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THE EFFECTS OF OIL EXPLORATION AND PRODUCTION IN THE FLADEN GROUND: COMPOSITION AND CONCENTRATION OF HYDROCARBONS IN SEDIMENT SAMPLES COLLECTED DURING 2001 AND THEIR COMPARISON WITH SEDIMENT SAMPLES COLLECTED IN 1989

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SUMMARY

1. One hundred and fifty eight sediment samples (138 by Day Grab and 20 by Multi-corer) were collected from the Fladen Ground in 2001 as part of an assessment of the impact of oil exploration and production in this potentially accumulative area of the North Sea and to compare the hydrocarbon composition and concentrations with those determined in sediments collected during previous surveys in the area.

2. All sediments were screened for polycyclic aromatic hydrocarbons (PAHs) using ultraviolet fluorescence (UVF). Forties oil equivalent concentrations ranged from 5.5 to 61.3 µg g^{-1} dry weight (mean = 20.7 µg g^{-1} dry weight, SD = 11.4µg g^{-1} dry weight, median = 18.0 µg g^{-1} dry weight) while diesel oil equivalent concentrations ranged from 1.5 to 44.5 µg g^{-1} dry weight (mean = 6.3 µg g^{-1} dry weight, SD = 5.2 µg g^{-1} dry weight, median = 5.1 µg g^{-1} dry weight).

3. PAH (2- to 6-ring, parent and alkylated) concentrations ranged from 29.1 to 641.2 ng g^{-1} dry weight (mean = 156.7 ng g^{-1} dry weight, SD = 108.8 ng g^{-1} dry weight, median = 129.6 ng g^{-1} dry weight). The PAH profiles were dominated by the heavier and more persistent 5- and 6-ring compounds. The PAH profiles and concentration ratios indicated a mainly pyrolytic input.

4. *n*-Alkane (nC_{12} – nC_{33}) concentrations ranged from 31.0 to 2638 ng g^{-1} dry weight (mean = 283.1 ng g^{-1} dry weight, SD = 295.4 ng g^{-1} dry weight, median = 201.3 ng g^{-1} dry weight). The *n*-alkane profiles indicated a predominately biogenic input, showing an odd carbon number, long chain predominance.

5. UVF oil equivalent concentrations and total PAHs are variable, with little difference between near (<5 km) and far (>5 km) field sites. However, there are areas (both near and far field) with values more than twice the median value or greater for diesel and Forties oil equivalent values and total PAHs.

6. In comparison with the 1989 survey there is a significant decrease in the total PAH (ng g^{-1} dry weight) (average 73%) and oil equivalent concentrations (average decrease for Forties oil equivalents 62% and for diesel oil equivalents 89%) over the whole of the Fladen Ground.

INTRODUCTION

The Fladen Ground has been the focus of offshore oil and gas production over the past 20 years. As a result of this activity, hydrocarbons have been historically discharged to the area during drilling, during production *via* produced water discharge, and *via* flaring operations[1,2]. Of these three, discharges of oil on cuttings during drilling (actually of the oil component of oil based drilling muds adhering to the cleaned cuttings prior to their discharge) were by far the most important, although more recently the importance of oil discharged in produced water has become more relevant. By 1985, levels of oil discharged on cuttings in the oil and gas producing areas of the North Sea had risen to *ca* 25,000 tonnes oil per annum but these discharges have now been effectively banned. Harmonised oil in produced water levels have been successively tightened but approximately 5,500 tonnes of oil per annum currently reaches the North Sea by this route. Since the amounts of produced water increase as fields mature, present regulatory attention in OSPAR (Oslo and Paris Commission) is being directed towards even tighter controls – a 15% reduction on the overall tonnes of oil discharged in 2000 *via* this route is sought by 2006. One source of pyrolytic PAHs in the North Sea, or indeed in any oil and gas exploration/production area, is the flaring of unwanted gases, with incomplete combustion at the flarestacks producing high temperature pyrolytic PAHs. Although atmospheric discharges of hydrocarbons, *e.g. via* fall out from inefficient flaring, are more difficult to assess, they are thought to be a relatively small proportion of combined oil and gas inputs and an especially small proportion of overall atmospheric inputs from all UK sources.

The Fladen Ground is characterised by fine grained sediments and sediment organic carbon levels of between 0.5 and 1%[3,4]. This results in generally increased levels of benthic productivity[3,4] that serves as the base of a food chain culminating in abundant fish and shellfish stocks. As a consequence, the Fladen Ground is one of the most intensively fished areas of the North Sea. Many of the components of oil are hydrophobic in nature and as a result they tend to associate with particulate material. Finer sediments (those with a high [greater than 65%[5]] proportion of particles < 63 µm) tend to accumulate relatively higher loads of hydrophobic contaminants because of their greater surface area per unit of volume. Sediments with higher organic carbon contents also have the potential to accumulate significant concentrations of hydrocarbons. Fine muddy sediments, such as those found in the Fladen Ground, therefore accumulate hydrocarbons to a greater extent than coarser sandy sediments[4,5]. In addition, the Fladen Ground is in the centre of a gyre (Fig. 1) and therefore hydrocarbons have a greater potential to accumulate in the area.

Due to the potential accumulative nature of the Fladen Ground and the oil production activity in the area, a survey of the Fladen Ground was carried out in 1989 to map the distribution of hydrocarbon contamination in relation to the offshore oil and gas exploration and production activities[1]. Sediments were collected from the FRV *Scotia* III, by Day Grab, at 3 km intervals along five transects spaced 5 km apart. One hundred and twenty-three sediments were collected and all were initially screened for the presence of PAHs by ultraviolet fluorescence (UVF). Twenty-five samples were also analysed for *n*-alkanes and PAHs. The *n*-alkane profiles indicated a predominately biogenic input, showing an odd carbon, long chain predominance. The PAH profiles were dominated by the heavier and more persistent 5- and 6-ring compounds and the PAH profiles and concentration ratios indicated a mainly pyrolytic input. UVF oil equivalent concentrations increased close to oil platforms, with mean concentrations ~ 1 km from an oil platform approximately double those ~ 10 km from an oil platform. There was no evidence that *n*-alkane and PAH concentrations increased close to oil platforms, however only four samples taken within 5 km of an oil platform were analysed for *n*-alkanes and PAHs. In 2000, during passage through the North Sea after a DTI sponsored 'White Zone' cruise, some of these 1989 stations were re-visited along with stations to the north and south[2]. Forty-seven sites were visited, twenty-seven of which had

also been visited in 1989. Seventy-three samples were collected in total and all samples were screened by UVF and analysed for *n*-alkanes and geochemical biomarkers. In addition the fifteen Day Grab and fifteen Mega Core samples with the highest UVF oil equivalents were analysed for PAHs. Sources of PAHs in the Fladen Ground were investigated using *n*-alkane profiles, PAH concentration ratios and geochemical biomarker profiles. Thirty-six sediments showed evidence of petrogenic contamination based on GC-FID chromatograms with unresolved complex mixtures (UCMs). On the basis of their geochemical biomarker profiles, most sediments showed evidence of crude oil contamination, due to both Middle Eastern and North Sea oils. Hydrocarbon concentrations in far field sediments (> 5km from an oil platform) were compared with those in far field sediments collected from the Fladen Ground in 1989. UVF diesel oil equivalent concentrations and total PAH concentrations were lower in 2000 than in 1989 by an estimated 79% and 47% respectively, but there was no evidence of any difference in total *n*-alkane concentrations.

Only a very limited assessment of temporal trends in hydrocarbon concentrations and composition between 1989 and 2000 could be made as the spatial coverage of the 1989 and 2000 surveys was quite different and very few of the locations sampled in 1989 were also sampled in 2000. For a more robust temporal assessment of the Fladen Ground area all the sites sampled in 1989 would have to be revisited and the results compared. With this aim in mind, sediment samples were collected in September 2001, from the 1989 locations, for hydrocarbon analysis and the results are reported here. In addition, replicate Grab samples and core samples (0-2 cm, 2-4 cm, 4-6 cm and 6-8 cm) were taken at five sites. This report assesses the differences in Forties and diesel oil equivalents, *n*-alkane and PAH concentration and composition, grain size and % TOC between the 1989 and 2001 surveys.

EXPERIMENTAL

Materials

Dichloromethane (DCM), *iso*-hexane, methanol, water and acetone were purchased from Rathburn Chemicals Ltd., Walkerburn, Scotland. Anhydrous sodium sulphate ($Na_2 SO_4$) was of analytical grade from Fisher Chemicals, Loughborough, UK.

Sample Collection

One hundred and fifty eight sediment samples were collected by Day Grab (138) or Multi-corer (20) from the FRV *Scotia* IV at the 119 locations shown in Figure 2a. The sampling locations replicated those visited in 1989; sediments were collected at 3 km intervals along five transects spaced 5 km apart. The top 2 cm layer of sediment was transferred from the Day Grab sample to a metal beaker and the sediment mixed before transferring (~200 g) to a solvent washed aluminium can which was labelled and stored at -20 ± 5^{o}C until required for analysis. Samples collected by Multi-corer were cut into sections at 0-2 cm, 2-4 cm, 4-6 cm and 6–8 cm before transferring to individual solvent washed cans. Cores were collected at five sampling sites (common site numbers 46, 37, 66, 88 and 111). In addition, five replicate Day Grab samples were also collected at these locations. Multi-core samples and replicate Day Grabs are discussed separately. All sediments collected were analysed for UVF oil equivalent concentrations, PAHs and *n*-alkanes while selected samples were analysed for steranes and triterpanes. Full details of the sampling locations are given in Appendix 1.

Preparation of Glassware and Sodium Sulphate

All glassware was washed and dried in a GW 4000 glassware washer (Camlab Ltd., Cambridge, UK). Prior to use, all glassware was rinsed twice with DCM and then twice with *iso*-hexane, the latter being allowed to evaporate before proceeding.

Anhydrous sodium sulphate, used for drying the organic extracts, was washed ultrasonically with DCM (2 x 500 ml) followed by *iso*-hexane (2 x 500 ml) and dried overnight at 150 ^{o}C.

Determination of Particle Size and Total Organic Carbon

The particle size (PS) of the sediment samples was determined, after freeze drying, by laser granulometry employing a Malvern Mastersizer E Particle Size Analyser[1]. The total organic carbon was determined on freeze-dried, ground sediment, following acid treatment to remove carbonate. Total organic carbon (TOC) was determined using a Perkin Elmer CHN elemental analyser[6,7].

Extraction of Sediments for Fluorescence and Hydrocarbon Analysis[1,2,6,7]

Each sediment sample was thoroughly mixed and an aliquot (approximately 10 g) removed for determination of water content by oven drying at 80 ± 5^{o}C overnight. To a second aliquot (~20 g) was added the aliphatic hydrocarbon internal standards (heptamethylnonane and squalane) and the six deuterated aromatic hydrocarbon standards (d_8-naphthalene, d_{10}-biphenyl, d_8-dibenzothiophene, d_{10}-anthracene, d_{10}-pyrene and d_{12}-benzo[*a*]pyrene). The hydrocarbons were extracted twice using dichloromethane/methanol with sonication and the halogenated solvent isolated and dried over Na_2SO_4. The DCM fraction was made to a known volume and an aliquot (10 ml) removed for UVF analysis. The remaining extract was solvent exchanged to *iso*-hexane and the extract reduced in volume by rotary evaporation prior to concentration to a small volume (~500 µl) under a nitrogen stream. The aliphatic and aromatic hydrocarbons were separated by isocratic high performance liquid chromatography (HPLC). An aliquot (150 µl) of the *iso*-hexane solution was injected on to a previously calibrated Genesis SIL 4 µm HPLC column (25 x 4.6 cm id; Jones Chromatography, Mid Glamorgan, UK) and eluted with *iso*-hexane at a flow rate of 2 ml min^{-1}. The two fractions collected were concentrated (~ 50 µl) prior to chromatographic analysis. The extracts were analysed by gas chromatography with flame ionisation detection (GC-FID) for aliphatic hydrocarbon analysis and gas chromatography – mass spectroscopy (GC-MS) for PAHs and biomarkers.

Fluorescence Determinations[1,2]

Calibration standards were prepared for reference diesel fuel oil and reference Forties crude oil, these were analysed with each batch of samples. A stock solution of each oil was prepared (~ 100 µg ml^{-1}). From this, aliquots were removed and dilutions prepared covering the concentration range 0.02 µg ml^{-1} to 5 µg ml^{-1}. The samples were introduced, *via* a cuvette, into a Perkin Elmer LS 5 spectrophotometer (Perkin Elmer, Beaconsfield, UK).

The optimum excitation and emission wavelengths were determined for both Forties crude oil and diesel fuel. Diesel calibration standards were read with the spectrometer set with an excitation of 270 nm and an emission of 330 nm, while Forties calibration standards were read with an excitation of 310 nm and an emission of 360 nm. Samples were read against the wavelength settings for both diesel fuel oil and Forties crude oil. The instrument was set with a fixed scale of one and a slit width of 5 nm. Fluorescence analyses at high concentrations are susceptible to self-quenching. Self-quenching results from the collisions of excited molecules and it increases with concentration due to the increased probability of

collisions. To account for any self-quenching, samples were measured at each wavelength and then diluted (50%) in dichloromethane and re-read. This step was repeated until readings were approximately half that of the previous reading.

Determination of Aliphatic Hydrocarbons (*n*-alkanes)[6,7]

The *n*-alkane distribution was determined by GC-FID using an HP 5890 Series II gas chromatograph (Agilent Ltd., Stockport, England) equipped with an HP 7673 automated, cool on-column injector and fitted with a non-polar, Ultra 1 column (25 m x 0.2 mm id, film thickness 0.33 µm; Agilent Ltd., Stockport, England). The carrier gas was nitrogen (16 psi). Injections were made at 60^{o}C and the oven temperature held constant for 3 minutes. Thereafter the temperature was raised at 4^{o}C min^{-1} up to 280^{o}C and held at this temperature until the end of the run. The detector was maintained at 300^{o}C throughout. Data were collected using a PE Nelson 600 series link box and processed using Turbochrom Navigator software (Perkin-Elmer Ltd, Beaconsfield, England).

Determination of Biomarkers (Steranes and Triterpanes)[6,7]

The sterane and triterpane compositions were determined by GC-MSD using an HP6890 Series gas chromatograph interfaced with an HP5973 MSD and fitted with a cool on-column injector. A Zebron column with a 5% phenyl polysiloxane film was used for the analyses (ZB5, 30 m x 0.25 mm id, 0.25 µm film thickness: Phenomenex, Cheshire, UK). Injections were made at 60^{o}C and the oven temperature held constant for 0.5 min after which it was increased at 40^{o}C min^{-1} up to 150^{o}C. This was followed by a slower ramp of 5^{o}C min^{-1} up to a final temperature of 300^{o}C and held at this temperature for 22 min. The carrier gas was helium set at a constant flow of 0.7 ml min^{-1}. Biomarker analysis was carried out using the selected ion-monitoring mode (SIM). Triterpanes were monitored using *m/z* 177 and 191 and steranes monitored using *m/z* 217 and 218 with a dwell time of 80 msec and a delay of 10 msec.

Determination of Polycyclic Aromatic H(PAHs) by GC-MSD[6,7]

The concentration and composition of the PAHs were determined by GC-MSD using an HP6890 Series gas chromatograph interfaced with an HP5973 MSD and fitted with a cool on-column injector. A Zebron column with a 5% phenyl polysiloxane film was used for the analyses (ZB5, 30 m x 0.25 mm id, 0.25 µm film thickness: Phenomenex, Cheshire, UK). The carrier gas was helium set at a constant flow of 0.7 ml min^{-1}. Injections were made at 50^{o}C and the oven temperature held constant for 3 minutes. Thereafter the temperature was raised at 20^{o}C min^{-1} up to 100^{o}C. This was followed by a ramp of 4^{o}C min^{-1} up to a final temperature of 270^{o}C. The MSD was set for selective ion monitoring (SIM) with a dwell time of 50 ms. A total of 26 ions plus the six internal standard ions were measured over the period of the analysis and are discussed in this report, with an additional 4 ions measured but not discussed here. Thus the analysis incorporated 2- to 6-ring, parent and alkylated PAHs. The limit of detection was found to be less than 0.1 ng g^{-1} for benzo[*b*]fluoranthene and less than 0.2 ng g^{-1} for benzo[*a*]pyrene. Recoveries of greater than 70% were achieved for sediments spiked to give a concentration of 1 ng g^{-1} dry weight individual PAHs. Good reproducibility was achieved for individual PAHs.

Quality Control Procedures

The PAH, total organic carbon and particle size analytical methods are accredited by the United Kingdom Accreditation Services (UKAS). Internal quality control procedures include the use of a laboratory reference material (LRM) or a certified reference material (CRM) in each batch of samples. Procedural blanks were also analysed with each batch of samples,

and the final concentrations adjusted accordingly. The data obtained from the LRM and CRMs was transferred onto NWA Quality Analyst and Shewhart charts produced with warning and action limits drawn at ± 2 x and ± 3 x the standard deviation of the mean. Further quality control was assured through successful participation in the QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring in Europe) Laboratory Performance Studies.

A standard check was run every six samples of *n*-alkanes, the performance of which was monitored by a Shewhart chart.

RESULTS AND DISCUSSION

Data Summary

The raw data are summarised in Table 1 and tabulated in Appendices 2-6 (2001 Forties and diesel oil equivalent values, 2001 *n*-alkanes, 2001 PAH, 2001 particle size analysis and TOC, 1989 *vs* 2001 Forties and diesel oil equivalent values). The 2001 sample sites are shown in Figure 2a, with near field (<5 km from an oil platform) and far field (>5 km from an oil platform) sites indicated by red (dark) and blue (light) circles respectively. Forty eight sites are classed as near field and seventy one as far field. Figure 2b shows the same sample sites with the locations of oil platforms in operation by 1989 and still in operation in 2001 plus those platforms which have come into operation since 1989. Sample are identified by their common site numbers, shown in Figure 2a and used in the appendices. The 1989 sample sites were in virtually identical positions but the spread of near field sites (not shown for 1989) was less due to the lower number of platforms in operation at that time. Figure 2c shows the distribution of sub-sea wells in the Fladen Ground survey area.

To enable the comparison of data between samples collected in 1989 with those collected in 2001 total and parent PAH concentrations refer to the 36 2- to 6-ring parent and alkylated PAHs (Appendix 4) but do not include acenaphthene, acenaphthylene, fluorene and dibenz[*a,h*]anthracene, which were not analysed in 1989. Only the Day Grab samples from 2001 will be used in the comparison, along with replicate Day Grab sample A (first Day Grab sample at each of the replicate sites), on the basis that the first sample at the replicate sites is analogous to the single Day Grab sample taken at the other sites. The replicate Day Grab samples and the core samples will be discussed separately. One of the replicate sediments (from site 66) and the sediment from sites 67 and 72 were lost. Results from sites 100 and 112 are not included in the text, except where specifically mentioned, due to unusually high concentrations of the biogenic PAH perylene (site 100 = 746.1 ng g^{-1} dry weight, site 112 = 145.0 ng g^{-1} dry weight, median value of all other samples 1.3 ng g^{-1} dry weight). Perylene is widespread in sediments, with its major source from natural processes (biogenic or diagenetic), however perylene does not normally account for such a high proportion of the total PAH (normally less than 1%)[8].

Bulk Characteristics

The results of the particle size analysis (% sediment < 63 µm) for the 2001 Day Grab sediment samples is reported in Appendix 5 and summarised in Table 1. The percentage of the < 63 µm fraction ranged from 34.0 to 91.5% (mean = 75.4%, SD = 12.6%, median = 79.6%). The sediments were classified as predominantly coarse silts, sandy medium-coarse silts and fine sands. The total organic carbon (TOC) content (Appendix 5, Table 1) ranged from 0.25 to 1.6% (mean = 0.86%, SD = 0.29%, median = 0.84%). There was no clear correlation ($p>0.05$; ANOVA) between grain size and TOC (Fig. 3a) or between TOC and total PAH (Fig. 3b).

Fluorescence Analysis (UVF Oil Equivalent Concentrations)

Ultraviolet fluorescence (UVF) determination is a rapid, low cost method for screening large numbers of samples. Estimates of 'total hydrocarbon' concentrations are expressed as 'oil' equivalents of crude (Forties) or diesel oil and can be used to select samples for more detailed analysis by GC-MSD. An average value of around 50 µg g^{-1} dry weight (Forties crude oil equivalent) is typical for muddy sediments, such as those predominating in the Fladen Ground[9]. In addition, values around 50 µg g^{-1} dry weight (Forties crude oil equivalent) are normally found in areas remote from oil and gas activity, with concentrations in offshore sediments above this background value generally associated with offshore oil exploration and production activity[1,2].

All 1989 sediments (Table 2, Appendix 6), as well as the 2001 sediments (Table 1), were screened for total hydrocarbons using this method. The total hydrocarbons for the 2001 Day Grab sediments, measured as Forties crude oil equivalents and diesel oil equivalents are reported in Appendix 2. The Forties crude oil equivalents ranged from 5.5 µg g^{-1} dry weight to 61.3 µg g^{-1} dry weight (mean = 20.7 µg g^{-1} dry weight, SD = 11.4 µg g^{-1} dry weight, median = 15.2 µg g^{-1} dry weight; Table 1, Fig. 4a), while those for diesel oil equivalents ranged from 1.5 µg g^{-1} dry weight to 44.5 µg g^{-1} dry weight (mean = 6.3 µg g^{-1} dry weight, SD = 5.2 µg g^{-1} dry weight, median = 5.1 µg g^{-1} dry weight; Table 1, Fig. 4b). There are clusters of sites where the values are approximately twice the median value or greater for both Forties and diesel oil equivalents and these are outlined on Figure 4a and b (areas A-D). These areas are of both near and far field sites. For the Forties oil equivalents areas A, B and C are predominantly of far field sites, and D predominantly of near field sites. For the diesel oil equivalents areas A and B are predominantly of far field sites, whilst C and D are predominantly of near field sites. Sediment grain size distribution and % total organic carbon (TOC) content for the sites in these areas are similar to the sites outwith the areas. For the 1989 sediments UVF Forties crude oil equivalents ranged from 18.9 µg g^{-1} dry weight to 148.9 µg g^{-1} dry weight (mean = 53.5 µg g^{-1} dry weight, SD = 19.4 µg g^{-1} dry weight, median = 52.2 µg g^{-1} dry weight) and diesel equivalents ranged from 6.2 µg g^{-1} dry weight to 154.0 µg g^{-1} dry weight (mean = 52.1 µg g^{-1} dry weight, SD = 20.3 µg g^{-1} dry weight, median = 49.7 µg g^{-1} dry weight; Table 2, Appendix 6). The concentrations of Forties and diesel oil equivalents for each site for the 1989 and 2001 surveys are shown superimposed in Figure 5a (Forties) and 5b (diesel). The Forties oil equivalents have generally decreased from 1989 to 2001 with lower values being found at 116 out of 119 sites. However, 3 sites (38, 68 and 101) showed increases of 18.1%, 0.5% and 25.9% respectively. Sites 68 and 101 are close to the positions of oil platforms which have come into operation since 1989, but site 38 is a far field site (>5 km from an oil platform). Of these three sites only site 68 was analysed for PAHs in both 1989 and 2001, and it showed a decrease of 33.5% in total PAH by 2001, though it had above the median concentration of total PAHs for 2001 (site 68 = 230.8 ng g^{-1} dry weight, 2001 median concentration = 129.6 ng g^{-1} dry weight). Excluding sites 38, 68 and 101 (i.e. the sites showing an increase) the Forties oil equivalents decreased by between 12.6% and 91.6% (mean = 65.5%, SD = 17.9%, median = 70.9%). Diesel oil

equivalents decreased at all sites, with a decrease of between 15.4% and 96.4% (mean = 87.1%, SD = 12.4%, median = 90.0%).

Table 3 summarises the averages of the near (<5 km from an oil platform) and far (>5 km from an oil platform) field data for the 1989 and 2001 sediments. There is little difference between the Forties and diesel oil equivalent values for the near and far field sites in 2001. Diesel oil equivalents for near field sites ranged from 1.5 to 14.4 µg g^{-1} dry weight (mean = 6.0 µg g^{-1} dry weight, SD = 2.9 µg g^{-1} dry weight, median = 5.4 µg g^{-1} dry weight) and for the far field sites ranged from 1.6 to 44.5 µg g^{-1} dry weight (mean = 6.5 µg g^{-1} dry weight, SD = 6.3 µg g^{-1} dry weight, median = 4.9 µg g^{-1} dry weight; Fig. 6a). Forties oil equivalent values for the near field sites ranged from 5.5 to 61.3 µg g^{-1} dry weight (mean = 22.7 µg g^{-1} dry weight, SD = 12.1 µg g^{-1} dry weight, median = 21.5 µg g^{-1} dry weight) and for the far field sites ranged from 5.6 to 60.6 µg g^{-1} dry weight (mean = 19.3 µg g^{-1} dry weight, SD = 10.7 µg g^{-1} dry weight, median = 16.2 µg g^{-1} dry weight; Fig. 6b).There was found to be no significant difference between Forties and diesel oil equivalents for the near and far field sites ($p > 0.05$ t-test). This would suggest that we are approaching a 'steady state' for the Forties and diesel oil equivalents for the Fladen Ground. For both Forties and diesel oil equivalents, median values for the 2001 near field sites (18.3 µg g^{-1} and 5.4 µg g^{-1} dry weight respectively) are lower than the 1989 far field sites (50.9 µg g^{-1} and 48.7 µg g^{-1} dry weight respectively), indicating that the level of contamination has decreased. The boxplots for the 1989 *vs* 2001 Forties and diesel oil equivalents, where there is no overlap between the boxes, illustrates this (Figs 7a and b). In addition, oil equivalent concentrations were found to be significantly lower in 2001 compared to 1989 ($p > 0.05$, paired t-test).

Polycyclic Aromatic hydrocarbons (PAHs)

One consequence of offshore oil production is the input of polycyclic aromatic hydrocarbons (PAHs) to the marine environment. PAHs of offshore industry origin have to be seen in the wider context, e.g. with pyrolytic PAHs, which originate from overall atmospheric deposition, and PAHs that are of biogenic origin. The concern about PAHs in the marine environment relates to their toxicity, particularly of the 4- to 6-ring compounds, some of which are also carcinogenic and mutagenic (e.g. benzo[*a*]pyrene, dibenz[*a,h*]anthracene)[10,11]. Because of this, PAHs are on the OSPAR List of Chemicals for Priority Action.

Total PAH concentrations (2- to 6-ring parent and alkylated) (see Table 1 for definition of total PAH) in the 2001 Day Grab sediments ranged from 29.1 ng g^{-1} dry weight (site 3, far field) to 641.2 ng g^{-1} dry weight (site 45, far field) (mean = 156.7 ng g^{-1} dry weight, SD = 108.8 ng g^{-1} dry weight, median = 129.6 ng g^{-1} dry weight, n = 119; Table 1, Fig. 8a, Appendix 4). Only two sites (44 and 45) had concentrations greater than 500 ng g^{-1} dry weight (560.0 and 641.2 ng g^{-1} dry weight respectively (Fig. 8a). Sites 44 and 45 were situated next to each other and were classed as far field sites. Sediments from sites 44 and 45 were not analysed for PAHs in 1989 so no direct comparison can be made. The outlined areas in Figure 8a (A-D) again highlight the clusters of sites where the total PAH concentrations were twice the median value (129.6 ng g^{-1} dry weight) or greater. The areas occupy the same general positions but do not include exactly the same sites as for the oil equivalents shown in Figure 4.

Total PAH concentrations in near and far field Day Grab sediments collected in 2001 were similar (Table 3, Fig. 6c). PAH concentrations from near field sediments ranged from 30.6 ng g^{-1} dry weight to 455.1 ng g^{-1} dry weight (mean = 164.3 ng g^{-1} dry weight, SD = 107.4 ng g^{-1} dry weight, median = 147.1 ng g^{-1} dry weight, n = 49). In far field sediments total PAH concentrations ranged from 29.1 ng g^{-1} dry weight to 641.2 ng g^{-1} dry weight (mean = 151.5 ng g^{-1} dry weight, SD = 110.3 ng g^{-1} dry weight, median = 121.4 ng g^{-1}

dry weight, n = 70). No significant difference was found between the total PAH concentrations in near and far field sites for 2001 ($p > 0.05$, t-test).

Only twenty-five sediments from the same sites were analysed for PAHs in 1989 (Table 4). The total PAH concentrations in all 2001 sediments were lower compared to the 1989 sediments collected from the same sites (Table 4), even for site 112 which has a higher than normal perylene content (it did not have a high perylene content in 1989, reinforcing the interpretation that the perylene is biogenic in origin). In 1989 total PAH concentrations ranged from 307.2 ng g^{-1} dry weight (site 56) to 881.3 ng g^{-1} dry weight (site 20) (mean = 597.5 ng g^{-1} dry weight, SD = 171.5 ng g^{-1} dry weight, median 565.7 ng g^{-1} dry weight). In 2001 total PAH concentrations in sediments from the same twenty five sites ranged from 30.6 ng g^{-1} dry weight (site 5) to 476.4 ng g^{-1} dry weight (site 112) (mean = 174.8 ng g^{-1} dry weight, SD = 124.7 ng g^{-1} dry weight, median = 136.9 ng g^{-1} dry weight). The decrease in total PAH concentration ranged from 14.9% (site 112) to 93.4% (site 17) (mean = 70.2%, SD = 21.2%, median = 78.9%) (Fig. 8b, Table 4). If site 112 is discounted then, for twenty four sites, the total PAH concentration in 1989 ranged from 307.2 ng g^{-1} dry weight (site 56) to 881.3 ng g^{-1} dry weight (site 20) (mean = 599.0 ng g^{-1} dry weight, SD = 175.05 ng g^{-1} dry weight, median 575.1 ng g^{-1} dry weight) and in 2001 ranged from 30.6 ng g^{-1} dry weight (site 5) to 387.2 ng g^{-1} dry weight (site 118) (mean = 162.3 ng g^{-1} dry weight, SD = 110.1 ng g^{-1} dry weight, median = 128.5 ng g^{-1} dry weight). The decrease was then 33.5% (site 68, near field) to 93.4% (site 17, far field) (mean = 72.5%, SD = 20.3%, median = 79.3%; Table 4, Figure 8b). As was found with the oil equivalent values, even with the inclusion of site 112, the 2001 near field sites had a lower median total PAH concentration (193.9 ng g^{-1} dry weight) than the 1989 far field sites (611.9 ng g^{-1} dry weight), emphasising the decrease in concentration from 1989 to 2001. The boxplot of the 1989 and 2001 total PAH concentrations (Fig. 7c) illustrates this, with no overlap between the boxes. Total PAH concentrations in 2001 were found to be significantly lower than the total PAH concentrations from the 1989 sediment collected from the same site ($p < 0.05$, paired t-test).

The reduction in total PAH concentrations, which includes PAHs of pyrolytic and petrogenic origin, may be explained by an increase in degradation, particularly of the lower molecular weight material, and/or a decrease in input, with a combination of both factors being most likely. Increased regulations are, on the whole, reducing inputs to the North Sea. Cuttings are no longer dumped at sea and the amount of oil discharged along with produced water is more tightly controlled, with a decrease in concentration of oil in the produced water. On the other hand though, the amount of produced water discharged has increased therefore the overall amount of oil discharged to the North Sea in produced water has remained relatively steady since 1991[12]. In addition, new regulations controlling the amount of flaring allowed at the flarestacks have been introduced and could therefore account for the decrease in the concentration of the pyrolytic component to the total PAHs (Fig. 9a). Another possible explanation for the initial high pyrolytic content, and its subsequent significant decrease (Fig. 9a) is the explosion on the Piper Alpha platform in July 1988 – this would have been a significant point source in time of pyrolytic PAHs in that part of the North Sea. The Piper field is at the north west end of the survey area for the 1989 and 2001 surveys (site number 106). A literature survey has found reference only to chlorobiphenyl (CB) contamination, from the transformers aboard the platform at the time of the explosion[13]. However, news reports at the time showed substantial clouds of black smoke above the platform, which would contain abundant soot particles to which the pyrolytic PAHs would adhere and thus be transported away from the platform site and across the Fladen Ground.

However, the PAH profile of sediment 106 (Fig. 10), collected in 2001 close to the site of the Piper Alpha platform, was similar to the other 2001 sediments. The total PAH concentration of this sediment (193.9 ng g^{-1} dry weight) was slightly higher than the median value (129.6 ng g^{-1} dry weight). The 1989 sediment from the same location had a total PAH concentration of 478.3 ng g^{-1} dry weight, which was less than the 1989 median (565.7 ng g^{-1}

dry weight, n=25; Table 4). The profile of the 1989 sediment (Fig. 10), contained a higher proportion of 2- and 3-ring PAHs than the 2001 sediment, indicating a higher level of petrogenic input in 1989 than 2001. PAH concentration ratios (phenanthrene/anthracene [P/A], fluoranthene/pyrene [Fl/Py], methylphenanthrene/phenanthrene [MP/P] and fluoranthene + pyrene/methylfluoranthene + methylpyrene [Fl + Py]/[MFl + MPy]), which can be used to indicate a pyrolytic or petrogenic source (see below), were comparable to other sites in the survey for 2001, indicating a mainly pyrolytic origin for the PAHs. Biomarkers were also comparable to the other sites of the 2001 survey and indicate a mixed Middle Eastern – North Sea oil input (see below).

Comparison to Background Reference Concentrations (BRCs)[i]

The Oslo and Paris Commission (OSPAR) have established Background Reference Concentrations (BRCs) and Ecotoxicological Assessment Criteria (EACs) to assess chemical monitoring data and identify areas of environmental concern[14]. BRCs are the typical range of concentrations found in the OSPAR area (North-East Atlantic). The highest PAH concentrations in sediment are normally found in estuaries, river mouths and areas of regular shipping, oil production and transportation[14]. The BRCs for the northern North Sea are higher than other regions in the OSPAR area (Table 5) with ranges of 8.8–112, 14–160, 46–434 and 11-128 ng g^{-1} dry weight for benzo[*a*]pyrene, fluoranthene, benzofluoranthene and pyrene, respectively (Table 5). Similar to the 1989 sediments, concentrations of these PAHs in the Fladen Ground sediments collected in 2001 were below or at the lower end of the BRC ranges for the northern North Sea (Table 5).

PAH Distributions and Concentration Ratios

PAHs are generated by two main processes - the combustion of organic matter (pyrolytic) and from the release of petroleum (petrogenic). By studying the PAH distribution it may be possible to distinguish these sources. Petrogenic sources are dominated by 2- and 3-ring alkylated PAHs, whereas pyrolytic sources are characterised by the heavier, parent PAHs. Similar to the results for the 1989 sediments, the proportion of parent PAHs was high in all sediments for the 2001 survey, ranging from 37.1% to 79.5% (mean = 51.8%, SD = 4.9%, median = 51.9%) (Table 1), indicating a predominately pyrolytic input. In addition, the 1989 PAH profiles were dominated by the heavier, more persistent, 4-, 5- and 6-ring compounds (Fig. 9b), which accounted for an average of 23.4%, 28.9% and 23.0% of the total PAHs, respectively. As in 1989, the 2001 PAH profiles are dominated by the 4-, 5- and 6-ring compounds, accounting for an average of 21.4%, 34.3% and 27.3% respectively. However, there is a slight decrease in the percentage of the 2- and 3-ring compounds and an increase in the 5- and 6-ring compounds in 2001 (Fig. 9b), suggesting either a greater petrogenic input in 1989 than 2001 or a greater degradation of the 2- and 3-ring PAHs in 2001 compared to 1989.

The PAH profiles of the 1989 and 2001 sediments were investigated further using principal component analysis (PCA). The statistical analysis used looked at the parent and alkylated PAH distributions to determine if there were any temporal trends. Due to the large number of samples PCA was used to examine temporal differences in the PAH profiles. The results were simplified by summarising the multivariate data set using relatively few components. This method forms a lower number of variables from linear combinations of the original data. Clustering only occurs if samples have similar properties and does not include any information on group membership (*e.g.* location of the sample). Specifically, PCA was

[i]Following an OSPAR/ICES Worshop on The Evaluation and Update of BRCs and EACs, The Netherlands, February 2004, it is proposed that the terminology should change to BC – background concentration and EAC – environmental assessment criteria and a review of the limits is in progress at the present time[15].

applied to the parent and alkylated concentrations normalised to the total PAH concentration; *i.e.* so the data are in the form of proportions of the total concentration. Minitab13 was used for the PCA. The results of the analysis were viewed by plotting the principal components (PC) which had the greatest variance against one another. PC1 and PC2 accounted for 46.9% and 13.2% of the variance present in the data set, respectively. PAHs the same distance from the centre and with the same direction are positively correlated, those in opposite directions are negatively correlated, and those perpendicular are not correlated. The first component was a contrast between the 2- and 3-ring (parent and alkylated), parent 4-ring and alkylated fluoranthenes/pyrenes and the heavier, parent, 5- and 6-rings and the alkylated benzanthracenes/chrysenes/triphenylenes (Fig. 11a). The second component was essentially a contrast between the alkylated and parent PAHs, although DBT were also grouped with alkylated PAHs. All of the 1989 samples scored positively on Factor 1, indicating a higher proportion of the 2- and 3-ring PAHs compared to the 2001 samples (Fig. 11b). The 2001 samples had a higher proportion of parent 5- and 6-ring PAHs. This suggests that the 1989 had a greater petrogenic loading compared to the 2001 sediments.

Analysis of PAH concentration ratios can be used to distinguish between pyrolytic and petrogenic sources[6,7,16-22]. A summary of the ratios commonly used was presented recently by Webster *et al.*,[6,7] the main ratios being phenanthrene/anthracene (P/A), fluoranthene/pyrene (Fl/Py), methylphenanthrene/phenanthrene (MP/P) and fluoranthene + pyrene/methylfluoranthene + methylpyrene (Fl + Py) / (MFl + MPy). By examining several ratios simultaneously, it is possible to distinguish between pyrolytic and petrogenic sources[1,2,6,7]. Plotting the Fl/Py ratio against either the P/A ratio or the MP/P ratio gives pyrolytic and petrogenic zones, with the zones defined by high Fl/Py ratios and low P/A or MP/P characteristic of pyrolytic PAHs (top left quadrant in Fig. 12a and b, *cf* petrogenic zones in bottom right quadrant). The other two quadrants may be indicative of a mixed source of PAHs. A plot of these ratios for the 2001 sediments shows that 48 of the sediment samples, approximately half of those with measurable anthracene, fell in the mixed zone due to the P/A ratios being >10. The remaining samples clustered in the pyrolytic zone (Fig. 12a). These high P/A ratios suggest a possible petrogenic input, however, a low proportion of anthracene can often be found at remote sites if the main source is atmospheric deposition. It has previously been reported that sediments from remote areas can have lower concentrations of anthracene, compared to urban areas, as a result of selective photo-oxidation of anthracene during long range atmospheric transportation[23]. Higher P/A (>10) ratios at offshore locations compared to estuarine sites have also been reported in the UK[24]. In addition, the MP/P ratios were mostly low, <2 (Appendix 4), again suggesting a pyrolytic input. A plot of Fl/Py ratios against MP/P ratios shows that in all but four sediments the samples fell within the pyrolytic quadrant (Fig. 12b). The remaining four sediments (sites 12, 25, 44 and 64) were within the top right hand mixed quadrant (Fig. 12b). These four sediments were within the top right hand mixed quadrant in Figure 12a. Although only 25 samples were analysed in 1989 for PAHs a similar pattern can be seen in the Fl/Py *vs* P/A plot, where P/A ratios > 10 meant 14 of the 25 samples were within the top right hand mixed quadrant. The plot of Fl/Py *vs* MP/P left four samples of the 1989 sediments within the top right hand mixed quadrant (sites 2, 14, 56 and 62). For both ratios all the remaining samples clustered in the pyrolytic zone. There is no evidence in the other parameters measured in this study that the four samples are significantly different from the other 115 samples of 2001 or that the four from 1989 are significantly different from the other 21 samples analysed for PAHs. Therefore, the possibility that selective photo-oxidation of anthracene during long range atmospheric transport can give lower concentrations of anthracene suggests that the P/A to Fl/Py plot is less reliable as a source input indicator than the Fl/Py to MP/P plot.

Aliphatic Hydrocarbon Analysis (*n*-alkanes)

It is possible to identify petrogenic contamination by looking at *n*-alkane profiles. Biogenic *n*-alkanes are dominated by odd number carbons, shorter chain (nC_{12}-nC_{25}) reflecting a phytoplankton input and longer chain (nC_{21}-nC_{33}) a terrestrial or vascular plant input[6,7,25]. Crude oils contain a range of *n*-alkanes with the maximum around nC_{13}-nC_{15} and with no odd carbon number predominance. Carbon Preference Indices (CPI) can be used to distinguish biogenic and petrogenic sources. The CPI value is a measure of the relative abundance of odd *versus* even carbon numbered *n*-alkanes and can be used to assess whether the input source is predominately biogenic or petrogenic. Typically, *n*-alkanes from a petrogenic source have a CPI value of ~1, while *n*-alkanes from biogenic sources have CPI values >1. For this report the the Carbon Preference Index of Bray & Evans[25], modified by Allan & Douglas[26] is used:

$$CPI = (C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32}).$$

For the 2001 samples the CPI values (nC_{23} – nC_{33}) range from 1.06 to 7.20 (mean = 2.28, SD = 0.98, median = 1.98) (Table 1, Appendix 3), indicating a predominately biogenic input, with a higher proportion of vascular plant input to those sediments with CPI much greater than 1. Total *n*-alkane concentrations (nC_{12} – nC_{33}) in the 2001 Day Grab sediments ranged from 31.0 to 2638 ng g^{-1} dry weight (mean = 283.1 ng g^{-1} dry weight, SD = 295.4 ng g^{-1} dry weight, median = 201.3 ng g^{-1} dry weight; Table 1), with only 12 of the 119 sediments having a total *n*-alkane concentration greater than 500 ng g^{-1} dry weight (Fig. 13a, Appendix 3). Again, as for the oil equivalent values and total PAHs, there are clusters of sites with concentrations twice the median value (201.3 ng g^{-1} dry weight, Table 1) or greater. These areas are less well defined than for the oil equivalent values and total PAHs, but are still in the same general area, centred around sites 36, 44, 107 and 99 (Fig. 13a). The highest concentration of *n*-alkanes was found in the sediment sample at site number 99 (Fig. 14a), where odd carbon, long chain biogenic *n*-alkanes predominate. However, a minor high boiling UCM indicates that there was a limited petrogenic contribution to this site. The corresponding Forties and diesel UVF oil equivalents were 38.8 and 8.8 µg g^{-1} dry weight (Figs 4a and b) and the total PAH concentration was 281.2 ng g^{-1} dry weight (Fig. 8a), all above the median values for this survey (Table 1). Concentrations of *n*-alkanes in 1989 ranged from 272.9 to 665.0 ng g^{-1} dry weight (mean = 483.3 ng g^{-1} dry weight, SD = 110.7 ng g^{-1} dry weight, median = 510.5 ng g^{-1} dry weight; Fig. 13b, Table 6), however only twenty five of the 1989 sediments were analysed for *n*-alkanes, not including site 99, therefore no comparison could be made. Total *n*-alkane concentrations in sediments from the same twenty five sites, collected in 2001, ranged from 31.0 ng g^{-1} dry weight to 831.8 ng g^{-1} dry weight (mean = 254.1 ng g^{-1} dry weight, SD = 165.6 ng g^{-1} dry weight, median = 236.5 ng g^{-1} dry weight; Table 6). Twenty four of the twenty five sites which were sampled again in 2001 showed a decrease in the total *n*-alkane (nC_{12} – nC_{33}) concentrations from 1989 to 2001 (Fig. 13b); only at sampling site 8 was an increase observed (from 428.1 to 831.8 ng g^{-1} dry weight; Fig. 13b, Table 6), with *n*-alkanes ranging from nC_{17} – nC_{33} with no long chain, odd carbon predominance (CPI = 1.06). Contamination from either an anthropogenic source or a biogenic source, *e.g.* from planktonic algae and/or bacteria, which do not generate a long chain, odd carbon preference[27] cannot be discounted. Figure 15 shows the mean concentration of the nC_{12}–nC_{33} alkanes for the 1989 survey and the corresponding sites for the 2001 survey. There is a distinct predominance of the odd number, long chain carbons in the *n*-alkanes in both 1989 and 2001, indicating that the input is predominantly biogenic. There is a significant decrease in the mean of the *n*-alkane concentrations (ng g^{-1} dry weight) from 1989 to 2001, particularly of the odd number, long chain carbons (Fig. 15), which possibly indicates less vascular plant (terrestrial) input.

The composition of oil released into the marine environment changes as a result of evaporation, dispersion and dilution, and degradation. The lighter *n*-alkanes are lost first and eventually almost all the *n*-alkanes will be lost leaving only a 'hump' to be observed in the GC-FID chromatogram. This hump, the unresolved complex mixture (UCM), is due to the more recalcitrant components in the oil, mainly alkylated and cyclic compounds, and is characteristic of petrogenic contamination. There are minor high boiling UCMs present in many (31) of the sample sites, both near (<5 km) and far field (>5 km) of the oil platforms, indicating there may be some petrogenic contamination from highly weathered oil. The most significant UCMs for the 2001 samples are at sites 88 (Fig. 14b) and 36 where, in addition to the high boiling UCM there are also minor low boiling (petrogenic) UCMs. Site 88 has three platform sites at less than 5 km, *i.e.* it is a near field site. Site 36 is a far field site, more than 5 km from a platform. These UCMs suggests distinct, though minor, petrogenic inputs to these sites.

The distribution of UCMs differs from the areas of higher concentrations of Forties and diesel oil equivalents (Figs 4a and b), total PAHs (Fig. 8a) and total *n*-alkanes (Fig. 13a) (areas with values twice the median value or greater). Areas around sites 99 and 107, which are of predominantly near field sites, have high boiling and some bimodal UCMs whereas the areas around sites 37 and 42, which are predominantly far field sites, have no perceptible UCMs. As the TOC and particle size of the sites with higher values are not appreciably different from the rest of the sites then the conclusion must be that there was a higher petrogenic input to these areas than in the rest of the Fladen Ground.

Geochemical Biomarkers

It can sometimes be difficult to identify petrogenic sources of PAHs using PAH concentration ratios alone. Due to the chronic input of pyrolytic PAHs into the environment the PAH profiles are normally dominated by these pyrolytic PAHs and any petrogenic input may be masked. In addition, weathering results in the altering of the *n*-alkane and PAH profiles. However, the geochemical biomarkers, such as the pentacyclic triterpanes (hopanes) and the tetracyclic steranes are resistant to degradation due to weathering and their profiles remain relatively unchanged with time. Geochemical biomarkers are abundant in crude oils, such as Gulfaks, and give a characteristic profile which can be used to aid the identification of crude oil contamination[27-30]. The doublet peaks in the *m/z* 191 mass chromatogram are due to the 22S and 22R diastereoisomers of each of the C_{31} to C_{35} homohopanes and are characteristic of all crude oils. These doublets decrease in size with increasing carbon number. North Sea and Middle Eastern oils can readily be distinguished from their triterpane profiles. North Sea crude oil contains a characteristic triterpane - bisnorhopane, and C_{29} hopane (nor-hopane) in lower abundance compared to the C_{30} hopane (Fig. 16a). Middle Eastern oil does not contain bisnorhopane and the ratio of C_{29} hopane to hopane is higher than that found in North Sea oils.

All 158 sediment samples (Day Grabs, Day Grab replicates and cores) were analysed for geochemical biomarkers to further identify any petrogenic contamination. One hundred and forty eight of the one hundred and fifty eight sediment samples showed evidence of crude oil contamination from their biomarker profiles. The triterpane mass chromatograms (*m/z* 191) of these samples contained the homohopane C_{31}-C_{35} doublets, hopane and nor-hopane (Fig. 16b). In addition there was a small bisnorhopane peak indicating the presence of North Sea crude oil (Fig. 16b). However, the proportion of bis-norhopane to nor-hopane was smaller than normally found in North Sea oils, and similar to Middle Eastern oils, and the proportion of nor-hopane to hopane was high. Therefore, the geochemical biomarker profiles indicate that most sediment samples had been exposed to both North Sea and Middle Eastern crude oils (Fig. 16b). The presence of Middle Eastern oil in sediments from the North Sea is not unusual, as it is used in bunker fuel and is often found in the marine

environment as a result of shipping activity[1,2]. The 1989 samples were not analysed for biomarkers therefore no comparison is possible.

Variation in Hydrocarbon Concentrations in the Replicate Day Grab Samples

At five of the sample sites five sediment samples were collected in five separate deployments of the Day Grab, the results for which are summarised in Table 7. The total PAH concentrations in the replicate samples were found to be variable with %CV between 12.3 and 52.8% (Table 8), with the highest total PAH in replicate 46c and the lowest in replicate 37e (Table 9), both of which are classified as far field sites. The TOC (%CV 26.0 - 36.7), Forties (%CV 3.5 – 76.5) and diesel oil equivalents (%CV 8.8 – 130.6) and total *n*-alkanes (%CV 25.6 – 137.6) (Table 9) are also highly variable, though there was little variation in the particle size (%CV 0.4 – 4.4). The highest variances were generally at site 46 and the lowest at site 111. These results indicate that the Fladen Ground replicate Day Grab sediments were relatively inhomogenous with regard to hydrocarbon and PAH content. Despite this inhomogeneity, when the PAH profiles were examined the proportion of parent PAHs was high in all the replicate sediments, ranging from 44.0% to 66.7% (mean = 53.3%, SD = 7.7%, median = 49.8%; Table 7) and, as with the Day Grab samples (Fig. 9b), the replicate Day Grab PAH profiles are dominated by the 4- to 6-ring compounds (Fig. 17). both indicating a predominately pyrolytic input. Replicate Day Grab samples were not taken in 1989 and none of the 2001 replicates were taken at the sites where the 1989 *n*-alkanes and PAHs were determined, therefore no direct comparisons were possible.

The Fladen Ground sediments are predominantly of very poorly sorted, fine to coarse silts[31]. These silty sediments would be disturbed relatively easily, particularly the fine fraction, therefore subsequent Day Grabs, although not being taken in exactly same positions, could be sampling disturbed sediment and not the pristine sediment surface of the first Day Grab sample. Of these Day Grabs only site 66 had the highest values for Total PAH, Parent PAH, PS, %TOC and Forties and diesel oil equivalents recorded in the first Day Grab, at all other sites subsequent Day Grabs had the highest values. The PAH profiles (Fig. 17) are virtually identical to those of the main Day Grab samples indicating that, although the absolute concentrations for each of the replicate Day Grabs were variable, the distribution of the PAH was the same. Thus although the replicate Day Grab sediments have variable concentrations it is likely that this is due to disturbance of the sediments during replicate sampling rather than the sediments being highly inhomogenous in the relatively small area of the Fladen Ground that each replicate site sampled.

For this reason, in the discussion of the 2001 survey sites the results from the first Day Grab sample at the replicate sites were used, on the assumption that first Day Grab sampled undisturbed sediment and would be more on a par with the other sites in the 2001 survey and also with the sites of the 1989 survey.

Variation in Hydrocarbon Concentrations in the Short Cores

In addition, at each of these replicate Day Grab sites a short sediment core was taken and samples analysed in 2 cm slices (0-2 cm, 2-4 cm, 4-6 cm and 6-8 cm) (Table 10). For the Forties and diesel oil equivalents there was little variation downcore except for site 88 which had relatively high surface values (75.3 and 18.7 µg g^{-1} dry weight oil equivalents respectively) compared to the other cores (Figs 18a and b). The surface sample of the site 88 core also contained a bimodal UCM (the largest for the whole of the 2001 survey) and also bimodal UCMs downcore. The *n*-alkanes were also high for the surface sample at site 88 compared to the other sites (Fig. 18c). However, a distinct odd carbon, long chain predominance indicated that the dominant input for the *n*-alkanes was biogenic. For total PAH (ng g^{-1} dry weight; Fig. 18d) three of the five cores increased with depth (sites 37, 66

and 111) with site 111 increasing by over 200 ng g^{-1} dry weight. Of the other two sites, site 88 decreased with depth (407.0 to 123.7 ng g^{-1} dry weight) whilst at site 46 there is an increase then a decrease with depth. This pattern correlates with the *n*-alkane profiles but not for the Forties/diesel where site 46 had similar profiles to the other three cores (Figs 18a –d). All core samples gave % parent PAH values greater than 44%, i.e. predominant pyrolytic input (Fig. 18e). This predominant pyrolytic input is also reinforced by the PAH distributions in which, as for the total survey area, the 5- and 6-ring PAHs were dominant (Fig. 19). The core samples were taken after the five replicate Day Grabs at each site and some of the variability may be due to the possibility of disturbed sediments as noted above. There were no cores taken in 1989 and none of the 2001 cores were taken at sites where *n*-alkanes and PAHs were determined for the surface sediments in 1989, therefore no comparisons were possible.

CONCLUSIONS

1. The levels of Forties and diesel oil equivalents (µg g^{-1} dry weight), total *n*-alkanes (ng g^{-1} dry weight) and total PAHs (ng g^{-1} dry weight) in sediments collected in 2001 showed a decrease compared to those collected in 1989. The total PAH concentrations decreased by an average of 72.5%. There was also a decrease in the average Forties (62.0%) and diesel (89.0%) oil equivalent concentrations.

2. Forties and diesel oil equivalents and total PAHs in the 2001 sediments were variable with no significant difference between near (<5 km from an oil platform) and far (>5 km from an oil platform) field sites. However, there were areas (both near and far field) in which these concentrations were twice the median value or greater (median value for Forties = 18.0 µg g^{-1} dry weight, diesel = 5.1 µg g^{-1} dry weight) for the 2001 sediments.

3. Similar to the 1989 sediments, PAH distributions, concentrations and ratios indicated a predominantly pyrolytic input to the 2001 sediments, being dominated by the heavier and more persistent 5- and 6-ring compounds, and containing a high proportion of parent PAH. However, 1989 sediments had a higher proportion of the 2- and 3-ring PAHs compared to 2001 sediments suggesting that there was either a greater petrogenic input to the 1989 sediments or that the 2001 sediments were more weathered.

4. The *n*-alkane profiles of a number of sediments contained a small, high boiling UCM, indicative of a limited petrogenic input from highly weathered oil.

5. The geochemical biomarker profiles of the majority of sediments contained a small bisnorhopane peak and a high proportion of norhopane to hopane, indicating that there was contamination from both Middle Eastern and North Sea oils.

6. Replicate Day Grab samples at all sites were variable for all the parameters studied, indicating that the Fladen Ground sediments are relatively inhomogenous with regard to hydrocarbon and PAH content. It is likely that this is due to disturbance of the sediments during replicate sampling rather than the sediments being highly inhomogenous in the relatively small area of the Fladen Ground that each replicate site sampled.

7. The replicate cores showed little variation downcore for all sites bar site 88. Site 88 had higher values for its surface sediments for Forties and diesel oil equivalents, total *n*-alkanes and total PAHs. All core samples had %PAH profiles which showed a predominantly pyrolytic input.

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TABLE 1

Summary of UVF, PAH (2- to 6- ring, parent and alkylated),*n*-alkane (nC_{12} – nC_{33}), PSA and %TOC data. All concentrations are on a dry weight basis.

2001	No of samples	min	mean	med	max	SD
UVF oil equivalent concentrations						
Forties (µg g^{-1})	119	5.5	20.7	18.0	61.3	11.4
diesel (µg g^{-1})	119	1.5	6.3	5.1	44.5	5.2
PAHs						
total concentration (ng g^{-1}) [a]	119	29.1	156.7	129.6	641.2	108.8
parent concentration (ng g^{-1}) [b]	119	17.8	81.3	65.9	333.3	57.7
parent % [c]	119	37.1	51.8	51.9	79.5	4.9
n-alkanes						
total concentration (ng g^{-1})	119	31.0	283.1	201.3	2638	295.4
CPI	119	1.06	2.28	1.98	7.20	0.98
PSA (%<63 µm)	119	34.0	75.4	79.6	91.5	12.6
% TOC	119	0.25	0.85	0.84	1.60	0.29

min = minimum; med = median; max = maximum; SD = standard deviation; PSA = particle size analysis; TOC = total organic carbon

[a]sum of (total naphthalenes + total 178 + total DBTs + total 202 + total 228 + total 252 + total 276). Numbers represent ions monitored for that group of compounds (see appendix 4 for list of individual compounds).

[b]sum of naphthalene, phenanthrene, anthracene, dibenzothiophene, fluoranthene, pyrene, benzo[*c*]phenanthrene, benz[*a*]anthracene, chrysene/triphenylene, benz[*b*]anthracene, benzofluoranthenes, benzo[*e*]pyrene, benzo[*a*]pyrene, perylene, indenopyrene, benzoperylene

[c]parent concentration/(total concentration/100)

TABLE 2

Summary of UVF data for the 1989 survey. All concentrations are on a dry weight basis.

1989	No of samples	min	mean	median	max	SD
UVF oil equivalent concentrations						
Forties (µg g^{-1})	119	18.9	53.5	52.2	148.9	19.4
diesel (µg g^{-1})	119	6.2	52.1	49.7	154.0	20.3

min = minimum; max = maximum; SD = standard deviation

TABLE 3

Summary of the near (<5 km from an oil platform) and far (>5 km from an oil platform) field data for the samples analysed in 2001 (a) and 1989 (b) for Forties and diesel oil equivalents (µg g^{-1} dry weight), total PAHs (ng g^{-1} dry weight) and total *n*-alkanes (ng g^{-1} dry weight). Note only 25 sites (listed in Table 4) were analysed for total PAHs and total *n*-alkanes in 1989. All the 1989 sites were analysed for Forties and diesel oil equivalents (c).

		Near field				Far field			
(a)		Forties n=49	Diesel n=49	Total PAH n=49	total *n*-Alkanes n=49	Forties n=70	Diesel n=70	total PAH n=70	total *n*-Alkanes n=70
	min	5.5	1.5	30.6	47.0	5.6	1.6	29.1	31.0
2001	mean	22.7	6.0	164.3	298.0	19.3	6.5	151.5	272.6
	med	21.5	5.4	147.1	197.5	16.2	4.9	121.4	207.6
	max	61.3	14.4	455.1	2638.1	60.6	44.5	641.2	1063.4
	SD	12.1	2.9	107.4	394.1	10.7	6.3	110.3	202.2
(b)		Forties n=4	Diesel n=4	Total PAH n=4	total *n*-Alkanes n=4	Forties[a] n=21	Diesel[a] n=21	total PAH[a] n=21	total[a] *n*-Alkanes n=21
	min	35.6	38.1	389.0	375.1	24.4	27.2	307.2	272.9
1989	mean	87.8	92.4	521.7	499.9	47.6	46.4	611.9	480.2
	med	83.3	88.7	467.9	509.3	50.9	48.7	584.4	510.5
	max	148.9	154.0	761.9	605.8	65.8	59.9	881.3	665.0
	SD	46.9	48.4	164.6	97.9	11.6	9.6	172.8	114.9
(c)		Forties n=23	Diesel n=23			Forties n=96	Diesel n=96		
	min	30.1	32.6			18.9	6.2		
1989	mean	66.6	68.4			50.4	48.2		
	med	53.9	54.5			51.3	49.0		
	max	148.9	154.0			99.5	102.6		
	SD	30.2	30.9			14.3	14.4		

min = minimum; med = median; max = maximum; SD = standard deviation

[a]includes site 112 which is not included in the remainder of this table

TABLE 4

Total PAH (ng g^{-1} dry weight) for the 25 sites analysed for PAHs in 1989 and 2001

Common site number	TOTAL PAH 2001	TOTAL PAH 1989	TOTAL PAH 2001[a]	TOTAL PAH 1989[a]
2	106.6	370.9	106.6	370.9
5	30.6	389.0	30.6	389.0
8	36.9	522.8	36.9	522.8
11	59.4	565.7	59.4	565.7
14	120.0	717.2	120.0	717.2
17	49.1	742.4	49.1	742.4
20	85.9	881.3	85.9	881.3
23	96.3	833.5	96.3	833.5
26	136.9	676.3	136.9	676.3
56	45.9	307.2	45.9	307.2
59	60.5	423.0	60.5	423.0
62	76.7	457.4	76.7	457.4
65	102.4	485.3	102.4	485.3
68	230.8	347.1	230.8	347.1
71	301.4	792.7	301.4	792.7
74	280.7	837.3	280.7	837.3
77	364.3	761.9	364.3	761.9
80	305.2	548.4	305.2	548.4
103	160.2	497.9	160.2	497.9
106	193.9	478.3	193.9	478.3
109	250.6	584.4	250.6	584.4
112[b]	476.4	559.7		
115	273.6	782.0	273.6	782.0
118	387.2	597.5	387.2	597.5
121	139.4	777.3	139.4	777.3
min	**30.6**	**307.2**	**30.6**	**307.2**
mean	**174.8**	**597.5**	**162.3**	**599.0**
median	**136.9**	**565.7**	**128.5**	**575.1**
max	**476.4**	**881.3**	**387.2**	**881.3**
SD	**124.7**	**171.5**	**110.1**	**175.0**
Sum of all sites	**4370.9**	**14936.5**	**3894.5**	**14376.8**

min = minimum; max = maximum; SD = standard deviation

[a]2001 and 1989 site specific total PAH minus site 112

[b]site 112 high content of perylene and benzoperylene (145.0 and 147.2 ng g^{-1} respectively) in 2001 compared to 1989

TABLE 5

Background reference concentrations (BRCs)[a] for specific PAHs in sediment (ng g^{-1} dry weight), established by OSPAR for three areas in the North East Atlantic with values for the 119 Day Grab samples from the Fladen Ground in 2001 for comparison.

Geographical location	Fluoranthene	Pyrene	Benzo[*a*]pyrene	Benzo[*b*]fluoranthene
northern North Sea/ Skagerrak	14-160	11-128	8.8 – 112	46 – 434
southern North Sea	0.72 – 97	0.6 – 78	<0.2 – 51	1.1– 142
Arctic Ocean/ Iceland Sea	7.4 –30	1.7 –6.4	1.0 - 3.8	7.4 - 30
Fladen Ground	0.6 – 15.8	0.4 – 11.3	0.6 –12.7	4.10 – 86.4[b]

[a]Following an OSPAR/ICES Workshop on The Evaluation and Update of BRCs and EACs, The Netherlands, February 2004, it is proposed that the terminology should change to BC – background concentration and EAC – environmental assessment criteria and a review of the limits is in progress at the present time[15].

[b]Total benzofluoranthene

TABLE 6

Comparison of the 25 sites analysed in both 1989 and 2001 for *n*-alkanes

Common site Number	Sum of *n*-Alkanes 2001 nC_{12}-nC_{33} (ng g^{-1})	Sum *n*-alkanes 1989 nC_{12}-nC_{33} (ng g^{-1})	CPI 2001	CPI 1989
2	180.6	272.9	3.2	2.3
5	48.1	375.1	1.8	2.1
8	831.8	428.1	1.1	2.5
11	201.3	378.7	1.9	2.0
14	323.5	523.5	3.1	2.7
17	149.0	546.5	2.3	2.4
20	358.8	588.8	1.4	2.7
23	197.5	559.7	1.3	2.5
26	93.8	558.6	1.2	2.3
56	74.6	273.6	2.1	2.6
59	31.0	490.0	3.5	1.7
62	138.0	479.4	1.7	1.5
65	207.9	353.8	2.0	1.9
68	236.5	375.6	4.0	2.1
71	305.2	622.3	2.7	2.7
74	408.8	560.8	1.4	2.9
77	311.1	605.8	2.7	2.7
80	357.1	394.0	2.3	2.5
103	88.5	340.8	4.9	2.2
106	381.7	539.2	3.4	2.3
109	302.2	609.1	2.0	1.6
112	236.7	522.3	3.2	2.0
115	272.9	665.0	2.9	2.2
118	425.2	510.5	2.5	2.6
121	189.9	509.3	3.7	2.7
min	**31.0**	**272.9**	**1.1**	**1.5**
mean	**254.1**	**483.3**	**2.5**	**2.3**
median	**236.5**	**510.5**	**2.3**	**2.3**
max	**831.8**	**665.0**	**4.9**	**2.9**
SD	**165.6**	**110.7**	**1.0**	**0.4**

min = minimum; max = maximum; SD = standard deviation

TABLE 7

Summary of UVF, PAH (2- to 6- ring, parent and alkylated), PSA and %TOC data for the replicate Day Grab samples. All concentrations are on a dry weight basis.

2001	No of samples	min	mean	med	max	SD
UVF oil equivalent concentrations						
Forties (µg g^{-1})	24	9.0	23.0	14.5	52.0	13.6
diesel (µg g^{-1})	24	2.8	5.8	3.9	13.2	3.1
PAHs						
total concentration (ng g^{-1}) [a]	24	74.9	183.7	169.6	545.2	107.1
parent concentration (ng g^{-1}) [b]	24	45.0	49.7	49.0	57.0	3.0
parent % [c]	24	44.0	48.3	48.0	55.7	2.9
PSA (%<63 µm)	24	71.4	82.7	84.2	89.3	5.6
% TOC	24	0.3	0.9	0.9	1.6	0.3

min = minimum; med = median; max = maximum; SD = standard deviation; PSA = particle size analysis; TOC = total organic carbon.

[a]sum of (total naphthalenes + total 178 + total DBTs + total 202 + total 228 + total 252 + total 276). Numbers represent ions monitored for that group of compounds (see appendix 4 for list of individual compounds).

[b]sum of naphthalene, phenanthrene, anthracene, dibenzothiophene, fluoranthene, pyrene, benzo[*c*]phenanthrene, benz[*a*]anthracene, chrysene/triphenylene, benz[*b*]anthracene, benzofluoranthenes, benzo[*e*]pyrene, benzo[*a*]pyrene, perylene, indenopyrene, benzoperylene.

[c]parent concentration/(total concentration/100)

TABLE 8

%CV for selected parameters for the replicate Day Grab sites

	Site No	Total PAH	PS (%<63 µm)	%TOC	Forties	Diesel	Total *n*-Alkanes
9381/2001	46	52.8	0.8	35.0	76.6	55.2	137.6
9391/2001	37	32.3	4.4	26.0	36.2	33.1	55.1
9413/2001	66	35.5	2.1	36.7	50.9	130.6	89.3
9443/2001	88	51.3	1.7	44.1	56.5	49.2	71.0
9460/2001	111	12.3	1.3	28.7	3.5	8.8	25.6

PS = particle size analysis; TOC = total organic carbon

TABLE 9

Total PAH concentrations (ng g^{-1} dry weight) in replicate Day Grab samples

Sample No	Site No	Min	Mean	Max	n	SD	CV%
9381/2001	46	172.1	310.1	545.2	5	163.6	52.8
9391/2001	37	74.9	167.7	217.9	5	54.2	32.3
9413/2001	66	87.2	129.8	195.1	4	46.0	35.5
9443/2001	88	83.5	168.8	279.6	5	86.6	61.3
9460/2001	111	107.1	137.9	151.7	5	16.2	12.3

min = minimum; max = maximum; SD = standard deviation

TABLE 10

Total PAH concentrations (ng g^{-1} dry weight) in core sediment samples.

Sample No	Site No	Depth			
		0-2 cm	2-4 cm	4-6 cm	6–8 cm
9382/2001	46	283.2	401.9	211.8	181.7
9392/2001	37	83.5	146.4	179.2	259.3
9414/2001	66	111.3	135.0	128.6	229.7
9444/2001	88	407.0	252.8	200.4	123.7
9461/2001	111	146.5	84.2	119.8	372.3

Figure 1 Generalised pattern of North Sea currents in relation to the Fladen Ground. Note the Fladen Ground is the centre of a gyre, with currents sweeping round the outside.

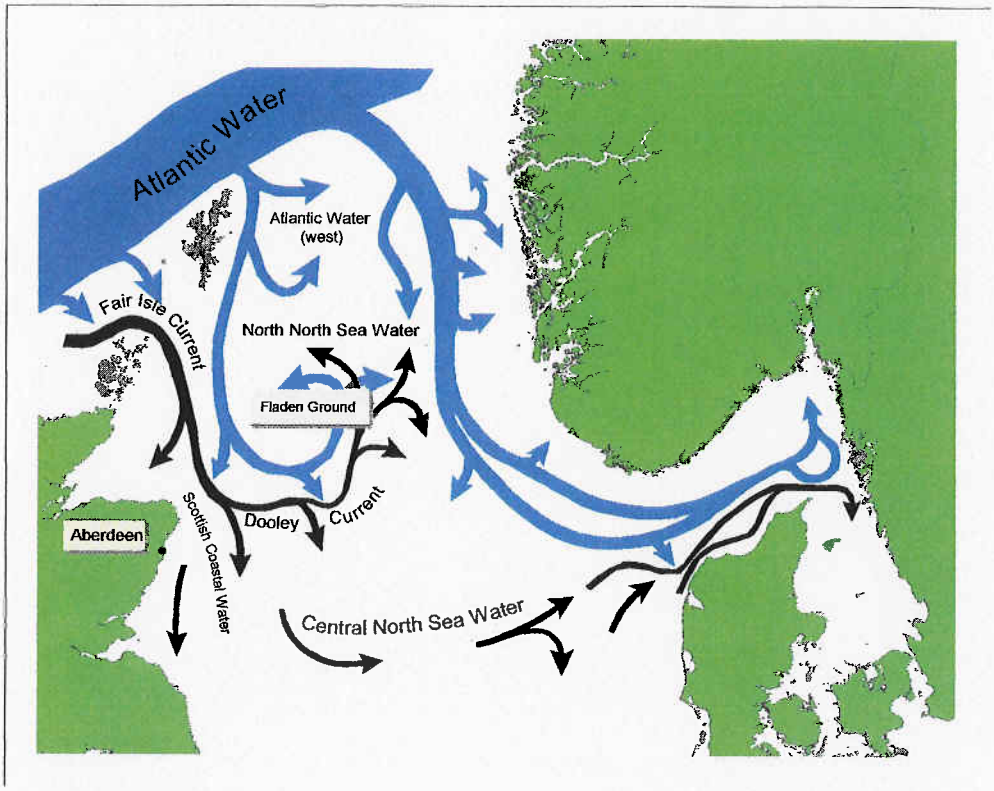
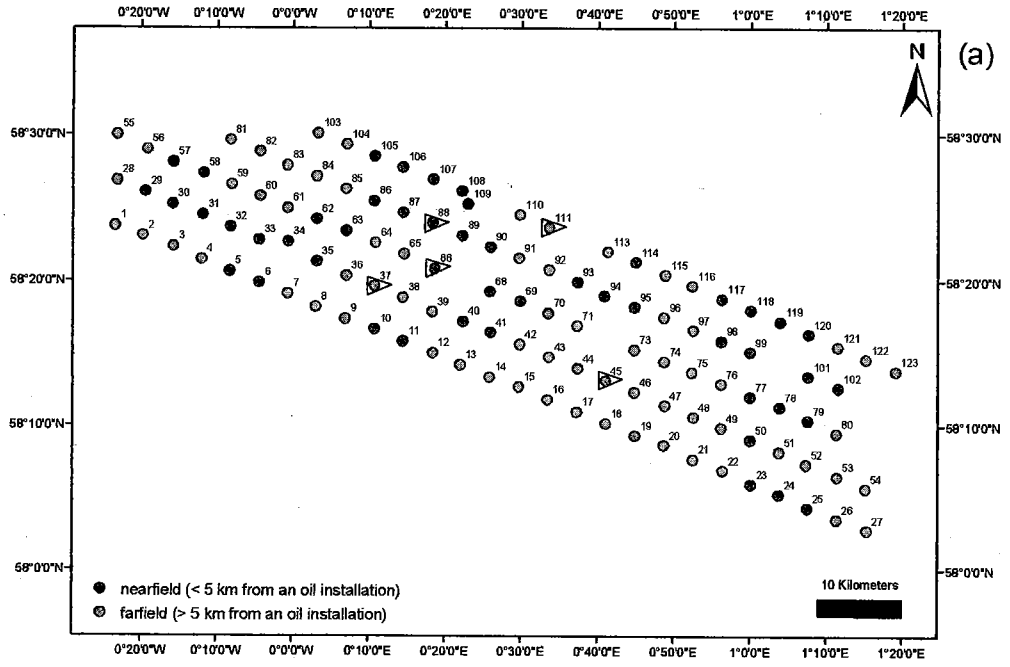


Figure 2 (a) Location of 2001 sampling sites and (b) with oil platforms indicated. All 2001 samples were analysed for UVF, *n*-alkanes, and PAHs. Near field sites (<5 km from an oil platform) are indicated by a red (dark) circle, far field sites (>5 km) by a blue (light) circle. Sample sites are labelled with a common site number. The 2001 core and replicate Day Grab sites (37, 46, 66, 88 & 111) are enclosed in open triangles. Sites 67, 72, 100 and 112 are not included (see text). Further description of symbols is provided on each figure.



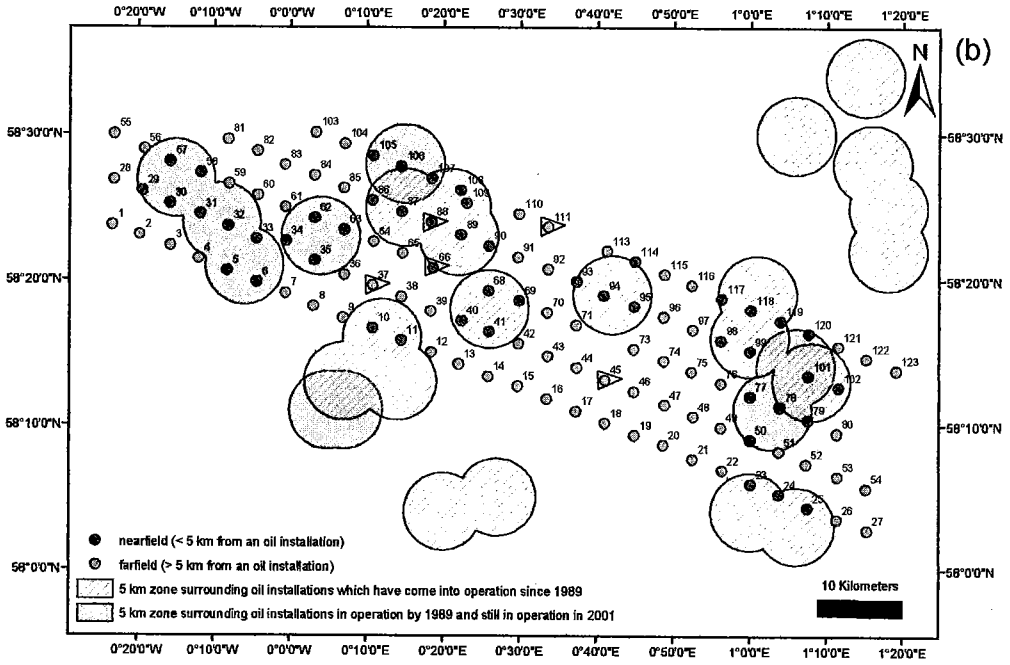


Figure 2 (cont) (c) 2001 near and far field sites, along with oil platforms and sub-sea well heads. Note that few of the sample sites are actually more than 5 km from a subsea well head or oil platform. Sample sites are labelled with a common site number. The 2001 core and replicate Day Grab sites (37, 46, 66, 88 & 111) are enclosed in open triangles.

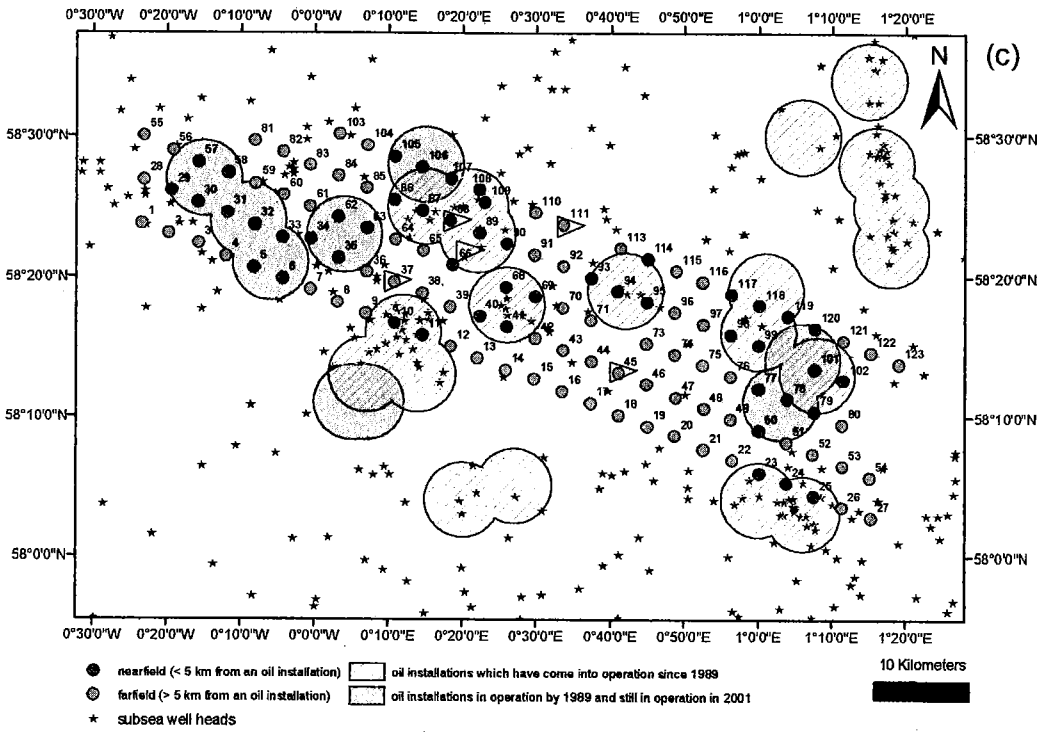
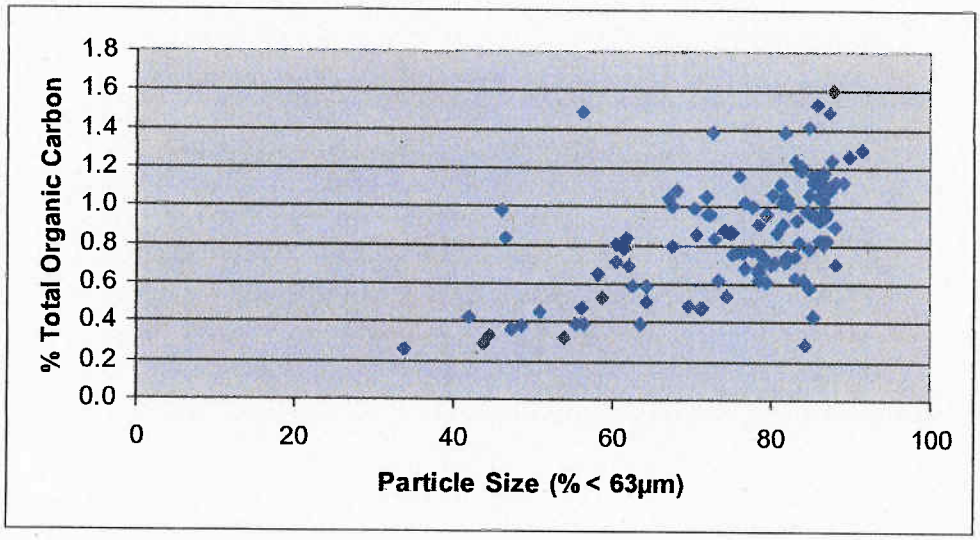


Figure 3 Total organic carbon (%TOC) *vs* (a) particle size (% < 63µm) and (b) total PAH (ng g^{-1} dry weight) for the 2001 Day Grab samples. Note the lack of correlation between TOC and particle size (% < 63µm) or total PAH (see Appendix 4 for definition of Total PAH).

(a)



(b)

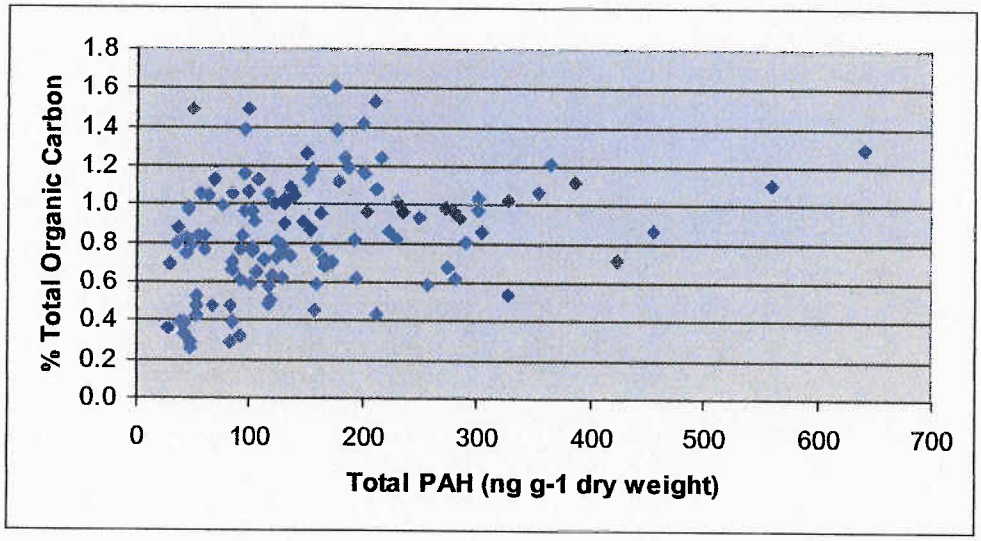
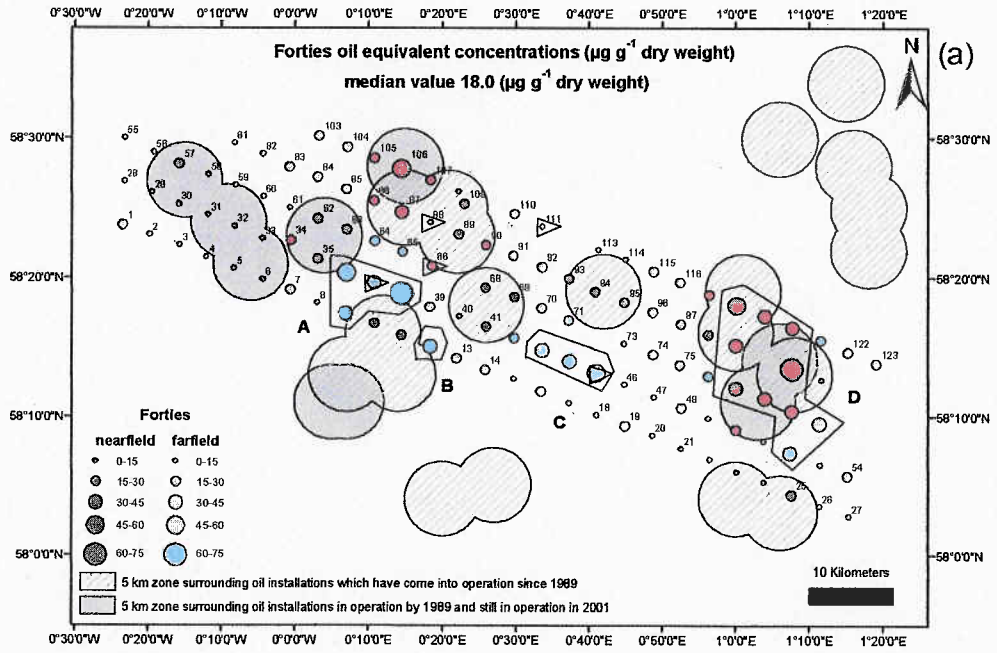


Figure 4 Spatial distribution of (a) Forties oil equivalent concentrations (μg g^{-1} dry weight) and (b) diesel oil equivalent concentrations (μg g^{-1} dry weight) for the 2001 sediments. Circles are proportional to concentrations. Sample sites are labelled with a common site number. The 2001 core and replicate Day Grab sites (sites 37, 46, 66, 88 & 111) are enclosed in open triangles. See text for discussion of outlined areas A-D.



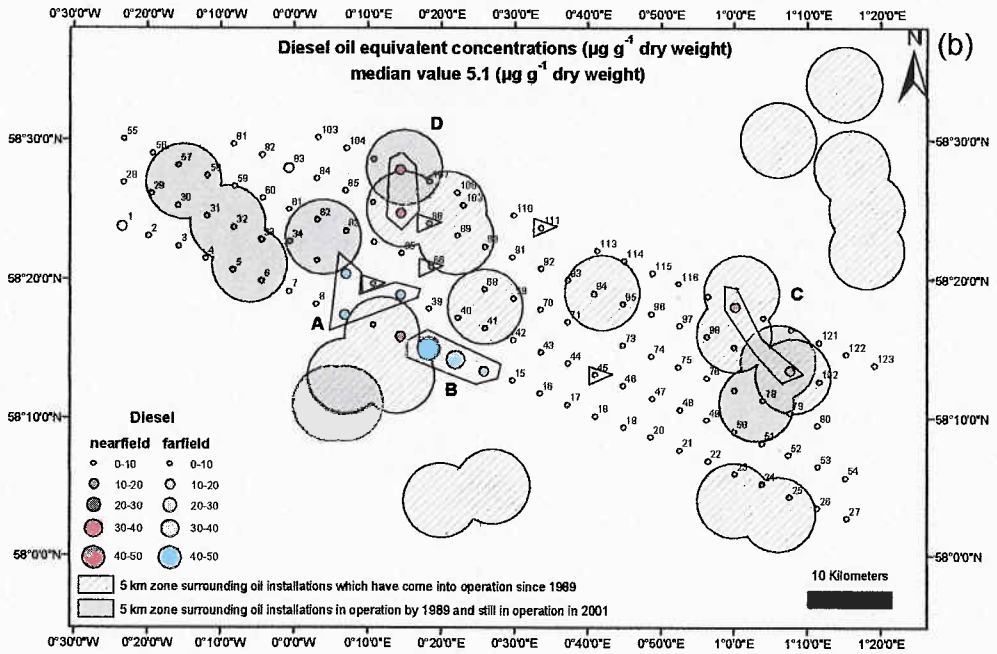
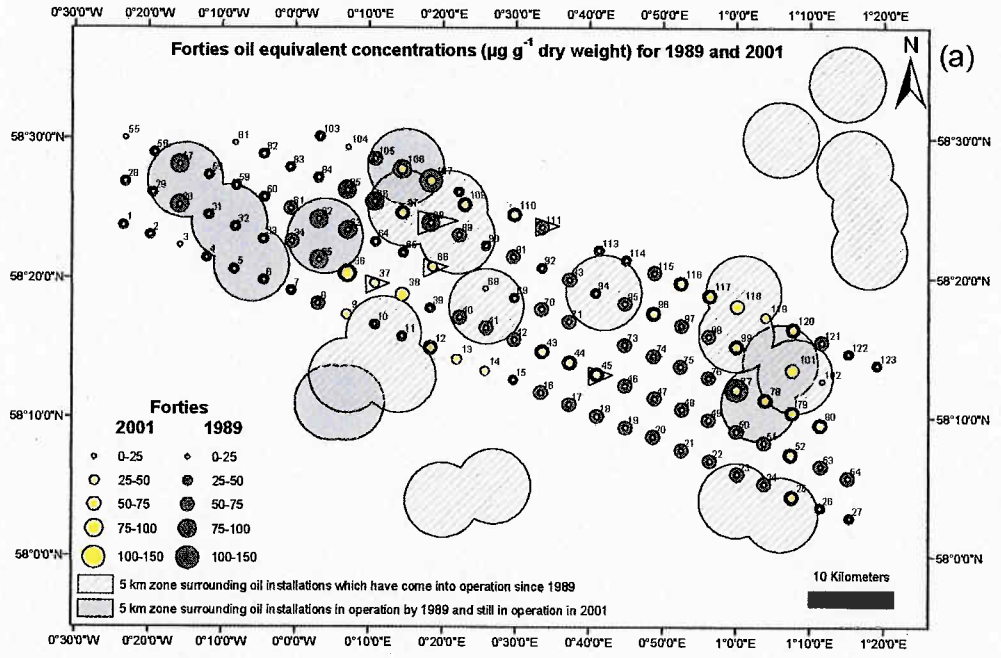


Figure 5 Oil equivalent values for 1989 and 2001 superimposed (a) Forties oil equivalents (μg g^{-1} dry weight) and (b) diesel oil equivalents (μg g^{-1} dry weight). Note the significant reduction from 1989 to 2001. Circles are proportional to concentrations. Sample sites are labelled with a common site number. The 2001 core and replicate Day Grab sites (sites 37, 46, 66, 88 & 111) are enclosed in open triangles.



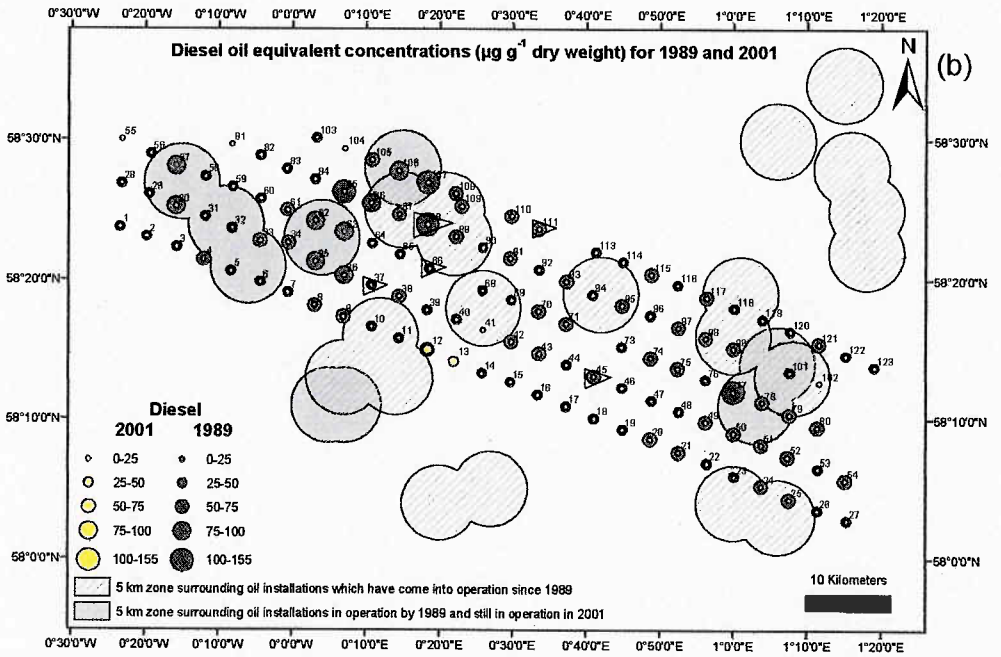


Figure 6 Boxplots of (a) diesel (μg g^{-1} dry weight), (b) Forties (μg g^{-1} dry weight) oil equivalents and (c) total PAH (ng g^{-1} dry weight) for near and far field sites in 2001. The line within the box denotes the median concentration, the crossed circle denotes the mean concentration and the asterisks show 'extreme' values. There is no difference between the positions of the boxes for Forties, diesel or total PAH, indicating that the populations are statistically the same, *i.e.* that there is no difference between near and far field sites.

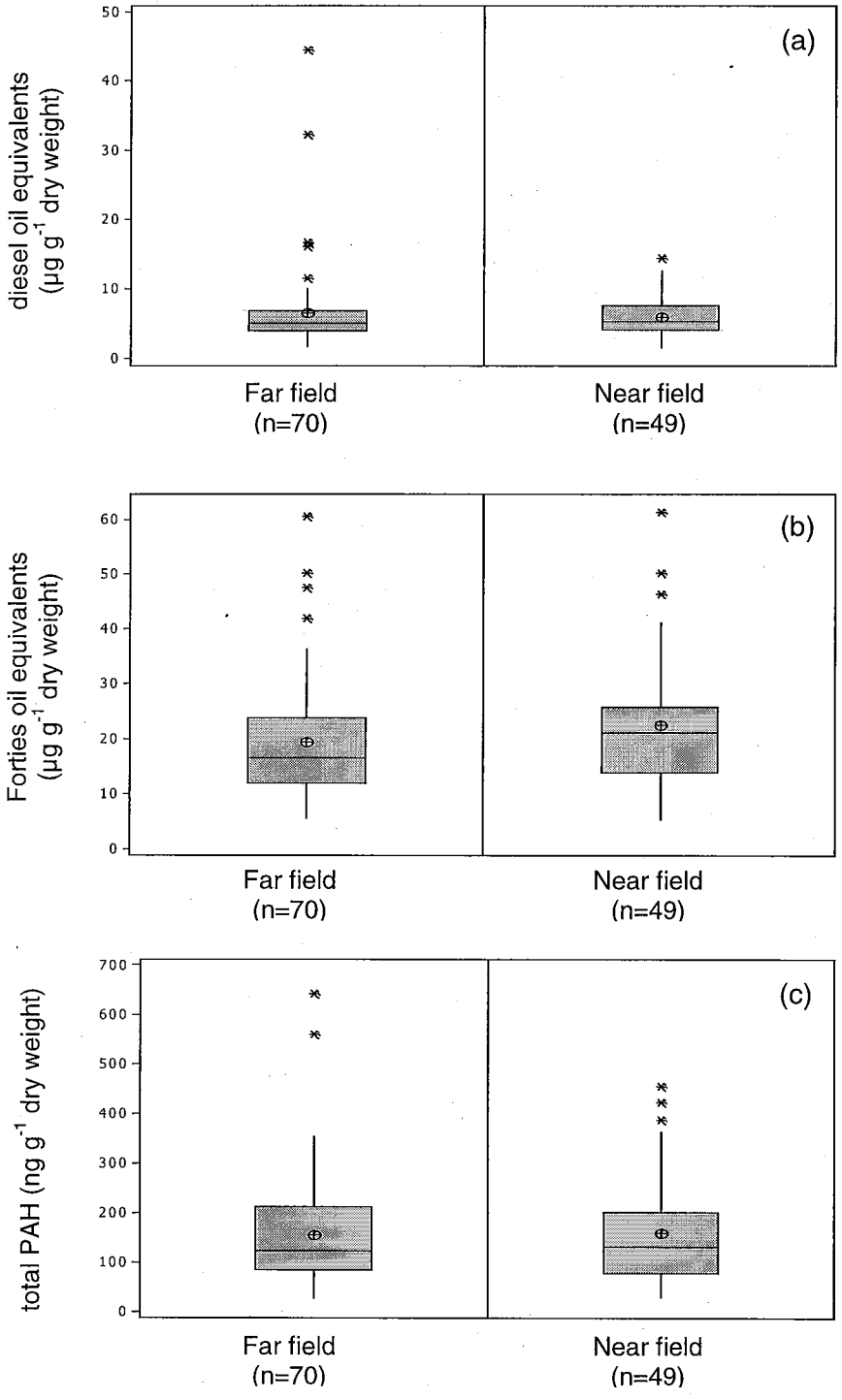


Figure 7 Boxplots of (a) diesel (µg g^{-1} dry weight), (b) Forties (µg g^{-1} dry weight) oil equivalents and (c) total PAH (ng g^{-1} dry weight) for 1989 and 2001. The line within the box denotes the median concentration, the crossed circle denotes the mean concentration and the asterisks show 'extreme' values. There is no overlap between the positions of the boxes for Forties, diesel or total PAH, indicating that the populations are statistically different, *i.e.* that there is a significant decrease from 1989 to 2001.

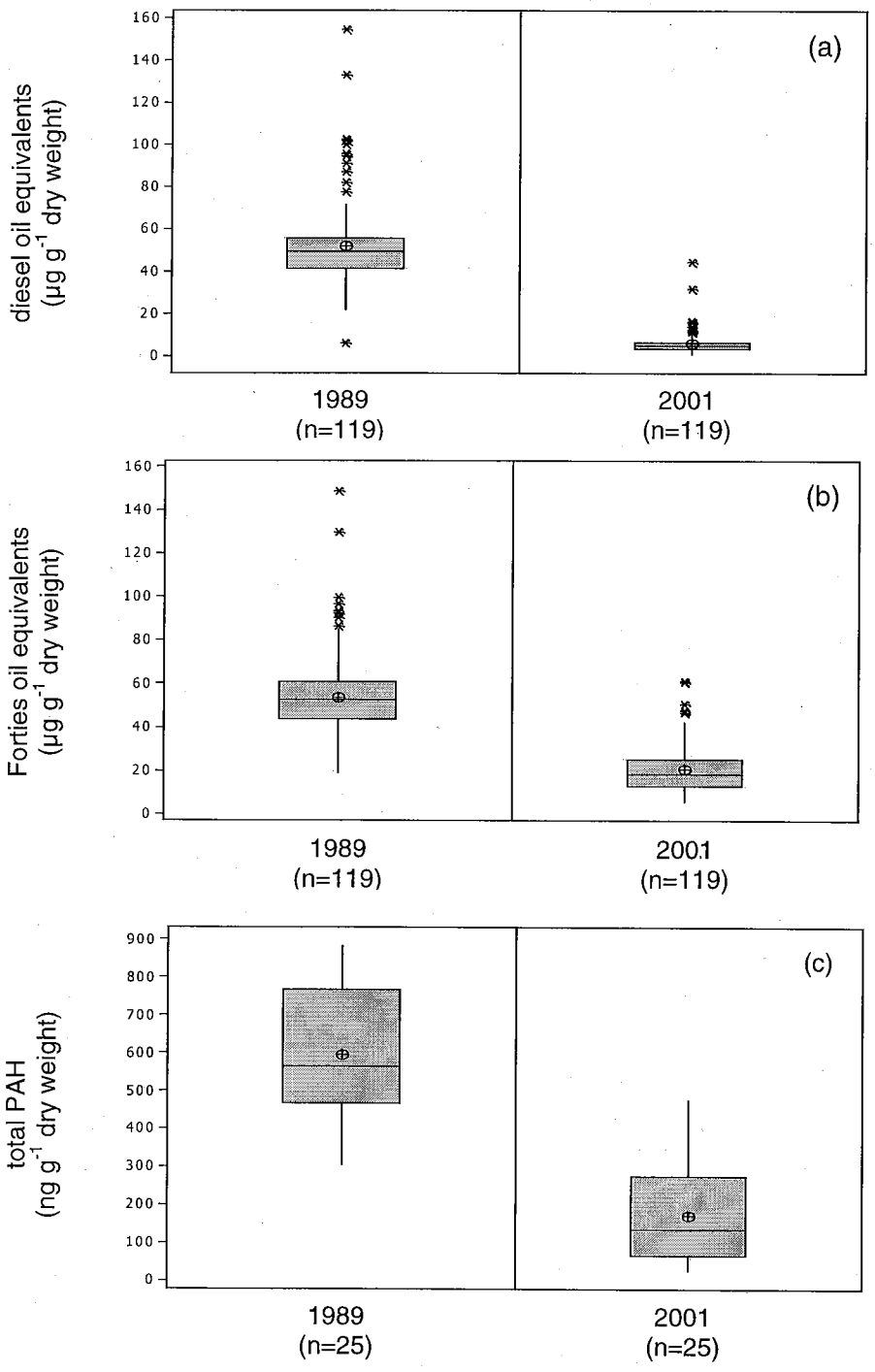
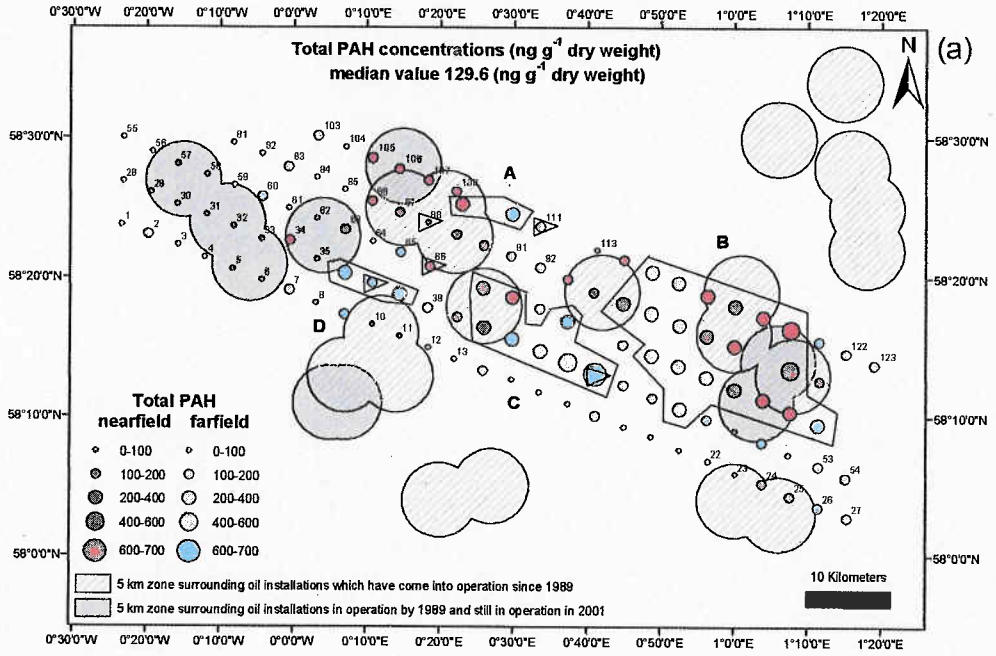


Figure 8 Total PAHs (ng g^{-1} dry weight) for (a) the 2001 sediments and (b) the 25 sites common to 2001 and 1989. Circles are proportional to concentrations. Sample sites are labelled with a common site number. The 2001 core and replicate Day Grab sites (sites 37, 46, 66, 88 & 111) are enclosed in open triangles. The sites analysed for PAHs in 1989 are listed in Table 4. See text for discussion of outlined areas A-D.



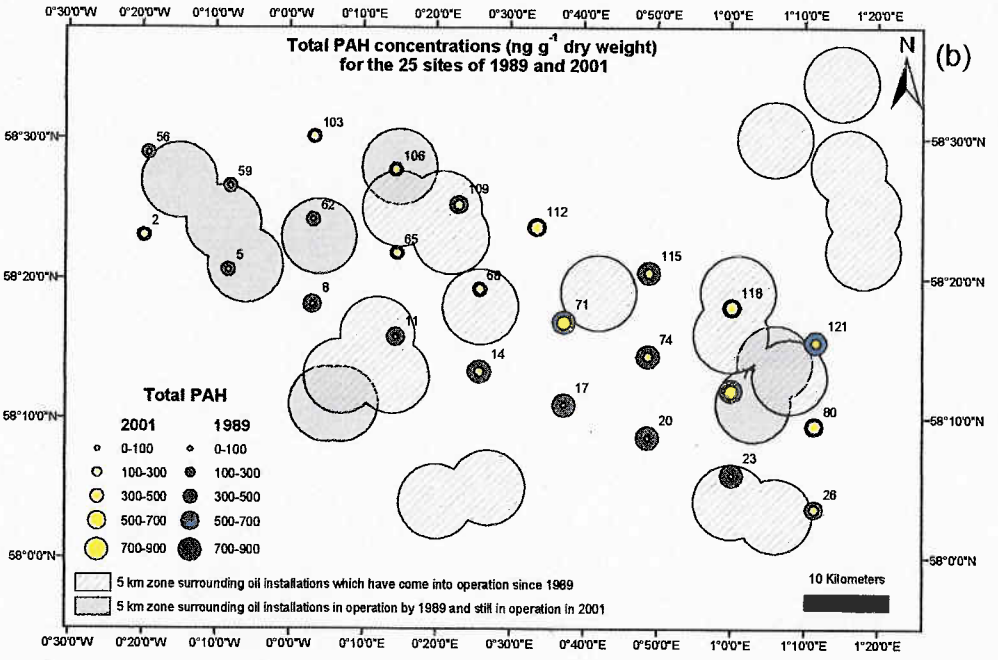
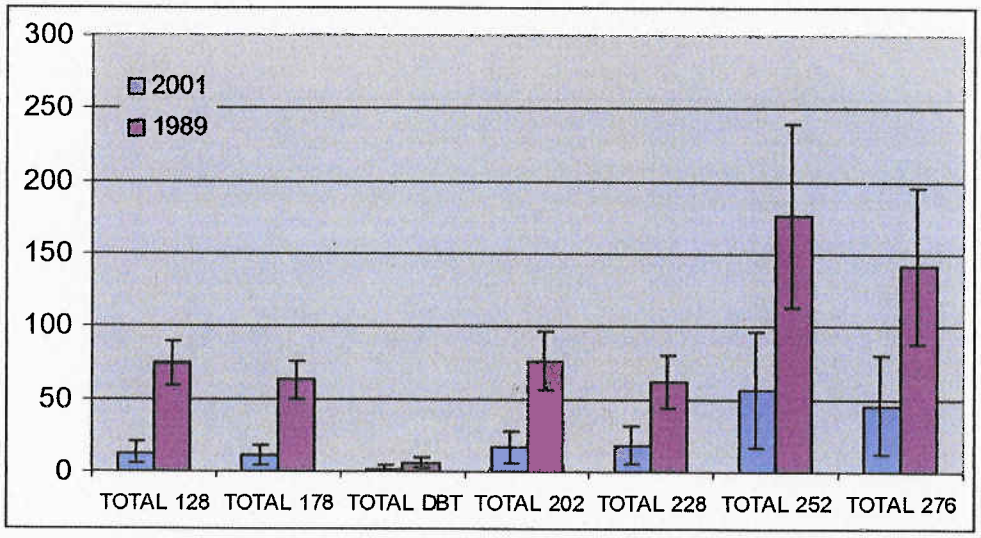
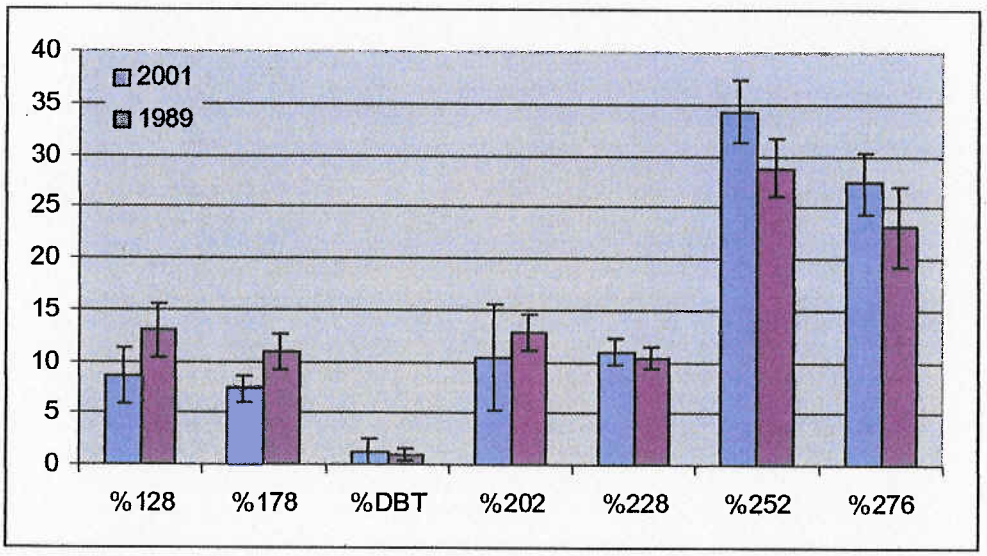


Figure 9 Mean PAH values for sediments collected in 1989 and 2001 from the same sites (n=24), represented by ring classes, (a) concentrations (ng g^{-1} dry weight) and (b) percentages of the total PAH. Error bars represent the standard deviation from the mean.



(a)

Total 128, naphthalenes (parent and C_1-C_4); total 178, phenanthrene/anthracene (parent and C_1-C_3); total DBT, dibenzothiophenes (parent and C_1-C_3); total 202, fluoranthene/pyrene (parent and C_1-C_3); total 228, benzanthracenes/ benzophenanthrenes/ chrysene/ triphenylenes (parent and C_1-C_2); total 252, benzofluoranthene/benzopyrene/perylene (parent and C_1-C_2) and total 276, indenopyrene/benzoperylene (parent and C_1-C_2).

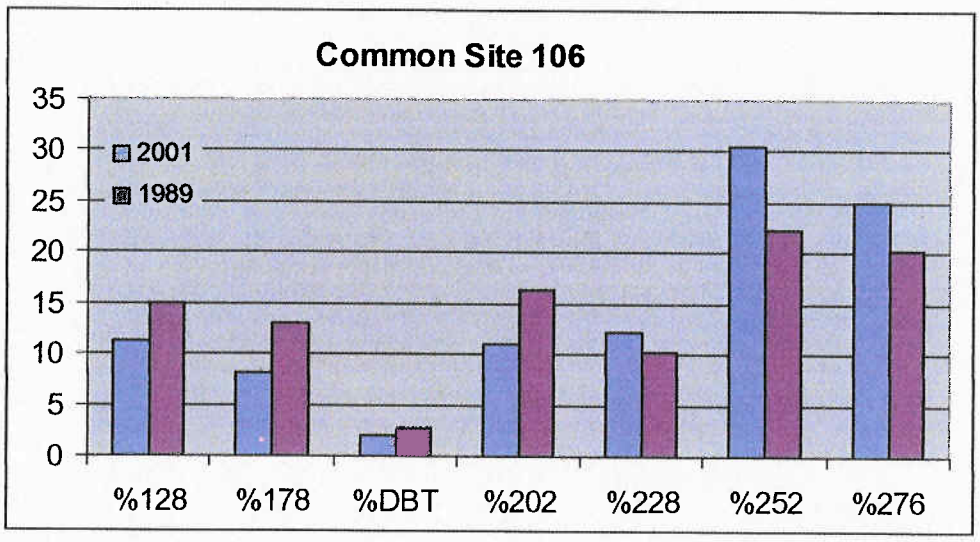


(b)

%128, naphthalenes (parent and C_1-C_4); %178, phenanthrene/anthracene (parent and C_1-C_3); %DBT, dibenzothiophenes (parent and C_1-C_3); %202, fluoranthene/pyrene (parent and C_1-C_3); %228, benzanthracenes/ benzophenanthrenes/ chrysene/ triphenylenes (parent and C_1-C_2); %252, benzofluoranthene/benzopyrene/perylene (parent and C_1-C_2) and %276, indenopyrene/benzoperylene (parent and C_1-C_2).

Total and %128 2-ring PAH; Total and %178 and DBT - 3-ring PAH; Total and %202 and 228 - 4-ring PAH; Total and % 252 - 5-ring PAH; Total and % 276 6-ring PAH.

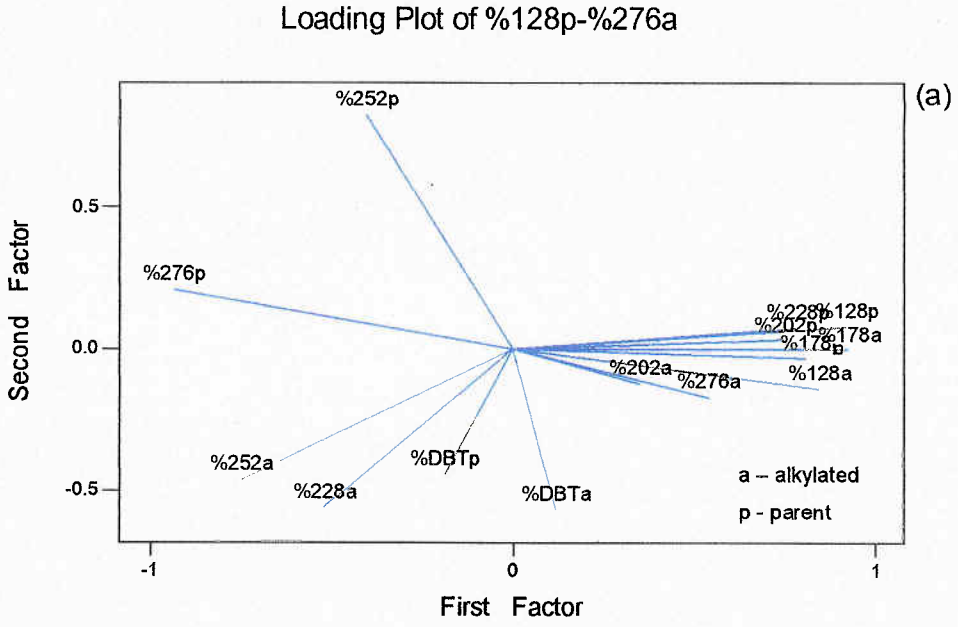
Figure 10 PAH profiles for common site 106, the site closest to location of the former Piper Alpha platform. Note that the 2- and 3-ring (%128, %178 & %DBT) compounds are more predominant in 1989, but that overall the 5- and 6-ring (%252 & %276) PAHs, which indicate a more pyrolytic input, predominate in both years.



%128, naphthalenes (parent and C_1-C_4); %178, phenanthrene/anthracene (parent and C_1-C_3); %DBT, dibenzothiophenes (parent and C_1-C_3); %202, fluoranthene/pyrene (parent and C_1-C_3); %228, benzanthracenes/ benzophenanthrenes/ chrysene/ triphenylenes (parent and C_1-C_2); %252, benzofluoranthene/benzopyrene/perylene (parent and C_1-C_2) and %276, indenopyrene/benzoperylene (parent and C_1-C_2).

%128 2-ring PAH; %178 and %DBT – 3-ring PAH; %202 and %228 - 4-ring PAH; % 252 - 5-ring PAH; %276 - 6-ring PAH.

Figure 11 Principal component analysis of the 1989 *vs* 2001 PAH (for the common 25 sites), by ring group, parent and alkylated (a) loading plot, showing the 2- and 3- ring compounds with a positive first factor, and the 5- and 6-ring with a negative first factor, (b) the 1989 vs 2001 samples (the outlier in the 2001 area is for site 112, with high perylene and benzoperylene). The 1989 samples all scored positively on factor 1, indicating a higher proportion of 2- and 3-ring PAHs and the 2001 samples have a higher proportion of the 5- and 6-ring PAHs.



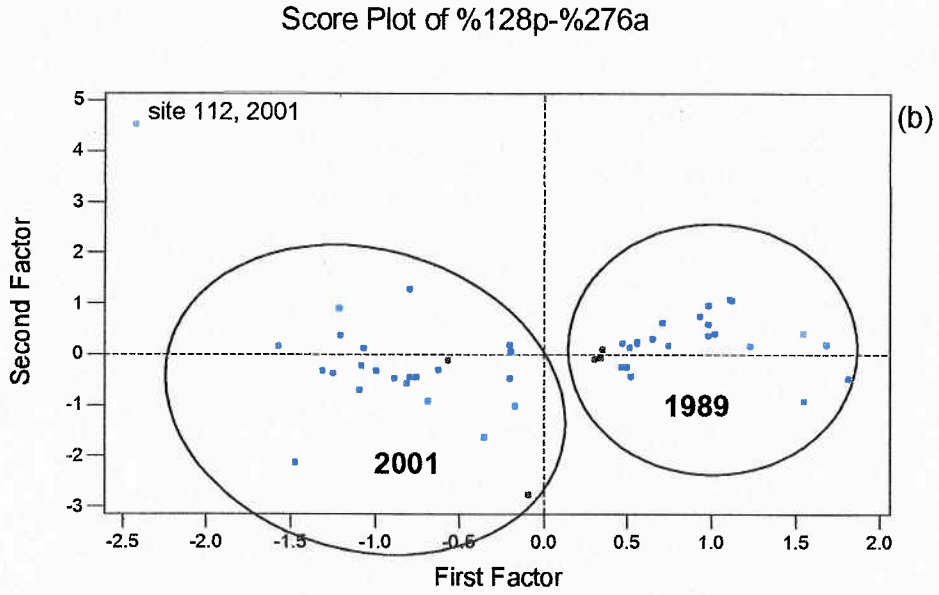


Figure 12 PAH concentration ratios used to assess the sources of PAHs in the Fladen Ground sediments collected in 2001. The zones identified by high fluoranthene/pyrene (Fl/Py) ratios and low phenathrene/anthracene (P/A) ratios and high Fl/Py and low methylphenanthrene/phenanthrene (MP/P) ratios are characteristic of pyrolytic PAHs. **(a)** Plot of Fl/Py ratios against P/A ratios **(b)** Plot of Fl/Py ratios against MP/P ratios.

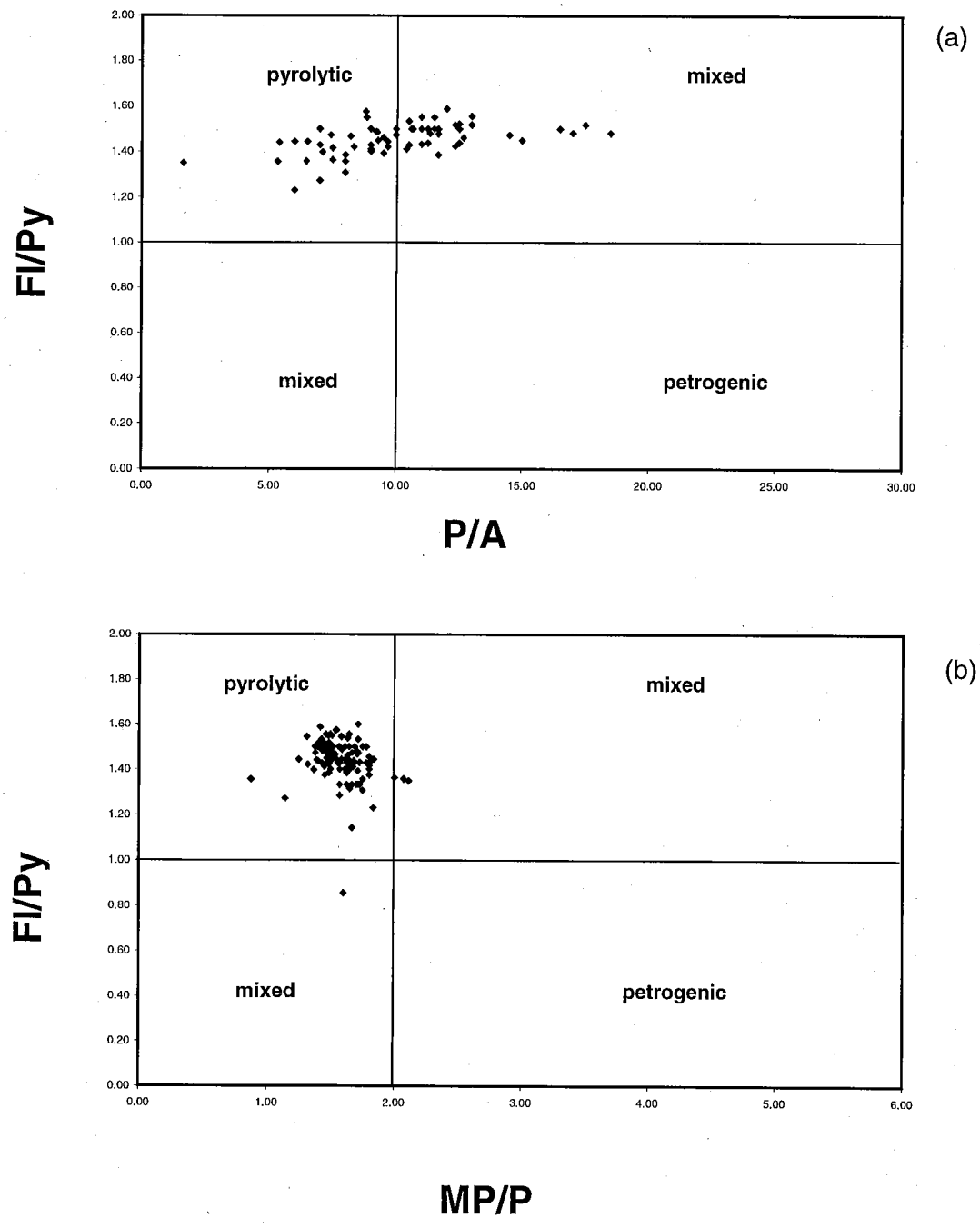


Figure 13 (a) Total *n*-alkanes (nC_{12} – nC_{33} ng g^{-1} dry weight) for the 2001 sediments and (b) for the 25 sites common to 2001 and 1989. Circles are proportional to concentrations. Sample sites are labelled with a common site number. The 2001 replicate Day Grab sites (sites 37, 46, 66, 88 & 111) are enclosed in open triangles. The 25 sites analysed for *n*-alkanes in 1989 are listed in Table 6.

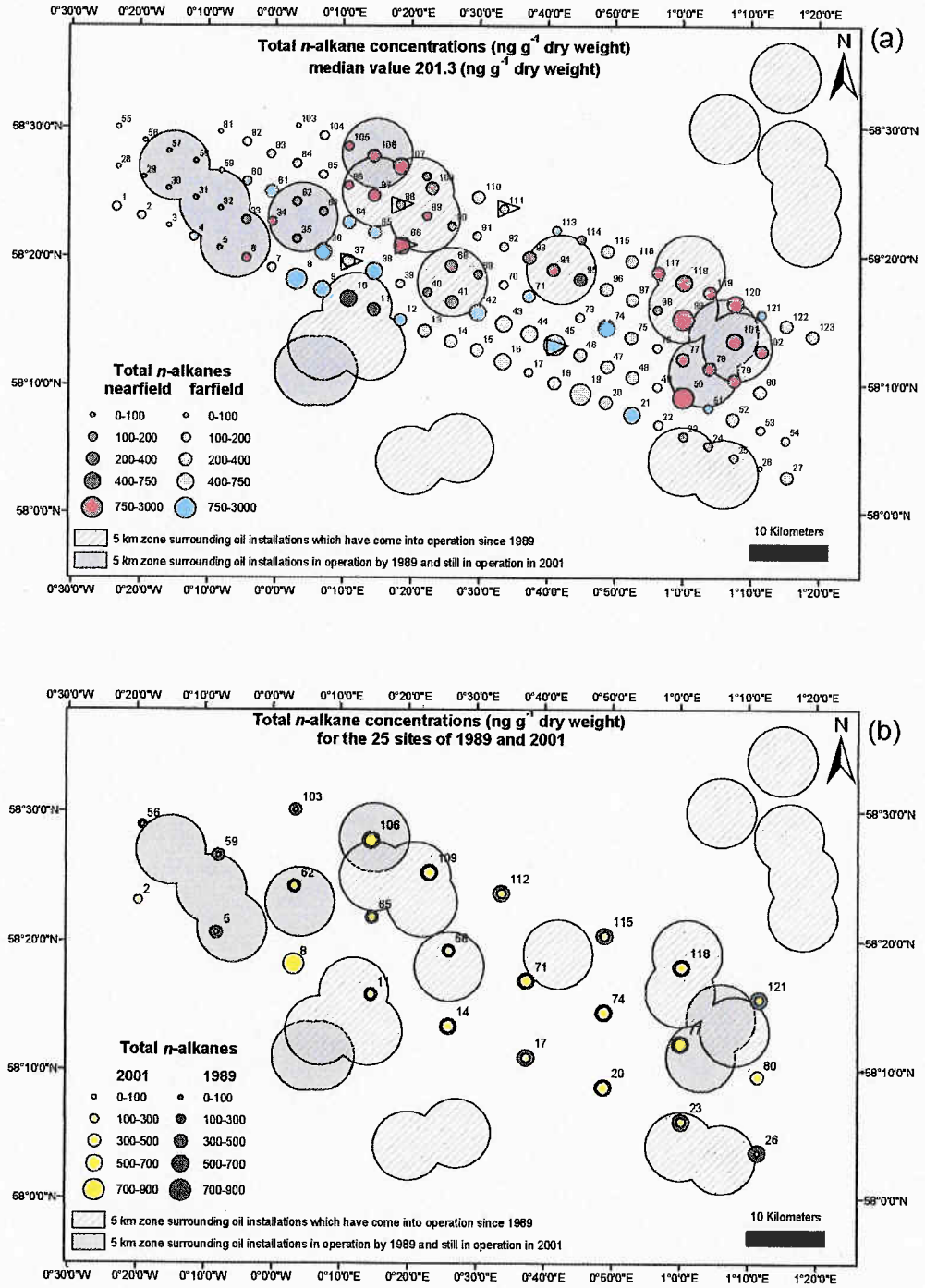
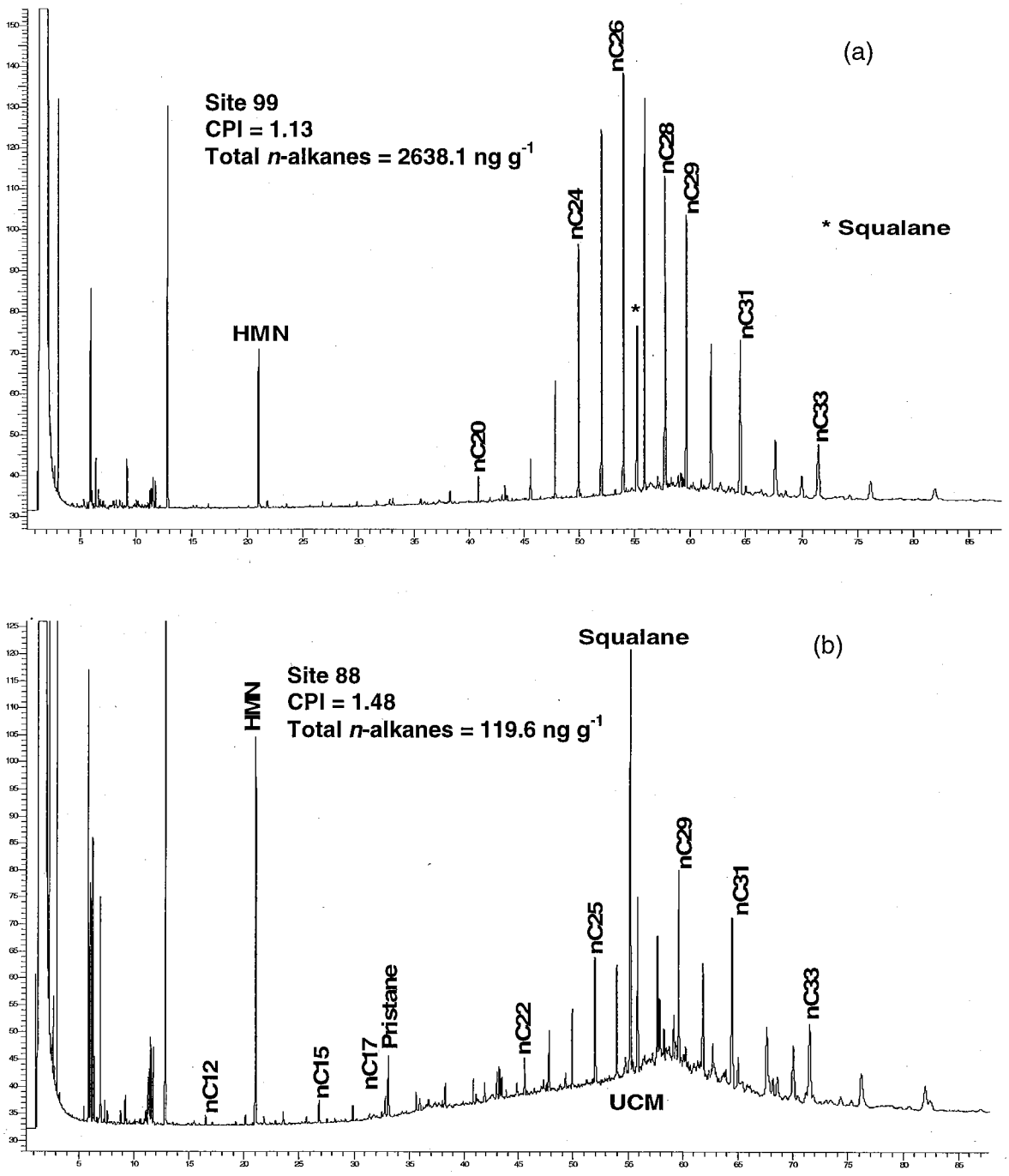


Figure 14 The aliphatic hydrocarbon profiles of sediment samples from common site numbers (a) 99 and (b) 88. Note the bimodal unresolved complex mixture in (b) which suggests petrogenic contamination at this site. Also note the difference in the total *n*-alkane concentration, which is much higher for site 99. The internal standards were squalane and heptamethylnonane (HMN). Squalane was used for quantification.



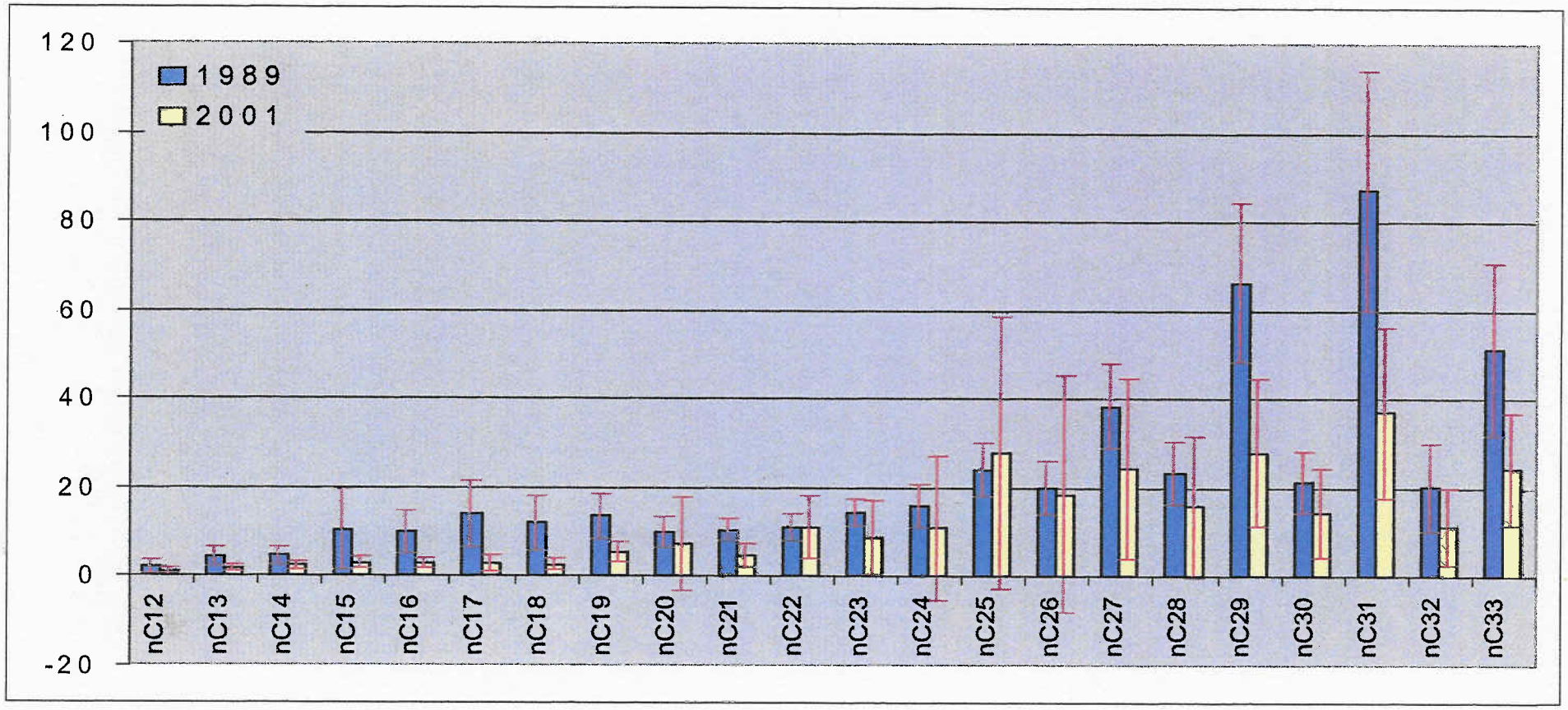
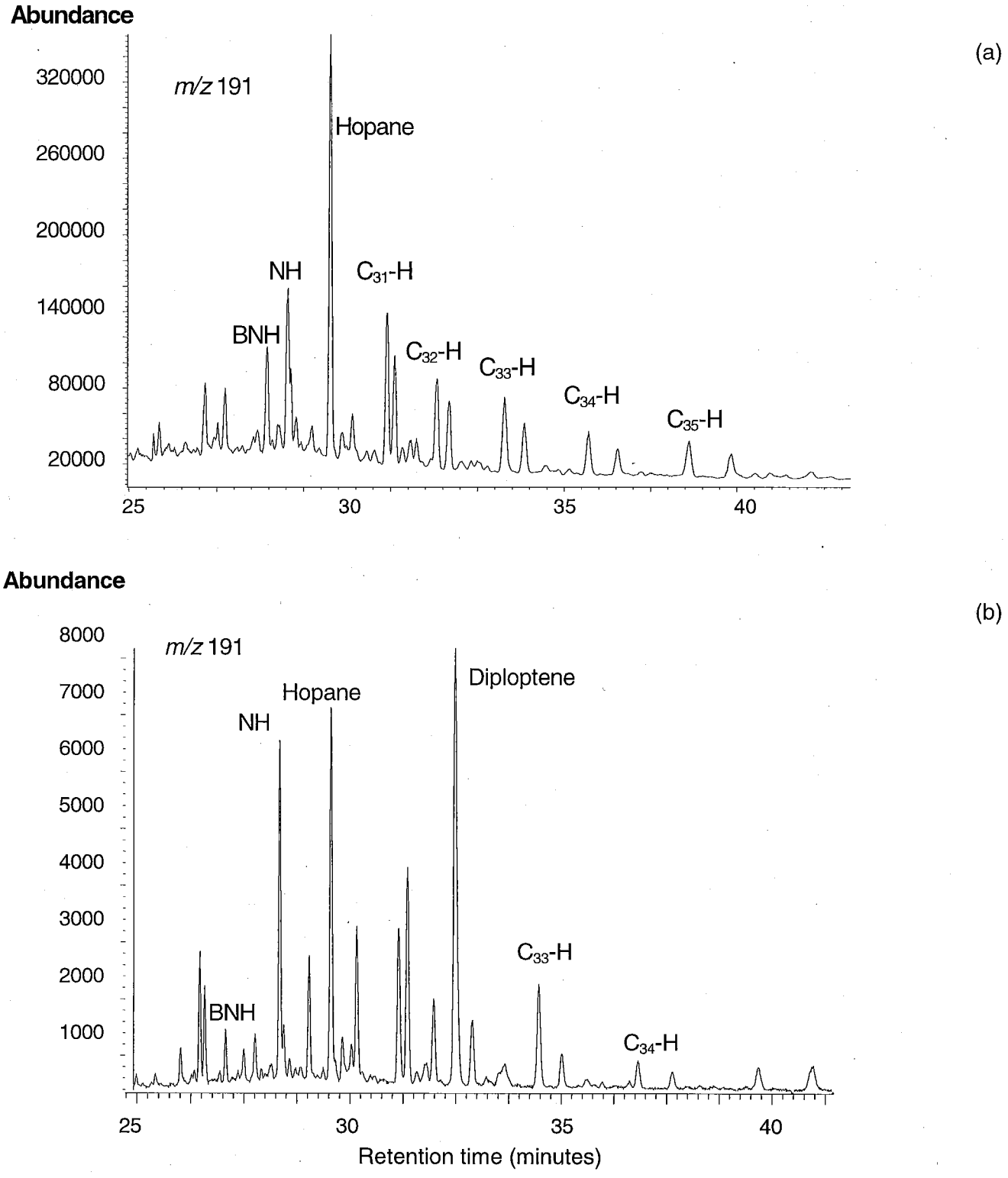
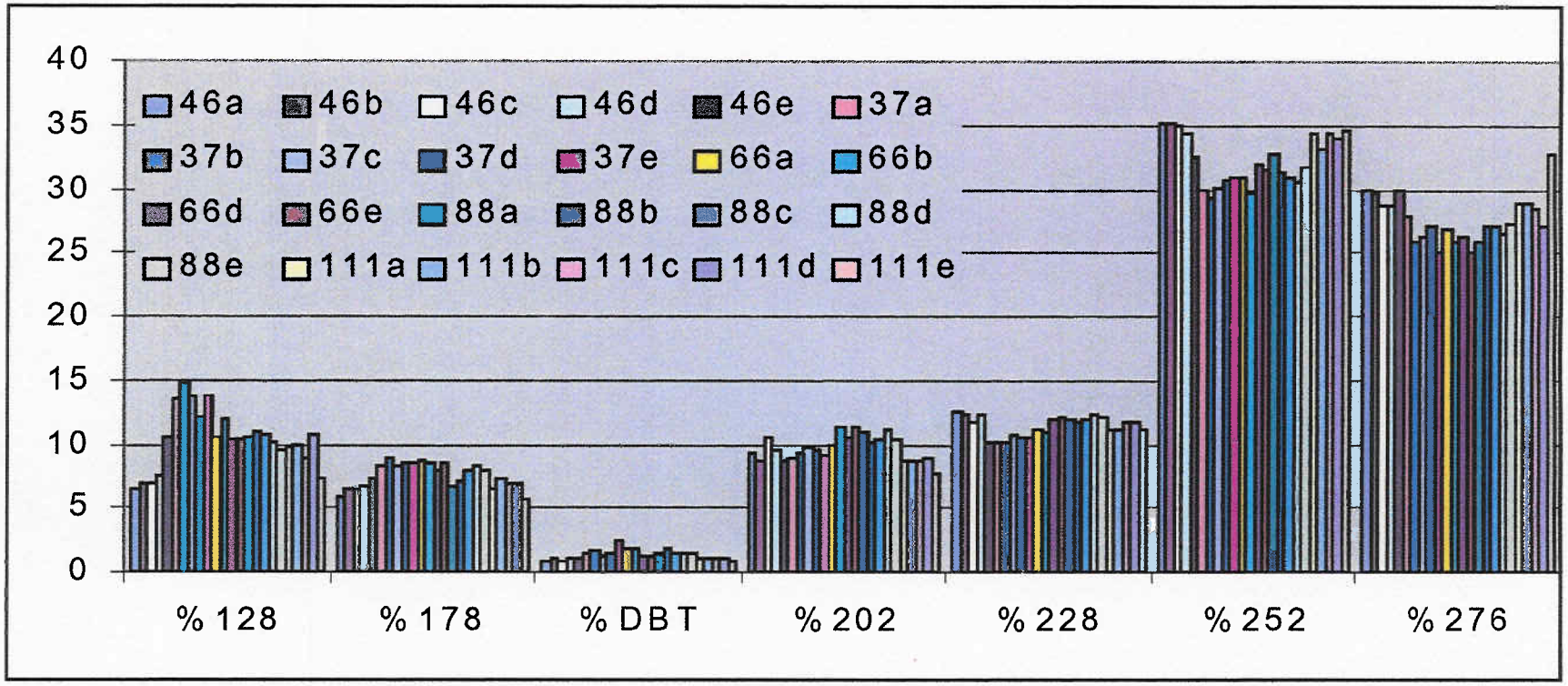


Figure 15 Mean concentration (ng g^{-1} dry weight) of the *n*-alkanes from the 25 corresponding sites sampled in 1989 and 2001. Note the reduction in total *n*-alkanes from 1989 to 2001 and also the low molecular weight *n*-alkanes with no odd-even preference in the 2001 sediments. Error bars represent the standard deviation from the mean.

Figure 16 (a) Triterpane profile of Gulfaks crude oil containing C_{29} hopane (NH), hopane and the doublet peaks due to the C_{31}-C_{35} homohopane diasteroisomers (C_{31}-H to C_{35}-H). The North Sea oil specific marker bisnorhopane (BNH) can also be seen. (b) Triterpane profile of a typical sediment collected from the Fladen Ground in 2001. The high ratio of C_{29} hopane to hopane and the small bisnorhopane (BNH) peak indicate the contamination is due to a combination of North Sea and Middle Eastern crude oils.





%128, naphthalenes (parent and C_1-C_4); %178, phenanthrene/anthracene (parent and C_1-C_3); %DBT, dibenzothiophenes (parent and C_1-C_3); %202, fluoranthene/pyrene (parent and C_1-C_3); %228, benzanthracenes/ benzophenanthrenes/ chrysene/ triphenylenes (parent and C_1-C_2); %252, benzofluoranthene/benzopyrene/perylene (parent and C_1-C_2) and %276, indenopyrene/benzoperylene (parent and C_1-C_2).

Figure 17 PAH profiles for the 2001 replicate Day Grab samples. Note the predominance of the 5- and 6-ring (%252 & %276) PAHs, which indicate a more pyrolytic input. Numbers are site numbers, letters indicate the replicate sampling order.

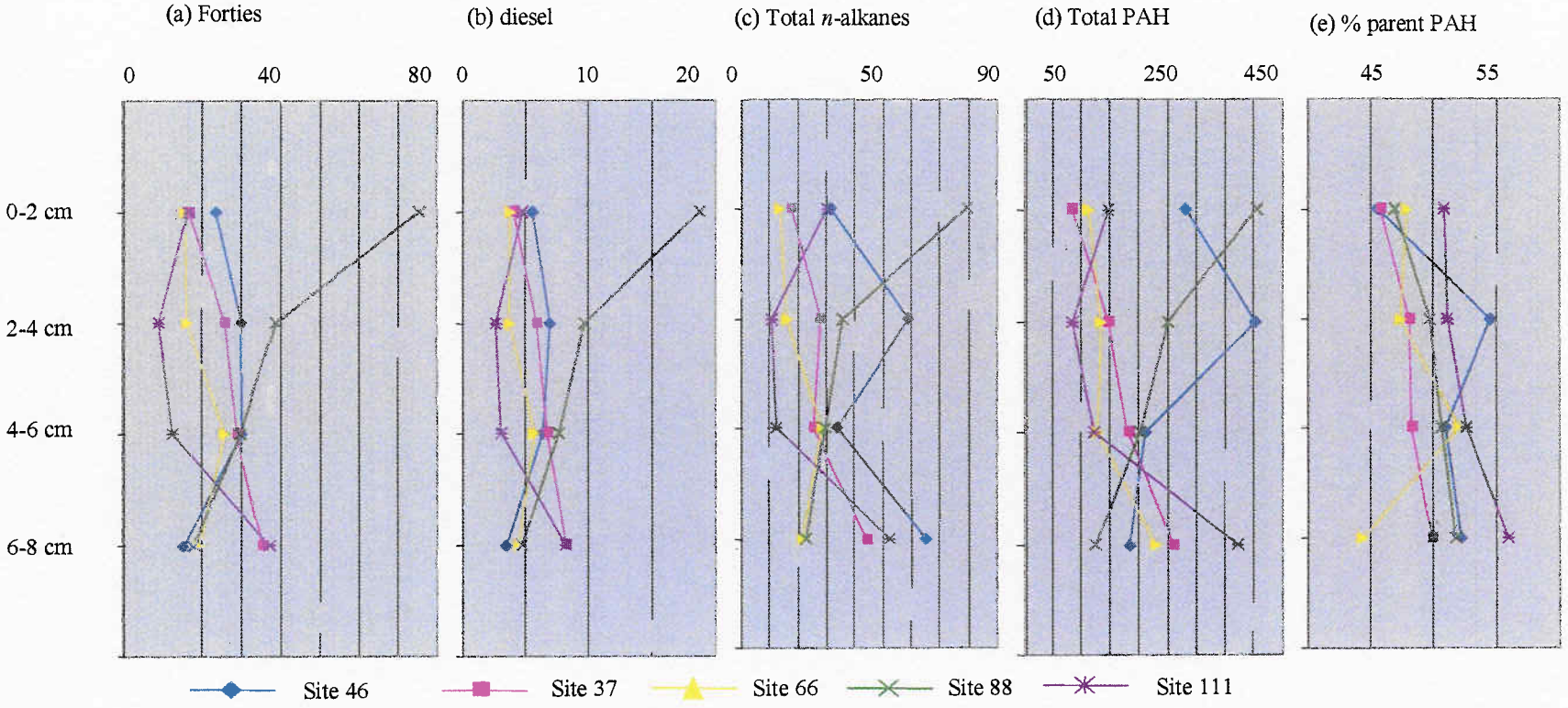
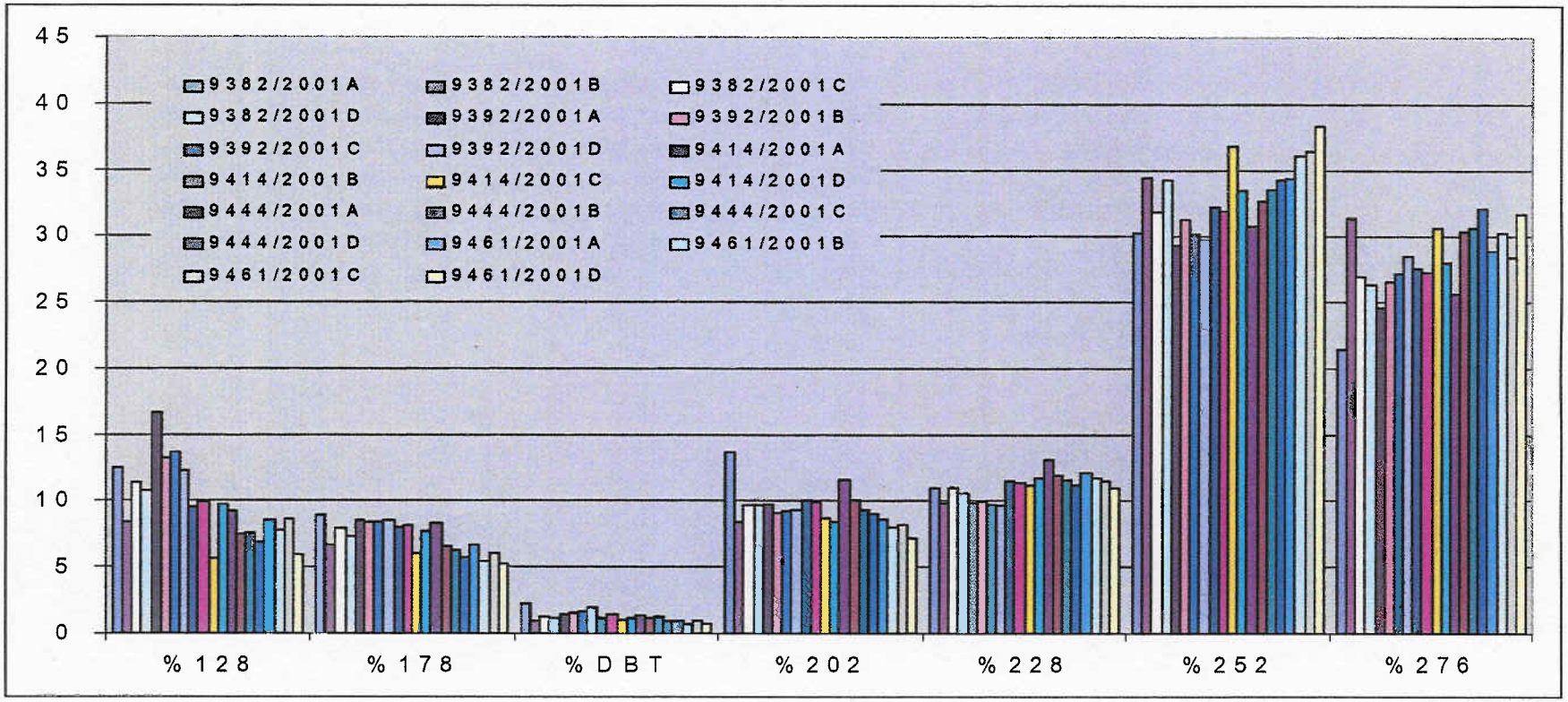


Figure 18 Concentrations of (a) Forties (µg g^{-1} dry weight), (b) diesel oil equivalents (µg g^{-1} dry weight), (c) total *n*-alkanes (µg g^{-1} dry weight), (d) total PAH (ng g^{-1} dry weight), **(e)** % parent PAH, for all the core samples of the 2001 surve``y.



%128, naphthalenes (parent and C_1-C_4); %178, phenanthrene/anthracene (parent and C_1-C_3); %DBT, dibenzothiophenes (parent and C_1-C_3); %202, fluoranthene/pyrene (parent and C_1-C_3); %228, benzanthracenes/ benzophenanthrenes/ chrysene/ triphenylenes (parent and C_1-C_2); %252, benzofluoranthene/benzopyrene/perylene (parent and C_1-C_2) and %276, indenopyrene/benzoperylene (parent and C_1-C_2).

Figure 19 PAH profiles for the 2001 core samples. Note the predominance of the 5- and 6-ring (%252 & %276) PAHs, which indicate a more pyrolytic input. A = 0-2 cm; B = 2-4 cm; C = 4-6 cm; D = 6-8 cm.

Appendix 1

Sediment sample site positions and numbering

Sample number	Common site number[a]	Sampling equipment	Latitude	Longitude
9346/01	1	Day Grab	58 23.78N	000 23.42W
9347/01	2	Day Grab	58 23.10N	000 19.81W
9348/01	3	Day Grab	58 22.37N	000 15.72W
9349/01	4	Day Grab	58 21.48N	000 12.05W
9350/01	5	Day Grab	58 20.65N	000 08.29W
9351/01	6	Day Grab	58 19.85N	000 04.36W
9352/01	7	Day Grab	58 19.10N	000 00.64W
9353/01	8	Day Grab	58 18.17N	000 03.05E
9354/01	9	Day Grab	58 17.38N	000 06.89E
9355/01	10	Day Grab	58 16.67N	000 10.79E
9356/01	11	Day Grab	58 15.83N	000 14.52E
9357/01	12	Day Grab	58 15.01N	000 18.39E
9358/01	13	Day Grab	58 14.18N	000 21.96E
9359/01	14	Day Grab	58 13.33N	000 25.84E
9360/01	15	Day Grab	58 12.68N	000 29.67E
9361/01	16	Day Grab	58 11.77N	000 33.41E
9362/01	17	Day Grab	58 10.93N	000 37.26E
9363/01	18	Day Grab	58 10.10N	000 41.05E
9364/01	19	Day Grab	58 09.28N	000 41.91E
9365/01	20	Day Grab	58 08.61N	000 48.63E
9366/01	21	Day Grab	58 07.64N	000 52.53E
9367/01	22	Day Grab	58 06.86N	000 56.42E
9368/01	23	Day Grab	58 05.92N	001 00.10E
9369/01	24	Day Grab	58 05.20N	001 03.77E
9370/01	25	Day Grab	58 04.26N	001 07.50E
9371/01	26	Day Grab	58 03.47N	001 11.32E
9372/01	27	Day Grab	58 02.72N	001 15.29E
9373/01	54	Day Grab	58 05.62N	001 15.10E
9374/01	53	Day Grab	58 06.44N	001 11.40E
9375/01	52	Day Grab	58 07.31N	001 07.33E
9376/01	51	Day Grab	58 08.14N	001 03.79E
9377/01	50	Day Grab	58 08.99N	001 00.00E
9378/01	49	Day Grab	58 09.81N	000 56.21E
9379/01	48	Day Grab	58 10.56N	000 52.59E
9380/01	47	Day Grab	58 11.36N	000 48.81E
9381/01A	46	Day Grab	58 12.30N	000 44.83E
9381/01B	46	Day Grab	58 12.31N	000 44.84E
9381/01C	46	Day Grab	58 12.31N	000 44.83E
9381/01D	46	Day Grab	58 12.31N	000 44.83E
9381/01E	46	Day Grab	58 12.31N	000 44.83E
9382/01A	46	MULTI-CORER	58 12.32N	000 44.82E
9382/01B	46	MULTI-CORER	58 12.32N	000 44.82E
9382/01C	46	MULTI-CORER	58 12.32N	000 44.82E
9382/01D	46	MULTI-CORER	58 12.32N	000 44.82E
9383/01	45	Day Grab	58 13.10N	000 41.04E

[a] Sites 37, 46, 66, 88 and 111 have replicate grabs (A, B, C, D, E) and cores (A 0-2 cm; B 2-4 cm; C 4-6 cm ; D 6-8 cm)

Sample number	Common site number	Sampling equipment	Latitude	Longitude
9384/01	44	Day Grab	58 13.95N	000 37.35E
9385/01	43	Day Grab	58 14.73N	000 33.59E
9386/01	42	Day Grab	58 15.61N	000 29.80E
9387/01	41	Day Grab	58 16.43N	000 25.96E
9388/01	40	Day Grab	58 17.19N	000 22.32E
9389/01	39	Day Grab	58 17.84N	000 18.32E
9390/01	38	Day Grab	58 18.83N	000 14.52E
9391/01A	37	Day Grab	58 19.62N	000 10.78E
9391/01B	37	Day Grab	58 19.62N	000 10.80E
9391/01C	37	Day Grab	58 19.62N	000 10.82E
9391/01D	37	Day Grab	58 19.61N	000 10.81E
9391/01E	37	Day Grab	58 19.61N	000 10.83E
9392/01A	37	MULTI-CORER	58 19.61N	000 10.83E
9392/01B	37	MULTI-CORER	58 19.61N	000 10.83E
9392/01C	37	MULTI-CORER	58 19.61N	000 10.83E
9392/01D	37	MULTI-CORER	58 19.61N	000 10.83E
9393/01	36	Day Grab	58 20.34N	000 07.05E
9394/01	35	Day Grab	58 21.32N	000 03.18E
9395/01	34	Day Grab	58 22.68N	000 00.56W
9396/01	33	Day Grab	58 22.81N	000 04.39W
9397/01	32	Day Grab	58 23.71N	000 08.18W
9398/01	31	Day Grab	58 24.54N	000 11.83W
9399/01	30	Day Grab	58 25.29N	000 15.82W
9400/01	29	Day Grab	58 26.14N	000 19.43W
9401/01	28	Day Grab	58 26.92N	000 23.17W
9402/01	55	Day Grab	58 30.05N	000 23.14W
9403/01	56	Day Grab	58 29.02N	000 19.20W
9404/01	57	Day Grab	58 28.17N	000 15.73W
9405/01	58	Day Grab	58 27.41N	000 11.73W
9406/01	59	Day Grab	58 26.64N	000 08.02W
9407/01	60	Day Grab	58 25.83N	000 04.26W
9408/01	61	Day Grab	58 25.01N	000 00.65W
9409/01	62	Day Grab	58 24.25N	000 03.20E
9410/01	63	Day Grab	58 23.45N	000 07.08E
9411/01	64	Day Grab	58 22.62N	000 10.88E
9412/01	65	Day Grab	58 21.84N	000 14.68E
9413/01A	66	Day Grab	58 20.83N	000 18.68E
9413/01B	66	Day Grab	58 20.83N	000 18.68E
9413/01D	66	Day Grab	58 20.83N	000 18.68E
9413/01E	66	Day Grab	58 20.83N	000 18.68E
9414/01A	66	MULTI-CORER	58 20.83N	000 18.68E
9414/01B	66	MULTI-CORER	58 20.83N	000 18.68E
9414/01C	66	MULTI-CORER	58 20.83N	000 18.68E
9414/01D	66	MULTI-CORER	58 20.83N	000 18.68E

[a] Sites 37, 46, 66, 88 and 111 have replicate grabs (A, B, C, D, E) and cores (A 0-2 cm; B 2-4 cm; C 4-6 cm ; D 6-8 cm)

Sample number	Common site number	Sampling equipment	Latitude	Longitude
9416/01	68	Day Grab	58 19.25N	000 25.88E
9417/01	69	Day Grab	58 18.59N	000 29.85E
9418/01	70	Day Grab	58 17.77N	000 33.51E
9419/01	71	Day Grab	58 16.89N	000 37.29E
9421/01	73	Day Grab	58 15.24N	000 44.80E
9422/01	74	Day Grab	58 14.43N	000 48.71E
9423/01	75	Day Grab	58 13.68N	000 52.40E
9424/01	76	Day Grab	58 12.86N	000 56.22E
9425/01	77	Day Grab	58 11.99N	000 59.99E
9426/01	78	Day Grab	58 11.24N	001 03.89E
9427/01	79	Day Grab	58 10.34N	001 07.58E
9428/01	80	Day Grab	58 09.43N	001 11.33E
9429/01	102	Day Grab	58 12.60N	001 11.57E
9430/01	101	Day Grab	58 13.39N	001 07.62E
9431/01	100	Day Grab	58 14.06N	001 03.18E
9432/01	99	Day Grab	58 15.10N	001 00.01E
9433/01	98	Day Grab	58 15.85N	000 56.25E
9434/01	97	Day Grab	58 16.60N	000 52.55E
9435/01	96	Day Grab	58 17.48N	000 48.70E
9436/01	95	Day Grab	58 18.19N	000 44.86E
9437/01	94	Day Grab	58 18.95N	000 40.88E
9438/01	93	Day Grab	58 19.91N	000 37.35E
9439/01	92	Day Grab	58 20.75N	000 33.61E
9440/01	91	Day Grab	58 21.55N	000 29.69E
9441/01	90	Day Grab	58 22.33N	000 25.97E
9442/01	89	Day Grab	58 23.11N	000 22.27E
9443/01A	88	Day Grab	58 23.98N	000 18.37E
9443/01B	88	Day Grab	58 23.98N	000 18.37E
9443/01C	88	Day Grab	58 23.98N	000 18.37E
9443/01D	88	Day Grab	58 23.98N	000 18.37E
9443/01E	88	Day Grab	58 23.98N	000 18.37E
9444/01A	88	MULTI-CORER	58 23.97N	000 18.37E
9444/01B	88	MULTI-CORER	58 23.97N	000 18.37E
9444/01C	88	MULTI-CORER	58 23.97N	000 18.37E
9444/01D	88	MULTI-CORER	58 23.97N	000 18.37E
9445/01	87	Day Grab	58 24.70N	000 14.55E
9446/01	86	Day Grab	58 25.50N	000 10.75E
9447/01	85	Day Grab	58 26.32N	000 07.02E
9448/01	84	Day Grab	58 27.20N	000 03.18E
9449/01	83	Day Grab	58 27.93N	000 00.69W
9450/01	82	Day Grab	58 28.89N	000 04.31W
9451/01	81	Day Grab	58 29.67N	000 08.18W
9452/01	103	Day Grab	58 30.15N	000 03.35E
9453/01	104	Day Grab	58 29.37N	000 07.14E
9454/01	105	Day Grab	58 28.57N	000 10.83E

[a] Sites 37, 46, 66, 88 and 111 have replicate grabs (A, B, C, D, E) and cores (A 0-2 cm; B 2-4 cm; C 4-6 cm ; D 6-8 cm)

Sample number	Common site number	Sampling equipment	Latitude	Longitude
9455/01	106	Day Grab	58 27.81N	000 14.51E
9456/01	107	Day Grab	58 26.99N	000 18.47E
9457/01	108	Day Grab	58 26.19N	000 22.23E
9458/01	109	Day Grab	58 25.30N	000 22.99E
9459/01	110	Day Grab	58 24.56N	000 29.84E
9460/01A	111	Day Grab	58 23.68N	000 33.60E
9460/01B	111	Day Grab	58 23.68N	000 33.60E
9460/01C	111	Day Grab	58 23.68N	000 33.59E
9460/01D	111	Day Grab	58 23.68N	000 33.58E
9460/01E	111	Day Grab	58 23.68N	000 33.58E
9461/01A	111	MULTI-CORER	58 23.69N	000 33.58E
9461/01B	111	MULTI-CORER	58 23.69N	000 33.58E
9461/01C	111	MULTI-CORER	58 23.69N	000 33.58E
9461/01D	111	MULTI-CORER	58 23.69N	000 33.58E
9462/01	112	Day Grab	58 23.69N	000 33.58E
9463/01	113	Day Grab	58 22.01N	000 41.31E
9464/01	114	Day Grab	58 21.29N	000 45.00E
9465/01	115	Day Grab	58 20.41N	000 48.86E
9466/01	116	Day Grab	58 19.64N	000 52.44E
9467/01	117	Day Grab	58 18.75N	000 56.36E
9468/01	118	Day Grab	58 17.96N	001 00.14E
9469/01	119	Day Grab	58 17.20N	001 03.98E
9470/01	120	Day Grab	58 16.33N	001 07.69E
9471/01	121	Day Grab	58 15.44N	001 11.53E
9472/01	122	Day Grab	58 14.58N	001 15.21E
9473/01	123	Day Grab	58 13.77N	001 19.09E

[a] Sites 37, 46, 66, 88 and 111 have replicate grabs (A, B, C, D, E) and cores (A 0-2 cm; B 2-4 cm; C 4-6 cm ; D 6-8 cm)

Appendix 2

UVF oil equivalent concentrations (µg g^{-1} dry weight) of sediment samples collected from the Fladen Ground in 2001.

Sample Number	Common site number[a]	Forties µg g^{-1} dry wt	Diesel µg g^{-1} dry wt	Sample number	Common site number[a]	Forties µg g^{-1} dry wt	Diesel µg g^{-1} dry wt
9346/2001	1	15.10	11.55	*9381/2001C*	*46*	*10.66*	*3.05*
9347/2001	2	11.73	3.12	*9381/2001D*	*46*	*14.13*	*3.75*
9348/2001	3	11.94	3.85	*9381/2001E*	*46*	*40.89*	*8.68*
9349/2001	4	12.16	7.05	**9382/2001A**	**46**	**23.47**	**5.55**
9350/2001	5	6.77	3.98	**9382/2001B**	**46**	**29.71**	**6.91**
9351/2001	6	7.83	4.13	**9382/2001C**	**46**	**29.88**	**6.32**
9352/2001	7	21.15	7.01	**9382/2001D**	**46**	**14.82**	**3.47**
9353/2001	8	14.90	6.64	9383/2001	45	47.57	9.76
9354/2001	9	34.56	10.08	9384/2001	44	42.04	6.97
9355/2001	10	23.71	7.60	9385/2001	43	32.40	7.31
9356/2001	11	22.34	12.64	9386/2001	42	18.35	4.59
9357/2001	12	32.33	44.51	9387/2001	41	18.24	4.42
9358/2001	13	28.97	32.37	9388/2001	40	14.69	3.63
9359/2001	14	26.37	10.07	9389/2001	39	19.79	5.33
9360/2001	15	13.15	5.99	9390/2001	38	60.62	16.07
9361/2001	16	18.48	5.95	*9391/2001A*	*37*	*36.47*	*8.77*
9362/2001	17	11.64	4.39	*9391/2001B*	*37*	*35.00*	*8.43*
9363/2001	18	8.63	3.95	*9391/2001C*	*37*	*44.88*	*10.43*
9364/2001	19	16.35	8.44	*9391/2001D*	*37*	*41.25*	*9.65*
9365/2001	20	13.89	4.56	*9391/2001E*	*37*	*13.15*	*3.53*
9366/2001	21	10.77	4.58	**9392/2001A**	**37**	**16.15**	**3.97**
9367/2001	22	10.50	4.82	**9392/2001B**	**37**	**25.38**	**5.86**
9368/2001	23	10.64	4.77	**9392/2001C**	**37**	**28.60**	**6.58**
9369/2001	24	12.01	4.67	**9392/2001D**	**37**	**35.07**	**8.15**
9370/2001	25	26.33	7.68	9393/2001	36	50.22	11.59
9371/2001	26	6.77	3.11	9394/2001	35	21.54	5.39
9372/2001	27	12.90	4.26	9395/2001	34	22.05	5.17
9373/2001	54	16.03	5.04	9396/2001	33	11.01	2.87
9374/2001	53	13.13	4.34	9397/2001	32	7.97	2.12
9375/2001	52	32.35	8.77	9398/2001	31	8.31	2.26
9376/2001	51	11.20	3.76	9399/2001	30	14.23	3.39
9377/2001	50	18.03	5.38	9400/2001	29	5.50	1.51
9378/2001	49	10.19	3.76	9401/2001	28	6.17	1.78
9379/2001	48	19.34	5.30	9402/2001	55	5.62	1.63
9380/2001	47	12.79	3.68	9403/2001	56	7.52	1.83
9381/2001A	*46*	*12.07*	*3.74*	9404/2001	57	16.41	4.19
9381/2001B	*46*	*9.01*	*2.78*	9405/2001	58	7.37	1.94

[a] Sites in bold are multi-cores, sites in italics are the replicate grabs

Sample number	Common site number[a]	Forties µg g^{-1} dry wt	Diesel µg g^{-1} dry wt	Sample number	Common site number[a]	Forties µg g^{-1} dry wt	Diesel µg g^{-1} dry wt
9406/2001	59	11.98	4.04	9439/2001	92	17.00	5.15
9407/2001	60	11.41	3.12	9440/2001	91	16.09	3.91
9408/2001	61	11.84	2.79	9441/2001	90	16.47	3.89
9409/2001	62	16.82	4.31	9442/2001	89	16.56	5.11
9410/2001	63	20.42	4.95	*9443/2001A*	*88*	*13.67*	*4.24*
9411/2001	64	15.19	4.09	*9443/2001B*	*88*	*14.48*	*4.43*
9412/2001	65	16.83	4.15	*9443/2001C*	*88*	*28.62*	*7.62*
9413/2001A	*66*	*28.17*	*6.63*	*9443/2001D*	*88*	*51.98*	*13.19*
9413/2001B	*66*	*14.49*	*3.40*	*9443/2001E*	*88*	*44.47*	*11.19*
9413/2001D	*66*	*15.41*	*3.66*	**9444/2001A**	**88**	**75.33**	**18.76**
9413/2001E	*66*	*10.95*	*3.02*	**9444/2001B**	**88**	**38.72**	**9.60**
9414/2001A	**66**	**15.18**	**3.75**	**9444/2001C**	**88**	**29.46**	**7.61**
9414/2001B	**66**	**15.76**	**3.74**	**9444/2001D**	**88**	**17.42**	**4.75**
9414/2001C	**66**	**25.29**	**5.64**	9445/2001	87	40.53	10.46
9414/2001D	**66**	**19.04**	**4.39**	9446/2001	86	24.77	5.69
9416/2001	68	24.53	6.05	9447/2001	85	15.68	4.35
9417/2001	69	24.63	5.72	9448/2001	84	15.48	4.44
9418/2001	70	17.27	3.92	9449/2001	83	16.74	16.69
9419/2001	71	24.03	5.25	9450/2001	82	10.62	3.11
9421/2001	73	14.69	3.44	9451/2001	81	6.75	1.71
9422/2001	74	23.96	5.31	9452/2001	103	19.43	5.33
9423/2001	75	23.11	5.20	9453/2001	104	15.86	4.11
9424/2001	76	23.65	5.62	9454/2001	105	24.22	6.30
9425/2001	77	34.10	7.53	9455/2001	106	46.39	11.05
9426/2001	78	35.07	8.02	9456/2001	107	25.07	6.85
9427/2001	79	34.27	7.88	9457/2001	108	12.92	3.80
9428/2001	80	34.07	7.99	9458/2001	109	25.22	6.47
9429/2001	102	14.95	2.16	9459/2001	110	26.09	6.81
9430/2001	101	61.31	14.40	*9460/2001A*	*111*	*13.72*	*3.26*
9431/2001	100	51.84	11.97	*9460/2001B*	*111*	*14.48*	*3.68*
9432/2001	99	38.80	8.76	*9460/2001C*	*111*	*14.76*	*3.43*
9433/2001	98	23.23	6.18	*9460/2001D*	*111*	*13.69*	*4.09*
9434/2001	97	23.87	6.30	*9460/2001E*	*111*	*14.51*	*3.48*
9435/2001	96	25.31	6.62	**9461/2001A**	**111**	**16.47**	**4.65**
9436/2001	95	21.12	5.10	**9461/2001B**	**111**	**8.75**	**2.58**
9437/2001	94	21.05	5.36	**9461/2001C**	**111**	**12.51**	**3.06**
9438/2001	93	22.33	6.12	**9461/2001D**	**111**	**37.00**	**8.12**

[a] Sites in bold are multi-cores, sites in italics are the replicate grabs

Sample Number	Common site number[a]	Forties µg g^{-1} dry wt	Diesel µg g^{-1} dry wt
9462/2001	112	21.74	5.80
9463/2001	113	9.36	2.94
9464/2001	114	12.42	3.71
9465/2001	115	22.37	4.57
9466/2001	116	26.97	5.95
9467/2001	117	29.64	6.26
9468/2001	118	50.33	12.24
9469/2001	119	39.26	9.88
9470/2001	120	41.14	9.05
9471/2001	121	20.97	5.09
9472/2001	122	18.89	4.70
9473/2001	123	18.79	4.92

[a] Sites in bold are multi-cores, sites in italics are the replicate grabs

Appendix 3

n-Alkane concentration (ng g^{-1} dry weight) and composition of sediments collected from the Fladen Ground in 2001. All are day grab samples unless indicated otherwise.

Sample number	9346/2001	9347/2001	9348/2001	9349/2001	9350/2001	9351/2001	9352/2001
Common site number	1	2	3	4	5	6	7
nC_{12}	0.8	ND	ND	ND	ND	Tr	ND
nC_{13}	2.0	ND	ND	ND	ND	ND	ND
nC_{14}	3.0	ND	ND	ND	ND	1.3	2.0
nC_{15}	2.8	2.7	ND	ND	ND	1.1	2.5
nC_{16}	1.9	ND	ND	ND	ND	1.0	2.5
nC_{17}	0.4	1.8	4.9	2.2	2.0	1.1	0.8
nC_{18}	1.3	2.5	ND	ND	ND	0.9	2.4
nC_{19}	1.4	2.9	ND	ND	ND	0.2	3.3
nC_{20}	ND	0.9	ND	ND	Tr	ND	1.7
nC_{21}	0.4	1.8	ND	1.2	ND	ND	1.9
nC_{22}	5.8	6.3	0.9	7.2	2.2	2.7	5.7
nC_{23}	6.8	6.5	1.8	7.4	2.2	4.7	6.0
nC_{24}	11.0	7.3	2.3	11.7	3.3	7.8	7.2
nC_{25}	14.5	13.2	2.7	15.9	2.8	10.6	11.7
nC_{26}	14.7	9.4	2.5	13.9	4.1	10.2	9.2
nC_{27}	16.3	19.5	5.1	17.7	6.1	11.4	17.1
nC_{28}	12.1	ND	2.5	10.9	4.0	8.4	2.0
nC_{29}	15.0	26.8	6.9	18.1	7.9	11.4	23.4
nC_{30}	8.3	11.2	3.1	9.7	4.1	6.1	12.9
nC_{31}	15.0	37.4	10.4	23.2	9.4	13.4	31.8
nC_{32}	4.8	7.2	ND	9.0	ND	5.8	9.1
nC_{33}	9.0	23.2	8.1	14.9	ND	9.3	20.3
Pristane (Pr)	1.9	7.0	1.9	3.7	ND	2.2	4.6
Phytane (Ph)	0.7	1.0	ND	ND	ND	0.8	0.5
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**147.3**	**180.6**	**51.2**	**163.00**	**48.10**	**107.40**	**173.50**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**52.1**	**45.9**	**12.6**	**45.6**	**12.5**	**31.4**	**47.7**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**149.9**	**188.6**	**53.1**	**168.1**	**53.6**	**129.2**	**199.9**
CPI	**1.35**	**3.18**	**2.89**	**1.56**	**1.76**	**1.40**	**2.40**
Ratio (12-25)/(12-33)	**0.4**	**0.3**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9353/2001	9354/2001	9355/2001	9356/2001	9357/2001	9358/2001	9359/2001
Common site number	8	9	10	11	12	13	14
nC_{12}	ND	ND	1.8	1.6	ND	ND	ND
nC_{13}	ND	2.9	2.8	2.1	ND	ND	2.4
nC_{14}	ND	3.5	2.8	2.3	ND	1.7	3.6
nC_{15}	ND	5.1	2.9	2.6	ND	1.8	4.3
nC_{16}	ND	4.2	2.2	2.2	ND	1.7	4.3
nC_{17}	4.5	6.8	ND	ND	0.6	ND	4.4
nC_{18}	ND	3.8	1.4	1.4	ND	0.9	3.2
nC_{19}	ND	7.1	6.4	4.9	ND	3.8	6.2
nC_{20}	3.6	7.2	6.9	5.2	3.4	4.8	5.9
nC_{21}	5.4	8.2	5.6	4.8	4.0	4.9	7.7
nC_{22}	31.1	16.9	18.7	9.7	11.8	11.2	15.3
nC_{23}	41.3	11.6	16.4	6.3	10.6	8.4	10.4
nC_{24}	82.8	10.9	25.8	6.2	17.3	11.5	9.5
nC_{25}	114.1	21.5	37.6	11.8	28.4	18.0	21.5
nC_{26}	119.8	15.9	35.6	8.3	24.1	15.6	14.4
nC_{27}	105.6	35.9	38.9	15.5	24.4	20.5	30.2
nC_{28}	78.3	3.8	32.3	11.2	18.3	14.3	21.2
nC_{29}	75.4	52.3	40.0	23.1	23.3	23.8	41.2
nC_{30}	50.3	29.7	33.0	15.2	15.3	14.2	19.1
nC_{31}	56.2	80.7	46.1	33.4	24.1	29.9	64.5
nC_{32}	34.4	41.0	28.8	11.5	10.7	10.3	14.0
nC_{33}	29.0	53.0	29.1	22.0	15.4	19.2	38.4
Pristane (Pr)	3.3	7.0	3.3	4.4	2.0	3.7	7.0
Phytane (Ph)	ND	1.8	1.8	ND	ND	2.3	ND
Sum of *n*-Alkanes nC_{12}-nC_{33} (ng g^{-1})	**831.80**	**422.00**	**415.10**	**201.30**	**231.70**	**216.50**	**323.5**
Sum of *n*-Alkanes nC_{12}-nC_{25} (ng g^{-1})	**282.8**	**109.7**	**131.3**	**61.1**	**76.1**	**68.7**	**98.7**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**924.9**	**525.7**	**532.1**	**362.1**	**292.1**	**340.8**	**330.5**
CPI	**1.06**	**2.20**	**1.19**	**1.87**	**1.32**	**1.61**	**3.09**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9360/2001	9361/2001	9362/2001	9363/2001	9364/2001	9365/2001	9366/2001
Common site number	15	16	17	18	19	20	21
nC_{12}	ND	2.8	0.9	0.2	2.9	1.0	ND
nC_{13}	ND	3.2	1.0	ND	2.8	1.0	ND
nC_{14}	1.1	4.5	1.6	ND	3.8	1.0	ND
nC_{15}	1.0	4.8	2.1	1.7	3.9	1.7	ND
nC_{16}	1.1	3.5	1.3	1.5	3.7	1.8	ND
nC_{17}	0.8	7.7	0.5	ND	5.6	ND	ND
nC_{18}	1.2	3.4	0.4	ND	2.9	0.4	ND
nC_{19}	4.2	6.8	3.5	ND	14.5	11.0	ND
nC_{20}	8.6	8.1	3.6	ND	97.2	9.4	5.5
nC_{21}	6.3	10.1	3.7	2.6	10.9	5.6	5.7
nC_{22}	10.5	25.9	6.8	20.2	31.9	15.4	23.2
nC_{23}	7.6	20.6	6.1	20.7	29.1	13.8	23.0
nC_{24}	9.2	29.6	7.4	36.3	50.6	21.9	40.4
nC_{25}	6.3	49.4	12.5	49.2	76.1	33.2	56.9
nC_{26}	13.3	41.9	10.1	48.7	77.7	31.7	62.3
nC_{27}	20.1	58.5	15.1	46.1	84.9	37.1	54.4
nC_{28}	14.6	15.6	7.4	33.6	25.2	27.2	38.8
nC_{29}	25.0	64.3	18.5	36.6	82.1	38.5	43.20
nC_{30}	13.9	31.3	9.0	21.6	43.4	20.5	26.2
nC_{31}	32.2	77.9	23.1	30.5	85.6	42.6	37.8
nC_{32}	9.4	32.7	0.9	18.9	38.7	19.9	11.5
nC_{33}	20.8	46.1	13.5	16.6	49.1	24.1	19.9
Pristane (Pr)	4.2	6.0	3.0	2.6	8.1	2.9	3.0
Phytane (Ph)	10.9	2.8	1.2	ND	4.1	1.9	ND
Sum of *n*-Alkanes nC_{12}-nC_{33} (ng g^{-1})	**207.20**	**548.7**	**149.00**	**385.00**	**822.60**	**358.80**	**448.8**
Sum of *n*-Alkanes nC_{12}-nC_{25} (ng g^{-1})	**57.9**	**180.4**	**51.4**	**132.4**	**335.9**	**117.2**	**154.7**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**222.3**	**557.5**	**153.2**	**387.6**	**834.8**	**363.6**	**451.8**
CPI	**1.62**	**1.88**	**2.27**	**1.14**	**1.56**	**1.41**	**1.19**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9367/2001	9368/2001	9369/2001	9370/2001	9371/2001	9372/2001	9373/2001
Common site number	22	23	24	25	26	27	54
nC_{12}	1.2	0.8	ND	0.4	ND	ND	0.2
nC_{13}	ND	2.7	1.5	2.0	1.0	0.9	1.2
nC_{14}	ND	3.9	2.3	3.1	1.7	1.0	2.2
nC_{15}	1.8	3.2	2.1	2.6	1.4	1.8	2.0
nC_{16}	ND	2.8	ND	2.3	1.1	1.5	1.6
nC_{17}	Tr	ND	ND	ND	ND	ND	ND
nC_{18}	2.3	3.1	ND	ND	ND	ND	ND
nC_{19}	8.9	Tr	ND	ND	ND	ND	5.8
nC_{20}	18.0	ND	ND	ND	ND	ND	5.8
nC_{21}	4.1	2.1	2.1	2.0	ND	3.2	13.8
nC_{22}	8.6	10.0	10.3	10.4	4.6	16.4	7.2
nC_{23}	4.6	8.8	6.3	7.5	4.2	14.4	5.0
nC_{24}	5.6	14.3	9.2	10.9	7.3	24.4	5.7
nC_{25}	13.0	21.7	19.2	18.6	7.6	34.8	14.8
nC_{26}	7.2	18.8	13.7	15.6	11.1	33.7	8.0
nC_{27}	11.7	20.3	17.8	18.4	11.0	35.1	14.3
nC_{28}	3.5	15.3	15.6	14.5	8.4	25.4	104
nC_{29}	14.9	19.5	21.8	29.7	9.5	28.7	19.0
nC_{30}	6.3	11.2	15.2	13.2	4.9	16.2	8.1
nC_{31}	21.6	18.1	22.4	20.6	9.4	26.8	27.2
nC_{32}	2.8	9.3	15.5	11.5	4.3	9.1	6.1
nC_{33}	12.0	11.6	13.4	11.4	6.3	14.8	17.0
Pristane (Pr)	2.9	2.6	2.3	2.5	1.7	3.5	2.5
Phytane (Ph)	3.2	ND	0.8	3.2	ND	ND	ND
Sum of *n*-Alkanes nC_{12}-nC_{33} (ng g^{-1})	**148.1**	**197.5**	**188.4**	**194.7**	**93.8**	**288.2**	**175.4**
Sum of *n*-Alkanes nC_{12}-nC_{25} (ng g^{-1})	**68.1**	**73.4**	**53.0**	**59.8**	**28.9**	**98.4**	**65.3**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**154.2**	**200.1**	**191.5**	**200.4**	**95.5**	**291.7**	**177.9**
CPI	**2.74**	**1.30**	**1.32**	**1.47**	**1.19**	**1.29**	**2.25**
Ratio (12-25)/(12-33)	**0.5**	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$;
petroleum hydrocarbons input ~ 1.0

Sample number	9374/2001	9375/2001	9376/2001	9377/2001	9378/2001	9379/2001	9380/2001
Common site number	53	52	51	50	49	48	47
nC_{12}	0.2	0.6	ND	1.0	Tr	1.0	Tr
nC_{13}	ND	2.1	0.7	2.4	0.8	2.3	1.2
nC_{14}	1.8	3.5	1.1	3.4	1.4	3.5	2.0
nC_{15}	1.6	4.4	1.2	3.8	1.2	5.0	2.0
nC_{16}	1.5	3.9	1.0	2.8	1.1	4.4	2.2
nC_{17}	ND	ND	ND	ND	ND	ND	ND
nC_{18}	ND	0.8	0.4	ND	ND	2.1	ND
nC_{19}	3.9	15.9	8.3	13.1	8.9	ND	ND
nC_{20}	5.3	41.9	20.1	27.7	8.1	ND	ND
nC_{21}	1.0	16.7	0.7	11.8	0.5	9.1	4.3
nC_{22}	5.6	13.0	3.3	47.4	3.8	22.0	17.2
nC_{23}	3.3	9.4	2.4	56.4	3.1	15.0	14.5
nC_{24}	3.9	9.4	2.9	111.2	4.5	17.1	21.5
nC_{25}	8.7	19.9	10.0	151.4	9.2	19.1	33.7
nC_{26}	5.8	15.4	4.0	160.6	6.7	27.4	30.6
nC_{27}	10.9	32.5	6.8	143.4	9.9	42.5	36.9
nC_{28}	7.7	19.3	5.1	107.5	7.5	32.6	27.9
nC_{29}	12.9	39.3	9.0	99.5	12.2	50.2	39.0
nC_{30}	7.5	20.4	4.7	64.1	5.4	22.0	21.1
nC_{31}	17.3	57.4	16.9	72.4	15.3	59.4	43.9
nC_{32}	6.9	16.0	5.5	40.9	4.7	11.7	13.1
nC_{33}	11.7	35.8	8.8	36.0	10.2	31.5	25.5
Pristane (Pr)	2.7	8.5	2.1	3.9	5.2	52.1	3.6
Phytane (Ph)	ND	0.4	ND	ND	ND	3.0	0.7
Sum of *n*-Alkanes nC_{12}-nC_{33} (ng g^{-1})	**117.5**	**377.6**	**112.9**	**1156.8**	**114.5**	**377.9**	**336.6**
Sum of *n*-Alkanes nC_{12}-nC_{25} (ng g^{-1})	**36.8**	**141.5**	**52.1**	**432.4**	**42.6**	**100.6**	**98.6**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**120.2**	**386.5**	**115.0**	**1160.7**	**119.7**	**433.0**	**340.9**
CPI	**1.80**	**2.13**	**2.18**	**1.06**	**1.85**	**1.75**	**1.52**
Ratio (12-25)/(12-33)	**0.3**	**0.4**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9381/2001 A	9381/2001 B	9381/2001 C	9381/2001 D	9381/2001 E
Common site number	46	46	46	46	46
nC_{12}	ND	0.2	ND	0.8	1.4
nC_{13}	1.1	1.1	1.5	1.5	3.0
nC_{14}	1.5	1.5	2.4	1.9	4.2
nC_{15}	1.8	1.6	1.9	2.4	6.0
nC_{16}	1.8	1.5	2.0	2.3	5.0
nC_{17}	ND	1.1	ND	ND	8.9
nC_{18}	ND	ND	ND	ND	6.4
nC_{19}	3.5	1.4	2.3	3.4	10.2
nC_{20}	1.5	0.7	1.7	1.5	4.5
nC_{21}	2.3	0.9	1.5	2.3	10.4
nC_{22}	10.4	5.0	4.9	7.1	52.8
nC_{23}	8.3	3.7	3.6	5.0	68.8
nC_{24}	10.7	4.1	3.5	5.1	132.7
nC_{25}	19.0	9.8	9.3	12.3	179.2
nC_{26}	14.9	9.4	5.5	8.8	188.1
nC_{27}	22.0	11.8	10.5	18.4	179.2
nC_{28}	15.5	7.2	6.6	11.9	129.0
nC_{29}	26.3	12.3	14.6	25.1	141.6
nC_{30}	11.8	5.6	4.0	10.3	84.4
nC_{31}	38.5	16.0	21.7	37.6	124.3
nC_{32}	9.4	10.9	4.7	18.6	63.8
nC_{33}	24.6	10.4	13.8	25.1	66.6
Pristane (Pr)	3.3	2.6	3.4	3.7	9.0
Phytane (Ph)	ND	ND	ND	0.2	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**224.9**	**116.2**	**116.0**	**201.4**	**1470.5**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**61.9**	**32.6**	**34.6**	**45.6**	**493.5**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**228.2**	**118.8**	**119.4**	**205.3**	**1479.5**
CPI	**1.96**	**1.53**	**2.67**	**1.98**	**1.16**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.2**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

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Sample number	9382/2001 A	9382/2001 B	9382/2001 C	9382/2001 D
Common site number	46	46	46	46
nC_{12}	0.5	1.3	0.8	0.6
nC_{13}	2.3	3.0	2.1	1.4
nC_{14}	3.2	3.7	2.9	2.0
nC_{15}	4.1	5.5	3.9	2.8
nC_{16}	3.5	4.9	3.5	2.5
nC_{17}	4.6	7.8	6.7	3.5
nC_{18}	3.6	5.5	4.0	2.8
nC_{19}	8.6	9.3	7.5	5.0
nC_{20}	2.2	3.5	3.1	1.7
nC_{21}	3.5	7.2	4.7	4.3
nC_{22}	16.2	20.2	10.7	23.5
nC_{23}	11.9	19.7	9.0	29.6
nC_{24}	12.3	26.5	9.5	56.2
nC_{25}	23.2	42.5	26.6	77.0
nC_{26}	17.2	41.5	14.1	78.9
nC_{27}	29.8	60.4	32.4	80.8
nC_{28}	18.3	45.6	25.0	58.4
nC_{29}	38.4	77.5	45.0	66.1
nC_{30}	18.3	30.0	19.9	36.5
nC_{31}	53.3	92.7	59.5	60.1
nC_{32}	8.7	26.9	10.5	26.9
nC_{33}	31.5	55.0	37.0	31.3
Pristane (Pr)	8.9	8.7	6.6	4.4
Phytane (Ph)	ND	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**315.2**	**590.2**	**338.4**	**651.9**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**99.7**	**160.6**	**95.0**	**212.9**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**324.1**	**598.9**	**345.0**	**656.3**
CPI	**2.22**	**1.82**	**2.36**	**1.22**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9383/2001	9384/2001	9385/2001	9386/2001	9387/2001	9388/2001	9389/2001
Common site number	45	44	43	42	40	40	39
nC_{12}	1.4	2.0	1.2	2.2	0.7	0.5	0.9
nC_{13}	3.3	3.6	2.7	3.6	1.9	1.2	1.4
nC_{14}	4.7	5.0	3.5	5.7	3.1	1.7	1.8
nC_{15}	8.0	7.1	5.1	7.1	0.9	2.3	2.5
nC_{16}	6.8	6.3	4.4	14.0	3.3	2.1	2.1
nC_{17}	11.1	10.2	5.5	8.8	5.2	3.8	2.8
nC_{18}	7.9	7.0	4.9	13.1	3.5	2.7	2.5
nC_{19}	12.7	11.8	9.5	85.3	7.2	5.1	4.1
nC_{20}	7.2	5.8	6.2	121.8	3.3	1.3	0.2
nC_{21}	12.8	8.9	6.9	7.8	4.0	1.4	1.4
nC_{22}	36.3	18.3	24.5	19.1	11.1	4.2	5.5
nC_{23}	38.4	16.1	28.4	15.2	6.9	3.9	5.5
nC_{24}	60.3	17.5	50.9	21.4	9.2	5.1	7.1
nC_{25}	93.0	32.8	73.4	34.3	16.6	9.3	14.0
nC_{26}	91.3	26.1	72.9	31.4	12.4	7.3	11.1
nC_{27}	108.6	55.1	82.1	46.7	24.1	14.9	17.5
nC_{28}	86.4	38.0	60.2	35.5	19.2	11.9	14.6
nC_{29}	126.3	79.2	78.4	56.2	32.3	20.6	22.8
nC_{30}	59.0	36.6	40.9	34.6	17.0	10.5	13.6
nC_{31}	140.1	108.7	83.1	64.9	43.1	27.0	29.6
nC_{32}	59.9	16.8	18.2	21.3	9.0	6.3	17.5
nC_{33}	87.9	72.2	45.3	37.5	25.7	18.1	20.3
Pristane (Pr)	14.4	15.1	9.9	16.1	7.6	4.6	4.2
Phytane (Ph)	ND	ND	ND	4.2	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**1063.4**	**585.1**	**708.2**	**687.5**	**259.7**	**161.2**	**198.8**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**303.9**	**152.4**	**227.1**	**359.4**	**76.9**	**44.6**	**51.8**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**1077.8**	**600.2**	**718.1**	**707.8**	**267.3**	**165.8**	**203.0**
CPI	**1.49**	**2.37**	**1.46**	**1.58**	**1.98**	**2.01**	**1.51**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.5**	**0.3**	**0.3**	**0.2**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9391/2001 A	9391/2001 B	9391/2001 C	9391/2001 D	9391/2001 E
Common site number	37	37	37	37	37
nC_{12}	0.5	0.7	1.1	0.8	ND
nC_{13}	2.0	2.0	2.6	2.7	1.0
nC_{14}	2.3	2.5	2.8	2.7	1.4
nC_{15}	3.2	3.4	4.2	3.8	1.8
nC_{16}	3.1	3.2	3.9	3.7	1.8
nC_{17}	4.0	4.2	5.0	5.9	2.1
nC_{18}	3.9	4.0	5.5	4.9	2.0
nC_{19}	6.2	7.0	9.2	7.1	2.2
nC_{20}	1.5	2.6	5.0	2.9	ND
nC_{21}	2.9	3.9	6.2	4.4	Tr
nC_{22}	8.2	11.4	21.8	12.1	0.9
nC_{23}	7.8	8.3	21.9	10.2	1.6
nC_{24}	6.9	9.4	35.1	11.2	1.7
nC_{25}	13.5	17.5	61.4	19.9	3.9
nC_{26}	10.2	13.1	50.7	17.1	2.5
nC_{27}	24.2	31.2	65.2	30.4	7.1
nC_{28}	17.5	21.4	45.3	22.5	6.8
nC_{29}	37.6	39.8	63.3	43.1	11.1
nC_{30}	30.8	26.0	44.6	27.7	6.5
nC_{31}	55.2	57.1	79.2	62.5	15.7
nC_{32}	29.7	32.6	47.2	33.7	9.5
nC_{33}	40.6	38.3	50.8	44.2	11.7
Pristane (Pr)	6.4	6.8	7.6	7.6	3.5
Phytane (Ph)	ND	ND	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**311.8**	**339.6**	**632.0**	**373.5**	**91.3**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**66.0**	**80.1**	**185.7**	**92.3**	**20.4**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**318.2**	**346.4**	**639.6**	**381.1**	**94.8**
CPI	**1.63**	**1.65**	**1.37**	**1.63**	**1.65**
Ratio (12-25)/(12-33)	**0.2**	**0.2**	**0.3**	**0.2**	**0.2**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Multi-corer

Sample number	9392/2001 A	9392/2001 B	9392/2001 C	9392/2001 D
Common site number	37	37	37	37
nC_{12}	0.9	0.5	0.6	3.2
nC_{13}	1.5	1.7	1.8	5.3
nC_{14}	1.7	1.9	2.2	6.0
nC_{15}	1.7	2.6	3.1	6.4
nC_{16}	1.6	2.2	2.8	6.0
nC_{17}	1.7	2.8	4.6	7.6
nC_{18}	1.8	3.0	3.5	7.2
nC_{19}	3.0	4.4	5.5	9.4
nC_{20}	0.7	1.1	1.8	5.2
nC_{21}	0.5	1.8	2.7	7.3
nC_{22}	4.8	5.8	6.4	18.8
nC_{23}	5.2	5.1	5.1	13.6
nC_{24}	9.6	6.8	5.5	17.1
nC_{25}	13.0	15.0	11.6	27.8
nC_{26}	33.3	17.3	8.4	22.8
nC_{27}	14.6	30.4	20.2	38.9
nC_{28}	10.4	25.6	13.2	27.0
nC_{29}	15.2	39.4	31.8	53.1
nC_{30}	10.6	23.6	15.5	22.4
nC_{31}	17.2	41.4	49.0	65.5
nC_{32}	8.3	21.6	20.6	27.8
nC_{33}	13.4	24.2	34.4	45.3
Pristane (Pr)	8.1	3.9	4.5	6.8
Phytane (Ph)	ND	ND	ND	0.4
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**170.7**	**278.2**	**250.3**	**443.7**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**47.7**	**54.7**	**57.2**	**140.9**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**178.8**	**282.1**	**254.8**	**450.9**
CPI	**0.96**	**1.48**	**2.09**	**1.83**
Ratio (12-25)/(12-33)	**0.3**	**0.2**	**0.2**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9390/2001	9393/2001	9394/2001	9395/2001	9396/2001	9397/2001	9398/2001
Common site number	38	36	35	34	33	32	31
nC_{12}	2.0	1.3	0.4	0.5	ND	ND	Tr
nC_{13}	4.6	2.4	1.6	1.3	ND	0.6	0.6
nC_{14}	5.8	3.0	2.2	1.7	1.0	0.8	0.8
nC_{15}	7.4	4.1	1.9	2.4	1.6	0.8	0.9
nC_{16}	5.8	4.0	1.8	2.1	1.4	0.9	0.8
nC_{17}	8.0	5.1	2.3	2.8	1.9	1.1	1.7
nC_{18}	7.8	5.0	2.4	2.7	1.5	1.0	1.1
nC_{19}	11.3	15.8	5.1	4.6	3.6	1.7	2.7
nC_{20}	5.7	23.1	6.0	1.9	10.1	0.7	1.2
nC_{21}	9.0	6.4	2.1	2.6	1.7	1.0	1.1
nC_{22}	23.4	14.2	4.6	5.2	2.2	1.9	2.6
nC_{23}	17.4	12.5	3.7	4.3	2.5	1.8	2.1
nC_{24}	21.0	11.0	3.1	3.5	2.4	1.9	2.7
nC_{25}	34.1	17.1	5.6	6.8	4.8	2.2	4.3
nC_{26}	30.1	14.4	4.7	4.7	2.7	2.5	4.0
nC_{27}	55.5	32.5	12.5	13.5	7.9	3.4	6.4
nC_{28}	40.4	20.9	8.0	10.4	4.8	2.8	4.9
nC_{29}	79.8	43.9	14.1	20.2	12.4	5.0	8.6
nC_{30}	46.9	29.4	8.8	9.5	4.6	2.5	5.2
nC_{31}	102.5	63.8	19.6	30.5	19.4	7.2	12.1
nC_{32}	51.9	35.5	11.7	17.3	2.3	1.2	7.1
nC_{33}	70.2	51.8	15.8	21.0	13.0	6.7	9.0
Pristane (Pr)	13.6	7.7	2.8	5.2	3.1	0.9	1.6
Phytane (Ph)	1.8	2.8	0.5	0.3	0.5	ND	Tr
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**640.6**	**417.2**	**138.0**	**169.5**	**101.8**	**47.7**	**79.9**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**163.3**	**125.0**	**42.8**	**42.4**	**34.7**	**16.4**	**22.6**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**656.0**	**462.0**	**171.0**	**217.6**	**105.4**	**67.4**	**102.8**
CPI	**1.66**	**1.70**	**1.70**	**1.84**	**3.11**	**2.02**	**1.55**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9399/2001	9400/2001	9401/2001	9402/2001	9403/2001	9404/2001	9405/2001
Common site number	30	29	28	55	56	57	58
nC_{12}	ND	ND	0.3	ND	Tr	ND	ND
nC_{13}	0.5	0.3	ND	ND	0.6	0.8	0.3
nC_{14}	1.1	0.5	1.0	0.6	0.8	1.3	0.4
nC_{15}	1.3	0.7	1.1	0.9	1.0	1.5	0.5
nC_{16}	1.1	0.7	0.9	0.9	1.0	1.3	0.4
nC_{17}	1.3	0.2	1.6	0.6	1.3	1.4	0.6
nC_{18}	2.5	2.0	1.9	1.8	1.0	1.4	0.7
nC_{19}	9.1	8.1	7.9	5.5	4.4	3.8	2.1
nC_{20}	16.5	2.6	22.8	11.8	7.7	9.9	14.5
nC_{21}	1.0	0.5	1.1	1.1	1.2	1.3	0.3
nC_{22}	1.7	1.1	2.1	1.6	2.5	2.6	6.2
nC_{23}	1.5	0.7	1.8	1.7	2.0	1.7	1.2
nC_{24}	1.5	0.5	1.4	1.9	1.8	2.3	0.3
nC_{25}	2.7	1.2	2.3	2.9	2.5	3.2	0.3
nC_{26}	2.4	0.5	2.3	2.5	1.9	2.8	0.4
nC_{27}	5.4	2.4	4.8	4.7	4.6	5.9	2.0
nC_{28}	5.1	1.9	3.4	3.5	2.5	4.8	1.4
nC_{29}	6.6	4.2	6.4	5.5	7.4	8.0	2.4
nC_{30}	5.8	2.9	2.1	2.0	3.5	6.7	0.6
nC_{31}	10.2	6.4	9.4	9.1	12.9	15.4	11.9
nC_{32}	7.7	3.9	0.2	0.7	5.9	10.2	ND
nC_{33}	9.2	5.7	7.3	6.9	8.1	11.1	4.5
Pristane (Pr)	0.8	0.9	1.8	0.2	1.5	1.7	0.2
Phytane (Ph)	0.2	ND	0.2	ND	0.2	1.0	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**94.2**	**47.0**	**82.1**	**66.2**	**74.6**	**97.4**	**51.0**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**41.8**	**19.1**	**46.2**	**31.3**	**27.8**	**32.5**	**27.8**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**95.2**	**47.9**	**116.9**	**66.4**	**97.9**	**100.1**	**51.2**
CPI	**1.34**	**1.79**	**2.92**	**2.50**	**2.08**	**1.45**	**7.20**
Ratio (12-25)/(12-33)	**0.4**	**0.4**	**0.6**	**0.5**	**0.4**	**0.3**	**0.5**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number Common site number	9406/2001 59	9407/2001 60	9408/2001 61	9409/2001 62	9410/2001 63	9411/2001 64	9412/2001 65
nC_{12}	ND	Tr	0.2	Tr	0.6	0.4	0.3
nC_{13}	0.5	1.0	0.8	1.0	1.3	1.2	1.2
nC_{14}	0.6	1.2	1.1	1.3	1.6	1.4	1.5
nC_{15}	0.9	1.7	1.4	1.6	1.9	1.8	1.8
nC_{16}	2.4	1.5	1.4	1.7	1.7	1.8	1.7
nC_{17}	1.4	3.2	2.2	2.9	2.8	3.4	3.2
nC_{18}	1.0	1.9	1.8	2.0	11.3	2.4	1.8
nC_{19}	1.9	4.9	4.2	5.3	17.0	5.3	6.3
nC_{20}	3.3	18.8	13.7	19.4	masked	15.9	50.4
nC_{21}	0.4	2.6	2.3	1.8	4.5	3.1	2.2
nC_{22}	ND	4.2	10.2	3.7	2.6	7.9	3.5
nC_{23}	0.6	4.2	10.8	3.0	3.6	6.6	2.8
nC_{24}	0.6	3.9	18.4	2.7	4.3	7.5	2.6
nC_{25}	0.6	9.3	26.1	6.7	7.4	12.4	8.3
nC_{26}	1.4	5.6	27.5	4.8	5.6	12.2	3.9
nC_{27}	1.4	13.7	29.3	9.6	13.9	20.5	12.8
nC_{28}	0.2	8.6	19.1	7.0	9.2	14.5	9.5
nC_{29}	2.1	20.4	25.3	12.5	18.2	26.6	19.0
nC_{30}	ND	6.3	13.5	7.5	10.5	18.2	10.8
nC_{31}	4.8	32.1	27.2	18.3	28.7	35.9	29.0
nC_{32}	1.2	3.9	12.2	11.1	14.5	19.6	14.0
nC_{33}	5.7	20.0	18.0	14.1	20.5	24.1	21.3
Pristane (Pr)	1.3	3.2	1.5	2.2	2.1	3.3	3.3
Phytane (Ph)	ND	ND	ND	0.8	0.3	1.6	ND
Sum of *n*-Alkanes nC_{12}-nC_{33} (ng g^{-1})	**31.0**	**169.0**	**266.7**	**138.0**	**181.7**	**242.7**	**207.9**
Sum of *n*-Alkanes nC_{12}-nC_{25} (ng g^{-1})	**14.2**	**58.4**	**94.6**	**53.1**	**60.6**	**71.1**	**87.6**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**32.3**	**173.6**	**273.7**	**156.6**	**184.**	**266.9**	**248.9**
CPI	**3.54**	**3.10**	**1.35**	**1.68**	**1.82**	**1.54**	**1.99**
Ratio (12-25)/(12-33)	**0.5**	**0.3**	**0.4**	**0.4**	**0.3**	**0.3**	**0.4**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9413/2001 A	9413/2001 B	9413/2001 D	9413/2001 E
Common site number	66	66	66	66
nC_{12}	2.2	0.9	ND	ND
nC_{13}	2.9	1.4	1.1	1.0
nC_{14}	3.6	1.9	1.7	1.3
nC_{15}	5.1	2.0	1.7	1.6
nC_{16}	4.3	1.8	1.6	1.4
nC_{17}	7.6	0.5	ND	ND
nC_{18}	86.4	2.2	1.9	1.9
nC_{19}	99.0	6.8	2.1	2.0
nC_{20}	masked	51.7	0.4	0.5
nC_{21}	19.8	3.4	3.8	3.4
nC_{22}	5.1	6.7	11.3	8.5
nC_{23}	11.9	4.2	8.9	5.3
nC_{24}	10.4	4.1	9.8	7.7
nC_{25}	24.6	9.1	12.2	6.6
nC_{26}	21.3	7.3	13.0	9.6
nC_{27}	47.5	18.0	17.0	14.4
nC_{28}	33.3	12.3	8.5	8.4
nC_{29}	75.5	30.9	12.0	13.6
nC_{30}	43.6	13.6	1.2	4.2
nC_{31}	116.3	44.5	17.2	15.1
nC_{32}	51.6	19.5	4.1	4.2
nC_{33}	75.4	29.8	18.7	17.2
Pristane (Pr)	17.3	2.7	3.8	2.9
Phytane (Ph)	3.0	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**747.4**	**272.6**	**148.2**	**127.9**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**282.9**	**96.7**	**56.5**	**41.2**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**767.7**	**338.7**	**152.0**	**130.8**
CPI	**1.92**	**2.10**	**1.97**	**1.79**
Ratio (12-25)/(12-33)	**0.4**	**0.4**	**0.4**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

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Sample number	9414/2001 A	9414/2001 B	9414/2001 C	9414/2001 D
Common site number	66	66	66	66
nC_{12}	0.2	0.3	0.7	ND
nC_{13}	1.3	1.3	2.1	1.3
nC_{14}	1.8	1.8	2.8	2.0
nC_{15}	1.8	2.1	4.3	2.7
nC_{16}	1.7	2.1	3.6	2.7
nC_{17}	ND	0.6	3.0	1.5
nC_{18}	2.2	2.3	4.1	3.3
nC_{19}	11.1	3.5	6.5	14.0
nC_{20}	13.0	3.2	4.0	13.3
nC_{21}	5.2	4.4	6.9	6.2
nC_{22}	11.1	10.2	16.4	13.4
nC_{23}	6.0	6.1	11.7	8.0
nC_{24}	4.7	4.3	11.4	5.7
nC_{25}	5.2	7.5	17.5	10.5
nC_{26}	5.8	5.7	15.4	8.4
nC_{27}	11.0	13.6	28.4	19.4
nC_{28}	3.4	6.1	17.4	8.8
nC_{29}	7.9	17.2	34.3	23.9
nC_{30}	4.9	6.9	10.6	4.2
nC_{31}	14.0	25.9	43.1	34.8
nC_{32}	1.6	10.6	0.5	ND
nC_{33}	18.6	23.7	37.0	27.5
Pristane (Pr)	3.3	3.6	5.9	4.6
Phytane (Ph)	Tr	0.5	ND	0.9
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**132.5**	**159.4**	**281.7**	**211.6**
Sum of *n*-Alkanes nC_{12}-nC_{25} (ng g^{-1})	**65.3**	**49.7**	**95.0**	**84.6**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**135.8**	**163.5**	**287.6**	**217.1**
CPI	**2.47**	**2.35**	**2.67**	**3.92**
Ratio (12-25)/(12-33)	**0.5**	**0.3**	**0.3**	**0.4**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9416/2001	9417/2001	9418/2001	9419/2001	9421/2001	9422/2001	9423/2001
Common site number	68	69	70	71	73	74	75
nC_{12}	ND	ND	0.2	0.8	ND	0.5	Tr
nC_{13}	1.5	1.4	1.5	2.5	0.9	1.7	1.6
nC_{14}	2.4	2.2	1.8	3.0	1.2	2.4	2.3
nC_{15}	3.2	2.9	2.6	4.4	1.9	3.5	2.7
nC_{16}	3.2	2.8	2.3	3.9	1.8	3.2	2.6
nC_{17}	0.2	1.2	ND	0.8	ND	1.5	ND
nC_{18}	3.9	3.3	2.8	4.8	2.9	3.7	3.3
nC_{19}	9.0	4.5	3.1	7.0	3.2	4.4	3.8
nC_{20}	9.0	2.1	0.9	4.6	1.7	2.4	1.9
nC_{21}	8.4	6.3	4.6	8.4	5.2	6.8	5.6
nC_{22}	16.4	14.9	11.5	17.8	12.2	19.9	16.5
nC_{23}	10.1	9.1	8.3	12.2	7.2	18.5	13.2
nC_{24}	6.9	5.8	6.8	8.6	5.0	25.5	13.8
nC_{25}	12.1	11.6	8.8	22.7	6.7	35.5	20.2
nC_{26}	9.9	7.5	9.2	11.4	7.8	52.0	18.1
nC_{27}	21.7	17.2	15.3	26.7	15.4	45.6	29.5
nC_{28}	6.7	8.5	9.4	14.2	6.5	24.9	14.4
nC_{29}	25.6	19.1	18.5	33.1	18.9	39.7	25.6
nC_{30}	7.3	3.8	4.1	8.2	4.0	18.0	6.0
nC_{31}	40.2	32.3	26.3	52.3	26.5	46.9	36.7
nC_{32}	ND	8.1	6.6	17.8	3.0	15.9	ND
nC_{33}	38.8	33.6	24.9	40.0	24.6	36.3	31.3
Pristane (Pr)	6.4	5.3	4.7	8.3	5.8	9.6	5.3
Phytane (Ph)	0.5	4.7	0.2	12.6	ND	0.3	1.1
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**236.5**	**198.2**	**169.5**	**305.2**	**156.6**	**408.8**	**249.1**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**86.3**	**68.1**	**55.2**	**101.5**	**49.9**	**129.5**	**87.5**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**243.4**	**208.2**	**174.4**	**326.1**	**162.4**	**418.7**	**255.5**
CPI	**4.03**	**3.01**	**2.37**	**2.67**	**3.17**	**1.43**	**2.57**
Ratio (12-25)/(12-33)	**0.4**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9424/2001	9425/2001	9426/2001	9427/2001	9428/2001	9429/2001	9430/2001
Common site number	76	77	78	79	80	102	101
nC_{12}	0.6	0.4	3.1	0.7	2.9	0.2	1.4
nC_{13}	1.8	2.0	2.8	2.2	3.6	1.0	3.2
nC_{14}	2.4	2.7	3.2	3.1	4.3	1.6	4.3
nC_{15}	3.1	4.0	ND	3.4	5.3	1.9	6.4
nC_{16}	2.7	3.7	5.1	2.8	3.9	1.6	5.3
nC_{17}	ND	2.1	1.5	ND	3.4	ND	3.2
nC_{18}	3.2	4.3	3.5	3.0	4.1	1.6	6.0
nC_{19}	4.0	5.7	4.3	13.8	6.0	2.8	30.7
nC_{20}	2.2	3.8	2.9	35.2	4.3	2.7	52.0
nC_{21}	5.5	7.9	7.0	5.4	7.9	4.3	10.7
nC_{22}	11.6	17.7	17.0	10.7	17.6	13.5	25.8
nC_{23}	7.8	10.2	10.6	6.8	11.1	9.9	16.2
nC_{24}	4.7	7.6	8.7	4.5	10.6	ND	16.5
nC_{25}	12.2	13.4	12.7	8.8	44.7	18.2	28.2
nC_{26}	5.8	12.1	59.8	21.9	41.3	22.5	29.2
nC_{27}	15.7	33.8	24.3	16.7	29.4	32.3	64.6
nC_{28}	4.0	16.9	14.8	6.2	14.6	17.7	40.3
nC_{29}	14.5	35.5	28.5	21.6	35.1	22.3	80.6
nC_{30}	ND	15.1	9.6	2.2	12.8	9.0	39.0
nC_{31}	25.9	55.8	49.5	36.8	52.8	24.9	113.8
nC_{32}	ND	9.5	ND	ND	3.5	16.2	42.2
nC_{33}	24.1	46.9	38.2	27.3	37.9	20.5	71.7
Pristane (Pr)	5.2	8.6	17.0	5.3	14.4	3.1	9.9
Phytane (Ph)	1.4	1.1	1.9	0.4	1.9	0.2	4.0
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**151.8**	**311.1**	**307.1**	**233.1**	**357.1**	**224.7**	**691.3**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**61.8**	**85.5**	**82.4**	**100.4**	**129.7**	**59.3**	**209.9**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**158.4**	**320.8**	**326.0**	**238.8**	**373.4**	**228.0**	**705.2**
CPI	**5.81**	**2.73**	**1.50**	**2.90**	**2.25**	**1.73**	**1.98**
Ratio (12-25)/(12-33)	**0.4**	**0.3**	**0.3**	**0.4**	**0.4**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9431/2001	9432/2001	9433/2001	9434/2001	9435/2001	9436/2001	9437/2001
Common site number	100	99	98	97	96	95	94
nC_{12}	3.3	1.5	Tr	ND	ND	Tr	ND
nC_{13}	6.5	2.6	1.8	1.7	1.7	2.0	1.9
nC_{14}	8.8	3.4	2.4	2.8	2.4	3.8	4.2
nC_{15}	8.9	5.0	3.1	3.5	3.2	3.7	3.4
nC_{16}	7.2	4.5	2.9	3.2	2.9	3.5	3.5
nC_{17}	3.7	1.5	ND	1.7	1.0	2.9	0.8
nC_{18}	6.4	5.0	3.1	4.1	3.5	4.8	4.0
nC_{19}	10.4	13.7	5.9	6.6	8.3	9.9	7.6
nC_{20}	7.8	18.8	0.5	0.9	4.9	5.0	2.1
nC_{21}	15.2	13.2	3.0	4.1	4.0	6.4	3.9
nC_{22}	47.8	75.3	5.7	9.4	7.1	12.9	9.7
nC_{23}	37.4	98.8	5.5	9.3	6.6	9.3	6.3
nC_{24}	49.9	217.8	4.8	10.9	6.0	9.2	6.5
nC_{25}	72.0	329.6	12.5	20.7	14.4	18.0	13.2
nC_{26}	72.5	376.1	4.3	12.3	5.4	11.1	5.4
nC_{27}	97.7	349.0	17.4	29.4	22.7	28.1	18.3
nC_{28}	66.6	257.1	12.0	18.8	15.2	16.6	13.6
nC_{29}	90.2	262.7	27.0	38.1	33.4	40.6	24.2
nC_{30}	42.2	162.8	9.0	17.1	17.0	20.0	13.8
nC_{31}	105.6	217.1	39.6	54.8	48.8	55.5	31.5
nC_{32}	45.7	105.4	8.4	26.7	11.3	31.2	14.1
nC_{33}	72.3	117.2	25.6	39.6	32.3	37.5	21.8
Pristane (Pr)	11.6	7.3	4.6	6.5	5.7	6.1	5.2
Phytane (Ph)	2.8	1.0	ND	ND	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**878.1**	**2638.1**	**194.5**	**315.7**	**252.1**	**332.0**	**209.8**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**285.3**	**790.7**	**51.2**	**78.9**	**66.0**	**91.4**	**67.1**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**892.5**	**2646.4**	**199.1**	**322.2**	**257.8**	**338.1**	**215.0**
CPI	**1.52**	**1.13**	**2.91**	**1.95**	**2.53**	**1.88**	**1.90**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.2**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9438/2001	9439/2001	9440/2001	9441/2001	9442/2001	9445/2001	9446/2001
Common site number	93	92	91	90	89	87	86
nC_{12}	0.3	0.7	0.2	ND	ND	ND	ND
nC_{13}	2.5	2.5	1.9	1.1	1.5	1.9	1.4
nC_{14}	3.4	3.4	2.3	1.6	2.1	1.9	1.9
nC_{15}	3.7	4.4	3.6	2.0	2.4	2.8	1.8
nC_{16}	3.3	3.9	3.3	1.8	2.2	2.7	1.8
nC_{17}	0.5	1.7	ND	ND	ND	1.2	3.5
nC_{18}	3.8	4.2	3.7	2.4	2.4	3.9	1.6
nC_{19}	6.3	5.9	5.1	4.1	3.4	9.2	5.7
nC_{20}	0.9	1.5	0.8	ND	Tr	4.6	3.3
nC_{21}	4.1	4.4	3.3	1.9	1.9	4.4	1.4
nC_{22}	9.7	7.2	5.4	3.2	3.7	9.3	1.5
nC_{23}	9.6	6.3	4.8	3.7	3.3	6.8	2.0
nC_{24}	14.4	4.4	4.0	3.3	3.8	7.0	1.6
nC_{25}	24.0	12.6	12.0	9.2	4.5	22.1	3.8
nC_{26}	18.7	1.9	1.6	1.5	2.1	7.0	0.6
nC_{27}	30.2	15.9	13.6	13.2	12.2	32.1	8.3
nC_{28}	22.1	7.6	6.9	5.2	8.8	16.1	5.4
nC_{29}	33.7	24.0	22.1	19.2	18.2	30.2	16.0
nC_{30}	16.8	11.8	10.3	8.7	10.9	23.6	10.1
nC_{31}	35.5	30.7	30.6	28.7	25.9	40.4	20.2
nC_{32}	12.5	9.3	9.7	18.3	11.4	30.8	21.8
nC_{33}	22.0	18.7	19.8	19.3	17.7	24.7	15.8
Pristane (Pr)	7.8	6.4	6.0	4.2	4.2	6.8	2.6
Phytane (Ph)	ND	ND	ND	ND	ND	Tr	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**278.0**	**183.0**	**165.0**	**148.4**	**138.4**	**282.7**	**129.5**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**86.5**	**63.1**	**50.4**	**34.3**	**31.2**	**77.8**	**31.3**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**285.8**	**189.4**	**171.0**	**152.6**	**142.6**	**289.5**	**132.1**
CPI	**1.65**	**2.73**	**2.79**	**2.21**	**1.93**	**1.66**	**1.45**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.2**	**0.2**	**0.3**	**0.2**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9443/2001 A	9443/2001 B	9443/2001 C	9443/2001 D	9443/2001 E
Common site number	88	88	88	88	88
nC_{12}	ND	ND	ND	ND	0.4
nC_{13}	1.0	ND	1.3	2.2	2.2
nC_{14}	1.3	1.0	1.7	3.0	3.0
nC_{15}	1.5	1.3	2.8	4.4	4.4
nC_{16}	1.6	1.2	2.8	3.7	4.0
nC_{17}	ND	ND	0.7	1.5	2.6
nC_{18}	2.3	1.6	3.4	5.9	6.0
nC_{19}	3.7	3.3	5.7	8.3	8.7
nC_{20}	ND	ND	1.0	2.6	3.7
nC_{21}	1.4	1.1	3.6	5.5	6.5
nC_{22}	3.9	2.3	6.8	10.3	17.8
nC_{23}	4.3	2.3	5.0	8.0	17.7
nC_{24}	6.1	2.4	3.8	6.7	26.1
nC_{25}	11.9	7.7	11.2	17.7	43.9
nC_{26}	5.0	Tr	3.7	6.2	35.7
nC_{27}	11.6	7.3	16.4	27.0	55.3
nC_{28}	5.9	5.0	10.5	17.6	40.7
nC_{29}	12.1	13.0	26.0	41.2	65.7
nC_{30}	6.6	7.9	13.6	31.3	38.1
nC_{31}	15.2	18.6	39.1	60.3	83.0
nC_{32}	13.4	16.2	25.7	40.3	48.8
nC_{33}	10.8	13.6	28.1	42.8	54.2
Pristane (Pr)	3.0	2.7	5.2	8.2	8.2
Phytane (Ph)	ND	ND	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**119.6**	**105.8**	**212.9**	**346.5**	**568.5**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**39.0**	**24.2**	**49.8**	**79.8**	**147.0**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**122.6**	**108.5**	**218.1**	**354.7**	**576.7**
CPI	**1.58**	**1.73**	**1.91**	**1.68**	**1.50**
Ratio (12-25)/(12-33)	**0.3**	**0.2**	**0.2**	**0.2**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Multi-corer

Sample number	9444/2001 A	9444/2001 B	9444/2001 C	9444/2001 D
Common site number	88	88	88	88
nC_{12}	1.2	0.3	ND	ND
nC_{13}	3.8	2.3	1.4	0.7
nC_{14}	5.2	2.6	2.1	1.1
nC_{15}	9.9	4.3	3.2	1.7
nC_{16}	6.7	3.7	2.8	1.8
nC_{17}	5.2	0.7	0.8	Tr
nC_{18}	8.7	4.6	3.5	2.4
nC_{19}	13.0	9.0	8.8	4.8
nC_{20}	6.3	3.8	4.6	1.7
nC_{21}	10.5	5.8	5.2	3.0
nC_{22}	27.4	12.8	13.2	6.6
nC_{23}	22.5	9.5	10.6	6.4
nC_{24}	28.6	10.2	13.4	10.2
nC_{25}	53.8	22.2	27.5	26.3
nC_{26}	36.9	12.1	14.3	13.2
nC_{27}	69.3	30.1	25.2	20.7
nC_{28}	49.9	27.0	16.3	15.8
nC_{29}	91.6	42.0	34.8	24.9
nC_{30}	62.2	41.3	22.3	14.9
nC_{31}	115.1	56.5	41.9	27.4
nC_{32}	82.0	20.4	15.5	19.8
nC_{33}	86.6	34.1	26.9	20.2
Pristane (Pr)	27.2	7.6	4.9	2.7
Phytane (Ph)	1.3	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**796.4**	**355.3**	**294.3**	**223.6**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**202.8**	**91.8**	**97.1**	**66.7**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**824.9**	**362.9**	**299.2**	**226.3**
CPI	**1.48**	**1.55**	**1.81**	**1.52**
Ratio (12-25)/(12-33)	**0.3**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9447/2001	9448/2001	9449/2001	9450/2001	9451/2001	9452/2001	9453/2001
Common site number	85	84	83	82	81	103	104
nC_{12}	ND	0.4	ND	0.3	ND	ND	ND
nC_{13}	ND	1.3	ND	1.0	0.7	1.0	1.5
nC_{14}	1.1	2.0	ND	1.3	0.9	1.3	2.0
nC_{15}	1.4	1.8	1.7	1.7	1.1	1.5	2.4
nC_{16}	ND	1.8	1.7	1.6	1.1	1.4	1.9
nC_{17}	ND	2.0	ND	2.1	1.9	0.6	4.0
nC_{18}	1.5	1.2	1.1	1.3	0.8	1.2	1.4
nC_{19}	4.2	1.4	1.8	1.6	2.0	2.9	1.7
nC_{20}	1.7	1.1	1.3	1.3	0.8	1.1	1.5
nC_{21}	1.2	2.3	2.1	2.2	1.7	2.4	3.1
nC_{22}	1.4	4.8	5.7	4.1	3.2	4.6	5.9
nC_{23}	1.9	3.2	4.4	2.9	2.6	3.4	4.6
nC_{24}	1.4	2.6	5.4	2.3	1.5	2.1	4.0
nC_{25}	9.8	5.8	11.2	6.1	4.5	6.0	10.3
nC_{26}	0.6	ND	ND	ND	ND	ND	ND
nC_{27}	7.8	10.9	11.4	10.2	6.9	9.5	15.8
nC_{28}	11.0	7.5	7.3	6.6	3.5	4.7	10.3
nC_{29}	13.8	16.3	14.7	14.8	9.9	12.9	22.2
nC_{30}	9.5	8.0	7.5	6.0	2.6	3.4	10.0
nC_{31}	19.0	24.4	19.5	24.2	14.2	19.0	33.2
nC_{32}	18.5	5.2	3.7	3.9	0.8	0.8	6.5
nC_{33}	13.8	13.6	9.8	13.1	6.4	8.7	18.1
Pristane (Pr)	2.8	ND	ND	41.2	ND	ND	ND
Phytane (Ph)	ND	0.7	1.9	1.4	1.0	1.4	2.2
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**119.6**	**117.6**	**110.3**	**108.6**	**67.1**	**88.5**	**160.4**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**25.6**	**31.7**	**36.4**	**29.8**	**22.8**	**29.5**	**44.3**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**122.4**	**118.3**	**112.2**	**151.2**	**68.1**	**89.9**	**162.6**
CPI	**1.42**	**2.82**	**2.67**	**3.37**	**4.76**	**4.86**	**3.01**
Ratio (12-25)/(12-33)	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9454/2001	9455/2001	9456/2001	9457/2001	9458/2001	9459/2001
Common site number	105	106	107	108	109	110
nC_{12}	0.6	0.4	0.7	Tr	1.7	1.1
nC_{13}	0.9	1.8	2.1	1.2	2.2	2.6
nC_{14}	1.2	2.3	2.7	1.5	2.7	3.1
nC_{15}	1.6	2.8	3.6	2.1	3.7	4.7
nC_{16}	1.3	2.4	3.2	1.8	3.2	3.7
nC_{17}	2.0	4.5	5.6	3.2	3.9	5.8
nC_{18}	0.9	2.6	3.3	1.6	2.8	3.3
nC_{19}	2.9	3.6	7.1	4.0	5.3	6.5
nC_{20}	2.1	2.5	4.1	1.8	3.4	4.1
nC_{21}	2.3	3.7	5.2	2.9	5.4	6.1
nC_{22}	2.6	7.5	11.7	6.3	9.7	12.1
nC_{23}	2.7	6.2	7.6	4.0	7.6	8.3
nC_{24}	2.2	5.4	5.9	3.2	6.4	7.3
nC_{25}	5.7	121.7	142.1	8.0	14.9	17.6
nC_{26}	7.2	ND	ND	ND	13.5	ND
nC_{27}	10.5	22.0	21.0	13.2	26.2	30.0
nC_{28}	6.7	17.9	15.7	9.1	18.6	16.4
nC_{29}	15.2	36.7	36.8	21.6	39.1	43.8
nC_{30}	7.0	24.8	25.2	11.2	16.7	20.3
nC_{31}	23.0	54.9	56.1	34.0	58.0	64.5
nC_{32}	10.3	26.0	35.4	18.5	23.7	12.1
nC_{33}	14.5	32.0	33.9	20.1	33.5	34.6
Pristane (Pr)	3.0	ND	1.1	ND	5.4	0.8
Phytane (Ph)	1.5	2.4	3.8	1.8	2.6	2.4
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**123.4**	**381.7**	**429.0**	**169.3**	**302.2**	**308.0**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**29.0**	**167.4**	**204.9**	**41.6**	**72.9**	**86.3**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**127.9**	**384.1**	**433.9**	**171.1**	**310.2**	**311.2**
CPI	**1.89**	**3.43**	**3.37**	**2.12**	**2.01**	**3.16**
Ratio (12-25)/(12-33)	**0.2**	**0.4**	**0.5**	**0.2**	**0.2**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9460/2001 A	9460/2001 B	9460/2001 C	9460/2001 D	9460/2001 E
Common site number	111	111	111	111	111
nC_{12}	ND	ND	ND	ND	0.9
nC_{13}	1.3	ND	ND	ND	1.4
nC_{14}	1.6	ND	1.4	1.6	1.7
nC_{15}	2.0	ND	2.0	2.0	2.2
nC_{16}	1.9	ND	1.9	ND	2.0
nC_{17}	2.3	ND	2.2	ND	2.6
nC_{18}	1.5	ND	1.6	1.3	1.8
nC_{19}	2.2	ND	2.2	1.8	2.4
nC_{20}	1.3	ND	1.7	1.9	1.7
nC_{21}	2.7	3.6	2.8	2.2	2.9
nC_{22}	4.7	11.6	5.7	4.8	5.2
nC_{23}	3.8	12.9	3.6	3.1	3.9
nC_{24}	3.3	22.9	3.0	2.6	4.0
nC_{25}	7.5	33.3	90.0	99.2	107.7
nC_{26}	ND	13.4	ND	ND	2.3
nC_{27}	10.2	34.0	12.2	10.6	13.4
nC_{28}	7.7	22.2	9.1	8.9	9.8
nC_{29}	16.3	31.3	17.1	15.6	16.8
nC_{30}	5.7	20.1	8.4	8.0	8.1
nC_{31}	22.8	32.6	25.5	22.8	25.3
nC_{32}	2.1	ND	5.5	5.5	4.0
nC_{33}	11.1	ND	12.8	11.9	13.1
Pristane (Pr)	ND	ND	ND	ND	3.1
Phytane (Ph)	1.6	ND	15.0	14.7	1.3
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**112.0**	**237.9**	**208.7**	**203.8**	**233.2**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**36.1**	**84.3**	**118.1**	**120.5**	**140.4**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**113.6**	**237.9**	**223.7**	**218.5**	**237.6**
CPI	**3.42**	**1.75**	**5.88**	**6.23**	**6.09**
Ratio (12-25)/(12-33)	**0.3**	**0.4**	**0.6**	**0.6**	**0.6**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Multi-corer

Sample number	9461/2001 A	9461/2001 B	9461/2001 C	9461/2001 D
Common site number	111	111	111	111
nC_{12}	0.3	1.5	0.3	1.3
nC_{13}	1.9	ND	ND	3.1
nC_{14}	2.2	ND	ND	3.4
nC_{15}	3.0	ND	1.9	4.4
nC_{16}	2.3	ND	2.0	4.1
nC_{17}	3.0	ND	0.5	5.6
nC_{18}	1.9	0.9	1.6	4.2
nC_{19}	2.9	ND	2.2	6.6
nC_{20}	2.0	3.1	1.7	6.6
nC_{21}	3.5	2.2	2.6	8.5
nC_{22}	6.9	5.9	6.5	25.0
nC_{23}	5.4	4.4	5.1	22.9
nC_{24}	5.3	5.6	5.2	31.4
nC_{25}	135.7	13.8	10.0	26.0
nC_{26}	ND	12.8	ND	25.9
nC_{27}	16.2	9.8	12.2	59.7
nC_{28}	12.9	5.9	8.1	48.4
nC_{29}	23.6	11.0	16.6	67.6
nC_{30}	11.2	4.9	9.2	30.6
nC_{31}	34.8	15.0	23.2	81.7
nC_{32}	6.5	ND	3.1	12.6
nC_{33}	17.8	8.0	11.4	42.2
Pristane (Pr)	ND	3.1	ND	1.5
Phytane (Ph)	16.1	1.1	2.6	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**299.3**	**104.8**	**123.4**	**521.8**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**176.3**	**37.4**	**39.6**	**153.1**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**315.4**	**109.0**	**126.0**	**523.3**
CPI	**6.18**	**1.91**	**2.74**	**1.80**
Ratio (12-25)/(12-33)	**0.6**	**0.4**	**0.3**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9462/2001	9463/2001	9464/2001	9465/2001	9466/2001	9467/2001
Common site number	112	113	114	115	116	117
nC_{12}	0.9	0.2	0.7	2.2	0.9	1.8
nC_{13}	ND	ND	ND	2.0	ND	ND
nC_{14}	2.9	ND	ND	2.8	ND	3.3
nC_{15}	3.3	ND	ND	3.5	3.7	4.4
nC_{16}	3.1	ND	ND	3.3	3.4	3.7
nC_{17}	ND	ND	ND	4.4	ND	5.3
nC_{18}	3.0	ND	ND	2.9	2.1	3.7
nC_{19}	3.7	18.7	17.0	7.0	15.9	5.2
nC_{20}	2.9	4.0	18.7	5.5	14.7	4.8
nC_{21}	4.8	2.0	ND	5.5	6.0	6.3
nC_{22}	8.7	4.0	4.7	9.8	13.9	13.8
nC_{23}	6.1	3.3	4.3	7.2	10.6	9.0
nC_{24}	4.9	4.7	4.4	6.1	13.9	8.8
nC_{25}	45.2	31.3	39.9	39.7	22.6	48.9
nC_{26}	ND	ND	ND	9.0	ND	ND
nC_{27}	18.0	11.0	12.3	21.7	28.0	26.7
nC_{28}	17.0	10.7	9.4	19.0	22.3	24.0
nC_{29}	29.0	15.5	18.9	33.9	34.0	40.6
nC_{30}	15.8	9.1	10.3	14.4	17.0	17.6
nC_{31}	39.6	19.3	25.1	45.4	45.7	55.0
nC_{32}	7.6	4.1	ND	5.4	6.1	8.2
nC_{33}	20.2	8.5	11.0	22.2	22.2	28.0
Pristane (Pr)	ND	ND	ND	8.6	ND	2.4
Phytane (Ph)	ND	ND	ND	ND	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**236.7**	**146.4**	**176.7**	**272.9**	**283.0**	**319.1**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**89.5**	**68.2**	**89.7**	**101.9**	**107.7**	**119.0**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**236.7**	**146.4**	**176.7**	**281.5**	**283.0**	**321.5**
CPI	**3.20**	**2.90**	**4.31**	**2.88**	**2.47**	**3.24**
Ratio (12-25)/(12-33)	**0.4**	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Sample number	9468/2001	9469/2001	9470/2001	9471/2001	9472/2001	9473/2001
Common site number	118	119	120	121	122	123
nC_{12}	1.4	0.8	1.2	0.6	0.6	0.5
nC_{13}	2.9	1.9	2.6	1.4	1.6	1.5
nC_{14}	3.5	2.7	3.5	1.9	2.0	1.8
nC_{15}	5.1	3.7	4.7	2.3	2.1	2.5
nC_{16}	4.8	3.5	3.8	2.5	1.7	2.0
nC_{17}	6.5	6.9	8.1	5.3	3.7	3.1
nC_{18}	4.9	3.0	4.8	1.8	1.9	2.0
nC_{19}	9.2	5.5	8.7	2.6	2.4	3.1
nC_{20}	5.2	2.9	5.4	2.4	2.0	1.8
nC_{21}	8.3	4.3	8.3	3.0	2.8	2.8
nC_{22}	18.9	Tr	17.3	5.7	5.7	7.5
nC_{23}	14.1	6.9	14.1	3.6	4.6	6.5
nC_{24}	15.3	5.9	13.4	4.0	3.8	9.8
nC_{25}	37.4	58.4	30.1	45.8	111.4	15.8
nC_{26}	0.3	ND	2.8	ND	ND	ND
nC_{27}	43.3	25.4	50.2	21.9	21.5	20.4
nC_{28}	35.3	19.8	32.0	14.0	14.9	13.9
nC_{29}	57.3	88.0	60.1	18.5	26.1	23.2
nC_{30}	28.3	33.0	28.7	10.0	16.4	12.2
nC_{31}	74.0	45.4	78.8	25.7	38.0	35.2
nC_{32}	13.7	8.8	7.9	4.1	20.1	16.6
nC_{33}	35.5	26.5	39.3	12.8	18.0	19.4
Pristane (Pr)	5.1	ND	2.6	ND	ND	ND
Phytane (Ph)	2.8	1.6	2.7	1.1	ND	ND
Sum of *n*-alkanes nC_{12}-nC_{33} (ng g^{-1})	**425.2**	**353.3**	**425.8**	**189.9**	**301.3**	**201.6**
Sum of *n*-alkanes nC_{12}-nC_{25} (ng g^{-1})	**137.5**	**106.4**	**126.0**	**82.9**	**146.3**	**60.7**
Sum all nC_{12}-nC_{33} + Pr+ Ph (ng g^{-1})	**433.1**	**354.9**	**431.1**	**191.0**	**301.3**	**201.6**
CPI	**2.55**	**3.47**	**2.90**	**3.74**	**3.77**	**2.05**
Ratio (12-25)/(12-33)	**0.3**	**0.4**	**0.3**	**0.4**	**0.5**	**0.3**

ND = Not detected (<0.04 ng g^{-1})
Tr = Trace (0.04 – 0.14 ng g^{-1})
CPI (Carbon preference index) = $(C_{23}+2(C_{25}+C_{27}+C_{29}+C_{31})+C_{33})/2(C_{24}+C_{26}+C_{28}+C_{30}+C_{32})$; petroleum hydrocarbons input ~ 1.0

Appendix 4

PAH concentrations (ng g^{-1} dry weight) of sediments collected in the Fladen Ground during a survey of the area in 2001. All are day grab samples unless indicated otherwise.

Definitions to be used with Appendix 4

[a] numbers in brackets refer to ion monitored for that compound;

ND <0.04ng g^{-1};

TR 0.04 – 0.14 ng g^{-1};

P/A phenanthrene/anthracene;

Fl/Py fluoranthene/pyrene;

MP/P methylphenanthrene (C1 178)/phenanthrene;

Total PAH 1 sum of (total naphthalenes + total 178 + total DBTs + total 202 + total 228 + total 252 + total 276). These 36 PAHs are the group of compounds which were also analysed for the 1989 samples;

Total PAH 2 is Total PAH 1 plus acenaphthylene, acenaphthene, fluorene and dibenz [*a,h*]anthracene This total thus incorporates all 16 of the US EPA priority PAHs.

Parent ng g^{-1} sum of (naphthalene + phenanthrene + anthracene + dibenzothiophene + fluoranthene + pyrene + benzo[*c*]phenanthrene + benz[*a*]anthracene + chrysene/triphenylene + benz[*b*]anthracene + benzofluoranthenes + benzo[*e*]pyrene + benzo[*a*]pyrene + perylene + indenopyrene + benzoperylene)

% parent PAH Parent ng g^{-1} /(total PAH 1/100)

NB sites 100 and 112 (high perylene) are included in this appendix but are not used in discussion in text unless otherwise noted.

Sample number	9346/2001	9347/2001	9348/2001	9349/2001	9350/2001	93512001	9352/2001
Common site number	1	2	3	4	5	6	7
Naphthalene	0.8	0.6	0.2	0.4	0.2	0.5	0.8
2-Methyl Naphthalene	1.0	0.9	0.5	0.5	0.3	0.5	1.4
1-Methyl Naphthalene	1.1	0.9	0.5	0.5	0.3	0.5	1.5
C2 Naphthalenes	2.8	2.8	1.1	1.8	1.2	1.3	3.7
C3 Naphthalenes	2.1	2.3	0.8	1.4	0.8	0.9	2.6
C4 Naphthalenes	0.7	0.7	ND	0.3	ND	ND	0.8
TOTAL Naphthalenes	8.5	8.2	3.1	4.9	2.8	3.7	10.8
Phenanthrene (178)[a]	1.5	1.6	0.5	1.1	0.6	0.7	1.9
Anthracene (178) [a]	ND	ND	ND	ND	ND	ND	ND
C1 178	2.7	2.7	0.7	1.6	0.9	1.0	3.2
C2 178	2.1	2.1	0.6	1.2	0.6	0.7	2.2
C3 178	1.9	2.0	0.6	1.0	0.6	0.6	1.8
TOTAL 178	8.2	8.4	2.4	4.9	2.7	3.0	9.1
Dibenzothiophene	TR	TR	ND	TR	ND	ND	0.2
C1 Dibenzothiophenes	0.4	0.4	TR	0.2	TR	0.2	0.4
C2 Dibenzothiophenes	0.2	0.3	ND	ND	ND	ND	0.2
C3 Dibenzothiophenes	ND	ND	ND	ND	ND	ND	ND
TOTAL DBT	0.6	0.7	TR	0.2	TR	0.2	0.8
Fluoranthene (202) [a]	2.0	2.1	0.6	1.1	0.7	0.9	2.0
Pyrene (202) [a]	1.4	1.4	0.4	0.8	0.5	0.6	1.4
C1 202	2.7	2.7	0.7	1.5	0.8	0.9	2.6
C2 202	ND	ND	ND	ND	ND	ND	ND
C3 202	ND	ND	ND	ND	ND	ND	ND
TOTAL 202	6.1	6.2	1.7	3.4	2.0	2.4	6.0
Benzo[*c*]phenanthrene (228) [a]	0.3	0.3	TR	TR	TR	TR	0.3
Benz[*a*]anthracene (228) [a]	1.2	1.3	0.3	0.6	0.4	0.4	1.2
Chrysene/Triphenylene (228) [a]	1.9	2.0	0.6	1.0	0.7	0.7	1.9
Benz[*b*]anthracene (228) [a]	TR	TR	ND	ND	ND	ND	TR
C1 228	3.6	3.7	0.9	1.8	1.0	1.1	3.3
C2 228	4.2	4.4	1.1	2.2	1.3	1.3	4.2
TOTAL 228	11.2	11.7	2.9	5.6	3.4	3.5	10.9
Benzofluoranthenes (252) [a]	17.8	19.1	5.2	9.0	5.3	6.1	15.9
Benzo[*e*]pyrene (252) [a]	4.7	5.0	1.4	2.4	1.4	1.5	4.2
Benzo[*a*]pyrene (252) [a]	2.3	2.4	0.7	1.2	0.8	0.9	2.2
Perylene (252) [a]	0.8	0.9	0.2	0.5	0.3	0.3	0.9
C1 252	10.1	10.8	2.9	5.3	3.1	3.5	10.1
C2 252	4.3	4.9	0.9	2.1	0.7	1.0	5.2
TOTAL 252	40.0	43.1	11.3	20.5	11.6	13.3	38.5
Indenopyrene (276) [a]	13.5	15.3	4.1	7.3	4.3	4.9	13.9
Benzoperylene (276) [a]	11.7	13.0	3.6	6.4	3.8	4.2	12.0
C1 276	ND	ND	ND	ND	ND	ND	ND
C2 276	ND	ND	ND	ND	ND	ND	ND
TOTAL 276	25.2	28.3	7.7	13.7	8.1	9.1	25.9
TOTAL PAH 1	99.8	106.6	29.1	53.2	30.6	35.2	102.0
Acenaphthylene (152)	ND	ND	ND	ND	ND	ND	ND
Acenaphthene (154)	ND	ND	ND	ND	ND	ND	TR
Fluorene (166)	0.2	0.2	TR	TR	TR	TR	0.2
Dibenz[*a,h*]anthracene (278)	2.3	2.6	0.7	1.2	0.7	0.8	2.4
TOTAL PAH 2	102.3	109.4	29.8	54.4	31.3	36.0	104.6
Parent/ng g^{-1}	**59.9**	**65.0**	**17.8**	**31.8**	**19.0**	**21.7**	**58.8**
Parent %	**60.0**	**61.0**	**61.2**	**59.8**	**62.1**	**61.6**	**57.6**
P/A							
Fl/Py	1.4	1.5	1.5	1.4	1.4	1.2	1.5
MP/P	1.8	1.7	1.4	1.5	1.5	1.5	1.4

Sample number	9353/2001	9354/2001	9355/2001	9356/2001	9357/2001	9358/2001	9359/2001	9360/2001
Common site number	8	9	10	11	12	13	14	15
Naphthalene	0.2	0.5	0.3	0.4	0.2	TR	0.4	0.2
2-Methyl Naphthalene	0.4	1.2	0.6	0.6	0.2	0.3	0.9	0.3
1-Methyl Naphthalene	0.4	1.3	0.6	0.6	0.2	0.3	1.0	0.3
C2 Naphthalenes	1.3	3.2	1.6	1.7	0.7	1.0	3.0	1.0
C3 Naphthalenes	0.9	2.1	1.4	1.7	0.6	0.9	2.4	0.8
C4 Naphthalenes	0.4	1.1	0.6	0.7	0.3	0.4	1.2	0.4
TOTAL Naphthalenes	3.6	9.4	5.1	5.7	2.2	2.9	8.9	3.0
Phenanthrene (178)[a]	0.7	1.6	0.8	1.4	0.5	0.6	1.8	0.6
Anthracene (178) [a]	TR	0.2	TR	0.2	TR	TR	0.2	TR
C1 178	1.1	2.8	1.3	1.6	0.8	1.0	2.9	1.0
C2 178	0.8	2.0	1.0	1.2	0.5	0.7	2.0	0.9
C3 178	0.6	1.6	0.8	0.9	0.4	0.6	1.4	0.8
TOTAL 178	3.2	8.2	3.9	5.3	2.2	2.9	8.3	3.3
Dibenzothiophene	TR	0.2	TR	TR	TR	TR	0.2	TR
C1 Dibenzothiophenes	TR	0.4	0.2	0.2	TR	TR	0.3	TR
C2 Dibenzothiophenes	0.2	0.5	0.2	0.3	TR	TR	0.4	0.5
C3 Dibenzothiophenes	0.2	0.5	0.2	0.3	TR	0.2	0.4	TR
TOTAL DBT	0.4	1.6	0.6	0.8	0.0	0.2	1.3	0.5
Fluoranthene (202) [a]	0.7	1.7	0.8	1.4	0.6	0.8	2.1	0.8
Pyrene (202) [a]	0.5	1.3	0.6	1.1	0.7	0.6	1.5	0.6
C1 202	0.9	2.4	1.1	1.6	0.9	1.0	2.6	1.1
C2 202	0.6	2.0	0.8	1.0	0.4	0.7	2.1	0.7
C3 202	0.7	2.1	0.9	1.0	0.5	0.7	1.8	1.7
TOTAL 202	3.4	9.5	4.2	6.1	3.1	3.8	10.1	4.9
Benzo[*c*]phenanthrene (228) [a]	TR	0.2	TR	TR	TR	TR	0.3	TR
Benz[*a*]anthracene (228) [a]	0.4	1.0	0.4	0.8	0.3	0.5	1.2	0.5
Chrysene/Triphenylene (228) [a]	0.6	1.7	0.7	1.2	20.3	2.0	2.0	0.8
Benz[*b*]anthracene (228) [a]	ND	ND	ND	TR	ND	ND	ND	ND
C1 228	1.1	3.2	1.4	1.8	1.0	1.3	3.7	1.5
C2 228	1.3	3.9	1.8	2.0	1.1	1.6	4.2	1.8
TOTAL 228	3.4	10.0	4.3	5.8	22.7	5.4	11.4	4.6
Benzofluoranthenes (252) [a]	5.0	13.8	5.6	8.0	4.1	6.4	18.8	6.6
Benzo[*e*]pyrene (252) [a]	1.3	3.7	1.5	2.2	1.0	1.6	4.9	1.6
Benzo[*a*]pyrene (252) [a]	0.7	2.0	0.8	1.6	0.6	0.9	2.4	0.9
Perylene (252) [a]	0.3	0.7	0.3	0.5	0.2	0.3	0.8	0.3
C1 252	3.1	9.1	3.7	5.0	2.6	3.9	11.5	4.0
C2 252	2.1	5.4	2.4	2.7	1.4	2.1	6.3	3.7
TOTAL 252	12.5	34.7	14.3	20.0	9.9	15.2	44.7	17.1
Indenopyrene (276) [a]	4.5	12.7	5.2	6.7	18.8	6.5	15.8	5.3
Benzoperylene (276) [a]	4.0	11.1	4.6	6.2	3.1	4.7	13.5	4.4
C1 276	1.9	5.2	2.1	2.8	1.4	2.1	6.0	2.1
C2 276	ND	ND	ND	ND	ND	ND	ND	ND
TOTAL 276	10.4	29.0	11.9	15.7	23.3	13.3	35.3	11.8
TOTAL PAH 1	36.9	102.4	44.3	59.4	63.4	43.7	120.0	45.2
Acenaphthylene (152)	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthene (154)	ND	TR	ND	TR	ND	ND	TR	ND
Fluorene (166)	TR	0.2	TR	0.2	ND	TR	0.2	TR
Dibenz[*a,h*]anthracene (278)	0.8	2.2	0.9	1.2	0.7	1.0	2.8	1.0
TOTAL PAH 2	37.7	104.8	45.2	60.8	64.1	44.7	123.0	46.2
Parent/ng g^{-1}	**18.9**	**52.4**	**21.6**	**31.7**	**50.4**	**24.9**	**65.9**	**22.6**
Parent %	**51.2**	**51.2**	**48.8**	**53.4**	**79.5**	**57.0**	**54.9**	**50.0**
P/A		8.0		7.0			9.0	
Fl/Py	1.4	1.3	1.3	1.3	0.9	1.3	1.4	1.3
MP/P	1.6	1.8	1.6	1.1	1.6	1.7	1.6	1.7

Sample number	9361/2001	9362/2001	9363/2001	9364/2001	9365/2001	9366/2001	9367/2001	9368/2001
Common site number	16	17	18	19	20	21	22	23
Naphthalene	0.6	0.3	0.4	0.4	0.4	1.3	0.3	0.3
2-Methyl Naphthalene	1.0	0.5	1.0	0.6	0.6	0.4	0.3	0.7
1-Methyl Naphthalene	1.0	0.5	0.8	0.6	0.7	0.4	0.4	0.5
C2 Naphthalenes	2.8	1.5	2.7	2.0	1.7	0.9	1.0	1.6
C3 Naphthalenes	2.3	1.1	2.4	1.7	1.3	0.8	0.8	1.6
C4 Naphthalenes	1.0	0.5	1.5	0.8	0.7	0.3	0.4	0.8
TOTAL Naphthalenes	8.7	4.4	8.8	6.1	5.4	4.1	3.2	5.5
Phenanthrene (178)[a]	1.6	1.2	2.1	1.2	1.0	0.7	0.6	1.3
Anthracene (178) [a]	0.2	0.2	0.3	TR	TR	TR	TR	TR
C1 178	2.6	1.5	3.1	1.9	1.7	1.0	1.0	2.0
C2 178	1.9	1.0	2.5	1.4	1.2	0.7	0.8	1.7
C3 178	1.3	0.8	1.6	1.0	0.8	0.5	1.1	1.1
TOTAL 178	7.6	4.7	9.6	5.5	4.7	2.9	3.5	6.1
Dibenzothiophene	TR	TR	0.2	TR	TR	TR	TR	TR
C1 Dibenzothiophenes	0.3	ND	ND	0.2	0.2	TR	0.2	0.3
C2 Dibenzothiophenes	0.4	0.2	0.4	0.4	0.2	0.2	ND	0.3
C3 Dibenzothiophenes	0.3	TR	0.3	0.2	TR	0.2	0.4	0.3
TOTAL DBT	1.0	0.2	0.9	0.8	0.4	0.4	0.6	0.9
Fluoranthene (202) [a]	1.8	1.3	3.0	1.3	1.2	1.0	0.8	2.2
Pyrene (202) [a]	1.3	0.9	2.1	0.9	0.9	0.7	0.7	1.5
C1 202	2.3	1.5	3.6	1.6	1.6	1.1	1.6	2.5
C2 202	1.8	0.9	3.2	1.3	9.3	1.1	1.5	2.0
C3 202	1.8	1.1	3.4	1.1	14.8	0.7	5.1	1.6
TOTAL 202	9.0	5.7	15.3	6.2	27.8	4.6	9.7	9.8
Benzo[*c*]phenanthrene (228) [a]	0.2	TR	0.4	0.2	0.2	TR	TR	0.2
Benz[*a*]anthracene (228) [a]	1.1	0.7	1.9	0.8	0.7	0.5	0.6	1.4
Chrysene/Triphenylene (228) [a]	1.7	1.0	3.1	1.2	1.1	0.8	0.7	2.1
Benz[*b*]anthracene (228) [a]	TR	ND	TR	ND	ND	ND	ND	TR
C1 228	3.1	1.8	4.3	2.2	2.2	1.5	1.8	2.8
C2 228	3.7	1.9	8.5	2.6	2.6	1.8	2.0	5.7
TOTAL 228	9.8	5.4	18.2	7.0	6.8	4.6	5.1	12.2
Benzofluoranthenes (252) [a]	15.1	7.7	23.2	10.6	9.9	7.7	6.7	13.5
Benzo[*e*]pyrene (252) [a]	3.7	1.7	6.5	2.6	2.5	1.9	1.6	3.9
Benzo[*a*]pyrene (252) [a]	1.9	1.0	3.2	1.4	1.3	1.1	0.9	2.1
Perylene (252) [a]	0.7	0.3	1.4	0.5	0.4	0.3	0.3	1.0
C1 252	9.1	4.2	15.3	6.3	5.8	4.3	4.0	9.6
C2 252	5.6	2.5	8.7	3.8	4.2	2.4	9.3	4.3
TOTAL 252	36.1	17.4	58.3	25.2	24.1	17.7	22.8	34.4
Indenopyrene (276) [a]	12.1	5.1	21.9	8.5	7.6	6.4	5.1	13.2
Benzoperylene (276) [a]	10.2	4.3	16.4	7.1	6.4	5.4	4.4	10.4
C1 276	4.5	1.9	5.0	3.0	2.7	2.2	1.9	3.2
C2 276	ND	ND	1.6	ND	ND	ND	ND	0.6
TOTAL 276	26.8	11.3	44.9	18.6	16.7	14.0	11.4	27.4
TOTAL PAH 1	99.0	49.1	156.0	69.4	85.9	48.3	56.3	96.3
Acenaphthylene (152)	ND	ND	TR	ND	ND	ND	ND	ND
Acenaphthene (154)	TR	TR	TR	TR	ND	ND	TR	ND
Fluorene (166)	0.2	TR	0.3	TR	TR	TR	TR	0.2
Dibenz[*a,h*]anthracene (278)	2.2	1.0	2.9	1.6	1.4	1.1	1.0	1.8
TOTAL PAH 2	101.4	50.1	159.2	71.0	87.3	49.4	57.3	98.3
Parent/ng g^{-1}	**52.2**	**25.7**	**86.1**	**36.7**	**33.6**	**27.8**	**22.7**	**53.1**
Parent %	**52.7**	**52.3**	**55.2**	**52.9**	**39.1**	**57.6**	**40.3**	**55.1**
P/A	8.0	6.0	7.0					
Fl/Py	1.4	1.4	1.4	1.4	1.3	1.4	1.1	1.5
MP/P	1.6	1.3	1.5	1.6	1.7	1.4	1.7	1.5

Sample number	9369/2001	9370/2001	9371/2001	9372/2001	9373/2001	9374/2001	9375/2001	9376/2001
Common site number	24	25	26	27	54	53	52	51
Naphthalene	0.4	0.5	0.4	0.3	0.4	0.3	0.6	0.7
2-Methyl Naphthalene	0.9	1.1	0.8	0.6	0.7	0.7	1.1	1.2
1-Methyl Naphthalene	0.7	0.8	0.6	0.5	0.6	0.5	0.9	1.0
C2 Naphthalenes	2.7	2.6	1.9	1.6	1.9	1.7	2.0	2.7
C3 Naphthalenes	2.7	2.1	1.8	1.5	1.8	1.6	1.4	2.1
C4 Naphthalenes	ND	1.0	1.2	0.9	0.6	0.9	0.7	1.1
TOTAL Naphthalenes	7.4	8.1	6.7	5.4	6.0	5.7	6.7	8.8
Phenanthrene (178)[a]	1.8	1.8	1.4	1.3	1.5	1.3	1.2	1.6
Anthracene (178) [a]	0.2	1.1	TR	0.2	TR	TR	TR	TR
C1 178	3.1	3.8	2.4	2.1	2.2	2.0	1.9	2.5
C2 178	3.2	3.3	2.3	1.8	2.0	1.8	1.6	2.1
C3 178	3.1	1.7	1.9	0.7	1.5	1.2	1.1	1.4
TOTAL 178	11.4	11.7	8.0	6.1	7.2	6.3	5.8	7.6
Dibenzothiophene	0.3	0.2	TR	0.2	TR	0.2	TR	0.3
C1 Dibenzothiophenes	0.7	0.4	0.2	0.3	0.3	0.3	0.3	0.6
C2 Dibenzothiophenes	0.8	0.8	0.6	0.5	0.4	TR	0.4	0.3
C3 Dibenzothiophenes	1.1	0.7	0.6	0.4	0.5	0.4	0.4	0.4
TOTAL DBT	2.9	2.1	1.4	1.4	1.2	0.9	1.1	1.6
Fluoranthene (202) [a]	3.0	5.4	2.8	2.6	2.4	2.2	1.7	2.4
Pyrene (202) [a]	2.1	4.0	1.9	1.8	1.6	1.4	1.1	1.6
C1 202	4.2	6.7	3.5	3.0	2.7	2.5	2.1	2.9
C2 202	4.2	4.7	2.8	2.7	2.2	5.7	1.5	2.5
C3 202	5.3	4.2	3.1	2.1	2.3	2.5	1.5	3.1
TOTAL 202	18.8	25.0	14.1	12.2	11.2	14.3	7.9	12.5
Benzo[*c*]phenanthrene (228) [a]	0.4	0.5	0.4	0.3	0.3	0.3	0.2	0.3
Benz[*a*]anthracene (228) [a]	2.0	3.9	2.0	1.8	1.6	1.4	1.1	1.6
Chrysene/Triphenylene (228) [a]	2.9	4.8	2.7	2.3	2.3	2.1	1.7	2.3
Benz[*b*]anthracene (228) [a]	0.2	0.4	TR	TR	TR	TR	ND	TR
C1 228	5.0	5.9	4.2	3.5	3.6	3.4	2.7	3.4
C2 228	10.4	10.9	8.5	7.2	7.6	7.2	5.7	7.8
TOTAL 228	20.9	26.4	17.8	15.1	15.4	14.4	11.4	15.4
Benzofluoranthenes (252) [a]	19.2	22.7	19.4	15.9	17.7	16.6	12.9	17.3
Benzo[*e*]pyrene (252) [a]	5.7	6.4	5.7	4.6	5.2	4.9	3.8	5.0
Benzo[*a*]pyrene (252) [a]	2.9	4.2	2.9	2.4	2.6	2.4	1.8	2.6
Perylene (252) [a]	2.0	2.5	1.5	1.2	1.3	1.2	1.0	1.3
C1 252	14.2	15.9	13.4	10.7	12.3	11.9	9.0	12.2
C2 252	8.3	9.2	6.4	6.0	6.1	6.2	4.2	6.8
TOTAL 252	52.3	60.9	49.3	40.8	45.2	43.2	32.7	45.2
Indenopyrene (276) [a]	18.5	20.6	18.5	14.8	17.9	17.2	12.6	17.8
Benzoperylene (276) [a]	14.2	15.7	14.2	11.5	13.8	13.3	9.6	13.7
C1 276	4.9	6.0	5.3	4.1	5.6	5.4	4.0	5.6
C2 276	2.4	1.6	1.6	2.0	1.4	2.0	0.9	2.3
TOTAL 276	40.0	43.9	39.6	32.4	38.7	37.9	27.1	39.4
TOTAL PAH 1	153.7	178.1	136.9	113.4	124.9	122.7	92.7	130.5
Acenaphthylene (152)	TR	TR	TR	ND	ND	ND	ND	TR
Acenaphthene (154)	TR	TR	TR	TR	TR	ND	ND	TR
Fluorene (166)	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2
Dibenz[*a,h*]anthracene (278)	2.6	3.0	2.6	2.2	2.5	2.4	1.8	2.5
TOTAL PAH 2	156.6	181.4	139.7	115.8	127.6	125.3	94.7	133.2
Parent/ng g^{-1}	**75.8**	**94.7**	**73.8**	**61.2**	**68.6**	**64.8**	**49.3**	**68.5**
Parent %	**49.3**	**53.2**	**53.9**	**54.0**	**54.9**	**52.8**	**53.2**	**52.5**
P/A	9.0	1.6		6.5				
Fl/Py	1.4	1.4	1.5	1.4	1.5	1.6	1.5	1.5
MP/P	1.7	2.1	1.7	1.6	1.5	1.5	1.6	1.6

Sample number	9377/2001	9378/2001	9379/2001	9380/2001	9383/2001	9384/2001	9385/2001
Common site number	50	49	48	47	45	44	43
Naphthalene	0.6	0.8	0.8	0.6	8.9	3.9	2.3
2-Methyl Naphthalene	1.1	1.5	1.9	1.4	15.6	7.6	5.0
1-Methyl Naphthalene	0.9	1.2	1.5	1.2	15.2	7.0	5.0
C2 Naphthalenes	3.0	3.2	3.9	3.1	32.2	21.9	12.6
C3 Naphthalenes	2.5	2.9	3.2	2.6	12.4	12.5	5.6
C4 Naphthalenes	1.2	0.9	1.6	1.3	5.1	5.2	2.2
TOTAL Naphthalenes	9.3	10.5	12.9	10.2	89.4	58.1	32.7
Phenanthrene (178)[a]	1.5	2.5	2.6	2.0	14.2	8.4	4.5
Anthracene (178) [a]	TR	0.2	0.2	0.2	2.0	1.3	0.5
C1 178	2.7	3.6	3.9	3.0	19.4	17.4	7.4
C2 178	2.4	2.8	3.2	2.5	12.0	12.1	5.0
C3 178	1.8	1.6	2.1	1.6	8.2	8.2	4.0
TOTAL 178	8.4	10.7	12.0	9.3	55.8	47.4	21.4
Dibenzothiophene	TR	0.2	0.2	0.2	1.1	0.7	0.4
C1 Dibenzothiophenes	0.4	0.5	0.4	0.3	1.8	1.6	0.8
C2 Dibenzothiophenes	0.4	0.4	0.5	0.4	2.2	2.3	1.0
C3 Dibenzothiophenes	0.3	0.4	0.5	0.3	1.5	1.6	0.8
TOTAL DBT	1.1	1.5	1.6	1.2	6.6	6.2	3.0
Fluoranthene (202) [a]	1.6	3.5	4.2	2.8	15.8	14.8	5.5
Pyrene (202) [a]	1.1	2.3	2.7	1.9	11.3	10.9	3.9
C1 202	2.4	4.3	4.7	3.4	16.2	18.4	6.5
C2 202	2.6	3.0	3.5	2.7	10.6	12.0	5.4
C3 202	2.3	2.7	2.8	2.1	9.1	8.8	4.4
TOTAL 202	10.0	15.8	17.9	12.9	63.0	64.9	25.7
Benzo[*c*]phenanthrene (228) [a]	0.2	0.4	0.5	0.3	1.7	1.7	0.8
Benz[*a*]anthracene (228) [a]	1.1	2.3	2.7	1.9	9.2	9.4	3.4
Chrysene/Triphenylene (228) [a]	1.8	3.4	4.0	2.8	12.8	12.3	5.5
Benz[*b*]anthracene (228) [a]	ND	TR	TR	TR	0.7	0.6	0.2
C1 228	2.8	4.8	6.0	4.1	20.0	19.2	9.4
C2 228	7.3	10.8	12.6	9.1	23.1	22.2	10.9
TOTAL 228	13.2	21.7	25.8	18.2	67.5	65.4	30.2
Benzofluoranthenes (252) [a]	11.2	26.2	33.1	21.2	86.4	79.9	42.2
Benzo[*e*]pyrene (252) [a]	3.2	7.4	9.3	6.0	22.0	20.7	11.2
Benzo[*a*]pyrene (252) [a]	1.6	3.8	4.4	2.9	12.7	12.5	5.6
Perylene (252) [a]	0.8	1.7	1.7	1.3	4.2	3.9	2.0
C1 252	8.3	18.2	21.3	14.9	41.3	37.8	20.5
C2 252	3.2	9.0	10.2	7.2	29.6	25.9	14.2
TOTAL 252	28.3	66.3	80.0	53.5	196.2	180.7	95.7
Indenopyrene (276) [a]	11.2	26.7	30.7	21.4	71.3	59.8	36.3
Benzoperylene (276) [a]	8.6	20.2	23.1	15.9	59.0	50.1	30.4
C1 276	3.6	8.2	9.2	6.6	24.4	21.3	12.1
C2 276	2.4	2.5	3.1	1.8	8.0	6.1	3.9
TOTAL 276	25.8	57.6	66.1	45.7	162.7	137.3	82.7
TOTAL PAH 1	96.1	184.1	216.3	151.0	641.2	560.0	291.4
Acenaphthylene (152)	TR	TR	TR	TR	0.6	0.3	0.2
Acenaphthene (154)	TR	TR	TR	TR	1.9	0.5	0.3
Fluorene (166)	0.3	0.3	0.4	0.3	1.6	1.1	0.6
Dibenz[*a,h*]anthracene (278)	1.7	3.8	4.5	3.0	13.7	11.5	7.0
TOTAL PAH 2	98.1	188.2	221.2	154.3	659.0	573.4	299.5
Parent/ng g^{-1}	**44.5**	**101.6**	**120.2**	**81.4**	**333.3**	**290.9**	**154.7**
Parent %	**46.3**	**55.2**	**55.6**	**53.9**	**52.0**	**51.9**	**53.1**
P/A		12.5	13.0	10.0	7.1	6.5	9.0
Fl/Py	1.5	1.5	1.6	1.5	1.4	1.4	1.4
MP/P	1.8	1.4	1.5	1.5	1.4	2.1	1.6

Sample number	9381/2001A	9381/2001B	9381/2001C	9381/2001D	9381/2001E
Common site number	46	46	46	46	46
Naphthalene	0.7	0.7	2.4	1.2	2.9
2-Methyl Naphthalene	1.5	1.4	5.9	2.4	6.2
1-Methyl Naphthalene	1.2	1.2	5.2	2.0	6.0
C2 Naphthalenes	3.5	3.5	12.0	5.5	17.3
C3 Naphthalenes	2.9	3.4	7.7	4.8	7.6
C4 Naphthalenes	1.5	1.7	4.6	2.4	3.2
TOTAL Naphthalenes	11.3	11.9	37.8	18.3	43.2
Phenanthrene (178)[a]	2.3	2.4	7.3	3.6	6.4
Anthracene (178) [a]	0.2	0.2	0.9	0.3	0.7
C1 178	3.4	3.7	11.7	5.5	10.4
C2 178	2.7	3.0	9.2	4.4	7.1
C3 178	1.8	1.7	5.7	2.8	5.4
TOTAL 178	10.4	11.0	34.8	16.6	30.0
Dibenzothiophene	0.2	0.2	0.7	0.3	0.6
C1 Dibenzothiophenes	0.4	0.5	1.3	0.7	1.1
C2 Dibenzothiophenes	0.4	0.5	1.6	0.7	1.5
C3 Dibenzothiophenes	0.4	0.4	1.2	0.6	1.0
TOTAL DBT	1.4	1.6	4.8	2.3	4.2
Fluoranthene (202) [a]	3.1	3.0	10.3	4.7	7.9
Pyrene (202) [a]	2.0	2.0	6.7	3.1	5.6
C1 202	3.8	4.0	12.8	6.1	9.4
C2 202	5.0	3.1	17.8	5.2	6.7
C3 202	2.5	2.8	9.2	4.1	6.1
TOTAL 202	16.4	14.9	56.8	23.2	35.7
Benzo[*c*]phenanthrene (228) [a]	0.4	0.4	1.3	0.6	1.0
Benz[*a*]anthracene (228) [a]	2.1	2.1	6.9	3.2	4.8
Chrysene/Triphenylene (228) [a]	3.1	3.2	10.3	4.8	7.2
Benz[*b*]anthracene (228) [a]	TR	TR	0.5	0.2	0.3
C1 228	4.7	4.7	15.1	7.0	12.5
C2 228	11.6	10.7	30.0	14.2	15.8
TOTAL 228	21.9	21.1	64.1	30.0	41.6
Benzofluoranthenes (252) [a]	24.6	23.7	75.2	33.3	58.4
Benzo[*e*]pyrene (252) [a]	7.0	6.7	21.1	9.4	15.3
Benzo[*a*]pyrene (252) [a]	3.3	3.2	10.2	4.5	8.1
Perylene (252) [a]	1.4	1.5	4.4	2.0	2.8
C1 252	16.8	16.8	51.7	23.2	29.6
C2 252	8.5	8.5	27.6	12.0	19.8
TOTAL 252	61.6	60.4	190.2	84.4	134.0
Indenopyrene (276) [a]	24.5	23.5	73.1	32.8	51.9
Benzoperylene (276) [a]	18.1	17.5	53.4	24.2	47.0
C1 276	7.6	7.6	21.9	10.5	18.2
C2 276	2.3	2.6	8.3	3.1	6.4
TOTAL 276	52.5	51.2	156.7	70.6	123.5
TOTAL PAH 1	175.5	172.1	545.2	245.4	412.2
Acenaphthylene (152)	TR	TR	0.2	TR	0.3
Acenaphthene (154)	TR	TR	0.3	TR	0.5
Fluorene (166)	0.3	0.4	0.9	0.5	0.8
Dibenz[*a,h*]anthracene (278)	3.6	3.4	10.5	4.7	10.5
TOTAL PAH 2	179.5	175.9	557.1	250.6	424.3
Parent/ng g^{-1}	**93.0**	**90.3**	**284.7**	**128.2**	**220.9**
Parent %	**53.0**	**52.5**	**52.2**	**52.2**	**53.6**
P/A	11.5	12.0	8.1	12.0	
Fl/Py	1.6	1.5	1.5	1.5	
MP/P	1.5	1.5	1.6	1.5	

Multi-corer

Sample number	9382/2001A	9382/2001B	9382/2001C	9382/2001D
Common site number	46	46	46	46
Naphthalene	2.2	2.5	1.9	1.7
2-Methyl Naphthalene	4.9	4.5	3.7	2.9
1-Methyl Naphthalene	4.8	4.2	3.4	2.5
C2 Naphthalenes	14.4	13.2	9.3	7.4
C3 Naphthalenes	6.2	6.5	4.1	3.7
C4 Naphthalenes	3.0	2.8	1.6	1.4
TOTAL Naphthalenes	35.5	33.7	24.0	19.6
Phenanthrene (178)[a]	5.3	5.3	3.6	3.0
Anthracene (178) [a]	1.0	0.6	0.4	0.3
C1 178	7.4	9.1	6.2	4.4
C2 178	5.2	6.3	3.7	3.0
C3 178	6.5	5.3	2.9	2.5
TOTAL 178	25.4	26.6	16.8	13.2
Dibenzothiophene	0.6	0.5	0.4	0.3
C1 Dibenzothiophenes	1.3	0.9	0.7	0.5
C2 Dibenzothiophenes	2.5	1.4	0.9	0.7
C3 Dibenzothiophenes	2.0	1.0	0.7	0.5
TOTAL DBT	6.4	3.8	2.7	2.0
Fluoranthene (202) [a]	7.8	7.4	4.4	3.9
Pyrene (202) [a]	6.4	5.2	3.1	2.7
C1 202	7.3	8.6	4.9	4.3
C2 202	4.9	6.3	4.2	3.6
C3 202	12.3	6.2	3.8	3.0
TOTAL 202	38.7	33.7	20.4	17.5
Benzo[*c*]phenanthrene (228) [a]	1.0	1.0	0.7	0.5
Benz[*a*]anthracene (228) [a]	4.5	4.5	2.6	2.1
Chrysene/Triphenylene (228) [a]	6.0	6.8	4.2	3.3
Benz[*b*]anthracene (228) [a]	0.3	0.3	0.2	TR
C1 228	8.5	12.3	7.6	6.1
C2 228	10.8	14.8	8.0	7.2
TOTAL 228	31.1	39.7	23.3	19.2
Benzofluoranthenes (252) [a]	35.4	61.0	30.2	28.4
Benzo[*e*]pyrene (252) [a]	9.3	16.2	7.9	7.6
Benzo[*a*]pyrene (252) [a]	5.7	8.2	4.0	3.7
Perylene (252) [a]	1.9	2.8	1.3	1.4
C1 252	17.0	30.2	14.2	12.7
C2 252	16.2	20.0	9.8	8.5
TOTAL 252	85.5	138.4	67.4	62.3
Indenopyrene (276) [a]	26.2	54.0	25.1	20.8
Benzoperylene (276) [a]	21.9	47.9	21.0	17.8
C1 276	9.4	18.0	8.2	6.9
C2 276	3.1	6.1	2.9	2.4
TOTAL 276	60.6	126.0	57.2	47.9
TOTAL PAH 1	283.2	401.9	211.8	181.7
Acenaphthylene (152)	0.2	0.2	0.2	TR
Acenaphthene (154)	0.5	0.4	0.3	0.2
Fluorene (166)	0.6	0.7	0.5	0.4
Dibenz[*a,h*]anthracene (278)	5.4	11.2	4.7	3.8
TOTAL PAH 2	289.9	414.4	217.5	186.1
Parent/ng g^{-1}	**135.5**	**224.2**	**111.0**	**97.5**
Parent %	**47.8**	**55.8**	**52.4**	**53.7**
P/A	5.3	8.8	9.0	10.0
Fl/Py	1.2	1.4	1.4	1.4
MP/P	1.4	1.7	1.7	1.5

Sample number	9386/2001	9387/2001	9388/2001	9389/2001	9390/2001	9393/2001	9394/2001
Common site number	42	41	40	39	38	36	35
Naphthalene	4.1	2.4	1.4	1.2	2.9	1.2	0.4
2-Methyl Naphthalene	5.4	5.7	2.9	2.2	5.8	2.5	0.7
1-Methyl Naphthalene	4.9	5.9	3.0	2.0	5.6	2.3	0.5
C2 Naphthalenes	14.5	12.7	6.4	6.0	14.5	10.4	2.8
C3 Naphthalenes	6.9	5.4	3.3	3.6	7.0	4.7	1.7
C4 Naphthalenes	3.0	2.2	1.2	1.5	2.9	2.1	0.6
TOTAL Naphthalenes	38.8	34.3	18.2	16.5	38.7	23.2	6.7
Phenanthrene (178)[a]	5.2	3.8	2.1	2.5	5.5	5.4	1.1
Anthracene (178) [a]	0.5	0.4	0.2	0.2	0.5	1.0	TR
C1 178	8.7	6.5	3.5	4.2	9.5	7.5	1.9
C2 178	5.4	4.2	2.2	2.5	6.3	4.8	1.5
C3 178	4.0	3.2	1.9	2.0	4.8	3.8	1.2
TOTAL 178	23.8	18.1	9.9	11.4	26.6	22.5	5.7
Dibenzothiophene	0.5	0.4	0.2	0.3	0.5	0.5	TR
C1 Dibenzothiophenes	1.0	0.7	0.4	0.5	1.1	1.0	0.2
C2 Dibenzothiophenes	1.5	0.9	0.5	0.7	1.6	1.6	0.5
C3 Dibenzothiophenes	1.2	0.8	0.3	0.5	1.3	1.4	0.5
TOTAL DBT	4.2	2.8	1.4	2.0	4.5	4.5	1.2
Fluoranthene (202) [a]	5.5	3.9	2.0	2.3	5.3	8.5	1.2
Pyrene (202) [a]	3.9	2.8	1.4	1.6	3.7	5.9	0.9
C1 202	6.2	4.5	2.7	2.9	7.2	7.3	1.6
C2 202	5.4	5.3	2.6	2.5	6.6	5.2	1.3
C3 202	4.4	4.5	2.1	2.6	7.2	9.0	1.7
TOTAL 202	25.4	21.0	10.8	11.9	30.0	35.9	6.7
Benzo[*c*]phenanthrene (228) [a]	0.7	0.5	0.3	0.3	0.7	0.7	ND
Benz[*a*]anthracene (228) [a]	3.1	2.3	1.2	1.3	3.1	4.2	0.7
Chrysene/Triphenylene (228) [a]	5.3	3.9	2.1	2.4	5.5	5.6	1.2
Benz[*b*]anthracene (228) [a]	0.2	0.2	TR	TR	0.2	0.4	TR
C1 228	9.0	6.8	3.7	4.1	9.9	7.8	2.0
C2 228	10.9	7.9	5.1	5.5	15.9	11.8	3.3
TOTAL 228	29.2	21.6	12.4	13.6	35.3	30.5	7.2
Benzofluoranthenes (252) [a]	38.9	29.0	18.2	18.0	49.5	33.8	8.1
Benzo[*e*]pyrene (252) [a]	10.4	7.7	5.0	4.9	13.6	9.3	2.3
Benzo[*a*]pyrene (252) [a]	5.2	3.9	2.3	2.3	6.5	6.1	1.2
Perylene (252) [a]	1.9	1.4	0.9	0.9	2.8	2.3	0.5
C1 252	20.0	14.7	8.8	9.2	25.2	17.5	4.3
C2 252	13.4	11.2	6.7	8.4	20.8	15.5	3.8
TOTAL 252	89.8	67.9	41.9	43.7	118.4	84.5	20.2
Indenopyrene (276) [a]	33.3	25.2	15.4	16.1	43.2	31.8	8.1
Benzoperylene (276) [a]	28.0	21.1	12.8	14.0	36.2	26.8	6.8
C1 276	11.1	8.9	5.3	5.5	15.9	11.5	3.3
C2 276	2.5	2.5	1.5	1.7	5.0	3.7	0.9
TOTAL 276	74.9	57.7	35.0	37.3	100.3	73.8	19.1
TOTAL PAH 1	286.1	223.4	129.6	136.4	353.8	274.9	66.8
Acenaphthylene (152)	0.2	0.2	TR	TR	0.2	0.2	TR
Acenaphthene (154)	0.4	0.3	0.2	0.2	0.3	0.2	ND
Fluorene (166)	0.7	0.5	0.3	0.4	0.7	0.5	0.2
Dibenz[*a,h*]anthracene (278)	6.2	4.6	2.8	3.0	8.7	6.2	1.4
TOTAL PAH 2	293.6	229.0	132.9	140.0	363.7	282.0	68.4
Parent/ng g^{-1}	**146.7**	**108.9**	**65.5**	**68.3**	**179.7**	**143.5**	**32.5**
Parent %	**51.3**	**48.7**	**50.5**	**50.1**	**50.8**	**52.2**	**48.7**
P/A	10.4	9.5	10.5	12.5	11.0	5.4	
Fl/Py	1.4	1.4	1.4	1.4	1.4	1.4	1.3
MP/P	1.7	1.7	1.7	1.7	1.7	1.4	1.7

Sample number	9391/2001A	9391/2001B	9391/2001C	9391/2001D	9391/2001E
Common site number	37	37	37	37	37
Naphthalene	3.2	2.5	2.0	1.8	0.9
2-Methyl Naphthalene	4.1	4.3	3.9	3.6	1.6
1-Methyl Naphthalene	4.0	4.0	3.7	3.7	1.5
C2 Naphthalenes	9.7	9.8	9.1	9.9	3.6
C3 Naphthalenes	1.4	4.3	5.0	5.4	1.8
C4 Naphthalenes	1.8	1.7	1.9	2.2	0.9
TOTAL Naphthalenes	24.2	26.6	25.6	26.6	10.3
Phenanthrene (178)[a]	2.9	3.3	3.3	3.7	1.2
Anthracene (178) [a]	0.3	0.3	0.3	0.3	TR
C1 178	5.2	5.6	5.5	6.5	2.0
C2 178	3.5	3.9	3.7	4.4	1.6
C3 178	3.0	3.0	2.8	3.6	1.5
TOTAL 178	14.9	16.1	15.6	18.5	6.3
Dibenzothiophene	0.3	0.3	0.3	0.4	TR
C1 Dibenzothiophenes	0.6	0.7	0.5	0.8	0.3
C2 Dibenzothiophenes	1.0	1.1	0.8	1.0	0.8
C3 Dibenzothiophenes	0.8	0.9	0.8	0.8	0.7
TOTAL DBT	2.7	3.0	2.4	3.0	1.8
Fluoranthene (202) [a]	2.7	3.0	3.2	3.8	1.1
Pyrene (202) [a]	1.9	2.1	2.3	2.6	0.8
C1 202	3.8	4.1	4.3	5.3	1.5
C2 202	3.8	3.8	3.9	4.5	1.7
C3 202	3.7	3.7	4.2	4.7	1.7
TOTAL 202	15.9	16.7	17.9	20.9	6.8
Benzo[*c*]phenanthrene (228) [a]	0.4	0.4	0.4	0.5	TR
Benz[*a*]anthracene (228) [a]	1.6	1.8	2.0	2.2	0.6
Chrysene/Triphenylene (228) [a]	2.9	3.1	3.4	3.8	1.1
Benz[*b*]anthracene (228) [a]	TR	TR	TR	TR	ND
C1 228	5.1	5.5	6.1	6.8	2.2
C2 228	8.0	7.2	7.9	9.4	3.9
TOTAL 228	18.0	18.0	19.8	22.7	7.8
Benzofluoranthenes (252) [a]	21.7	21.5	22.8	27.9	9.3
Benzo[*e*]pyrene (252) [a]	5.8	5.9	6.3	7.6	2.6
Benzo[*a*]pyrene (252) [a]	2.9	3.0	3.2	3.8	1.3
Perylene (252) [a]	1.3	1.3	1.4	1.6	0.5
C1 252	11.6	11.3	12.1	14.5	4.9
C2 252	10.5	9.6	10.4	11.6	4.6
TOTAL 252	53.8	52.6	56.2	67.0	23.2
Indenopyrene (276) [a]	20.1	19.7	21.1	24.7	7.8
Benzoperylene (276) [a]	18.4	16.6	17.8	21.6	6.5
C1 276	7.5	7.1	7.7	9.5	2.7
C2 276	3.9	3.2	2.4	3.4	1.7
TOTAL 276	49.9	46.6	49.0	59.2	18.7
TOTAL PAH 1	179.4	179.6	186.5	217.9	74.9
Acenaphthylene (152)	TR	TR	TR	TR	TR
Acenaphthene (154)	0.2	0.2	0.2	0.2	TR
Fluorene (166)	0.4	0.5	0.5	0.5	0.2
Dibenz[*a,h*]anthracene (278)	3.6	3.6	3.8	4.3	1.5
TOTAL PAH 2	183.6	183.9	191.0	222.9	76.6
Parent/ng g^{-1}	**86.4**	**84.8**	**89.8**	**106.3**	**33.7**
Parent %	**48.2**	**47.2**	**48.2**	**48.8**	**45.0**
P/A	9.7	11.0	11.0	12.3	
Fl/Py	1.4	1.4	1.4	1.5	1.4
MP/P	1.8	1.7	1.7	1.8	1.7

Multi-corer

Sample number	9392/2001A	9392/2001B	9392/2001C	9392/2001D
Common site number	37	37	37	37
Naphthalene	1.2	1.5	2.6	3.4
2-Methyl Naphthalene	2.2	2.9	3.7	4.0
1-Methyl Naphthalene	2.1	2.8	3.4	3.7
C2 Naphthalenes	5.0	7.4	8.7	11.6
C3 Naphthalenes	2.5	3.3	4.1	6.3
C4 Naphthalenes	0.9	1.4	1.9	2.9
TOTAL Naphthalenes	13.9	19.3	24.4	31.9
Phenanthrene (178)[a]	1.6	2.6	3.1	4.4
Anthracene (178)[a]	TR	0.2	0.3	0.4
C1 178	2.6	4.5	5.3	7.4
C2 178	1.7	2.8	3.4	5.4
C3 178	1.2	2.2	3.0	4.4
TOTAL 178	7.1	12.3	15.1	22.0
Dibenzothiophene	0.2	0.3	0.3	0.5
C1 Dibenzothiophenes	0.3	0.5	0.7	1.1
C2 Dibenzothiophenes	0.4	0.8	1.1	1.9
C3 Dibenzothiophenes	0.3	0.6	0.9	1.6
TOTAL DBT	1.2	2.2	3.0	5.1
Fluoranthene (202)[a]	1.5	2.5	3.2	4.7
Pyrene (202)[a]	1.1	1.8	2.3	3.3
C1 202	1.9	3.2	4.1	6.0
C2 202	1.7	3.0	3.6	5.2
C3 202	1.9	2.9	3.4	5.1
TOTAL 202	8.1	13.4	16.6	24.3
Benzo[*c*]phenanthrene (228)[a]	0.2	0.3	0.4	0.6
Benz[*a*]anthracene (228)[a]	0.9	1.4	1.9	2.7
Chrysene/Triphenylene (228)[a]	1.4	2.5	3.0	4.3
Benz[*b*]anthracene (228)[a]	TR	TR	TR	0.2
C1 228	2.4	4.4	5.4	7.9
C2 228	3.3	5.9	6.8	9.3
TOTAL 228	8.2	14.5	17.5	25.0
Benzofluoranthenes (252)[a]	10.0	19.1	23.1	33.5
Benzo[*e*]pyrene (252)[a]	2.9	5.3	6.4	9.2
Benzo[*a*]pyrene (252)[a]	1.4	2.7	3.2	4.5
Perylene (252)[a]	0.6	1.2	1.3	2.0
C1 252	5.2	9.7	11.3	16.2
C2 252	4.4	7.8	8.7	11.7
TOTAL 252	24.5	45.8	54.0	77.1
Indenopyrene (276)[a]	8.7	16.6	20.2	28.9
Benzoperylene (276)[a]	7.5	14.1	17.2	29.7
C1 276	3.5	6.0	7.3	11.4
C2 276	0.8	2.2	3.9	3.9
TOTAL 276	20.5	38.9	48.6	73.9
TOTAL PAH 1	83.5	146.4	179.2	259.3
Acenaphthylene (152)	TR	TR	TR	0.2
Acenaphthene (154)	TR	0.2	0.2	0.3
Fluorene (166)	0.3	0.4	0.4	0.6
Dibenz[*a,h*]anthracene (278)	1.6	3.1	3.7	5.8
TOTAL PAH 2	85.4	150.1	183.5	266.2
Parent/ng g^{-1}	**39.2**	**72.1**	**88.5**	**132.3**
Parent %	**46.9**	**49.2**	**49.4**	**51.0**
P/A		13.0	10.3	11.0
Fl/Py	1.4	1.4	1.4	1.4
MP/P	1.6	1.7	1.7	1.7

Sample number	9395/2001	9396/2001	9397/2001	9398/2001	9399/2001	9400/2001	9401/2001	9402/2001
Common site number	34	33	32	31	30	29	28	55
Naphthalene	0.6	0.3	0.2	0.2	0.8	ND	TR	ND
2-Methyl Naphthalene	1.1	0.9	0.4	0.4	1.0	0.5	0.6	0.4
1-Methyl Naphthalene	0.9	0.6	0.3	0.2	0.8	0.3	0.6	0.2
C2 Naphthalenes	4.2	3.3	1.8	1.4	2.6	1.9	1.7	2.0
C3 Naphthalenes	2.6	1.7	1.1	0.8	1.1	1.0	0.9	1.0
C4 Naphthalenes	0.9	0.9	0.4	ND	0.5	0.5	0.4	0.5
TOTAL Naphthalenes	10.3	7.7	4.2	3.0	6.8	4.2	4.2	4.1
Phenanthrene (178)[a]	1.8	1.2	0.7	0.5	1.6	0.7	0.7	0.9
Anthracene (178) [a]	0.2	0.2	TR	TR	0.3	TR	TR	TR
C1 178	2.9	2.2	1.1	0.9	1.4	1.2	1.2	1.6
C2 178	2.1	1.7	0.8	0.2	1.1	0.8	0.8	1.3
C3 178	2.0	1.2	0.5	0.6	0.8	0.6	0.7	0.8
TOTAL 178	9.0	6.5	3.1	2.2	5.2	3.3	3.4	4.6
Dibenzothiophene	0.2	TR	TR	TR	0.2	TR	TR	0.2
C1 Dibenzothiophenes	0.4	0.2	TR	0.2	0.2	0.3	TR	ND
C2 Dibenzothiophenes	0.5	0.4	TR	0.2	0.5	0.2	0.3	0.4
C3 Dibenzothiophenes	0.6	0.4	0.2	TR	0.4	0.2	TR	0.2
TOTAL DBT	1.7	1.0	0.2	0.4	1.3	0.7	0.3	0.8
Fluoranthene (202) [a]	2.1	1.6	0.8	0.7	1.9	0.8	0.8	1.0
Pyrene (202) [a]	1.5	1.3	0.6	0.5	1.4	0.6	0.5	0.7
C1 202	2.5	2.1	0.9	1.0	1.5	0.9	0.9	1.3
C2 202	2.2	1.7	0.7	1.0	1.1	0.6	0.8	1.7
C3 202	1.5	1.7	0.6	2.5	1.1	0.7	0.7	1.2
TOTAL 202	9.8	8.4	3.6	5.7	7.0	3.6	3.7	5.9
Benzo[*c*]phenanthrene (228) [a]	ND	ND	ND	ND	ND	TR	TR	TR
Benz[*a*]anthracene (228) [a]	1.2	1.0	0.5	0.4	1.0	0.4	0.4	0.5
Chrysene/Triphenylene (228) [a]	2.1	1.6	0.7	0.6	1.3	0.7	0.7	1.0
Benz[*b*]anthracene (228) [a]	TR	TR	TR	ND	TR	ND	ND	ND
C1 228	3.6	2.6	1.2	1.2	1.5	1.2	1.2	1.6
C2 228	5.1	3.6	1.8	1.7	1.9	1.8	1.8	2.4
TOTAL 228	12.0	8.8	4.2	3.9	5.7	4.1	4.1	5.5
Benzofluoranthenes (252) [a]	16.8	12.2	5.7	6.2	6.6	6.9	7.0	7.7
Benzo[*e*]pyrene (252) [a]	4.5	3.5	1.6	1.7	1.9	1.9	2.0	2.2
Benzo[*a*]pyrene (252) [a]	2.3	1.9	0.9	0.8	1.3	0.9	0.9	1.0
Perylene (252) [a]	1.0	0.7	0.4	0.3	0.5	0.4	0.3	0.4
C1 252	8.3	6.2	2.7	2.8	2.8	2.9	2.9	3.4
C2 252	6.4	4.4	1.8	2.9	2.1	2.0	2.0	2.6
TOTAL 252	39.3	28.9	13.1	14.7	15.2	15.0	15.1	17.3
Indenopyrene (276) [a]	15.5	10.6	4.8	5.2	4.7	5.2	5.4	6.3
Benzoperylene (276) [a]	12.8	8.9	4.1	4.4	4.1	4.3	4.4	5.2
C1 276	5.4	3.8	1.6	2.0	1.7	1.6	1.7	2.0
C2 276	1.8	1.2	0.4	0.6	0.6	0.2	0.4	0.7
TOTAL 276	35.5	24.5	10.9	12.2	11.1	11.3	11.9	14.2
TOTAL PAH 1	117.6	85.8	39.3	42.1	52.3	42.2	42.7	52.4
Acenaphthylene (152)	TR	TR	ND	ND	TR	ND	ND	TR
Acenaphthene (154)	ND	ND	ND	ND	1.0	TR	ND	ND
Fluorene (166)	0.3	0.2	TR	ND	0.5	TR	0.7	TR
Dibenz[*a,h*]anthracene (278)	2.7	1.9	0.9	0.9	0.9	1.0	0.9	1.2
TOTAL PAH 2	120.6	87.9	40.2	43.0	54.7	43.2	44.3	53.6
Parent/ng g^{-1}	**62.6**	**45.0**	**21.0**	**21.5**	**27.6**	**22.8**	**23.1**	**27.1**
Parent %	**53.2**	**52.4**	**53.4**	**51.1**	**52.8**	**54.0**	**54.1**	**51.7**
P/A	9.0	6.0			5.3			
Fl/Py	1.4	1.2	1.3	1.4	1.4	1.3	1.6	1.4
MP/P	1.6	1.8	1.6	1.8	0.9	1.7	1.7	1.8

Sample number	9403/2001	9404/2001	9405/2001	9406/2001	9407/2001	9408/2001	9409/2001	9410/2001
Common site number	56	57	58	59	60	61	62	63
Naphthalene	ND	0.2	ND	0.6	0.7	0.7	0.9	0.9
2-Methyl Naphthalene	0.4	0.7	0.4	0.8	1.1	1.0	1.1	1.5
1-Methyl Naphthalene	0.2	0.7	0.4	2.4	2.8	2.6	2.9	3.6
C2 Naphthalenes	1.7	2.3	1.5	2.8	3.7	3.4	3.5	4.0
C3 Naphthalenes	0.9	1.3	0.7	1.5	2.3	1.5	1.7	2.0
C4 Naphthalenes	0.5	0.5	0.3	0.6	0.9	0.8	0.9	ND
TOTAL Naphthalenes	3.7	5.7	3.3	8.7	11.5	10.0	11.0	12.0
Phenanthrene (178)[a]	0.8	0.8	0.7	1.0	1.6	1.2	1.4	1.5
Anthracene (178) [a]	TR	TR	TR	TR	0.2	TR	0.2	0.2
C1 178	1.4	1.3	1.1	1.8	2.8	2.2	2.2	2.7
C2 178	1.1	1.1	0.9	1.4	2.0	1.7	1.8	1.3
C3 178	0.7	0.9	0.5	1.0	1.4	1.2	0.7	2.7
TOTAL 178	4.0	4.1	3.2	5.2	8.0	6.3	6.3	8.4
Dibenzothiophene	0.2	TR	TR	TR	0.2	0.2	0.2	0.2
C1 Dibenzothiophenes	ND	0.2	0.2	0.3	0.3	0.2	1.0	0.2
C2 Dibenzothiophenes	0.3	0.3	0.3	0.4	ND	ND	3.7	0.9
C3 Dibenzothiophenes	0.2	0.5	0.2	0.3	TR	0.4	ND	ND
TOTAL DBT	0.7	1.0	0.7	1.0	0.5	0.8	4.9	1.3
Fluoranthene (202) [a]	0.9	1.0	0.9	1.1	1.9	1.3	1.5	1.7
Pyrene (202) [a]	0.6	0.7	0.7	0.8	1.4	0.9	1.0	1.2
C1 202	1.1	1.2	1.0	1.6	2.5	1.8	2.0	2.5
C2 202	1.5	4.0	0.9	1.4	1.8	1.6	ND	1.8
C3 202	1.1	1.3	3.9	1.4	2.2	2.0	ND	4.5
TOTAL 202	5.2	8.2	7.4	6.3	9.8	7.6	4.5	11.7
Benzo[*c*]phenanthrene (228) [a]	TR	TR	TR	TR	0.3	0.2	0.2	0.2
Benz[*a*]anthracene (228) [a]	0.5	0.5	0.5	0.6	1.1	0.8	0.8	0.9
Chrysene/Triphenylene (228) [a]	0.8	0.8	0.7	1.1	1.7	1.3	1.3	1.6
Benz[*b*]anthracene (228) [a]	ND	ND	ND	ND	TR	TR	TR	ND
C1 228	1.4	1.4	1.3	1.9	3.1	2.4	2.2	2.7
C2 228	2.1	2.2	2.1	2.5	4.6	3.7	3.9	5.3
TOTAL 228	4.8	4.9	4.6	6.1	10.8	8.4	8.4	10.7
Benzofluoranthenes (252) [a]	6.7	5.9	7.0	8.0	14.5	11.5	8.5	13.0
Benzo[*e*]pyrene (252) [a]	1.9	1.7	1.9	2.3	4.1	3.1	2.7	3.6
Benzo[*a*]pyrene (252) [a]	0.9	0.8	0.9	1.0	1.9	1.5	1.3	1.8
Perylene (252) [a]	0.4	0.6	0.4	0.5	1.0	0.6	0.5	0.7
C1 252	3.0	2.7	3.1	4.0	7.2	5.9	5.1	6.8
C2 252	2.2	2.3	3.7	3.0	4.9	4.0	3.9	6.6
TOTAL 252	15.1	14.0	17.0	18.8	33.6	26.6	22.0	32.5
Indenopyrene (276) [a]	5.5	4.7	5.4	6.5	11.8	10.3	8.2	12.0
Benzoperylene (276) [a]	4.6	4.0	4.4	5.3	9.9	8.4	6.9	9.8
C1 276	1.7	1.6	2.0	2.2	4.2	3.7	3.1	4.5
C2 276	0.6	0.4	0.5	0.4	1.4	0.6	1.4	1.4
TOTAL 276	12.4	10.7	12.3	14.4	27.3	23.0	19.6	27.7
TOTAL PAH 1	45.9	48.6	48.5	60.5	101.5	82.7	76.7	104.3
Acenaphthylene (152)	ND	ND	ND	ND	TR	TR	TR	TR
Acenaphthene (154)	ND	TR	TR	TR	TR	TR	TR	TR
Fluorene (166)	TR	TR	TR	0.2	TR	0.2	TR	0.2
Dibenz[*a,h*]anthracene (278)	1.0	0.8	0.9	1.1	2.1	1.8	1.5	2.1
TOTAL PAH 2	46.9	49.4	49.4	61.8	103.6	84.7	78.2	106.6
Parent/ng g^{-1}	**23.8**	**21.7**	**23.5**	**28.8**	**52.3**	**42.0**	**35.6**	**49.3**
Parent %	**51.9**	**44.7**	**48.5**	**47.6**	**51.5**	**50.8**	**46.4**	**47.3**
P/A					8.0		7.0	7.5
Fl/Py	1.5	1.4	1.3	1.4	1.4	1.4	1.5	1.4
MP/P	1.8	1.6	1.6	1.8	1.8	1.8	1.6	1.8

Sample number	9413/2001A	9413/2001B	9413/2001D	9413/2001E
Common site number	66	66	66	66
Naphthalene	1.7	0.8	0.3	ND
2-Methyl Naphthalene	2.2	1.6	2.0	1.3
1-Methyl Naphthalene	2.1	1.7	1.7	1.1
C2 Naphthalenes	8.2	5.4	4.0	3.1
C3 Naphthalenes	4.5	3.6	2.6	2.2
C4 Naphthalenes	1.7	1.3	1.3	1.3
TOTAL Naphthalenes	20.4	14.4	11.9	9.0
Phenanthrene (178)[a]	3.4	2.1	2.0	1.5
Anthracene (178) [a]	0.3	0.2	0.2	TR
C1 178	5.8	3.6	3.0	2.6
C2 178	4.4	3.1	2.4	2.0
C3 178	2.9	1.2	1.5	1.3
TOTAL 178	16.8	10.2	9.1	7.4
Dibenzothiophene	0.4	0.4	0.2	TR
C1 Dibenzothiophenes	0.6	0.9	0.4	0.3
C2 Dibenzothiophenes	1.8	0.6	0.5	0.4
C3 Dibenzothiophenes	0.8	0.3	0.4	0.4
TOTAL DBT	3.6	2.2	1.5	1.1
Fluoranthene (202) [a]	3.7	2.3	2.2	1.5
Pyrene (202) [a]	2.5	1.5	1.5	1.0
C1 202	5.0	3.2	3.0	2.2
C2 202	4.0	2.8	2.9	2.1
C3 202	4.2	4.0	2.5	3.0
TOTAL 202	19.4	13.8	12.1	9.8
Benzo[*c*]phenanthrene (228) [a]	0.5	0.5	0.3	0.2
Benz[*a*]anthracene (228) [a]	2.0	1.3	1.5	1.1
Chrysene/Triphenylene (228) [a]	3.4	2.1	2.3	1.7
Benz[*b*]anthracene (228) [a]	TR	TR	TR	TR
C1 228	6.1	4.0	3.3	2.6
C2 228	9.8	5.3	6.3	5.0
TOTAL 228	21.8	13.2	13.7	10.6
Benzofluoranthenes (252) [a]	26.1	14.8	13.0	10.0
Benzo[*e*]pyrene (252) [a]	7.1	4.0	3.8	2.9
Benzo[*a*]pyrene (252) [a]	2.0	2.0	2.0	1.5
Perylene (252) [a]	1.5	0.9	1.1	0.8
C1 252	13.3	7.3	10.0	7.4
C2 252	10.5	6.9	7.1	4.8
TOTAL 252	60.5	35.9	37.0	27.4
Indenopyrene (276) [a]	23.0	13.0	13.8	10.0
Benzoperylene (276) [a]	18.6	10.8	10.4	7.6
C1 276	8.3	4.4	4.7	3.3
C2 276	2.7	3.2	1.4	1.0
TOTAL 276	52.6	31.4	30.3	21.9
TOTAL PAH 1	195.1	121.1	115.6	87.2
Acenaphthylene (152)	TR	TR	TR	ND
Acenaphthene (154)	0.2	TR	TR	TR
Fluorene (166)	ND	0.3	0.3	0.2
Dibenz[*a,h*]anthracene (278)	4.2	2.4	2.0	1.5
TOTAL PAH 2	199.5	123.8	117.9	88.9
Parent/ng g^{-1}	**96.2**	**56.7**	**54.6**	**39.8**
Parent %	**49.3**	**46.8**	**47.2**	**45.6**
P/A	11.0	7.7	10.0	
Fl/Py	1.5	1.5	1.5	1.5
MP/P	1.7	1.7	1.5	1.7

Multi-corer

Sample number	9414/2001A	9414/2001B	9414/2001C	9414/2001D
Common site number	66	66	66	66
Naphthalene	0.2	0.5	ND	0.8
2-Methyl Naphthalene	1.7	2.0	1.1	3.2
1-Methyl Naphthalene	1.2	1.7	ND	3.1
C2 Naphthalenes	3.7	4.3	2.7	5.9
C3 Naphthalenes	2.4	3.2	2.2	4.4
C4 Naphthalenes	1.4	1.7	1.2	2.5
TOTAL Naphthalenes	10.6	13.4	7.2	19.9
Phenanthrene (178)[a]	1.9	2.2	1.6	3.3
Anthracene (178) [a]	0.2	0.2	0.2	0.3
C1 178	3.1	3.8	2.6	5.3
C2 178	2.3	2.9	2.0	4.2
C3 178	1.4	1.9	1.4	2.7
TOTAL 178	8.9	11.0	7.8	15.8
Dibenzothiophene	0.2	0.2	0.2	0.3
C1 Dibenzothiophenes	0.4	0.5	0.3	0.6
C2 Dibenzothiophenes	0.4	0.6	0.4	0.7
C3 Dibenzothiophenes	0.3	0.6	0.4	0.6
TOTAL DBT	1.3	1.9	1.3	2.2
Fluoranthene (202) [a]	2.1	2.4	2.1	4.0
Pyrene (202) [a]	1.4	1.6	1.4	2.6
C1 202	2.9	3.3	2.6	5.4
C2 202	2.6	3.1	2.9	masked
C3 202	2.2	3.0	2.2	5.2
TOTAL 202	11.2	13.4	11.2	17.2
Benzo[*c*]phenanthrene (228) [a]	0.3	0.3	0.3	0.5
Benz[*a*]anthracene (228) [a]	1.4	1.6	1.3	2.5
Chrysene/Triphenylene (228) [a]	2.2	2.5	2.2	3.8
Benz[*b*]anthracene (228) [a]	TR	TR	TR	0.2
C1 228	3.1	3.8	3.3	5.9
C2 228	5.8	7.2	7.3	10.9
TOTAL 228	12.8	15.4	14.4	23.8
Benzofluoranthenes (252) [a]	13.3	16.5	18.2	26.7
Benzo[*e*]pyrene (252) [a]	3.9	4.8	5.3	7.8
Benzo[*a*]pyrene (252) [a]	1.9	2.2	2.4	3.6
Perylene (252) [a]	1.0	1.2	1.2	1.7
C1 252	10.1	11.9	12.6	18.8
C2 252	5.6	6.5	7.6	9.7
TOTAL 252	35.8	43.1	47.3	68.3
Indenopyrene (276) [a]	14.0	16.7	18.2	26.3
Benzoperylene (276) [a]	10.6	12.6	13.6	19.8
C1 276	4.6	5.5	4.8	8.2
C2 276	1.5	2.0	2.8	2.9
TOTAL 276	30.7	36.8	39.4	57.2
TOTAL PAH 1	111.3	135.0	128.6	204.3
Acenaphthylene (152)	TR	TR	TR	TR
Acenaphthene (154)	TR	TR	ND	TR
Fluorene (166)	0.3	0.3	0.2	0.6
Dibenz[*a,h*]anthracene (278)	1.9	2.3	4.4	3.6
TOTAL PAH 2	113.5	137.6	133.2	208.6
Parent/ng g^{-1}	**54.6**	**65.5**	**68.2**	**104.2**
Parent %	**49.1**	**48.5**	**53.0**	**45.4**
P/A	9.5	11.0	8.0	11.0
Fl/Py	1.5	1.5	1.5	1.5
MP/P	1.6	1.7	1.6	1.6

Sample number	9411/2001	9412\2001	9416/2001	9417/2001	9418/2001	9419/2001	9421/2001	9422/2001
Common site number	64	65	68	69	70	71	73	74
Naphthalene	0.8	1.2	0.8	0.8	0.7	1.6	0.4	1.2
2-Methyl Naphthalene	1.2	1.4	3.0	3.4	2.7	3.7	2.3	3.2
1-Methyl Naphthalene	2.8	3.4	2.3	3.1	2.2	3.2	1.7	2.5
C2 Naphthalenes	3.9	5.0	6.5	6.7	5.5	7.6	4.5	6.7
C3 Naphthalenes	2.5	2.5	5.0	4.9	3.5	5.7	2.7	5.7
C4 Naphthalenes	1.5	0.7	2.6	2.4	1.7	3.0	1.5	2.8
TOTAL Naphthalenes	12.7	14.2	20.2	21.3	16.3	24.8	13.1	22.1
Phenanthrene (178)[a]	1.5	1.9	3.8	3.7	3.0	5.2	2.5	4.6
Anthracene (178) [a]	0.2	0.2	0.3	0.3	0.2	0.7	0.2	0.4
C1 178	3.0	3.1	5.8	5.5	4.4	7.9	3.8	6.5
C2 178	2.4	2.2	4.3	4.1	3.1	5.0	2.6	4.6
C3 178	1.8	1.5	2.6	2.4	1.8	2.9	1.6	2.6
TOTAL 178	8.9	8.9	16.8	16.0	12.5	21.7	10.7	18.7
Dibenzothiophene	0.2	0.3	0.4	0.3	0.3	0.5	0.3	0.4
C1 Dibenzothiophenes	0.4	ND	0.7	0.6	0.5	0.8	0.4	0.8
C2 Dibenzothiophenes	0.8	0.6	0.7	0.6	0.5	0.8	0.5	0.7
C3 Dibenzothiophenes	0.4	TR	0.6	0.5	0.4	0.6	0.3	0.5
TOTAL DBT	1.8	0.9	2.4	2.0	1.7	2.7	1.5	2.4
Fluoranthene (202) [a]	1.5	1.9	3.8	3.7	2.9	5.3	2.7	5.1
Pyrene (202) [a]	1.1	1.3	2.6	2.6	2.0	3.6	1.8	3.4
C1 202	2.3	2.8	5.2	4.9	3.8	6.9	3.4	6.1
C2 202	1.9	3.6	5.0	4.7	3.4	5.9	3.5	5.3
C3 202	2.3	2.0	19.5	3.9	2.5	4.5	2.4	4.2
TOTAL 202	9.1	11.6	36.1	19.8	14.6	26.2	13.8	24.1
Benzo[*c*]phenanthrene (228) [a]	0.2	0.2	0.5	0.5	0.4	0.7	0.4	0.6
Benz[*a*]anthracene (228) [a]	0.8	1.0	2.5	2.4	1.8	3.6	1.7	3.2
Chrysene/Triphenylene (228) [a]	1.4	1.7	4.1	4.0	3.1	5.8	2.7	5.1
Benz[*b*]anthracene (228) [a]	TR	TR	0.2	0.2	TR	0.2	TR	0.2
C1 228	2.5	3.0	5.8	5.6	4.3	7.7	4.1	7.2
C2 228	4.1	4.4	11.9	10.8	9.5	17.5	9.2	15.5
TOTAL 228	9.0	10.3	25.0	23.5	19.1	35.5	18.1	31.8
Benzofluoranthenes (252) [a]	9.7	11.7	26.4	23.9	23.1	41.3	23.5	39.7
Benzo[*e*]pyrene (252) [a]	2.8	3.2	7.5	6.8	6.7	11.9	6.8	11.3
Benzo[*a*]pyrene (252) [a]	1.3	1.6	3.6	3.3	3.1	5.7	3.1	5.2
Perylene (252) [a]	0.6	0.7	2.0	1.8	1.5	2.9	1.3	2.4
C1 252	5.2	6.5	19.2	17.6	16.2	28.7	15.9	27.4
C2 252	4.0	8.2	12.0	9.6	8.4	14.4	7.9	13.4
TOTAL 252	23.6	31.9	70.7	63.0	59.0	104.9	58.5	99.4
Indenopyrene (276) [a]	8.5	10.3	27.5	25.4	23.1	39.4	21.8	37.9
Benzoperylene (276) [a]	7.1	8.5	20.4	19.1	17.4	29.9	16.5	28.8
C1 276	3.1	3.7	8.7	8.1	7.1	12.2	6.5	11.9
C2 276	0.5	2.1	3.0	2.5	2.4	4.1	2.3	3.6
TOTAL 276	19.2	24.6	59.6	55.1	50.0	85.6	47.1	82.2
TOTAL PAH 1	84.3	102.4	230.8	200.7	173.2	301.4	162.8	280.7
Acenaphthylene (152)	TR	TR	TR	TR	TR	TR	TR	TR
Acenaphthene (154)	TR	0.2	TR	TR	TR	0.2	TR	TR
Fluorene (166)	0.2	0.3	0.5	0.5	0.4	0.7	0.3	0.7
Dibenz[*a,h*]anthracene (278)	1.5	1.8	3.8	3.5	3.2	5.4	3.0	5.2
TOTAL PAH 2	86.0	104.7	235.1	204.7	176.8	307.7	166.1	286.6
Parent/ng g^{-1}	**37.7**	**45.7**	**106.4**	**98.8**	**89.3**	**158.3**	**85.7**	**149.5**
Parent %	**44.7**	**44.6**	**46.1**	**49.2**	**51.6**	**52.5**	**52.6**	**53.3**
P/A	7.5	9.5	12.7	12.3	15.0	7.4	12.5	11.5
Fl/Py	1.4	1.5	1.5	1.4	1.5	1.5	1.5	1.5
MP/P	2.0	1.6	1.5	1.5	1.5	1.5	1.5	1.4

Sample number	9423/2001	9424/2001	9425/2001	9426/2001	9427/2001	9428/2001	9429/2001	9430/2001
Common site number	75	76	77	78	79	80	102	101
Naphthalene	0.6	1.0	0.8	1.0	1.2	1.5	0.4	2.7
2-Methyl Naphthalene	2.6	2.8	3.0	3.1	2.7	3.0	2.0	5.2
1-Methyl Naphthalene	2.1	2.1	2.2	2.4	2.2	2.4	2.1	4.1
C2 Naphthalenes	5.1	6.0	7.1	6.7	6.6	6.6	3.4	10.8
C3 Naphthalenes	4.4	4.3	6.6	6.2	5.3	5.0	2.4	7.2
C4 Naphthalenes	2.1	2.2	3.7	2.9	2.7	2.7	1.2	3.7
TOTAL Naphthalenes	16.9	18.4	23.4	22.3	20.7	21.2	11.5	33.7
Phenanthrene (178)[a]	3.7	3.9	5.5	5.3	4.6	4.1	2.5	6.5
Anthracene (178) [a]	0.3	0.3	0.5	0.5	0.5	0.5	0.3	0.7
C1 178	5.2	5.8	8.2	7.4	7.3	7.0	3.3	10.0
C2 178	3.7	3.8	5.2	7.0	5.5	5.9	2.1	7.9
C3 178	2.2	2.3	3.2	3.1	3.4	3.7	1.3	4.7
TOTAL 178	15.1	16.1	22.6	23.3	21.3	21.2	9.5	29.8
Dibenzothiophene	0.3	0.4	0.5	0.5	0.4	0.4	0.2	0.6
C1 Dibenzothiophenes	0.6	0.6	0.8	0.9	0.8	0.8	0.3	1.3
C2 Dibenzothiophenes	0.6	0.7	0.9	0.9	1.1	1.2	0.4	1.6
C3 Dibenzothiophenes	0.5	0.5	0.6	0.7	0.8	1.0	0.3	1.4
TOTAL DBT	2.0	2.2	2.8	3.0	3.1	3.4	1.2	4.9
Fluoranthene (202) [a]	4.1	4.1	5.7	5.7	5.8	6.9	2.7	8.7
Pyrene (202) [a]	2.7	2.7	3.8	3.8	3.9	4.7	1.9	6.0
C1 202	4.9	4.8	7.2	6.9	7.1	8.2	3.3	10.6
C2 202	4.5	4.4	6.7	6.2	6.5	7.6	2.8	9.7
C3 202	3.6	3.8	5.6	5.4	6.1	6.4	2.6	8.5
TOTAL 202	19.8	19.8	29.0	28.0	29.4	33.8	13.3	43.5
Benzo[*c*]phenanthrene (228) [a]	0.5	0.5	0.8	0.7	0.8	0.8	31.8	1.0
Benz[*a*]anthracene (228) [a]	2.5	2.5	3.7	3.6	3.8	4.6	1.8	5.9
Chrysene/Triphenylene (228) [a]	4.1	4.1	6.1	5.7	5.8	6.2	2.5	8.6
Benz[*b*]anthracene (228) [a]	0.2	0.2	0.3	0.3	0.3	0.5	0.2	0.6
C1 228	6.0	5.9	8.9	7.9	8.8	8.8	3.5	12.3
C2 228	13.1	13.4	21.1	19.0	19.8	18.1	7.5	25.4
TOTAL 228	26.4	26.6	40.9	37.2	39.3	39.0	47.3	53.8
Benzofluoranthenes (252) [a]	32.3	32.4	51.7	43.9	45.1	39.3	16.1	51.2
Benzo[*e*]pyrene (252) [a]	9.3	9.4	15.3	12.7	13.2	11.3	4.9	15.6
Benzo[*a*]pyrene (252) [a]	4.3	4.4	7.2	6.4	6.3	6.4	2.7	8.9
Perylene (252) [a]	2.0	2.1	3.4	3.0	3.1	5.4	1.3	4.5
C1 252	22.2	22.6	37.0	32.1	32.2	28.3	11.8	39.2
C2 252	11.9	12.4	19.3	17.1	17.1	14.9	6.5	21.6
TOTAL 252	82.0	83.3	133.9	115.2	117.0	105.6	43.3	141.0
Indenopyrene (276) [a]	31.5	31.8	50.5	45.1	44.4	36.9	15.4	52.3
Benzoperylene (276) [a]	24.0	24.5	39.8	34.5	34.2	28.9	12.0	40.9
C1 276	9.5	9.8	15.9	14.1	13.6	11.5	4.8	17.8
C2 276	3.0	3.2	5.5	4.4	5.4	3.7	1.8	6.3
TOTAL 276	68.0	69.3	111.7	98.1	97.6	81.0	34.0	117.3
TOTAL PAH 1	230.2	235.7	364.3	327.1	328.4	305.2	160.1	424.0
Acenaphthylene (152)	TR	TR	TR	TR	TR	TR	TR	0.2
Acenaphthene (154)	TR	TR	0.2	0.2	0.2	TR	TR	0.4
Fluorene (166)	0.6	0.5	0.8	0.8	0.6	0.6	0.3	0.9
Dibenz[*a,h*]anthracene (278)	4.3	4.4	6.9	6.3	6.1	5.2	2.2	7.6
TOTAL PAH 2	235.1	240.6	372.2	334.4	335.3	311.0	162.6	433.1
Parent/ng g^{-1}	**122.4**	**124.3**	**195.6**	**172.7**	**173.4**	**158.4**	**96.7**	**214.7**
Parent %	**53.2**	**52.7**	**53.7**	**52.8**	**52.8**	**51.9**	**60.4**	**50.6**
P/A	12.3	13.0	11.0	10.6	9.2	8.2	8.3	9.3
Fl/Py	1.5	1.5	1.5	1.5	1.5	1.5	1.4	1.5
MP/P	1.4	1.5	1.5	1.4	1.6	1.7	1.3	1.5

Sample number	9431/2001	9432/2001	9433/2001	9434/2001	9435/2001	9436/2001	9437/2001	9438/2001
Common site number	100	99	98	97	96	95	94	93
Naphthalene	1.9	1.0	1.0	1.0	1.0	1.1	1.1	1.1
2-Methyl Naphthalene	4.8	3.4	2.1	2.4	2.1	2.2	2.3	2.4
1-Methyl Naphthalene	3.7	2.9	3.4	3.9	3.3	3.5	3.8	3.9
C2 Naphthalenes	10.4	8.4	4.8	5.2	5.1	5.1	5.0	5.6
C3 Naphthalenes	8.7	5.9	3.5	4.2	4.5	4.7	4.2	4.8
C4 Naphthalenes	4.6	2.8	1.9	2.0	2.2	2.0	1.9	2.2
TOTAL Naphthalenes	34.1	24.4	16.7	18.7	18.2	18.6	18.3	20.0
Phenanthrene (178)[a]	6.7	4.5	3.4	3.3	3.5	3.5	3.3	3.7
Anthracene (178) [a]	1.1	0.4	0.2	0.3	0.3	0.2	0.2	0.2
C1 178	9.9	7.4	5.1	4.9	5.1	5.2	4.8	5.3
C2 178	7.7	5.9	4.0	4.1	4.1	3.5	3.4	4.1
C3 178	4.9	3.6	2.5	2.6	2.6	2.5	1.9	2.4
TOTAL 178	30.3	21.8	15.2	15.2	15.6	14.9	13.6	15.7
Dibenzothiophene	0.7	0.4	0.4	0.4	0.3	0.4	0.3	0.4
C1 Dibenzothiophenes	1.2	0.8	0.7	0.6	0.6	0.6	0.5	0.6
C2 Dibenzothiophenes	1.6	0.9	0.8	0.8	0.7	0.9	0.8	0.7
C3 Dibenzothiophenes	1.2	0.7	0.5	0.6	0.6	0.5	0.4	0.5
TOTAL DBT	4.7	2.8	2.4	2.4	2.2	2.4	2.0	2.2
Fluoranthene (202) [a]	8.8	5.4	4.3	4.5	4.2	4.1	4.2	4.0
Pyrene (202) [a]	6.0	3.6	2.9	2.9	2.8	2.7	2.8	2.7
C1 202	10.6	7.3	5.4	5.4	5.5	5.1	4.8	5.1
C2 202	9.2	7.3	4.7	4.8	5.3	4.9	4.1	4.8
C3 202	7.4	6.3	3.7	4.3	4.0	4.7	3.2	3.9
TOTAL 202	42.0	29.9	21.0	21.9	21.8	21.5	19.1	20.5
Benzo[*c*]phenanthrene (228) [a]	1.1	0.7	0.5	0.5	0.5	0.5	0.5	0.5
Benz[*a*]anthracene (228) [a]	5.7	3.7	2.7	2.9	2.8	2.6	2.8	2.5
Chrysene/Triphenylene (228) [a]	8.5	5.6	4.2	4.3	4.4	4.2	4.3	4.1
Benz[*b*]anthracene (228) [a]	0.5	0.3	0.2	0.2	0.2	0.2	0.3	0.2
C1 228	11.6	8.4	6.1	6.2	6.2	6.1	5.5	5.7
C2 228	24.9	15.6	11.8	12.4	12.8	12.4	10.4	10.9
TOTAL 228	52.3	34.3	25.5	26.5	26.9	26.0	23.8	23.9
Benzofluoranthenes (252) [a]	50.9	33.4	26.1	26.8	27.4	27.3	23.7	24.4
Benzo[*e*]pyrene (252) [a]	14.7	9.4	7.5	7.6	7.8	7.7	6.7	6.9
Benzo[*a*]pyrene (252) [a]	8.1	4.9	3.8	3.9	3.9	3.7	3.8	3.4
Perylene (252) [a]	746.1 [a]	2.3	1.7	1.8	1.8	1.9	1.8	1.7
C1 252	42.9	25.5	18.7	19.3	19.6	19.7	16.8	17.5
C2 252	22.2	14.5	9.7	10.8	10.5	10.3	8.8	9.5
TOTAL 252	884.9	90.0	67.5	70.2	71.0	70.6	61.6	63.4
Indenopyrene (276) [a]	51.2	35.5	24.2	26.2	26.3	26.4	22.3	24.6
Benzoperylene (276) [a]	39.1	27.4	18.8	19.8	19.8	20.0	17.0	18.6
C1 276	16.0	11.2	7.9	8.4	8.4	8.5	7.2	7.8
C2 276	6.0	3.9	2.5	2.8	2.9	2.8	2.6	2.9
TOTAL 276	112.3	78.0	53.4	57.2	57.4	57.7	49.1	53.9
TOTAL PAH 1	1160.6	281.2	201.7	212.1	213.1	211.7	187.5	199.6
Acenaphthylene (152)	0.2	TR	TR	TR	TR	TR	TR	TR
Acenaphthene (154)	0.3	0.2	TR	TR	TR	TR	TR	TR
Fluorene (166)	1.1	0.6	0.4	0.5	0.5	0.5	0.5	0.5
Dibenz[*a,h*]anthracene (278)	7.6	5.0	3.4	3.7	3.7	3.7	3.3	3.5
TOTAL PAH 2	1169.8	287.0	205.5	216.3	217.3	215.9	191.3	203.6
Parent/ng g^{-1}	**951.1**	**138.5**	**101.9**	**106.4**	**107.0**	**106.5**	**95.1**	**99.0**
Parent %	**81.9[a]**	**49.3**	**50.5**	**50.2**	**50.2**	**50.3**	**50.7**	**49.6**
P/A	6.1	11.3	17.0	11.0	11.7	17.5	16.5	18.5
Fl/Py	1.5	1.5	1.5	1.6	1.5	1.5	1.5	1.5
MP/P	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.4

[a] note very high perylene content, resulting in high parent and high parent % values

Sample number	9439/2001	9440/2001	9441/2001	9442/2001	9445/2001	9446/2001	9447/2001
Common site number	92	91	90	89	87	86	85
Naphthalene	1.2	0.6	0.5	0.6	0.5	0.5	0.4
2-Methyl Naphthalene	2.8	1.3	1.3	1.3	1.2	1.0	0.8
1-Methyl Naphthalene	4.4	2.8	2.8	2.6	2.8	2.5	2.0
C2 Naphthalenes	6.0	2.8	3.2	2.7	3.2	2.6	1.8
C3 Naphthalenes	4.8	2.5	3.3	2.6	3.5	2.8	2.4
C4 Naphthalenes	2.1	1.2	1.0	1.3	1.6	1.3	0.8
TOTAL Naphthalenes	21.3	11.2	12.1	11.1	12.8	10.7	8.2
Phenanthrene (178)[a]	3.4	2.0	2.2	1.8	2.1	1.7	1.1
Anthracene (178) [a]	TR	TR	TR	TR	TR	TR	ND
C1 178	5.6	2.9	3.3	2.8	3.5	2.8	1.8
C2 178	4.2	2.2	2.6	2.2	2.8	2.2	1.3
C3 178	2.5	1.4	1.1	1.4	2.1	1.4	0.9
TOTAL 178	15.7	8.5	9.2	8.2	10.5	8.1	5.1
Dibenzothiophene	0.3	0.2	0.2	0.2	0.2	0.2	TR
C1 Dibenzothiophenes	0.8	0.3	0.4	0.3	0.5	0.4	0.2
C2 Dibenzothiophenes	0.7	0.4	0.4	0.5	0.7	0.4	0.2
C3 Dibenzothiophenes	0.4	0.3	0.3	0.4	0.7	0.4	0.3
TOTAL DBT	2.2	1.2	1.3	1.4	2.1	1.4	0.7
Fluoranthene (202) [a]	2.5	2.4	2.3	2.0	2.8	2.8	1.3
Pyrene (202) [a]	1.9	1.7	1.6	1.4	1.9	2.0	0.9
C1 202	5.4	3.0	3.4	2.6	3.6	3.2	1.7
C2 202	5.1	3.0	3.5	2.9	4.0	3.8	1.8
C3 202	3.7	2.0	2.4	2.1	3.9	3.1	1.9
TOTAL 202	18.6	12.1	13.2	11.0	16.2	14.9	7.6
Benzo[*c*]phenanthrene (228) [a]	0.3	0.3	0.3	0.2	0.4	0.3	0.2
Benz[*a*]anthracene (228) [a]	1.6	1.5	1.5	1.3	1.8	1.8	0.9
Chrysene/Triphenylene (228) [a]	3.0	2.4	2.4	2.1	2.9	2.5	1.5
Benz[*b*]anthracene (228) [a]	TR	TR	TR	TR	TR	TR	1.5
C1 228	4.5	3.3	3.4	2.8	4.4	3.5	2.1
C2 228	8.9	6.8	7.0	5.8	10.0	7.6	5.5
TOTAL 228	18.3	14.3	14.6	12.2	19.5	15.7	11.7
Benzofluoranthenes (252) [a]	15.0	14.2	14.8	12.4	20.1	14.5	9.4
Benzo[*e*]pyrene (252) [a]	4.8	4.1	4.3	3.6	5.9	4.2	2.8
Benzo[*a*]pyrene (252) [a]	2.1	2.0	2.0	1.8	2.8	2.2	1.4
Perylene (252) [a]	2.5	1.0	1.1	1.0	1.6	1.2	0.7
C1 252	12.4	10.4	10.8	9.4	15.5	11.1	7.3
C2 252	7.3	5.8	5.9	5.9	9.5	8.7	4.9
TOTAL 252	44.1	37.5	38.9	34.1	55.4	41.9	26.5
Indenopyrene (276) [a]	13.3	14.5	15.2	13.8	22.7	15.9	10.6
Benzoperylene (276) [a]	10.6	11.0	12.0	10.6	17.4	12.5	8.4
C1 276	4.7	4.8	5.0	4.5	7.6	5.5	3.6
C2 276	2.8	1.9	1.8	1.9	3.0	3.6	1.8
TOTAL 276	31.4	32.2	34.0	30.8	50.7	37.5	24.4
TOTAL PAH 1	151.6	117.0	123.3	108.8	167.2	130.2	84.2
Acenaphthylene (152)	TR	TR	TR	TR	TR	TR	ND
Acenaphthene (154)	TR	TR	TR	TR	TR	TR	ND
Fluorene (166)	0.6	0.3	0.3	0.3	0.3	0.3	0.2
Dibenz[*a,h*]anthracene (278)	1.9	2.0	2.0	1.9	3.1	2.2	1.5
TOTAL PAH 2	154.1	119.3	125.6	111.0	170.6	132.7	85.9
Parent/ng g^{-1}	**62.5**	**57.9**	**60.4**	**52.8**	**83.1**	**62.3**	**41.1**
Parent %	**41.2**	**49.5**	**49.0**	**48.5**	**49.7**	**47.8**	**48.8**
P/A							
Fl/Py	1.3	1.4	1.4	1.4	1.5	1.4	1.4
MP/P	1.6	1.5	1.5	1.6	1.7	1.6	1.6

Sample number	9443/2001 A	9443/2001 B	9443/2001 C	9443/2001 D	9443/2001 E

Common site number	88	88	88	88	88
Naphthalene	0.4	0.5	1.0	1.2	2.7
2-Methyl Naphthalene	1.0	1.2	2.4	2.8	2.8
1-Methyl Naphthalene	2.5	3.0	4.2	4.3	3.9
C2 Naphthalenes	2.1	2.1	4.9	6.3	7.0
C3 Naphthalenes	1.8	1.6	3.5	5.6	6.6
C4 Naphthalenes	1.0	0.9	1.8	2.7	3.3
TOTAL Naphthalenes	8.8	9.3	17.8	22.9	26.3
Phenanthrene (178)[a]	1.3	1.2	2.8	4.0	4.7
Anthracene (178)[a]	TR	ND	0.2	0.3	0.4
C1 178	2.1	2.1	4.3	6.2	7.3
C2 178	1.7	1.7	3.5	5.0	5.9
C3 178	0.5	1.1	2.2	3.3	3.7
TOTAL 178	5.6	6.1	13.0	18.8	22.0
Dibenzothiophene	TR	0.2	0.3	0.4	0.4
C1 Dibenzothiophenes	0.4	0.3	0.6	0.8	1.0
C2 Dibenzothiophenes	0.4	0.5	0.8	1.0	1.3
C3 Dibenzothiophenes	0.3	0.5	0.7	1.0	1.1
TOTAL DBT	1.1	1.5	2.4	3.2	3.8
Fluoranthene (202)[a]	1.8	1.6	3.2	4.5	5.5
Pyrene (202)[a]	1.2	1.1	2.2	3.1	3.7
C1 202	2.3	2.1	4.3	6.3	7.3
C2 202	2.0	2.0	3.9	6.1	7.0
C3 202	1.8	1.8	3.6	5.5	5.3
TOTAL 202	9.1	8.6	17.2	25.5	28.8
Benzo[*c*]phenanthrene (228)[a]	0.2	0.2	0.4	0.6	0.7
Benz[*a*]anthracene (228)[a]	1.1	1.0	2.1	3.0	3.5
Chrysene/Triphenylene (228)[a]	1.7	1.6	3.3	4.8	5.6
Benz[*b*]anthracene (228)[a]	TR	TR	0.2	0.3	0.3
C1 228	2.3	2.3	4.6	6.5	7.6
C2 228	4.6	4.9	9.2	12.8	16.0
TOTAL 228	9.9	10.0	19.8	28.0	33.7
Benzofluoranthenes (252)[a]	9.7	9.7	19.0	24.8	33.0
Benzo[*e*]pyrene (252)[a]	2.9	2.8	5.3	7.2	9.6
Benzo[*a*]pyrene (252)[a]	1.5	1.4	2.8	3.8	4.8
Perylene (252)[a]	0.8	0.8	1.6	2.2	2.7
C1 252	7.1	7.3	14.2	19.4	24.4
C2 252	5.4	4.8	8.7	12.1	14.3
TOTAL 252	27.4	26.8	51.6	69.5	88.8
Indenopyrene (276)[a]	9.6	10.2	20.5	27.7	34.4
Benzoperylene (276)[a]	7.6	7.8	15.3	20.9	26.2
C1 276	3.3	3.4	6.1	8.3	11.4
C2 276	1.1	1.8	3.4	3.4	4.2
TOTAL 276	21.6	23.2	45.3	60.3	76.2
TOTAL PAH 1	83.5	85.5	167.1	228.2	279.6
Acenaphthylene (152)	TR	TR	TR	TR	0.2
Acenaphthene (154)	ND	ND	TR	TR	0.2
Fluorene (166)	0.2	0.2	0.4	0.6	0.7
Dibenz[*a,h*]anthracene (278)	1.3	1.4	2.8	3.9	4.7
TOTAL PAH 2	85.0	87.1	170.3	232.7	285.4
Parent/ng g^{-1}	**39.8**	**40.1**	**80.2**	**108.8**	**138.2**
Parent %	**47.7**	**46.9**	**48.0**	**47.7**	**49.4**
P/A			14.0	13.3	11.8
Fl/Py	1.5	1.5	1.5	1.5	1.5
MP/P	1.6	1.8	1.5	1.6	1.6

Multi-corer

Sample number	9444/2001A	9444/2001B	9444/2001C	9444/2001D
Common site number	88	88	88	88
Naphthalene	2.9	1.4	1.1	0.3
2-Methyl Naphthalene	4.3	2.0	1.4	0.8
1-Methyl Naphthalene	5.6	3.6	2.7	2.0
C2 Naphthalenes	10.6	4.8	3.7	2.2
C3 Naphthalenes	9.7	4.7	4.2	2.1
C4 Naphthalenes	4.6	2.5	2.0	1.1
TOTAL Naphthalenes	37.7	19.0	15.1	8.5
Phenanthrene (178)[a]	7.5	3.5	2.6	1.5
Anthracene (178) [a]	0.7	0.3	0.2	TR
C1 178	10.9	5.3	4.0	2.3
C2 178	8.8	4.4	3.4	2.0
C3 178	5.7	3.0	2.3	1.3
TOTAL 178	33.6	16.5	12.5	7.1
Dibenzothiophene	0.7	0.3	0.2	TR
C1 Dibenzothiophenes	1.3	0.7	0.6	0.3
C2 Dibenzothiophenes	1.8	1.0	0.8	0.5
C3 Dibenzothiophenes	1.7	0.9	0.8	0.4
TOTAL DBT	5.5	2.9	2.4	1.2
Fluoranthene (202) [a]	9.4	4.8	3.6	2.2
Pyrene (202) [a]	6.4	3.3	2.4	1.5
C1 202	11.7	6.1	4.5	2.7
C2 202	10.4	6.0	4.5	2.5
C3 202	9.2	5.2	3.6	2.2
TOTAL 202	47.1	25.4	18.6	11.1
Benzo[*c*]phenanthrene (228) [a]	1.0	0.6	0.5	0.3
Benz[*a*]anthracene (228) [a]	6.0	3.2	2.3	1.4
Chrysene/Triphenylene (228) [a]	9.2	4.9	3.6	2.2
Benz[*b*]anthracene (228) [a]	0.6	0.3	0.2	TR
C1 228	12.0	6.8	5.1	3.2
C2 228	24.7	14.2	11.5	6.7
TOTAL 228	53.5	30.0	23.2	13.8
Benzofluoranthenes (252) [a]	45.1	30.1	25.1	16.2
Benzo[*e*]pyrene (252) [a]	13.1	8.8	7.4	4.8
Benzo[*a*]pyrene (252) [a]	7.1	4.5	3.5	2.3
Perylene (252) [a]	4.0	2.4	1.8	1.1
C1 252	35.2	22.6	18.4	11.5
C2 252	20.6	13.9	11.0	6.4
TOTAL 252	125.1	82.3	67.2	42.3
Indenopyrene (276) [a]	47.9	34.3	28.1	17.9
Benzoperylene (276) [a]	35.7	26.0	21.3	13.7
C1 276	16.1	11.4	9.0	5.7
C2 276	4.8	5.0	3.0	2.4
TOTAL 276	104.5	76.7	61.4	39.7
TOTAL PAH 1	407.0	252.8	200.4	123.7
Acenaphthylene (152)	0.2	TR	TR	TR
Acenaphthene (154)	0.3	TR	TR	TR
Fluorene (166)	1.1	0.5	0.4	0.2
Dibenz[*a,h*]anthracene (278)	6.6	4.8	3.9	2.7
TOTAL PAH 2	415.2	258.1	204.7	126.6
Parent/ng g^{-1}	**197.3**	**128.7**	**103.9**	**65.4**
Parent %	**48.5**	**50.9**	**51.8**	**52.9**
P/A	10.7	11.7	13.0	
Fl/Py	1.5	1.5	1.5	1.5
MP/P	1.5	1.5	1.5	1.5

Sample number	9448/2001	9449/2001	9450/2001	9451/2001	9452/2001	9453/2001	9454/2001	9455/2001
Common site number	84	83	82	81	103	104	105	106
Naphthalene	0.9	0.8	0.8	0.6	1.3	0.9	1.5	2.2
2-Methyl Naphthalene	1.7	1.4	1.3	1.0	2.4	1.9	2.8	3.6
1-Methyl Naphthalene	1.3	1.1	1.1	0.8	1.9	1.4	2.3	2.8
C2 Naphthalenes	3.2	2.8	2.7	2.0	4.5	3.3	5.6	6.3
C3 Naphthalenes	2.4	2.2	2.2	1.3	3.9	2.5	4.5	4.4
C4 Naphthalenes	1.2	1.1	1.0	0.7	1.9	1.2	2.2	2.4
TOTAL Naphthalenes	10.7	9.4	9.1	6.4	15.9	11.2	18.9	21.7
Phenanthrene (178)[a]	1.6	1.4	1.6	0.9	2.6	1.6	3.3	3.5
Anthracene (178) [a]	TR	TR	TR	ND	0.2	TR	0.2	0.3
C1 178	2.5	2.3	2.1	1.6	3.8	2.4	4.7	5.2
C2 178	1.8	1.8	1.6	1.1	2.7	1.8	3.4	3.9
C3 178	1.1	1.1	1.0	0.8	1.8	1.1	2.1	2.8
TOTAL 178	7.0	6.6	6.3	4.4	11.1	6.9	13.7	15.7
Dibenzothiophene	0.2	TR	0.2	TR	0.3	0.2	0.3	0.4
C1 Dibenzothiophenes	0.3	0.3	0.2	0.2	0.4	0.3	0.6	1.0
C2 Dibenzothiophenes	0.3	0.3	0.3	0.2	0.5	0.3	0.6	1.4
C3 Dibenzothiophenes	0.3	30.0	0.2	0.2	0.4	0.2	0.5	1.2
TOTAL DBT	1.1	30.6	0.9	0.6	1.6	1.0	2.0	4.0
Fluoranthene (202) [a]	1.5	1.4	1.7	0.9	2.8	1.5	3.0	3.6
Pyrene (202) [a]	1.0	0.9	1.1	0.6	1.8	1.0	2.0	2.6
C1 202	2.2	2.1	2.1	1.5	3.6	2.2	4.1	5.1
C2 202	2.1	2.0	1.8	2.0	3.3	2.1	3.9	5.2
C3 202	2.0	1.8	1.5	1.2	2.7	2.1	3.2	4.8
TOTAL 202	8.8	8.2	8.2	6.2	14.2	8.9	16.2	21.3
Benzo[*c*]phenanthrene (228) [a]	0.2	0.2	0.2	TR	0.3	0.2	0.4	0.4
Benz[*a*]anthracene (228) [a]	1.0	0.9	1.0	0.6	1.8	0.9	1.8	2.2
Chrysene/Triphenylene (228) [a]	1.7	1.5	1.7	0.9	2.8	1.6	3.0	3.7
Benz[*b*]anthracene (228) [a]	ND	ND	ND	ND	TR	ND	TR	0.2
C1 228	2.5	2.3	2.4	1.5	3.9	2.3	4.3	4.9
C2 228	5.7	5.0	4.9	3.1	8.7	5.2	9.3	12.2
TOTAL 228	11.1	9.9	10.2	6.1	17.5	10.2	18.8	23.6
Benzofluoranthenes (252) [a]	11.7	11.1	12.4	6.5	21.0	11.2	19.2	20.1
Benzo[*e*]pyrene (252) [a]	3.4	3.1	3.6	1.9	6.0	3.2	5.5	6.0
Benzo[*a*]pyrene (252) [a]	1.6	1.5	1.7	0.9	3.1	1.5	2.8	3.3
Perylene (252) [a]	1.0	0.9	1.0	1.1	1.7	0.9	1.6	2.5
C1 252	8.5	7.8	8.2	4.6	14.1	8.0	14.2	16.6
C2 252	4.6	4.3	4.1	2.4	7.6	4.6	8.1	10.5
TOTAL 252	30.8	28.7	31.0	17.4	53.5	29.4	51.4	59.0
Indenopyrene (276) [a]	12.0	11.2	11.9	6.0	21.0	11.4	20.5	21.3
Benzoperylene (276) [a]	9.8	8.9	9.7	5.0	16.7	9.2	16.2	16.8
C1 276	4.0	3.6	3.9	1.9	6.5	3.7	7.0	7.7
C2 276	1.2	1.1	1.2	0.6	2.2	1.1	2.3	2.8
TOTAL 276	27.0	24.8	26.7	13.5	46.4	25.4	46.0	48.6
TOTAL PAH 1	96.5	118.2	92.4	54.6	160.2	93.0	167.0	193.9
Acenaphthylene (152)	TR	TR	TR	ND	TR	TR	TR	TR
Acenaphthene (154)	TR	ND	TR	ND	TR	TR	TR	0.2
Fluorene (166)	0.2	0.2	0.3	TR	0.4	0.3	0.4	0.5
Dibenz[*a,h*]anthracene (278)	1.5	1.4	1.5	0.7	2.8	1.4	2.6	2.9
TOTAL PAH 2	98.2	119.8	94.2	55.3	163.4	94.7	170.0	197.5
Parent/ng g^{-1}	**47.6**	**43.8**	**48.6**	**25.9**	**83.4**	**45.3**	**81.3**	**89.1**
Parent %	**49.3**	**37.1**	**52.6**	**47.4**	**52.1**	**48.7**	**48.7**	**46.0**
P/A					13.0		16.5	11.7
Fl/Py	1.5	1.6	1.5	1.5	1.6	1.5	1.5	1.4
MP/P	1.6	1.6	1.3	1.8	1.5	1.5	1.4	1.5

Sample number	9456/2001	9457/2001	9458/2001	9459/2001	9462/2001	9463/2001	9464/2001	9465/2001
Common site number	107	108	109	110	112	113	114	115
Naphthalene	1.2	0.9	1.6	1.9	1.1	1.4	0.9	0.8
2-Methyl Naphthalene	2.6	1.7	3.1	3.6	2.2	1.1	1.8	1.7
1-Methyl Naphthalene	2.1	1.3	2.5	2.9	1.8	0.8	1.3	1.4
C2 Naphthalenes	5.3	3.5	6.1	7.4	4.9	2.0	3.3	4.1
C3 Naphthalenes	4.0	2.7	4.9	6.3	4.4	1.6	2.9	4.0
C4 Naphthalenes	2.0	0.9	2.3	3.1	2.1	0.8	1.3	2.1
TOTAL Naphthalenes	17.2	11.0	20.5	25.2	16.5	7.7	11.5	14.1
Phenanthrene (178)[a]	2.9	1.9	3.5	4.5	3.1	1.2	2.1	3.2
Anthracene (178) [a]	0.2	TR	0.3	0.4	0.2	TR	TR	0.3
C1 178	4.0	3.1	5.1	6.3	4.7	1.8	3.3	4.4
C2 178	2.7	2.2	3.6	4.7	3.2	1.1	2.1	3.4
C3 178	1.9	1.4	2.3	2.9	2.0	0.7	1.2	2.2
TOTAL 178	11.7	8.6	14.8	18.8	13.2	4.8	8.7	13.5
Dibenzothiophene	0.3	0.2	0.4	0.4	0.3	TR	0.2	0.3
C1 Dibenzothiophenes	0.5	0.5	0.6	0.8	0.5	0.2	0.4	0.5
C2 Dibenzothiophenes	0.6	0.4	0.7	0.8	0.5	0.2	0.5	0.6
C3 Dibenzothiophenes	0.6	0.4	0.5	0.8	0.4	0.2	0.3	0.5
TOTAL DBT	2.0	1.5	2.2	2.8	1.7	0.6	1.4	1.9
Fluoranthene (202) [a]	2.8	2.0	3.4	4.6	3.4	1.3	2.0	4.5
Pyrene (202) [a]	1.9	1.3	2.3	3.2	2.5	0.9	1.4	3.0
C1 202	3.7	2.8	4.6	5.9	4.0	1.6	2.4	4.9
C2 202	3.8	2.9	4.5	5.1	4.1	2.0	2.5	4.3
C3 202	3.4	2.5	3.0	4.2	3.2	1.3	2.0	3.5
TOTAL 202	15.6	11.5	17.8	23.0	17.2	7.1	10.3	20.2
Benzo[*c*]phenanthrene (228) [a]	0.3	0.3	0.4	0.6	0.5	0.2	0.3	0.6
Benz[*a*]anthracene (228) [a]	1.8	1.2	2.2	2.9	2.1	0.8	1.1	2.8
Chrysene/Triphenylene (228) [a]	2.8	2.0	4.7	5.0	3.6	1.4	2.1	4.4
Benz[*b*]anthracene (228) [a]	TR	ND	TR	TR	TR	1.4	2.0	TR
C1 228	3.8	3.1	5.2	6.5	4.9	1.9	3.1	6.3
C2 228	8.5	7.1	12.6	14.4	11.2	5.5	7.6	15.4
TOTAL 228	17.2	13.7	25.1	29.4	22.3	11.2	16.2	29.5
Benzofluoranthenes (252) [a]	16.3	15.1	29.1	33.6	26.9	13.6	18.3	43.7
Benzo[*e*]pyrene (252) [a]	4.7	4.3	8.9	9.5	13.8	3.8	5.2	12.2
Benzo[*a*]pyrene (252) [a]	2.5	2.0	4.0	4.5	4.2	1.8	2.3	5.6
Perylene (252) [a]	1.7	1.2	15.4	2.3	145.0 [a]	0.8	1.1	2.4
C1 252	12.4	10.7	20.2	22.8	18.8	9.1	12.2	27.5
C2 252	7.7	6.1	11.2	12.2	9.6	5.0	6.6	14.2
TOTAL 252	45.3	39.4	88.8	84.9	218.3	34.1	45.7	105.6
Indenopyrene (276) [a]	16.6	13.9	33.3	33.2	29.5	12.6	16.5	40.7
Benzoperylene (276) [a]	13.5	11.1	34.8	25.1	147.2 [a]	10.3	14.2	32.3
C1 276	5.9	4.6	9.7	10.6	7.9	3.7	5.0	11.3
C2 276	2.1	1.8	3.6	3.5	2.6	1.6	2.1	4.5
TOTAL 276	38.1	31.4	81.4	72.4	187.2	28.2	37.8	88.8
TOTAL PAH 1	147.1	117.1	250.6	256.5	476.4	93.7	131.6	273.6
Acenaphthylene (152)	TR	TR	TR	TR	TR	ND	ND	TR
Acenaphthene (154)	TR	TR	TR	0.2	TR	ND	TR	TR
Fluorene (166)	0.4	0.3	0.5	0.7	0.5	0.2	0.3	0.5
Dibenz[*a,h*]anthracene (278)	2.3	1.9	8.0	4.6	6.9	1.7	2.2	5.4
TOTAL PAH 2	149.8	119.3	259.1	262.0	483.8	95.6	134.1	279.5
Parent/ng g^{-1}	**69.5**	**57.4**	**144.3**	**131.7**	**383.4** [a]	**51.5**	**69.7**	**156.8**
Parent %	**47.2**	**49.0**	**57.6**	**51.3**	**80.5** [a]	**55.0**	**53.0**	**57.3**
P/A	14.5		11.7	11.3	15.5			10.7
Fl/Py	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.5
MP/P	1.4	1.6	1.5	1.4	1.5	1.5	1.6	1.4

[a] note high perylene and benzoperylene content, resulting in high parent and high parent % values

Sample number	9460/2001 A	9460/2001 B	9460/2001 C	9460/2001 D	9460/2001 E
Common site number	111	111	111	111	111
Naphthalene	1.2	1.1	0.8	1.0	0.8
2-Methyl Naphthalene	2.1	2.2	1.8	1.9	1.7
1-Methyl Naphthalene	1.6	1.8	1.4	1.5	1.3
C2 Naphthalenes	3.8	4.2	3.5	3.4	3.4
C3 Naphthalenes	2.7	3.0	2.6	2.4	2.6
C4 Naphthalenes	1.2	1.4	1.3	1.2	1.3
TOTAL Naphthalenes	12.6	13.7	11.4	11.4	11.1
Phenanthrene (178)[a]	2.1	2.3	2.3	1.9	2.0
Anthracene (178) [a]	TR	0.2	0.2	TR	TR
C1 178	3.0	3.6	2.9	2.5	3.0
C2 178	2.2	2.4	2.2	1.8	2.2
C3 178	1.3	1.4	1.3	1.1	1.4
TOTAL 178	8.6	9.9	8.9	7.3	8.6
Dibenzothiophene	0.2	0.2	0.2	0.2	0.2
C1 Dibenzothiophenes	0.3	0.4	0.4	0.3	0.4
C2 Dibenzothiophenes	0.4	0.5	0.4	0.3	0.4
C3 Dibenzothiophenes	0.3	0.3	0.3	0.2	0.3
TOTAL DBT	1.2	1.4	1.3	1.0	1.3
Fluoranthene (202) [a]	2.3	2.4	2.3	2.0	2.2
Pyrene (202) [a]	1.5	1.6	1.6	1.4	1.5
C1 202	2.8	3.1	2.8	2.4	2.9
C2 202	2.6	2.6	2.4	2.0	2.8
C3 202	2.2	2.4	2.2	1.7	2.3
TOTAL 202	11.4	12.1	11.3	9.5	11.7
Benzo[*c*]phenanthrene (228) [a]	0.3	0.3	0.3	0.2	0.4
Benz[*a*]anthracene (228) [a]	1.4	1.5	1.4	1.2	1.6
Chrysene/Triphenylene (228) [a]	2.3	2.5	2.2	2.0	2.7
Benz[*b*]anthracene (228) [a]	ND	ND	ND	ND	ND
C1 228	3.3	3.5	3.2	2.8	3.7
C2 228	7.2	7.5	8.0	6.4	8.4
TOTAL 228	14.5	15.3	15.1	12.6	16.8
Benzofluoranthenes (252) [a]	17.9	17.6	17.6	14.8	20.1
Benzo[*e*]pyrene (252) [a]	5.1	5.0	4.9	4.0	5.8
Benzo[*a*]pyrene (252) [a]	2.3	2.3	2.4	2.0	2.6
Perylene (252) [a]	1.1	1.2	1.2	1.0	4.3
C1 252	12.0	12.0	11.9	9.7	13.0
C2 252	6.7	7.5	6.4	4.9	6.7
TOTAL 252	45.1	45.6	44.4	36.4	52.5
Indenopyrene (276) [a]	17.2	18.1	16.7	13.2	18.8
Benzoperylene (276) [a]	13.8	14.0	13.3	10.7	23.5
C1 276	5.2	5.7	5.1	3.8	5.5
C2 276	1.7	2.1	1.7	1.2	1.9
TOTAL 276	37.9	39.9	36.8	28.9	49.7
TOTAL PAH 1	131.3	137.9	129.2	107.1	151.7
Acenaphthylene (152)	TR	TR	TR	TR	TR
Acenaphthene (154)	TR	TR	TR	TR	TR
Fluorene (166)	0.3	0.3	0.3	0.3	0.3
Dibenz[*a,h*]anthracene (278)	2.2	2.4	2.2	1.7	3.4
TOTAL PAH 2	133.8	140.6	131.7	109.1	155.4
Parent/ng g^{-1}	**68.7**	**70.3**	**67.4**	**55.6**	**86.5**
Parent %	**52.3**	**51.0**	**52.2**	**51.9**	**57.0**
P/A		11.5	11.5		
Fl/Py	1.5	1.5	1.4	1.4	1.5
MP/P	1.4	1.6	1.3	1.3	1.5

Multi-corer

Sample number	9461/2001A	9461/2001B	9461/2001C	9461/2001D
Common site number	111	111	111	111
Naphthalene	0.9	0.5	1.1	1.4
2-Methyl Naphthalene	1.8	1.1	1.4	3.0
1-Methyl Naphthalene	1.4	0.8	1.1	2.5
C2 Naphthalenes	3.6	1.9	2.9	6.2
C3 Naphthalenes	3.2	1.6	2.5	5.9
C4 Naphthalenes	1.6	0.7	1.3	3.0
TOTAL Naphthalenes	12.5	6.6	10.3	22.0
Phenanthrene (178)[a]	2.3	1.1	1.9	4.5
Anthracene (178) [a]	TR	TR	TR	0.6
C1 178	3.3	1.5	2.4	6.7
C2 178	2.4	1.2	1.8	4.7
C3 178	1.7	0.8	1.1	2.9
TOTAL 178	9.7	4.6	7.2	19.4
Dibenzothiophene	0.2	TR	0.2	0.4
C1 Dibenzothiophenes	0.4	0.2	0.3	0.7
C2 Dibenzothiophenes	0.4	0.2	0.3	0.8
C3 Dibenzothiophenes	0.3	0.2	0.3	0.6
TOTAL DBT	1.3	0.6	1.1	2.5
Fluoranthene (202) [a]	2.4	1.3	2.0	5.9
Pyrene (202) [a]	1.6	0.9	1.4	3.9
C1 202	3.3	1.6	2.4	6.8
C2 202	2.9	1.5	2.2	5.8
C3 202	2.4	1.4	1.8	4.5
TOTAL 202	12.6	6.7	9.8	26.9
Benzo[*c*]phenanthrene (228) [a]	0.3	0.2	0.3	0.8
Benz[*a*]anthracene (228) [a]	1.6	0.8	1.2	3.9
Chrysene/Triphenylene (228) [a]	2.7	1.4	2.0	5.9
Benz[*b*]anthracene (228) [a]	ND	ND	ND	0.2
C1 228	3.9	2.1	2.9	8.3
C2 228	9.2	5.3	7.4	21.7
TOTAL 228	17.7	9.8	13.8	40.8
Benzofluoranthenes (252) [a]	20.0	11.9	17.9	59.4
Benzo[*e*]pyrene (252) [a]	5.5	3.3	5.0	16.7
Benzo[*a*]pyrene (252) [a]	2.6	1.6	2.3	7.7
Perylene (252) [a]	1.3	0.8	1.0	3.2
C1 252	13.8	8.1	11.5	37.5
C2 252	7.1	4.7	5.9	18.2
TOTAL 252	50.3	30.4	43.6	142.7
Indenopyrene (276) [a]	19.3	11.2	15.5	55.5
Benzoperylene (276) [a]	15.2	8.9	12.5	42.1
C1 276	5.9	3.7	4.6	15.4
C2 276	2.0	1.7	1.4	5.0
TOTAL 276	42.4	25.5	34.0	118.0
TOTAL PAH 1	146.5	84.2	119.8	372.3
Acenaphthylene (152)	TR	TR	ND	TR
Acenaphthene (154)	TR	ND	TR	0.2
Fluorene (166)	0.3	0.2	0.3	0.6
Dibenz[*a,h*]anthracene (278)	2.5	1.5	2.1	8.6
TOTAL PAH 2	149.3	85.9	122.2	381.7
Parent/ng g^{-1}	**75.9**	**43.9**	**64.3**	**212.1**
Parent %	**51.8**	**52.1**	**53.7**	**57.0**
P/A				7.5
Fl/Py	1.5	1.4	1.4	1.5
MP/P	1.4	1.4	1.3	1.5

Sample number	9466/2001	9467/2001	9468/2001	9469/2001	9470/2001	9471/2001	9472/2001	9473/2001
Common site number	116	117	118	119	120	121	122	123
Naphthalene	1.1	1.4	1.0	0.9	1.1	0.5	0.4	1.0
2-Methyl Naphthalene	1.9	1.9	2.0	1.9	2.3	1.1	1.0	1.5
1-Methyl Naphthalene	1.5	1.6	1.7	1.5	1.9	0.9	0.8	1.1
C2 Naphthalenes	4.1	4.4	5.4	4.1	6.2	2.6	2.4	3.4
C3 Naphthalenes	3.8	4.3	5.6	3.8	6.3	2.4	2.5	3.2
C4 Naphthalenes	1.7	2.1	4.3	1.8	3.3	1.2	1.2	1.4
TOTAL Naphthalenes	14.1	15.7	20.0	14.0	21.1	8.7	8.3	11.6
Phenanthrene (178)[a]	3.0	3.7	4.4	2.9	5.3	1.8	1.8	2.4
Anthracene (178) [a]	0.3	0.4	0.5	0.3	0.6	0.2	TR	0.2
C1 178	4.4	5.4	6.8	4.3	8.0	2.9	2.7	3.4
C2 178	3.1	3.9	6.1	3.2	6.3	2.3	2.0	2.6
C3 178	2.1	2.6	4.5	2.2	4.3	1.6	1.3	1.6
TOTAL 178	12.9	16.0	22.3	12.9	24.5	8.8	7.8	10.2
Dibenzothiophene	0.3	0.3	6.4	0.3	0.5	0.2	0.2	0.2
C1 Dibenzothiophenes	0.5	0.6	0.9	0.5	0.9	0.4	0.3	0.4
C2 Dibenzothiophenes	0.6	0.7	1.2	0.5	1.1	0.4	0.3	0.4
C3 Dibenzothiophenes	0.4	0.6	1.3	0.5	1.0	0.4	0.3	0.4
TOTAL DBT	1.8	2.2	9.8	1.8	3.5	1.4	1.1	1.4
Fluoranthene (202) [a]	4.2	5.2	7.4	3.9	9.3	2.7	2.2	2.7
Pyrene (202) [a]	2.8	3.5	4.7	2.7	6.0	1.8	1.5	1.7
C1 202	4.7	5.9	8.5	4.7	9.9	3.3	2.8	3.3
C2 202	3.9	5.2	7.7	4.6	8.4	3.3	3.4	3.1
C3 202	3.6	4.6	7.0	4.0	7.3	2.8	2.8	3.0
TOTAL 202	19.2	24.4	35.3	19.9	40.9	13.9	12.7	13.8
Benzo[*c*]phenanthrene (228) [a]	0.5	0.7	0.9	0.5	1.1	0.3	0.3	0.3
Benz[*a*]anthracene (228) [a]	2.7	3.4	5.0	2.5	6.0	1.8	1.4	1.6
Chrysene/Triphenylene (228) [a]	4.1	5.1	7.6	3.9	8.4	2.6	2.2	2.7
Benz[*b*]anthracene (228) [a]	TR	0.2	0.3	TR	0.4	TR	ND	TR
C1 228	5.8	7.5	10.7	5.6	12.3	3.8	3.3	3.7
C2 228	13.3	17.9	24.0	12.5	25.7	8.5	8.0	9.9
TOTAL 228	26.4	34.8	48.5	25.0	53.9	17.0	15.2	18.2
Benzofluoranthenes (252) [a]	32.7	44.6	53.4	26.1	68.7	18.4	17.2	21.6
Benzo[*e*]pyrene (252) [a]	9.3	12.6	15.1	7.6	19.5	5.3	4.9	6.2
Benzo[*a*]pyrene (252) [a]	4.5	6.1	7.6	4.0	9.6	2.8	2.5	3.1
Perylene (252) [a]	3.5	2.5	3.2	1.9	4.4	1.4	1.4	1.7
C1 252	22.2	30.0	37.3	19.4	44.1	12.9	12.2	14.9
C2 252	12.0	16.0	20.0	11.4	22.9	8.0	7.6	8.8
TOTAL 252	84.2	111.8	136.6	70.4	169.2	48.8	45.8	56.3
Indenopyrene (276) [a]	31.9	43.5	52.3	26.9	65.8	17.9	17.1	20.4
Benzoperylene (276) [a]	26.1	35.2	40.6	20.9	49.2	14.0	13.5	16.4
C1 276	9.5	13.1	16.2	8.7	19.9	5.9	5.5	6.7
C2 276	3.5	4.3	5.6	2.9	7.1	3.0	1.9	2.8
TOTAL 276	71.0	96.1	114.7	59.4	142.0	40.8	38.0	46.3
TOTAL PAH 1	229.6	301.0	387.2	203.4	455.1	139.4	128.9	157.8
Acenaphthylene (152)	TR	TR	TR	TR	TR	TR	ND	TR
Acenaphthene (154)	TR	TR	TR	TR	0.2	TR	TR	TR
Fluorene (166)	0.4	0.5	0.6	0.5	0.7	0.3	0.3	0.4
Dibenz[*a,h*]anthracene (278)	4.2	5.8	7.2	3.6	9.2	2.4	2.3	2.7
TOTAL PAH 2	234.2	307.3	395.0	207.5	465.2	142.1	131.5	160.9
Parent/ng g^{-1}	**127.0**	**168.4**	**210.4**	**105.3**	**255.9**	**71.7**	**66.6**	**82.2**
Parent %	**55.3**	**55.9**	**54.3**	**51.8**	**56.2**	**51.4**	**51.7**	**52.1**
P/A	10.0	9.3	8.8	9.7	8.8	9.0		12.0
Fl/Py	1.5	1.5	1.6	1.4	1.6	1.5	1.5	1.6
MP/P	1.5	1.5	1.5	1.5	1.5	1.6	1.5	1.4

Appendix 5
Particle size (%<63µm) and % Total Organic Carbon of samples collected from the Fladen Ground in 2001

Sample Number	Common site number[a]	PS	TOC	Sample Number	Common site number[a]	PS	TOC
9346/2001	1	56.2	1.49	*9391/2001A*	*37*	*81.2*	*1.12*
9347/2001	2	58.3	0.66	*9391/2001B*	*37*	*83.8*	*1.11*
9348/2001	3	47.3	0.37	*9391/2001C*	*37*	*78.3*	*0.89*
9349/2001	4	58.7	0.53	*9391/2001D*	*37*	*81.7*	*0.55*
9350/2001	5	62.0	0.69	*9391/2001E*	*37*	*74.8*	*0.82*
93512001	6	67.5	0.79	**9392/2001A**	**37**	**78.2**	**0.38**
9352/2001	7	72.2	0.96	**9392/2001B**	**37**	**77.6**	**0.48**
9353/2001	8	74.2	0.88	**9392/2001C**	**37**	**78.6**	**0.55**
9354/2001	9	75.3	0.76	**9392/2001D**	**37**	**78.5**	**0.70**
9355/2001	10	82.1	0.74	9393/2001	36	78.4	0.69
9356/2001	11	78.6	0.77	9394/2001	35	71.1	0.47
9357/2001	12	82.1	1.04	9395/2001	34	69.5	0.49
9358/2001	13	86.6	0.83	9396/2001	33	63.6	0.40
9359/2001	14	83.0	0.64	9397/2001	32	56.4	0.39
9360/2001	15	86.6	0.97	9398/2001	31	48.7	0.38
9361/2001	16	84.7	1.06	9399/2001	30	56.3	0.48
9362/2001	17	87.4	1.48	9400/2001	29	44.5	0.33
9363/2001	18	86.6	1.18	9401/2001	28	55.5	0.39
9364/2001	19	88.0	1.13	9402/2001	55	42.0	0.43
9365/2001	20	86.1	1.05	9403/2001	56	46.0	0.98
9366/2001	21	84.8	0.78	9404/2001	57	34.0	0.25
9367/2001	22	81.7	1.06	9405/2001	58	43.7	0.29
9368/2001	23	75.9	1.16	9406/2001	59	61.7	0.84
9369/2001	24	74.9	0.87	9407/2001	60	64.4	0.59
9370/2001	25	72.7	1.39	9408/2001	61	71.3	0.48
9371/2001	26	68.0	1.09	9409/2001	62	70.5	1.00
9372/2001	27	60.6	0.71	9410/2001	63	78.6	0.91
9373/2001	54	60.4	0.80	9411/2001	64	78.5	0.66
9374/2001	53	67.5	1.01	9412/2001	65	77.6	0.78
9375/2001	52	75.6	0.76	*9413/2001A*	*66*	*73.4*	*0.62*
9376/2001	51	77.8	1.00	*9413/2001B*	*66*	*71.4*	*0.39*
9377/2001	50	81.7	1.39	*9413/2001D*	*66*	*74.9*	*0.44*
9378/2001	49	83.1	1.24	*9413/2001E*	*66*	*72.0*	*0.85*
9379/2001	48	87.5	1.25	**9414/2001A**	**66**	**73.5**	**0.70**
9380/2001	47	89.9	1.26	**9414/2001B**	**66**	**74.9**	**0.70**
9381/2001A	*46*	*87.8*	*1.60*	**9414/2001C**	**66**	**74.8**	**0.64**
9381/2001B	*46*	*87.7*	*1.22*	**9414/2001D**	**66**	**74.2**	**0.72**
9381/2001C	*46*	*87.4*	*0.73*	9416/2001	68	82.3	1.01
9381/2001D	*46*	*88.1*	*1.14*	9417/2001	69	84.7	1.42
9381/2001E	*46*	*89.3*	*0.69*	9418/2001	70	88.1	0.71
9382/2001A	**46**	**89.2**	**1.11**	9419/2001	71	87.0	0.97
9382/2001B	**46**	**88.7**	**1.47**	9421/2001	73	86.8	0.95
9382/2001C	**46**	**89.2**	**0.85**	9422/2001	74	85.2	0.97
9382/2001D	**46**	**86.7**	**0.87**	9423/2001	75	87.0	0.83
9383/2001	45	91.5	1.30	9424/2001	76	85.1	0.96
9384/2001	44	86.4	1.10	9425/2001	77	83.9	1.21
9385/2001	43	86.6	0.81	9426/2001	78	81.4	1.02
9386/2001	42	86.1	0.93	9427/2001	79	74.4	0.53
9387/2001	41	80.7	0.87	9428/2001	80	70.6	0.86
9388/2001	40	78.5	0.62	9429/2001	102	62.6	0.59
9389/2001	39	79.2	0.74	9430/2001	101	80.6	0.71
9390/2001	38	80.3	1.07	9431/2001	100	83.8	0.74

PS - %<63µm;

[a] Sites in bold are multi-cores, sites in italics are the replicate grabs

Sample Number	Common site number[a]	PS	TOC	Sample Number	Common site number[a]	PS	TOC
9432/2001	99	84.1	0.62	9455/2001	106	83.6	0.81
9433/2001	98	86.4	1.16	9456/2001	107	81.5	0.91
9434/2001	97	85.4	0.43	9457/2001	108	72.0	1.05
9435/2001	96	87.3	1.09	9458/2001	109	83.2	0.93
9436/2001	95	85.9	1.53	9459/2001	110	84.9	0.59
9437/2001	94	83.8	1.19	*9460/2001A*	*111*	*88.1*	*0.90*
9438/2001	93	85.2	1.17	*9460/2001B*	*111*	*87.0*	*0.55*
9439/2001	92	89.2	1.12	*9460/2001C*	*111*	*86.4*	*1.17*
9440/2001	91	84.8	0.58	*9460/2001D*	*111*	*87.4*	*1.23*
9441/2001	90	82.0	0.73	*9460/2001E*	*111*	*85.2*	*0.88*
9442/2001	89	85.3	1.12	**9461/2001A**	**111**	**86.7**	**0.56**
9443/2001A	*88*	*84.4*	*0.29*	**9461/2001B**	**111**	**84.7**	**1.05**
9443/2001B	*88*	*81.7*	*0.98*	**9461/2001C**	**111**	**85.7**	**0.84**
9443/2001C	*88*	*83.7*	*0.95*	**9461/2001D**	**111**	**82.9**	**0.99**
9443/2001D	*88*	*85.7*	*0.61*	9462/2001	112	83.6	0.96
9443/2001E	*88*	*84.0*	*1.19*	9463/2001	113	72.9	0.84
9444/2001A	**88**	**85.7**	**1.45**	9464/2001	114	76.6	1.03
9444/2001B	**88**	**83.5**	**1.16**	9465/2001	115	84.5	0.98
9444/2001C	**88**	**81.6**	**0.97**	9466/2001	116	86.0	0.83
9444/2001D	**88**	**81.7**	**0.82**	9467/2001	117	86.6	1.03
9445/2001	87	81.7	0.71	9468/2001	118	86.5	1.11
9446/2001	86	83.1	0.75	9469/2001	119	79.5	0.96
9447/2001	85	79.9	0.70	9470/2001	120	75.2	0.87
9448/2001	84	72.5	0.96	9471/2001	121	67.2	1.05
9449/2001	83	64.2	0.51	9472/2001	122	61.5	0.78
9450/2001	82	53.9	0.32	9473/2001	123	50.9	0.46
9451/2001	81	46.7	0.84				
9452/2001	103	76.5	0.76				
9453/2001	104	79.6	0.62				
9454/2001	105	76.6	0.69				

PS - %<63µm

[a] Sites in bold are multi-cores, sites in italics are the replicate grabs

Appendix 6

UVF oil equivalent concentrations (µg g^{-1} dry weight) of sediment samples collected from the Fladen Ground in 2001 and in 1989

Common site number	Forties 2001	Forties 1989	Diesel 2001	Diesel 1989	Common site number	Forties 2001	Forties 1989	Diesel 2001	Diesel 1989
1	15.10	29.45	11.55	31.16	37	36.47	41.73	8.77	41.68
2	11.73	26.39	3.12	30.01	36	50.22	78.61	11.59	82.05
3	11.94	24.69	3.85	28.07	35	21.54	80.35	5.39	81.90
4	12.16	47.00	7.05	50.13	34	22.05	66.41	5.17	65.00
5	6.77	35.61	3.98	38.11	33	11.01	49.53	2.87	53.75
6	7.83	30.09	4.13	32.58	32	7.97	45.97	2.12	49.65
7	21.15	44.85	7.01	46.33	31	8.31	43.64	2.26	46.56
8	14.90	53.91	6.64	59.03	30	14.23	96.85	3.39	95.27
9	34.56	48.05	10.08	50.51	29	5.50	39.04	1.51	41.37
10	23.71	35.96	7.60	38.75	28	6.17	28.74	1.78	30.19
11	22.34	39.34	12.64	40.44	55	5.62	19.29	1.63	22.35
12	32.33	50.15	44.51	53.11	56	7.52	25.58	1.83	29.18
13	28.97	45.37	32.37	38.27	57	16.41	86.32	4.19	87.19
14	26.37	45.90	10.07	39.50	58	7.37	35.14	1.94	36.07
15	13.15	47.04	5.99	39.47	59	11.98	39.54	4.04	42.57
16	18.48	56.29	5.95	48.25	60	11.41	33.64	3.12	37.08
17	11.64	52.27	4.39	43.50	61	11.84	50.12	2.79	51.28
18	8.63	55.76	3.95	46.03	62	16.82	76.15	4.31	77.36
19	16.35	59.57	8.44	49.82	63	20.42	92.31	4.95	94.41
20	13.89	59.86	4.56	53.22	64	15.19	44.53	4.09	45.65
21	10.77	61.31	4.58	51.77	65	16.83	40.66	4.15	40.36
22	10.50	54.13	4.82	46.59	66	28.17	43.14	6.63	48.37
23	10.64	54.57	4.77	49.19	68	24.53	24.41	6.05	27.21
24	12.01	64.26	4.67	54.16	69	24.63	46.35	5.72	49.39
25	26.33	63.50	7.68	60.77	70	17.27	59.42	3.92	58.79
26	6.77	48.73	3.11	46.80	71	24.03	65.75	5.25	56.14
27	12.90	41.80	4.26	35.50	73	14.69	50.37	3.44	49.27
54	16.03	54.36	5.04	55.84	74	23.96	61.12	5.31	52.50
53	13.13	57.33	4.34	47.47	75	23.11	62.93	5.20	54.14
52	32.35	54.00	8.77	52.66	76	23.65	58.75	5.62	49.92
51	11.20	61.79	3.76	59.70	77	34.10	148.86	7.53	153.99
50	18.03	57.27	5.38	54.45	78	35.07	53.92	8.02	57.10
49	10.19	65.26	3.76	54.84	79	34.27	53.29	7.88	54.05
48	19.34	53.29	5.3	43.55	80	34.07	50.85	7.99	50.95
47	12.79	54.94	3.68	44.92	102	14.95	18.85	2.16	22.92
46	12.07	50.24	3.74	42.30	101	61.31	48.72	14.4	49.67
45	47.57	59.88	9.76	51.58	100	51.84	54.38	11.97	52.99
44	42.04	58.81	6.97	49.79	99	38.80	53.68	8.76	51.57
43	32.40	57.06	7.31	51.55	98	23.23	51.73	6.18	51.98
42	18.35	60.69	4.59	52.20	97	23.87	60.66	6.3	52.26
41	18.24	52.16	4.42	6.18	96	25.31	57.47	6.62	48.89
40	14.69	56.53	3.63	49.85	95	21.12	60.76	5.1	61.53
39	19.79	40.11	5.33	41.43	94	21.05	43.40	5.36	44.51
38	60.62	51.35	16.07	56.99	93	22.33	61.91	6.12	58.23

Common site number	Forties 2001	Forties 1989	Diesel 2001	Diesel 1989
92	17.00	48.59	5.15	46.16
91	16.09	62.79	3.91	62.71
90	16.47	43.64	3.89	43.87
89	16.56	51.32	5.11	54.04
88	13.67	99.54	4.24	102.55
87	40.53	61.04	10.46	60.64
86	24.77	85.04	5.69	90.84
85	15.68	93.29	4.35	101.95
84	15.48	48.66	4.44	45.00
83	16.74	45.14	16.69	48.76
82	10.62	30.35	3.11	31.55
81	6.75	22.95	1.71	24.07
103	19.43	46.96	5.33	48.66
104	15.86	21.11	4.11	22.17
105	24.22	67.78	6.30	71.75
106	46.39	90.50	11.05	99.96
107	25.07	129.59	6.85	132.86
108	12.92	47.33	3.80	51.41
109	25.22	54.22	6.47	56.51
110	26.09	68.56	6.81	68.63
111	13.72	54.28	3.26	54.23
112	21.74	44.32	5.80	42.75
113	9.36	41.14	2.94	41.59
114	12.42	43.58	3.71	37.16
115	22.37	53.04	4.57	55.76
116	26.97	54.02	5.95	47.16
117	29.64	56.50	6.26	55.32
118	50.33	51.24	12.24	49.68
119	39.26	41.42	9.88	41.74
120	41.14	50.08	9.05	49.64
121	20.97	60.44	5.09	59.94
122	18.89	44.80	4.70	45.16
123	18.79	26.70	4.92	26.47