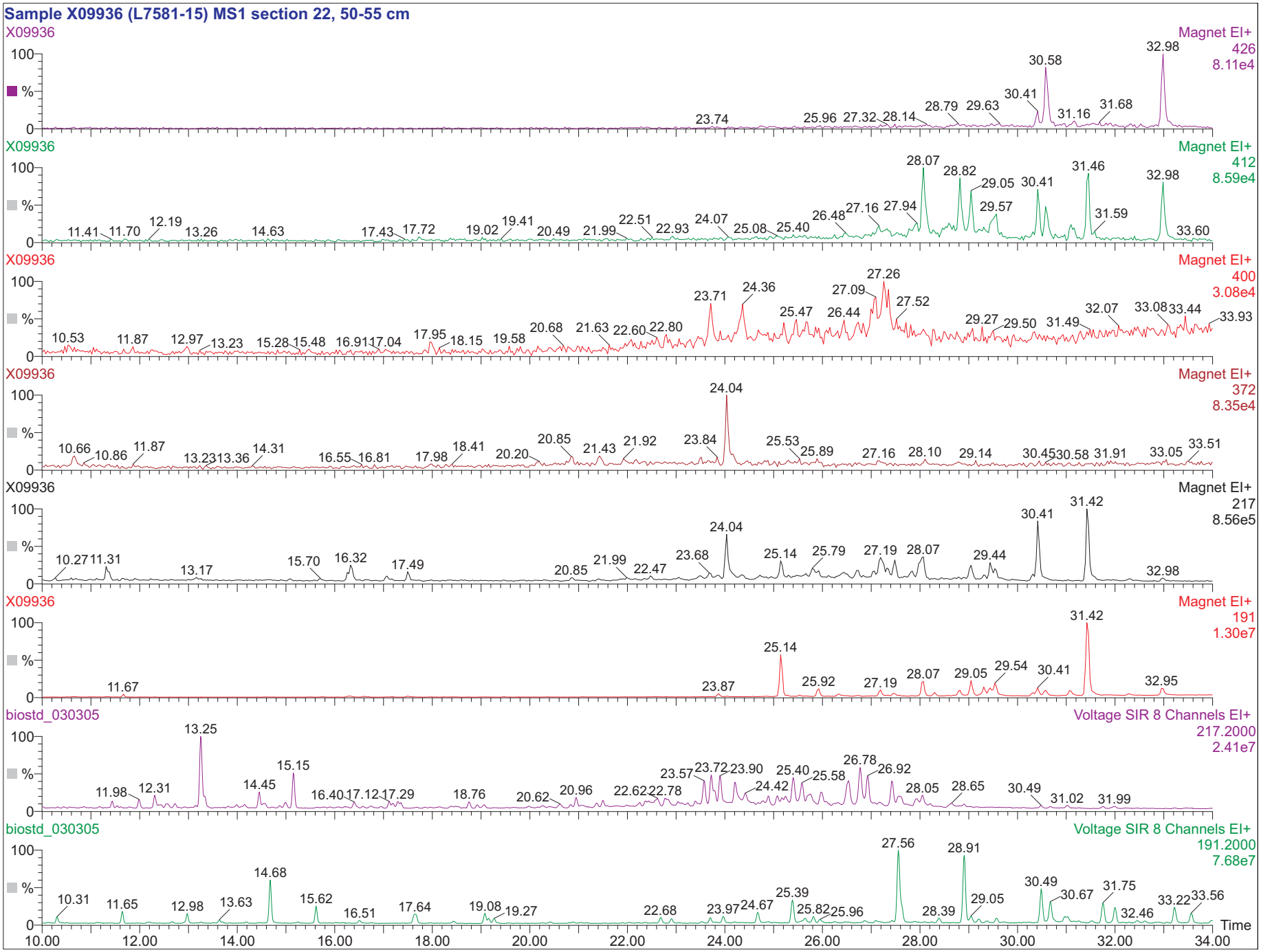

Sample X09928 (L7581-5) JP1 section 15, 34-39 cm
X09928
Magnet EI+
426
2.62e4
X09928
Magnet EI+
412
2.27e4
X09928
Magnet EI+
400
1.54e4
X09928
Magnet EI+
372
1.49e4
X09928
Magnet EI+
217
3.08e5
X09928
Magnet EI+
191
8.11e5
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time


Sample X09932 (L7581-11) MS1 section 1, 0-1 cm
X09932
Magnet EI+
426
1.20e5
X09932
Magnet EI+
412
6.11e6
X09932
Magnet EI+
400
1.78e5
X09932
Magnet EI+
372
2.02e5
X09932
Magnet EI+
217
5.39e6
X09932
Magnet EI+
191
1.36e7
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time


Sample X09933 (L7581-12) MS1 section 6, 5-6 cm
X09933
Magnet EI+
426
8.87e4
10.89 20.68 20.81 22.25 23.29 23.71 24.39 25.50 26.70 27.19 27.88 28.75 29.63 30.41 30.58 31.65 31.91 32.98 33.44
X09933
Magnet EI+
412
1.33e6
18.24 19.06 19.22 28.07 28.82 30.41 31.45 32.98
X09933
Magnet EI+
400
1.22e5
10.79 15.44 18.24 19.06 19.25 21.11 22.08 22.90 23.45 23.71 24.36 25.66 26.44 26.70 26.83 27.55 28.30 29.11 30.41 30.54 31.98 32.53 33.73
X09933
Magnet EI+
372
1.29e5
10.79 10.99 13.52 13.78 16.09 16.65 18.34 19.45 20.20 20.75 20.88 21.43 22.18 23.51 24.04 24.43 25.30 25.50 26.74 27.22 28.10 29.53 30.32 31.65 32.20 33.41 33.73
X09933
Magnet EI+
217
7.23e5
10.79 11.34 11.93 13.17 14.89 15.09 15.70 16.36 17.66 18.21 19.02 19.22 19.67 20.88 22.34 22.47 23.71 24.04 24.75 25.17 25.50 26.70 27.48 27.97 29.05 29.44 30.41 31.42 31.91 32.98
X09933
Magnet EI+
191
9.71e6
10.79 11.70 18.21 19.02 19.22 23.87 25.14 25.92 27.45 28.07 28.82 29.05 30.41 31.42 32.98
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
11.98 12.31 13.25 14.45 15.15 16.40 17.12 17.29 18.76 20.62 20.96 22.62 22.78 23.57 23.72 23.90 24.42 25.40 25.58 26.78 26.92 28.05 28.65 30.49 31.02 31.99
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
10.31 11.65 12.98 13.63 14.68 15.62 16.51 17.64 19.08 19.27 22.68 23.97 24.67 25.39 25.82 25.96 27.56 28.39 28.91 29.05 30.49 30.67 31.75 32.46 33.22 33.56
Time
10.00 12.00 14.00 16.00 18.00 20.00 22.00 24.00 26.00 28.00 30.00 32.00 34.00


Sample X09934 (L7581-13) MS1 section 11, 10-12 cm
X09934
Magnet EI+
426
3.54e4
X09934
Magnet EI+
412
6.43e5
X09934
Magnet EI+
400
5.69e4
X09934
Magnet EI+
372
5.91e4
X09934
Magnet EI+
217
4.47e5
X09934
Magnet EI+
191
5.26e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time


Sample X09935 (L7581-14) MS4 section 17, 25-30 cm
X09935
Magnet EI+
426
5.94e4
X09935
Magnet EI+
412
1.15e5
X09935
Magnet EI+
400
7.55e4
X09935
Magnet EI+
372
8.07e4
X09935
Magnet EI+
217
4.35e5
X09935
Magnet EI+
191
7.10e6
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time


Sample X09936 (L7581-15) MS1 section 22, 50-55 cm
X09936
Magnet EI+
426
8.11e4
X09936
Magnet EI+
412
8.59e4
X09936
Magnet EI+
400
3.08e4
X09936
Magnet EI+
372
8.35e4
X09936
Magnet EI+
217
8.56e5
X09936
Magnet EI+
191
1.30e7
biostd_030305
Voltage SIR 8 Channels EI+
217.2000
2.41e7
biostd_030305
Voltage SIR 8 Channels EI+
191.2000
7.68e7
Time

6.8 PEAK HEIGHTS AND SELECTED BIOMARKER PROPORTIONS FOR GC/MS/MS ANALYSES

The results for the available GC/MS/MS analyses of the alkane fraction for hopanes and steranes are given in this Appendix. Samples analyzed are JP8 18-20 cm, and MS1 5-6, 10-12, 25-30, 50-55 cm.

The first line in each group (in italics) gives the signal intensity (in thousand counts) for each MS-MS transition. This is followed by the height in cm for each peak measured (see Tables 1 and 2 for abbreviations). The signal intensity can be used to calculate peak ratios between different MS-MS transitions. Compound abbreviations are defined in Tables 1 and 2.

The transitions monitored are as follows:

Parent – daughter Transition	Compounds monitored
370-191	$C_{27}H_{46}$ hopanes
384-191	$C_{28}H_{48}$ hopanes
398-191	$C_{29}H_{50}$ hopanes
412-191	$C_{30}H_{52}$ hopanes
372-217	$C_{27}H_{48}$ diasteranes and steranes
386-217	$C_{28}H_{50}$ diasteranes and steranes
400-217	$C_{29}H_{52}$ diasteranes and steranes

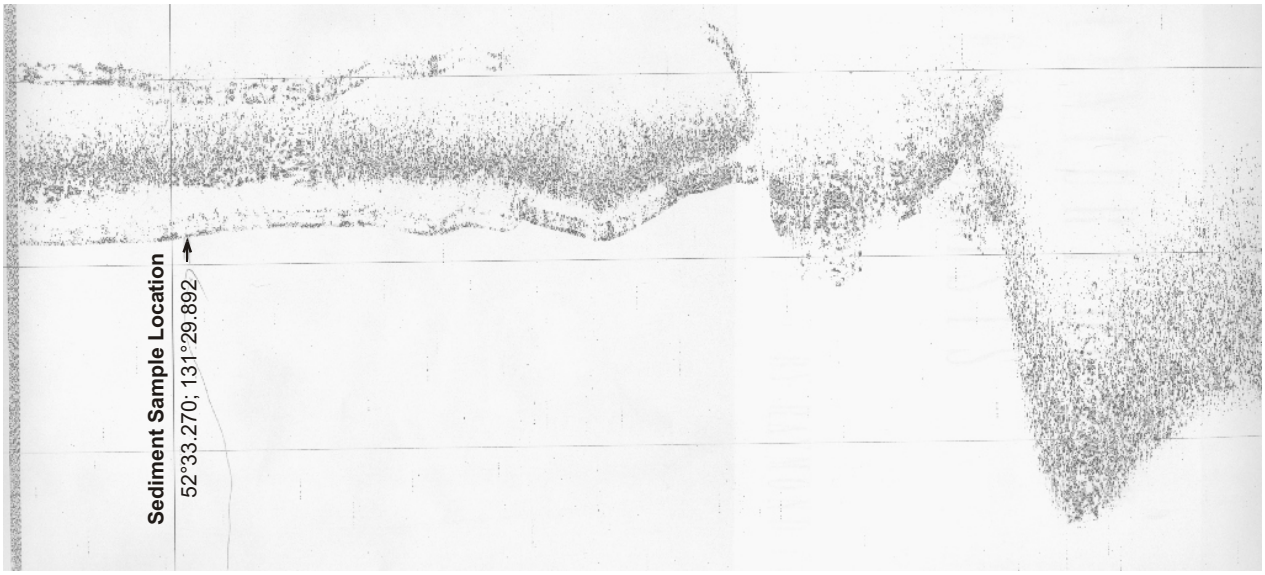
Location	Juan Perez Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd
Sample	JP8 #15	MS1 #6	MS1 #11	MS1 #17	MS1 #22
Latitude	52.5545º N	52.3817º N	52.3817º N	52.3817º N	52.3817º N
Longitude	131.1649º W	128.5502º W	128.5502º W	128.5502º W	128.5502º W
Depth, m	325 m	245 m	245 m	245 m	245 m
Collection Date	17-Sep-03	18-Sep-03	18-Sep-03	18-Sep-03	18-Sep-03
Section	18-20 cm	5-6 cm	10-12 cm	25-30 cm	50-55 cm
Axys ID (Alkanes)	L7581-9	L7581-12	L7581-13	L7581-14	L7581-15
Peak heights					
370-191 kCounts	*263.0*	*153.8*	*145.3*	*101.2*	*236.3*
Ts	3.3	5.8	7.0	8.0	1.2
27α (Tm)	4.6	6.2	5.6	10.1	2.5
27β	15.8	15.5	15.5	15.3	16.1
384-391 kCounts	*108.4*	*83.6*	*90.9*	*84.7*	*97.2*
28αβ	6.5	9.9	13.0	11.5	5.3
398-191 kCounts	*168.8*	*133.0*	*131.8*	*107.7*	*135.2*
29αβ	15.1	14.9	15.5	15.1	12.0
29βα	10.3	6.0	5.9	7.8	15.2
29ββ	10.7	5.7	5.9	6.1	14.6
412-191 kCounts	*257.0*	*186.8*	*158.8*	*135.1*	*160.5*
30O (18α(H)-oleanane)	2.4	3.3	4.2	4.0	3.0
30αβ	15.9	15.6	16.1	15.6	15.7
30βα	2.3	2.2	2.9	3.9	3.3
30ββ [1]	2.7	3.8	2.5	2.7	5.9
372-217 kCounts	*164.3*	*148.1*	*115.7*	*107.7*	*90.8*
27dβS	15.6	15.5	14.4	14.8	13.3
27dβR	9.3	9.5	12.3	9.8	8.1
27dαS	5.9	3.3	4.5	5.8	4.3
27dαR	4.8	4.0	7.3	6.5	5.4
27αααS	4.5	4.6	6.5	10.9	9.2
27αββR	4.8	4.9	6.2	7.0	4.4
27αββS	3.1	3.9	4.7	4.7	2.3
27αααR	4.2	2.4	4.9	6.2	8.2
386-217 kCounts	*118.8*	*116.7*	*113.2*	*106.3*	*83.2*
28dβS	13.5	14.4	14.0	14.6	-
28dβR	13.8	10.2	13.7	10.4	-
28dαS	6.0	8.8	4.5	6.3	-
28dαR	6.7	6.7	7.7	6.1	-
28αααS	7.9	5.3	8.5	5.2	-
28αββR	11.4	8.5	8.8	8.6	-
28αββS	6.7	3.6	4.7	7.1	-
28αααR	3.5	3.9	6.0	5.3	-

Location	Juan Perez Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd	Milbanke Snd
Sample	JP8 #15	MS1 #6	MS1 #11	MS1 #17	MS1 #22
Latitude	52.5545º N	52.3817º N	52.3817º N	52.3817º N	52.3817º N
Longitude	131.1649º W	128.5502º W	128.5502º W	128.5502º W	128.5502º W
Depth, m	325 m	245 m	245 m	245 m	245 m
Collection Date	17-Sep-03	18-Sep-03	18-Sep-03	18-Sep-03	18-Sep-03
Section	18-20 cm	5-6 cm	10-12 cm	25-30 cm	50-55 cm
Axys ID (Alkanes)	L7581-9	L7581-12	L7581-13	L7581-14	L7581-15
400-217 kCounts	*134.5*	*116.3*	*107.3*	*96.6*	*87.2*
29dβS	14.6	14.5	14.3	13.5	13.0
29dβR	8.9	10.6	12.1	8.8	10.6
29dαS	8.2	7.0	5.8	6.1	6.1
29dαR	4.7	5.2	4.2	3.7	3.9
29αααS	7.2	6.9	8.0	4.1	7.7
29αββR	8.4	5.9	7.4	8.7	7.7
29αββS	7.8	6.1	6.6	7.2	4.3
29αααR	3.2	6.5	5.8	5.5	8.9
Biomarker ratios					
Ts/(Ts + Tm)	0.42	0.48	0.56	0.44	0.33
27β/(27α +27β)	0.78	0.71	0.74	0.60	0.87
29ββ/(29αβ + 29ββ)	0.41	0.28	0.27	0.29	0.55
30ββ/(30αβ + 30ββ)	0.14	0.19	0.14	0.15	0.27
30O/(30O + 30αβ)	0.13	0.18	0.21	0.20	0.16
28αβ/(28αβ + 30αβ)	0.15	0.22	0.32	0.32	0.17
29αβ/(29αβ + 30αβ)	0.38	0.40	0.44	0.44	0.39
27ααα 20S/(20S + 20R)	0.52	0.65	0.57	0.64	0.53
27ββ/(27ββ + 27αα)	0.47	0.56	0.49	0.40	0.28
C27 diasterane/sterane	0.68	0.67	0.63	0.56	0.56
29ααα 20S/(20S + 20R)	0.69	0.52	0.58	0.42	0.47
29ββ/(29ββ + 29αα)	0.61	0.47	0.50	0.62	0.42
C29 diasterane/sterane	0.58	0.60	0.57	0.56	0.54

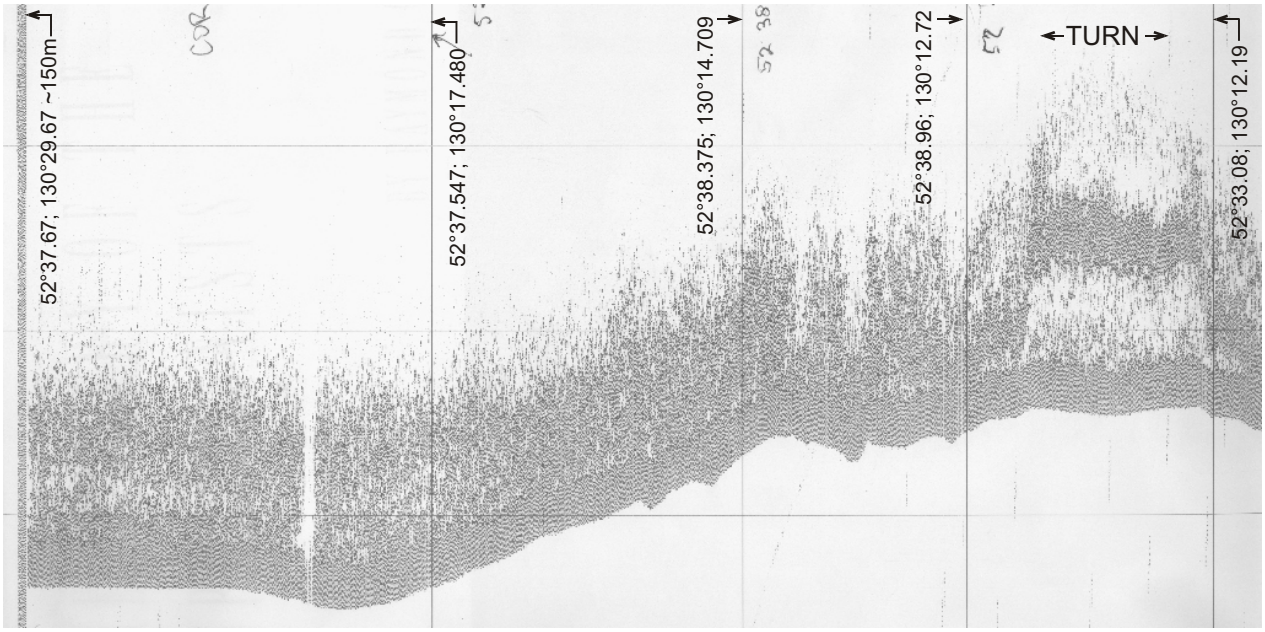
[1] The m/z 369 ion characteristic of hopanes is present for this peak in full scan GC/MS, hence 30G (gammacerane) is unlikely to be present (Philp, 1985).

6.9 SOUNDER SCANS: 3.5 KHz OUTPUT

JP-8



JP-1



MS-1