Benthic Profile Data Documentation

Introduction

During OMEXII-II, a total of 254 parameters were determined as profiles along sediment cores by 14 investigators using a number of different protocols. The data set includes profiles measured on sediment cores and *in-situ* profiles obtained by benthic landers. The aim of this document is to allow the protocol used to obtain any particular value in the COREPROF table to be determined with ease.

To help you find the information you require quickly, the document is subdivided into sections that describe groups of closely related parameters. These are listed below as a series of hot links. Each section starts with the definition of the parameter codes covered, followed by a list of who measured one or more of those parameters by cruise. Next, there is a protocol section describing the methods used by each principal investigator. Finally, there may be comments on data quality that have been noted by BODC or have come to our attention.

<TIP> If you want to find out how a particular parameter was measured and know the parameter code then the fastest way to find the information you require is to use the *Acrobat* 'find' tool to search for the parameter code. Then use the 'find' tool again to search for the name of the principal investigator. This will take you straight to the protocol description you require.

Document Index

Dry Bulk Density, Porosity and Water Content

Profiles of water content by both weight and volume (porosity) plus dry bulk density (sediment dry weight per unit wet volume) profiles.

Magnetic Susceptibility

Includes both raw magnetic susceptibility profiles and mass-normalised parameters.

Sediment Grain Size

A wide range of sediment grain size parameters determined by classical methods and particle sizers.

Sediment Mineralogy

X-ray diffraction mineralogy profiles including individual clay minerals.

Sedimentary Carbon and Total Nitrogen

Total, inorganic and organic carbon and total nitrogen profiles.

Solid Phase Chemistry

Elemental profiles in bulk sediment, including determinations by X-ray fluorescence and inductively-coupled atomic emission spectroscopy.

Sediment Amino Acid Content

Proportions of amino acids.

Pigments

Chlorophyll-a and phaeopigment content of sediments.

Radioisotopes

^{210}Pb, ^{226}Ra, ^{234}Th and ^{137}Cs activity profiles.

Stable Isotopes

Stable oxygen and carbon isotope composition of picked foraminifera tests.

Foraminiferal Coiling

These parameters specify the proportion of selected species of foraminifera that have their tests coiled in the dextral sense.

Sedimentary Diatom Counts

Counts of diatom species preserved in sediment cores.

Total Macrofauna Abundance

Along-core profiles of total macrofauna abundance.

Pore Water Dissolved Oxygen and Resistivity

Includes parameters measured on deck and *in-situ* profiles obtained by the TROL lander.

Pore Water Solutes

Profiles of dissolved nutrients, inorganic carbon and divalent iron and manganese.

Sediment Erosion Resistance

Flume determinations of critical shear velocity.

Sediment Redox Potential

Profiles of redox potential in the sediment.

Box Coring Protocols

Box core specifications and sampling information.

Kasten Coring Protocols

Kasten core specifications and sampling information.

Multicoring Protocols

Multicore specifications and sampling information.

Dry Bulk Density, Porosity and Water Content

Parameter Code Definitions

DBDXCMXX Dry bulk density
Salt-corrected particle mass and measured volume
Grams per cubic centimetre

DBDXCSXX Dry bulk density
Salt-corrected particle mass and volume computed from mass
Grams per cubic centimetre

DENSDWTX Bulk sediment mineral density
Sediment dry weight divided by dry sample volume
Grams per cubic centimetre

POROWMXX Porosity (water content by volume)
Weight of water liberated on oven/freeze drying per unit volume computed from mass and mean density
Per Cent

POROWVXX Porosity (water content by volume)
Weight of water liberated on oven/freeze drying per unit volume of wet sediment
Per Cent

WCWTDRXX Sediment water content by weight
Mass difference on oven/freeze drying per unit mass of wet sediment
Per Cent

Originator Code Definitions

Charles Darwin cruise CD105A

15	Prof. Nick McCave	Cambridge University, UK

Pelagia cruise PLG109

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands

Pelagia cruises PLG121 and PLG138

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands
11	Dr. Wim Helder	NIOZ, Texel, the Netherlands

Pelagia cruises PLG108 and PLG118

87 Prof. Carlo Heip NIOO, the Netherlands

Almeida de Carvalho cruise CORVET

98 Dr. J-M Jouanneau University of Bordeaux, France

Originator Protocols

Professor Nick McCave

Samples were collected using a Kasten core or box core. See the sections on Kasten Coring Protocols and Box Coring Protocols for details of the corer and sample handling.

Water content was determined on the syringed samples by weight loss after drying at 60 °C for 48 hours. Because it was difficult to accurately measure sample volume, dry bulk density was determined by assuming an average particle density of 2.65 g/cm^3, a salinity of 35 g/kg and a water density of 1.025 g/cm^3 to calculate the salt-corrected particle weight (from dry mud weight) and the total sample volume. Detailed equations are given in Manighetti (1993).

Dr. Tjeerd van Weering

Samples were taken using the NIOZ box corer (see the section on Box Coring Protocols) or piston corer. 9 cm diameter sub-cores were taken from the box cores.

Samples were taken from the sub-core in two different ways. Firstly, at 5cm depth intervals, sediment was sampled with a syringe (16mm inner diameter). Secondly, slices of sediment were taken using a spatula. The weight of the samples before and after freeze drying was determined. Dry bulk density was calculated using two methods. For samples of known volume, the dry bulk density was calculated as dry weight divided by the sample volume. Porosity (assumed to be water content by volume) was computed as the difference between wet weight over dry weight divided by the sample volume. For the second set of samples, the dry bulk density and porosity were calculated by using an average mineral density determined in syringe samples of known volume. In all calculations, a correction was made for salt water, of 35.4 per mil.

Dr. Wim Helder

Samples were taken using a multicorer (see the section on Multicoring Protocols). The cores were extruded using a hydraulically operated core slicer. Sample porosity was calculated from the weight loss after drying for 24 hours at 105 °C.

Dr. Jean-Marie Jouanneau

Core samples were collected using either a box corer or a MARK I minicorer. Water content was determined by measuring the difference between the wet and dry weights of the sediment.

Professor Carlo Heip

Samples were collected using the NIOZ box corer (see the section on Box Coring Protocols). 10 cm diameter sub-cores were taken using plastic tubes and cut into sections. Porosity was determined from the weight loss on drying the sediment.

Magnetic Susceptibility

Parameter Code Definitions

NMSKMSNC Mass-normalised low frequency magnetic susceptibility (non-carbonate fraction)
Magnetic susceptibility meter
Cubic metres per kilogram * 10^{-8}

NMSKMSXT Mass-normalised low frequency magnetic susceptibility (bulk sediment)
Magnetic susceptibility meter
Cubic metres per kilogram * 10^{-8}

XMGSXPBT Magnetic susceptibility (bulk wet sediment)
Magnetic susceptibility probe
Magnetic susceptibility cgs units

Originator Code Definitions

Cruise Charles Darwin CD105A

15	Prof. Nick McCave	Cambridge University, UK

Cruise Pelagia PLG109, PLG121, PLG138

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands

Originator Protocols

Professor Nick McCave

Bulk magnetic susceptibility measurements were made on-board ship using a Bartington Instruments MS2 C meter with a probe-type detector. The probe was held against the sediment slabs at 2 cm intervals. The readings were corrected for background susceptibility and instrumental drift by taking alternate measurements with the detector held away from the slab.

Samples were wet sieved at 1mm to remove possible ice-rafted debris. A sub-sample was digested to remove carbonate. Untreated and treated samples were then dried, weighed, and packed into sample holders. The magnetic susceptibility was determined using a Bartington MS2 B sensor with internal diameter for 36mm. Mass-normalised magnetic susceptibility of the bulk sediment and non-carbonate fraction were then calculated.

Dr. Tjeerd van Weering

Downcore bulk magnetic susceptibility was measured on deck using a Bartington Instruments MS2 C meter, applying a 12 cm spool.

Sediment Grain Size

Parameter Code Definitions

KRTSSSXX Grain size kurtosis
Sieving and settling tube method
Dimensionless

LDGSPSXX Logarithmic standard deviation of the grain size distribution
Computed from phi size distribution determined using a particle sizer
Dimensionless

LDGSSSXX Logarithmic standard deviation of the grain size distribution
Computed from phi size distribution determined by sieving and settling tube method
Dimensionless

MDGSPSXX Median grain size
Particle sizer
Micrometres (microns)

MNGSPSNC Mean grain size of non-carbonate sediment
Particle sizer after removal of carbonates by acidification
Micrometres (microns)

MNGSPSSA Mean grain size of the 63-1000µm size class
Particle sizer
Micrometres (microns)

MNGSPSXX Mean grain size
Particle sizer
Micrometres (microns)

MNGSSSXX Mean grain size
Sieving and settling tube method
Micrometres (microns)

MOGSPSXX Grain size mode
Particle sizer
Micrometres (microns)

MOGSSSXX Grain size mode
Sieving and settling tube method
Micrometres (microns)

PC05SSXX Grain size of the 5th percentile
Sieving and settling tube method assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC10PSNC Non-carbonate grain size of the 10th percentile
Particle sizer after acidification assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC10PSXX Grain size of the 10th percentile
Particle sizer assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC50PSNC Non-carbonate grain size of the 50th percentile
Particle sizer after acidification assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC50PSXX Grain size of the 50th percentile
Particle sizer assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC50SSXX Grain size of the 50th percentile
Sieving and settling tube method assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC90PSNC Non-carbonate grain size of the 90th percentile
Particle sizer after acidification assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC90PSXX Grain size of the 90th percentile
Particle sizer assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PC90SSXX Grain size of the 90th percentile
Sieving and settling tube method assuming cumulative frequency ordered by phi (coarse to fine)
Micrometres (microns)

PRSCPSMO Proportion of sediment in the mode size class
Particle sizer
Per Cent

PRSCPSSB Proportion of sediment in the 63-125 micron size class
Particle sizer
Per Cent

PRSCPSSC Proportion of sediment in the 30-63 micron size class
Particle sizer
Per Cent

PRSCPSSD Proportion of sediment in the 15-30 micron size class
Particle sizer
Per Cent

PRSCPSSE Proportion of sediment in the <15 micron size class
Particle sizer
Per Cent

PRSCPSSG Proportion of sediment in the 125-250 micron size class
Particle sizer
Per Cent

PRSCPSSO Proportion of sediment in the <63 micron size class
Particle sizer
Per Cent

PRSCPSSP Proportion of sediment in the 250-500 micron size class
Particle sizer
Per Cent

PRSCPSSQ Proportion of sediment in the >500 micron size class
Particle sizer
Per Cent

PRSCPSTT Proportion of sediment in the >63 micron size class
Particle sizer
Per Cent

PRSCPSTU Proportion of sediment in the <2 micron size class
Particle sizer
Per Cent

PRSCPSTW Proportion of sediment in the 5-15 micron size class
Particle sizer
Per Cent

PRSCPSTX Proportion of sediment in the 2-5 micron size class
Particle sizer
Per Cent

PRSCSNTU Proportion of non-carbonate sediment in the <2 micron size class
Particle sizer after removal of carbonates by acidification
Per Cent

PRSCSNTV Proportion of non-carbonate sediment in the >10 micron size class
Particle sizer after removal of carbonates by acidification
Per Cent

PRSCSNTW Proportion of non-carbonate sediment in the 2-63 micron size class
Particle sizer after removal of carbonates by acidification
Per Cent

PRSCSSSB Proportion of sediment in the 63-125 micron size class
Sieving and settling tube method
Per Cent

PRSCSSSC Proportion of sediment in the 30-63 micron size class
Sieving and settling tube method
Per Cent

PRSCSSSD Proportion of sediment in the 15-30 micron size class
Sieving and settling tube method
Per Cent

PRSCSSSG Proportion of sediment in the 125-250 micron size class
Sieving and settling tube method
Per Cent

PRSCSSSP Proportion of sediment in the 250-500 micron size class
Sieving and settling tube method
Per Cent

PRSCSSSS Proportion of sediment in the 2-4 micron size class
Sieving and settling tube method
Per Cent

PRSCSSTU Proportion of sediment in the <2 micron size class
Sieving and settling tube method
Per Cent

PRSCSSTY Proportion of sediment in the 8-15 micron size class
Sieving and settling tube method
Per Cent

PRSCSSTZ Proportion of sediment in the 4-8 micron size class
Sieving and settling tube method
Per Cent

PRSCSSUA Proportion of sediment in the <4 micron size class
Sieving and settling tube method
Per Cent

PRSCSSUB Proportion of sediment in the >2000 micron size class
Sieving and settling tube method
Per Cent

PRSCSSUC Proportion of sediment in the 1000-2000 micron size class
Sieving and settling tube method
Per Cent

PRSCSSUD Proportion of sediment in the 500-1000 micron size class
Sieving and settling tube method
Per Cent

SDGSPSXX Arithmetic standard deviation of the grain size distribution
Particle Sizer
Micrometres (microns)

SKGSPSXX Grain size skewness
Particle Sizer
Dimensionless

SKGSSSXX Grain size skewness
Sieving and settling tube method
Dimensionless

SPRPWSXB Dry weight proportion of sediment in the 63-125 micron size fraction
Wet sieving
Per Cent

SPRPWSXF Dry weight proportion of fine (<63 micron) size fraction
Wet sieving
Per Cent

SPRPWSXG Dry weight proportion of sediment in the 125-250 micron size fraction
Wet sieving
Per Cent

SPRPWSXP Dry weight proportion of sediment in the 250-500 micron size fraction
Wet sieving
Per Cent

SPRPWSZB Dry weight proportion of sediment in the >2000 micron size fraction
Wet sieving
Per Cent

SPRPWSZC Dry weight proportion of sediment in the 1000-2000 micron size fraction
Wet sieving
Per Cent

SPRPWSZD Dry weight proportion of sediment in the 500-1000 micron size fraction
Wet sieving
Per Cent

SRTCPSXX Grain size sorting coefficient
Particle sizer
Dimensionless

Originator Code Definitions

Charles Darwin cruise CD105A

15	Prof. Nick McCave	Cambridge University, UK

Charles Darwin cruise CD110A

89	Dr. Tomasz Boski	Universidade do Algarve, Portugal
98	Dr. J-M Jouanneau	University of Bordeaux, France
183	Prof. Alveirinho Diaz	Universidade do Algarve, Portugal

Almeida Carvalho cruise CORVET and Cotes de la Manche cruise GAMINEX

98	Dr. J-M Jouanneau	University of Bordeaux, France
91	Dr. Aurora Rodrigues	Instituto Hidrografico, Portugal

Almeida Carvalho cruise AC99

91	Dr. Aurora Rodrigues	Instituto Hidrografico, Portugal

Pelagia cruises PLG108 and PLG118

87	Prof. Carlo Heip	NIOO, the Netherlands

Pelagia cruise PLG109

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands
96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany

Pelagia cruise PLG121

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands
89	Dr. Tomasz Boski	Universidade do Algarve, Portugal
96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany
183	Prof. Alveirinho Diaz	Universidade do Algarve, Portugal

Pelagia cruise PLG138

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands

Meteor cruise M43_2

96	Dr. Laurenz Thomsen	GEOMAR, Kiel, Germany
183	Prof. Alveirinho Diaz	Universidade do Algarve, Portugal
184	Dr. Gerhard Graf	Universitat Röstock, Germany

Originator Protocols

Professor Nick McCave

Samples were collected using a Kasten core. See the section on Kasten Coring Protocols for details of the corer and sample handling. The fine (<63 micron) and coarse fractions of the sediment were separated by wet sieving and weighed.

Grain size distributions of the fine terrigenous fraction were determined using a Micromeritics SediGraph 5100.

Dr. Jean-Marie Jouanneau

Grain size analysis was carried out using a MALVERN 3600 E microgranulometric diffractometer laser.

Dr. Tjeerd van Weering

Samples were freeze-dried, passed through a 2mm sieve, and then ultrasonicated in tap water for 1 minute before analysis. Sample ultrasonication was continued during analysis with a Coulter LS230 particle sizer.

Detailed size distribution data were presented to BODC and these were combined into a summary of nine size classes.

Dr. Aurora Rodrigues

Two methods were used for grain size analysis. For CORVET and GAMINEX, samples were analysed using the traditional settling tube method. For AC99, a particle sizer was used.

Where the traditional settling tube method was used, data were presented to BODC in phi (ϕ) units. They were converted to units of microns using the relationship

$$\text{Microns} = 1000 * 2^{-\phi}$$

Dr. Laurenz Thomsen

A particle camera was used during sediment flume experiments in order to determine sediment grain-size. Resulting images were analysed on a Macintosh Power PC image analysis system following the method of Thomsen and Ritzrau (1996) to obtain the size data.

Prof. Alveirinho Diaz

In CD110A, samples were obtained by Kasten Coring (see section on Kasten Coring Protocols for more information). The grain size characteristics of sediment with and without carbonate were determined. Carbonate removal was carried out by addition of 10% HCl. Calgon (1g Calgon per 1 litre water) was added to the samples to prevent flocculation, and the samples were analysed using a Malvern Mastersizer.

Professor Carlo Heip

Samples were collected using the NIOZ box corer (see the section on Box Coring Protocols). 10 cm diameter sub-cores were taken using plastic tubes and cut into sections.

Sediment grain size distribution was determined using a Malvern Particle Sizer 3600 EC.

Dr. Tomasz Boski

Sediment samples were separated into coarse and fine fractions by washing on a 63 micron sieve, and the fine fraction was analysed using a Micrometrics SediGraph 5000ET particle sizer with a computer interface devised by Jones et al. (1988).

Sediment Mineralogy

Parameter Code Definitions

CHLOXDXT Chlorite content of bulk sediment
X-ray diffraction
Per cent

CLAYXDXT Total clay mineral content of bulk sediment
X-ray diffraction
Per cent

CLCTXDXT Calcite content of bulk sediment
X-ray diffraction
Per cent

ILLMXDXT Illite mixed layer (10-14V) content of bulk sediment
X-ray diffraction
Per cent

ILLPXDXT Pure Illite content of bulk sediment
X-ray diffraction
Per cent

KAOLXDXT Kaolinite content of bulk sediment
X-ray diffraction
Per cent

QRTZXDXT Quartz content of bulk sediment
X-ray diffraction
Per cent

SMECXDXT Smectite content of bulk sediment
X-ray diffraction
Per cent

Originator Code Definitions

Cruises Charles Darwin CD110A and Pelagia PLG121

89 Dr. Tomasz Boski Universidade do Algarve, Portugal

Originator Protocols

Dr. Tomasz Boski

Analyses were carried out predominantly on grab samples and surface sediments from box cores. Samples were also obtained, during CD110, using a piston corer and multicorer. Cores were sliced in 1 cm intervals from the top and frozen at -20 °C immediately after recovery where possible.

X-ray diffraction was carried out following two procedures. Overall mineralogical composition was determined in un-oriented powder mounts and the principal clay mineral species was determined on oriented aggregates. Three distinct series of oriented aggregates were prepared. The first series were analysed in a routine comprising three diffractometer runs: air dried or normal, solvated with ethylene glycol vapours and heated to 500 °C. The two following series were necessary because routine investigation (N---EG—500) did not allow a direct identification of several of the clay components. The second series were analysed after Li-saturation (Green-Kelly test), and were run after recording three X-ray patterns: air dried or normal; heated to 300 °C and treated with ethylene glycol vapour. The third series were run air-dried, after heating to 110 °C and treated with ethylene glycol vapour. The relative proportions of clay minerals were determined from the changes in the diffractograms produced by the various treatments.

The diffraction data were obtained using a Philips PW1390 diffractometer with Cu Kα radiation (30 kV, 30 mA) and a Philips PW1050 vertical goniometer equipped with a 4 degree divergence slit, a 0.2 mm receiving slit, 4 degree scatter slit, graphite monochromator and a proportional detector. The scanning velocity was 1° 2θ per minute.

Sedimentary Carbon and Total Nitrogen

Parameter Code Definitions

CALCACWF Carbonate content by weight (<63 micron size fraction)
Wet sieving then weight loss on acidification
Per Cent

CALCACXT Carbonate content by weight (bulk sediment)
Weight loss on acidification
Per Cent

CALCGAXT Carbonate content by weight (bulk sediment)
Gasometric determination of acid-liberated CO_2
Per Cent

OCCNBCXT Refractory organic carbon (black carbon) content of bulk sediment
C/N analyser after combustion at 375 °C and acidification
Per Cent

OCCNCAXT Organic carbon content (bulk sediment)
Acidification then carbon/nitrogen analyser
Per Cent

OCCNCIWF Organic carbon content (<63 micron size fraction)
Wet sieving then diff. of C/N analyser readings before and after 400 °C ignition
Per Cent

OCCNCIXT Organic carbon content (bulk sediment)
Difference of carbon/nitrogen analyser readings before and after 400 °C ignition
Per Cent

TCCNCNXT Total carbon content (bulk sediment)
Carbon/nitrogen analyser
Per Cent

TNCNCNXT Total nitrogen content (bulk sediment)
Carbon/nitrogen analyser
Per Cent

Originator Code Definitions

Charles Darwin cruise CD105A

15	Prof. Nick McCave	Cambridge University, UK

Pelagia cruises PLG108 and PLG118

87	Prof. Carlo Heip	NIOO, the Netherlands

Charles Darwin cruise CD110A

98	Dr. J-M Jouanneau	University of Bordeaux, France
89	Dr. Tomasz Boski	Universidade do Algarve, Portugal

Almeida Carvalho cruise CORVET and Cotes de la Manche cruise GAMINEX

98	Dr. J-M Jouanneau	University of Bordeaux, France

Pelagia cruise PLG109

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands
11	Dr. Wim Helder	NIOZ, Texel, the Netherlands

Pelagia cruise PLG121

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands
11	Dr. Wim Helder	NIOZ, Texel, the Netherlands
89	Dr. Tomasz Boski	Universidade do Algarve, Portugal

Pelagia cruise PLG138

11	Dr. Wim Helder	NIOZ, Texel, the Netherlands

Originator protocols

Professor Nick McCave

Calcium carbonate was determined on the bulk sediment and the fine fraction by gravimetric measurement of the quantity of carbon dioxide liberated by the addition of 5% v/v sulphurous acid.

The method used for organic carbon and nitrogen was based on the Carlo Erba EA1106 CHN-OS analyser. The essence of the technique was the determination of total carbon and nitrogen followed by elimination of the organic component by heating at 400 °C for 3 hours. The inorganic component was then determined and the organic component computed by difference. This method and possible alternatives are discussed in detail in Manighetti (1993),

including quantitative assessment of errors. It was concluded that incomplete destruction results in organic carbon being underestimated by up to 0.1% for the samples collected during the BOFS programme in 1989 and 1990.

Dr. Tomasz Boski

Analyses were carried out predominantly on grab samples and surface sediments from box cores. Samples were also obtained during PLG121 using a box-corer, and CD110 using a piston corer and multi-corer. Cores were sliced in 1 cm intervals from the top and frozen at -20 °C immediately after recovery where possible.

20 mg aliquots of each sediment sample were packed in tin capsules and compressed to remove air. Organic carbon was determined in silver crucibles after digestion of carbonates using hydrochloric acid. The analysis was performed using a GC Carlo Erba C/N gas phase elemental analyser coupled with a thermic conductivity detector.

Dr. Tjeerd van Weering

Samples were taken using the NIOZ box corer (see the section on Box Coring Protocols). 9 cm diameter sub-cores were taken.

Dried and homogenised sediment samples taken from a sectioned sub-core were analysed by on-line combustion in a Carlo-Erba NA-1500 elemental analyser after removal of inorganic carbon by treatment with sulphurous acid following the protocols of Verardo et al. (1990) to give total nitrogen and organic carbon. Carbon and nitrogen were analysed on separate runs.

Professor Carlo Heip

Samples were taken using the NIOZ box corer (see the section on Box Coring Protocols). 10 cm diameter sub-cores were taken.

The sub-cores were sectioned on board ship and stored frozen at -25 °C until analysed.

The samples were analysed using a Carlo-Erba NA-1500 elemental analyser according to the protocol of Nieuwenhuize et al. (1994). Carbon was partitioned into organic and inorganic fractions by acidification with 25% HCl *in-situ* within silver sample cups. Carbon and nitrogen were analysed on the same sample.

For the determination of ‘black carbon’, the samples were combusted at 375 °C overnight at ambient oxygen pressure and the carbon remaining was determined using a Carlo Erba Elemental analyser after *in-situ* acidification to remove inorganic carbon.

Dr. Jean-Marie Jouanneau

Samples were collected with either a box corer or a 'MARK 1 minicorer'. Total carbonate content was determined using a 'LECO Carbon Determinator'. Organic carbon was determined following the protocol of Strickland and Parsons (1972) as modified by Etcheber (1981). The analyses were carried out on a LECO CS-125 analyser after carbonates had been removed by addition of 2N HCl. The CaCO3 content was determined by a gasometric method showing a fairly low CaCO3 relative variation (<2%) in duplicate measurements.

Solid Phase Chemistry

Parameter Code Definitions

ALCNPEXT Bulk sediment aluminium content
ICP-AES analysis of acid digestion
Per Cent

ALCNXIXT Amorphous aluminium content of bulk sediment
ICP analysis of oxalic acid extract
Per Cent

BACNPEXT Bulk sediment barium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

CACNPEXT Bulk sediment calcium content
ICP-AES analysis of acid digestion
Per Cent

COCNPEXT Bulk sediment cobalt content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

CRCNPEXT Bulk sediment chromium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

CUCNPEXT Bulk sediment copper content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

FECNPEXT Bulk sediment total iron content
ICP-AES analysis of acid digestion
Per Cent

FECNXIXT Amorphous total iron content of bulk sediment
ICP analysis of oxalic acid extract
Per Cent

FELDXDXT Feldspar content of the bulk sediment
X-Ray diffraction
Per Cent

KXCNPEXT Bulk sediment potassium content
ICP-AES analysis of acid digestion
Per Cent

LICNPEXT Bulk sediment lithium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

MGCNPEXT Bulk sediment magnesium content
ICP-AES analysis of acid digestion
Per Cent

MNCNPEXT Bulk sediment total manganese content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Per Cent

NACNPEXT Bulk sediment sodium content
ICP-AES analysis of acid digestion
Per Cent

NBCNPEXT Bulk sediment niobium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

NICNPEXT Bulk sediment nickel content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

PXCNPEXT Bulk sediment phosphorus content
ICP-AES analysis of acid digestion
Per Cent

SCCNPEXT Bulk sediment scandium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

SICNPEXT Bulk sediment silicon content
ICP-AES analysis of acid digestion
Per Cent

SICNXIXT Amorphous silicon content of bulk sediment
ICP analysis of oxalic acid extract
Per Cent

SRCNPEXT Bulk sediment strontium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

TICNPEXT Bulk sediment titanium content
ICP-AES analysis of acid digestion
Per Cent

VXCNPEXT Bulk sediment vanadium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

XRFCCAWC Calcium XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCFEWC Total iron XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCKXWC Potassium XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCMNWC Manganese XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCSIWC Silicon XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCSRWC Strontium XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCSXWC Sulphur XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

XRFCTIWC Titanium XRF relative abundance
XRF scanner on whole core or split core sections
Counts per second

YXCNPEXT Bulk sediment yttrium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

ZNCNPEXT Bulk sediment zinc content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

ZRCNPEXT Bulk sediment zirconium content
Inductively-coupled plasma atomic emission spectroscopy (ICP-AES)
Parts per million

Originator Code Definitions

Charles Darwin cruise CD105A

15 Prof. Nick McCave Cambridge University, UK

Pelagia cruises PLG109, PLG121 and PLG138

75 Dr. Tjeerd van Weering NIOZ, Texel, the Netherlands

Charles Darwin cruise CD110A and Pelagia cruise PLG121

89 Dr. Tomasz Boski Universidade do Algarve, Portugal

Originator Protocols

Professor Nick McCave

Sediment sub-samples were digested with a hydrofluoric and perchloric acid mixture. They were evaporated to dryness, then re-dissolved in dilute hydrochloric acid. This solution was used for the determination of all elements except for Si, Al and Zr. A second sub-sample was fused with KOH, then dissolved in dilute nitric acid. This solution was used for the determination of SiO_2 and Al_2O_3 and Zr.

Solutions were analysed using the Perkin Elmer Optime 3300 ICP system, or Philips PB8060 simultaneous/sequention optical ICP system. The instruments were calibrated with laboratory reference materials. Precision and accuracy were monitored by analysis of international reference materials.

Dr. Tjeerd van Weering

X-ray fluorescence element scans of split piston core sections were made with a CORTEX XRF scanner. Relative abundance of elements are expressed in counts per second and used, in combination with Magnetic Susceptibility profiles, to estimate core ages.

Dr. Thomasz Boski

The amorphous iron and silicon content of sediment samples was determined by Inductively-Coupled Plasma analysis of oxalic acid extracts.

Sedimentary Amino Acids

Parameter Code Definitions

ALACHPXT Alanine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

ARGCHPXT Arginine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

ASPCHPXT Aspartic acid content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

GLUCHPXT Glutamic acid content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

GLYCHPXT Glycine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

ILECHPXT Isoleucine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

LEUCHPXT Leucine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

PHECHPXT Phenylalanine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

SERCHPXT Serine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

THRCHPXT Threonine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

TYRCHPXT Tyrosine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

VALCHPXT Valine content of bulk sediment
HPLC on hydrolysed sample
Micrograms per gram of dry sediment

Originator Code Definitions

Cruises Charles Darwin CD110A and Pelagia PLG121

89 Dr. Tomasz Boski Universidade do Algarve, Portugal

Originator Protocols

Dr. Tomasz Boski

Analyses were carried out predominantly on grab samples and surface sediments from box cores. Samples were also obtained, during CD110, using a piston corer and multicorer. Cores were sliced in 1 cm intervals from the top and frozen at -20 °C immediately after recovery where possible.

500 mg aliquots of homogenised and freeze dried sediment were hydrolised with 3 ml 6M HCl in a vacuum flushed with nitrogen. They were placed in an aluminium heating block and maintained at a temperature of 110 °C for 24 hours. Three amino acid standards (α-aminopimelic acid, *o*-methylthreonine and hydroxylysine) were added as recovery standards for acidic, neutral and basic amino acids respectively. HPLC analyses of amino acids were carried out on the fluorescent derivatives with orthophtaldialdehyde (OPA) (Lindroth and Mopper, 1979). The OPA solution was prepared by dissolving 135 mg of OPA in 5 ml of HPLC-grade methanol, adding 100 µl of 2-mercaptoethanol and making up the volume to 25 ml with borate buffer. This solution was prepared before each series of HPLC runs and stored in a refrigerator in the dark.

400 µl of OPA were added to 1ml of solution and the volume was made up to 10 ml by addition of borate buffer. The derivatisation reaction was carried out by agitation for 2 minutes. 6 minutes after the beginning of the derivatisation reaction, the analyte was injected through an Anotop filter into the instrument loop. Gradient elution was carried out in 7 steps during a 25 minute period in a reverse phase column.

The instrument used was a JASCO chromatograph equipped with two pumps, Lichrosorb 10 (Merck) inverse phase 25 cm RP-18 column enclosed in a thermostatic unit, Rheodyne 7125 injector, high pressure solvent mixing module, UV/VIS detector and 821-FP spectrofluorometer. The instrument was coupled to a computer running either Jones Chromatography JCL6000 which was subsequently replaced by a Borwin Access data system providing peak integration, baseline adjustment and calibration facilities. Individual amino acid concentrations were computed using the formula of Lindsay (1992).

Pigments

Parameter Code Definitions

SCLAFLTX Chlorophyll-a in sediment
Fluorometric assay of acetone extraction
Nanograms per ml of wet sediment

SCLAHPTX Chlorophyll-a in sediment
HPLC assay of acetone extraction
Nanograms per ml of wet sediment

SCSDFLTX Chlorophyll-a in sediment standard deviation
Fluorometric assay of acetone extraction
Nanograms per ml of wet sediment

SPHPFLTX Phaeopigments in sediment
Fluorometric assay of acetone extraction
Nanograms per ml of wet sediment

SPHPHPTX Phaeopigments in sediment
HPLC assay of acetone extraction
Nanograms per ml of wet sediment

SPSDFLTX Phaeopigments in sediment standard deviation
Fluorometric assay of acetone extraction
Nanograms per ml of wet sediment

Originator Code Definitions

Pelagia cruises PLG108, PLG118 and PLG123

180 Dr. Marc Lavaleye NIOZ, Texel, the Netherlands

Meteor cruise M43_2

184 Dr. Gerhard Graf Universität Rostock, Germany

Originator Protocols

Dr. Marc Lavaleye

Samples were taken using the NIOZ box corer and the multicorer (see the sections on Box Coring Protocols and Multi Coring Protocols). Samples were immediately transferred to a cool container, where they were stored an

treated at *in situ* bottom temperature. Sediment slicing was carried out using the NIOZ hydraulic slicing system. Samples were then stored at –80 ºC until analysis at NIOZ. The samples were freeze dried before being extracted into acetone containing a fixed volume of water. Pigments were assayed by HPLC using eluents, gradients and column similar to those described in Wright et al., 1991. Detection was by a photodiode array coupled with a fluorometer and the pigments were quantified as described in Tahey et al., 1994.

Dr. Gerhard Graf

Samples were taken with a multicorer, and the upper 9cm of each core were selected for analysis. The sediment was sliced and homogenised by stirring, then frozen. Pigment analyses were carried out on board using a fluorometer, after extraction with 90% acetone.

Radioisotopes

Parameter Code Definitions

C37CGSXT Bulk sediment caesium 137 content
Gamma-ray spectroscopy
Bequerels per kilogram

L210GSXX Solid phase lead-210 content
Gamma spectrometry
Bequerels per kilogram

L210IGXX Solid phase lead-210 content
Alpha spectroscopy on plated samples
Bequerels per kilogram

R226GSXT Radium-226 activity in bulk sediment
Gamma spectrometry
Bequerels per kilogram

R26EGSXT Radium-226 activity in bulk sediment standard error
Gamma spectrometry
Bequerels per kilogram

S37CGSXT Bulk sediment caesium 137 content standard error
Gamma spectrometry
Bequerels per kilogram

SL10GSXX Solid phase Lead-210 content standard error
Gamma spectrometry
Bequerels per kilogram

SL10IGXX Solid phase Lead-210 content standard error
Alpha spectroscopy on plated samples
Bequerels per kilogram

SX10GSXX Solid phase excess lead-210 content standard error
Gamma spectroscopy on compressed sediment pellets (Pb-210-Ra-226)
Bequerels per kilogram

X210GSXX Solid phase excess lead-210 content
Gamma spectroscopy on compressed sediment pellets (Pb-210-Ra-226)
Bequerels per kilogram

XT34GSXT Excess thorium-234 activity in bulk sediment
Gamma spectrometry
Bequerels per kilogram

XTE4GSXT Excess thorium-234 activity in bulk sediment standard error
Gamma spectrometry
Gamma spectrometry

Originator Code Definitions

Pelagia cruise PLG109

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands

Pelagia cruises PLG121 and PLG138

75	Dr. Tjeerd van Weering	NIOZ, Texel, the Netherlands
139	Dr. Sabine Schmidt	CNRS, Gif-sur-Yvette, France

Charles Darwin cruise CD110A, Almeida Carvalho cruise CORVET and Cotes de la Manche cruise GAMINEX

98	Dr. J-M Jouanneau	University of Bordeaux, France

Meteor cruise M43_2

139	Dr. Sabine Schmidt	CNRS, Gif-sur-Yvette, France

Originator Protocols

Dr. Tjeerd van Weering

Sediments were sampled using the NIOZ box core or multicore. See Box Coring Protocols and Multicoring Protocols for more information on sampling procedures.

0.5 g aliquots of dried, homogenised samples were spiked with ^{208}Po as a yield tracer. Samples were then dissolved in concentrated acids (12 ml HNO_3 and 2 ml HF). The resulting solution was evaporated to dryness and the residue dissolved in 1M HCl at 80 °C. Trivalent iron was reduced by the addition of ascorbic acid. The isotopes were then plated from this solution onto silver discs and then assayed by alpha spectrometry. Discs were counted for at least 24 hours with Canberra A-600-23-AM passively implanted planar silicon (PIPS) detectors. Total ^{210}Pb is determined from ^{210}Po activity, assuming secular equilibrium.

Dr. Jean-Marie Jouanneau

Samples were taken with a Smith & McIntyre sediment grab and surficial cores with a multicorer MARK I.

Radionuclide activities were determined from dried bulk sediment samples using high-resolution gamma spectrometry. The spectrometer used was an Intertechnique EGSP 2200-25-R with semi-planar detector. Samples of 6-10g were counted for between 10 and 20 hours. ^{210}Pb and ^{137}Cs isotopes were determined directly from their peaks, and ^{226}Ra from the peaks of its daughters, ^{214}Bi and ^{214}Pb. ^{210}Pb excess activities were calculated from ^{210}Pb total – ^{226}Ra activity.

Dr. Sabine Schmidt

Sediments were collected using a multicorer, or box corer, in order to recover a well-preserved water-sediment interface. Immediately after core retrieval, tubes were carefully extruded.

Sediment samples were weighed, dried at 60°C, and re-weighed to determine dry bulk density. Activities of radionuclides were measured by non-destructive gamma spectrometry on 0.5-3 g of dry sediment. Measurements were conducted in two steps. Firstly, uppermost layers of cores were rapidly investigated, immediately after the cruise, for ^{234}Th determination. These measurements were achieved within 6 weeks after sampling, due to the rapid decay of ^{234}Th. Each layer of sediment was investigated downcore until a fairly constant ^{234}Th activity, considered as the supported activity, was observed. After 3-4 months, a second determination was performed at the underground laboratory on selected samples to confirm supported activities. ^{210}Pb and ^{226}Ra activities were also determined by gamma spectrometry (^{226}Ra via the peak of its daughter, ^{214}Pb).

Counting was conducted using low-background, high-efficiency well-type Ge detectors: one of 130 cm^3 at the CNRS laboratory at Gif-sur-Yvette and two (215 and 430 cm^3) at the "Laboratoire Souterrain de Modane (LSM)" in the French Alps (Reyss et al., 1995). The standards used to calibrate the γ-detectors are a mock-up of sediment and U-Th U.S. standard from the NBS.

Stable Isotopes

Parameter Code Definitions

D13CMXFA Globigerina bulloides test 13C enrichment (delta-13C)
Mass spectrometry on combusted sample
Parts per Thousand

D13CMXFC Cibicidoides wuelerstorfi test 13C enrichment (delta-13C)
Mass spectrometry on combusted sample
Parts per Thousand

D13CMXFF Uvigerina spp. test 13C enrichment (delta-13C)
Mass spectrometry on combusted sample
Parts per Thousand

D18OMXFA Globigerina bulloides test 18O enrichment (delta-18O)
Mass spectrometry on combusted sample
Parts per Thousand

D18OMXFC Cibicidoides wuelerstorfi test 18O enrichment (delta-18O)
Mass spectrometry on combusted sample
Parts per Thousand

D18OMXFF Uvigerina spp. test 18O enrichment (delta-18O)
Mass spectrometry on combusted sample
Parts per Thousand

Originator Code Definitions

Cruise Charles Darwin CD105A

15	Prof. Nick McCave	Cambridge University, UK

Pelagia cruise PLG109

139	Dr. Sabine Schmidt	CNRS, Gif-sur-Yvette, France

Originator Protocols

Professor Nick McCave

Samples were collected using a Kasten core. See the section on Kasten Coring Protocols for details of the corer and sample handling.

Oxygen and carbon isotopes were determined on foramanifera tests taken from the conduit samples. The samples were disaggregated into distilled water, and washed through 150 mm or 63 mm sieves. The coarse fraction was washed and dried in an oven at 60 °C and then split using a Soiltest CL-242A splitter until a sample containing approximately 300 whole foraminifera tests was obtained. The final split was strewn into a picking tray and individual species were extracted.

Test tubes (washed in Decon 90) were soaked in aqueous NaOCl for an hour and washed in distilled water. In these the samples were left in 5ml aqueous NaOCl for 3 hours which was then pipetted off and replaced by 3ml of 20% aqueous HCl. The solution was ultrasonicated for 5 minutes, left overnight to digest and ultrasonicated for a further 5 minutes.

The resulting solution was transferred using a fine funnel into 500 MWCO dialysis tubing, sealed using medical clips and placed into 2.5 litres of distilled water. This water was changed at least 8 times and left overnight. The process was deemed complete when no change in pH was detected an hour after the water was changed.

The solution was then transferred into chromic acid washed 9mm Pyrex sample tubes and centrifuged at 10,000 rpm for 5 hours. The sample was frozen overnight and dried in a vacuum oven at room temperature. CuO, Cu and silver wire were added to the sample and the tubes were then evacuated, sealed and heated to 450 °C for at least 14 hours.

The sample tubes were broken in the vacuum line of a VG Isotech SIRA series II mass spectrometer using a stainless steel cracker. Carbon dioxide was cryogenically separated from other gases and analysed. A mass scan from 28-55 was made to ensure that the sample had not been contaminated. The sample was compared with a reference gas and the isotopic ratio calibrated to PDB.

Foraminiferal Coiling

Parameter Code Definitions

GHDXSRBS Proportion of Globorotalia hirsuta tests with dextral coiling
Hand picking from >150 micron fraction (shipboard: variable sample size)
Per Cent

GHDXFVBS Proportion of Globorotalia hirsuta tests with dextral coiling
Hand picking from >150 micron fraction (laboratory: fixed volume sample)
Per Cent

GTDXSRBS Proportion of Globorotalia truncatulinoides tests with dextral coiling
Hand picking from >150 micron fraction (shipboard: variable sample size)
Per Cent

GTDXFVBS Proportion of Globorotalia truncatulinoides tests with dextral coiling
Hand picking from >150 micron fraction (laboratory: fixed volume sample)
Per Cent

NPDXSRBS Proportion of Neogloboquadrina pachyderma tests with dextral coiling
Hand picking from >150 micron fraction (shipboard: variable sample size)
Per Cent

NPDXFVBS Proportion of Neogloboquadrina pachyderma tests with dextral coiling
Hand picking from >150 micron fraction (laboratory: fixed volume sample)
Per Cent

Originator Code Definitions

Pelagia cruises PLG109 and PLG121

75 Dr. Tjeerd van Weering NIOZ, Texel, the Netherlands

Originator Protocols

Dr. Tjeerd van Weering

The objective of these measurements was the biostratigraphic correlation and the determination of relative ages of sediment cores by looking at the relative proportion of foraminifera tests that are right-coiled. In the Bay of Biscay area, *N pachyderma* was predominantly left-coiled during the late Glacial (19-10 ka BP), but dominantly right-coiled in the Holocene (10-0 ka BP). *G. truncatulinoides* was dominantly right-coiled in the late Glacial and in the late Holocene (7-0 ka BP), but showed a shift to left-coiling in the early Holocene (10-7 ka BP). *G. hirstula* was left-coiled in the late Glacial and early Holocene, but dominantly right-coiled in the late Holocene.

Samples were taken using the NIOZ box corer (see the section on Box Coring Protocols) or piston corer. 9 cm diameter sub-cores were taken from the box cores.

The foraminifera populations were examined quickly on board ship. Small sediment samples were taken every 5 or 10 cm down the core and passed through a 150 μm sieve. The coiling sense of approximately 50 specimens of each species was determined in the total sieve residue. Where possible, determinations were made on replicate box cores.

More accurate determinations were done back in the laboratory on fixed volume samples. These were dried, weighed and then washed through a set of 150 μm and 63 μm sieves. The coiling sense of approximately 50 specimens per species was then determined in splits of the >150 μm residue.

Sedimentary Diatom Counts

Parameter Code Definitions

D000M01Z	Centrales spp.	Optical microscopy	per gram
D000M02Z	Pennales spp	Optical microscopy	per gram
D001M00Z	Achnanthes spp.	Optical microscopy	per gram
D001M02Z	Achnanthes delicatula	Optical microscopy	per gram
D001M03Z	Achnanthes lanceolata	Optical microscopy	per gram
D002M02A	Actinocyclus normanii morph. subsalsus	Optical microscopy	per gram
D003M02Z	Actinoptychus senarius	Optical microscopy	per gram
D007M00Z	Anaulus spp.	Optical microscopy	per gram
D012M00Z	Asteromphalus spp.	Optical microscopy	per gram
D017M00Z	Bacillariaceae spp.	Optical microscopy	per gram
D018M00Z	Bacteriastrum spp.	Optical microscopy	per gram
D030M00C	Chaetoceros resting spores	Optical microscopy	per gram
D032M00Z	Cocconeis spp.	Optical microscopy	per gram
D032M10Z	Cocconeis peltoides	Optical microscopy	per gram
D032M20Z	Cocconeis placentula	Optical microscopy	per gram
D032M30Z	Cocconeis scutellum	Optical microscopy	per gram
D034M00Z	Coscinodiscus spp.	Optical microscopy	per gram
D034M15Z	Coscinodiscus marginatus	Optical microscopy	per gram
D034M24Z	Coscinodiscus radiatus	Optical microscopy	per gram
D035M00Z	Cyclotella spp.	Optical microscopy	per gram
D035M20Z	Cyclotella meneghiniana	Optical microscopy	per gram
D035M30Z	Cyclotella ocellata	Optical microscopy	per gram
D043M00Z	Diploneis spp.	Optical microscopy	per gram
D043M15Z	Diploneis didyma	Optical microscopy	per gram
D043M20Z	Diploneis interrupta	Optical microscopy	per gram
D043M35Z	Diploneis subcincta	Optical microscopy	per gram
D049M00Z	Eunotia spp.	Optical microscopy	per gram
D052M02Z	Fragilaria brevistriata	Optical microscopy	per gram
D052M03Z	Fragilaria fasciculata	Optical microscopy	per gram
D052M04Z	Fragilaria investiens	Optical microscopy	per gram
D056M25Z	Grammatophora marina	Optical microscopy	per gram
D056M40Z	Grammatophora serpentina	Optical microscopy	per gram
D062M01Z	Hemidiscus cuneiformis	Optical microscopy	per gram
D073M00Z	Navicula spp.	Optical microscopy	per gram
D073M65Z	Navicula mutica	Optical microscopy	per gram
D074M00Z	Nitzschia spp.	Optical microscopy	per gram
D074M07Z	Nitzschia bicapitata	Optical microscopy	per gram
D074M77Z	Nitzschia marina	Optical microscopy	per gram
D074M78Z	Nitzschia navicularis	Optical microscopy	per gram
D074M80Z	Nitzschia filiformis	Optical microscopy	per gram
D074M81Z	Nitzschia frustulum	Optical microscopy	per gram

D077M20Z	Opephora olsenii	Optical microscopy	per gram
D078M01Z	Paralia sulcata	Optical microscopy	per gram
D082M30Z	Plagiogramma staurophorum	Optical microscopy	per gram
D084M00Z	Pleurosigma spp.	Optical microscopy	per gram
D084M24Z	Pleurosigma normanii	Optical microscopy	per gram
D092M00Z	Rhaphoneis spp.	Optical microscopy	per gram
D092M05Z	Rhaphoneis amphiceros	Optical microscopy	per gram
D093M00Z	Rhizosolenia spp.	Optical microscopy	per gram
D096M01Z	Roperia tesselata	Optical microscopy	per gram
D104M00Z	Stephanodiscus spp.	Optical microscopy	per gram
D110M01A	Thalassionema nitzschioides var. parva	Optical microscopy	per gram
D110M01Z	Thalassionema nitzschioides	Optical microscopy	per gram
D110M10Z	Thalassionema frauenfeldii	Optical microscopy	per gram
D111M00K	Thalassiosira sp. 1	Optical microscopy	per gram
D111M00Z	Thalassiosira spp.	Optical microscopy	per gram
D111M03Z	Thalassiosira angulata	Optical microscopy	per gram
D111M06Z	Thalassiosira decipiens	Optical microscopy	per gram
D111M07Z	Thalassiosira eccentrica	Optical microscopy	per gram
D111M10Z	Thalassiosira gravida	Optical microscopy	per gram
D111M11Z	Thalassiosira leptopus	Optical microscopy	per gram
D111M14Z	Thalassiosira oestrupii	Optical microscopy	per gram
D111M96Z	Thalassiosira lineata	Optical microscopy	per gram
D111M97Z	Thalassiosira tenera	Optical microscopy	per gram
D112M02Z	Thalassiothrix longissima	Optical microscopy	per gram
D190M00Z	Tabellaria spp.	Optical microscopy	per gram
D191M05Z	Proboscia alata	Optical microscopy	per gram
D192M25Z	Fragilariopsis pseudonana	Optical microscopy	per gram
D193M20Z	Delphineis karstenii	Optical microscopy	per gram
D193M40Z	Delphineis surirella	Optical microscopy	per gram
D194M15Z	Azpeitia nodulifera	Optical microscopy	per gram
D195M00Z	Aulacoseira spp.	Optical microscopy	per gram
D197M10Z	Pseudonitzschia pungens	Optical microscopy	per gram

Originator Code Definitions

Pelagia cruisse PLG109 and PLG121

81 Dr. R. Bao Casal Universidade da Coruna, Spain

Originator Protocols

Dr. Roberto Bao Casal

Samples were collected using the NIOZ box corer. The upper 1 cm of the surface sediment was collected. After standard acid cleaning (Schrader, 1973) an aliquot of each cleaned sample was mounted on 22 x 22 cm cover glasses with Hyrax (n=1.7). Counts were made at 1000x magnification with a

Nikon Optiphot II phase contrast microscope following random transects. At least 300 valves were counted per sample following standard counting procedures (Schrader and Gersonde, 1978).

A selection of cores from PLG109 and PLG121 were examined and found to be devoid of diatoms. This negative result has not been included in the database, but should be noted. The cores are given below.

PLG109	02_BC2, 06_BC, 11_BC2 and 12_BC1
PLG121	10_PC

Total Macrofauna Abundance

Parameter Code Definitions

MFABSBTL Total benthic macrofauna abundance
Sieving (0.5mm mesh) and picking
Number per square metre

Originator Code Definitions

Pelagia cruises PLG108, PLG118 and PLG138

87 Prof. Carlo Heip NIOO, the Netherlands

Originator Protocols

Prof. Carlo Heip

The samples were collected using a NIOZ box corer with a diameter of either 30cm or 50cm. Some cores were sub-sampled and the remainder of the sample taken for macrofaunal analysis. The resulting variation in sample size has been taken into account, with the data calculated on a per unit area basis.

The samples were sliced into layers between 1 and 5cm thick and sieved through a 0.5 mm mesh. Specimens were preserved in 4% buffered formaldehyde, stained with Rose Bengal and sorted under a 10× stereo microscope. The total macrofauna abundance profiles are held within the coreprof table.

Pore Water Dissolved Oxygen and Resistivity

Parameter Code Definitions

DOXYMETX Micro-electrode oxygen
Oxygen micro-electrode usually mounted on a micro-manipulator
Micromoles/litre

REFFMEXX Resistivity formation factor
Pt micro-electrode (ratio of resistivity/resistivity of overlying water)
Dimensionless

Originator Code Definitions

Cruises Pelagia PLG109, PLG121 and PLG138

11	Dr. Wim Helder	NIOZ, Texel, the Netherlands

Originator Protocols

Dr. Wim Helder

Pore water oxygen profiles in sediments retrieved by multicorer were measured on-deck, using a Clark type microelectrode and a four-wired platinum resistivity electrode (Andrews and Bennett, 1981) mounted on a micro-manipulator. The concentration gradient of oxygen across the sediment-water interface was measured with a vertical resolution of 100 μm. The sediment surface was gently pushed up to the rim of the liner, and the core was positioned in a flow chamber to create a "laminar flow" over the sediment surface. This was carried out at *in-situ* temperature for up to six cores at each station.

Oxygen and resistivity profiles were also measured *in-situ*, using the free-falling TROL vehicle (Temperature, Resistivity and Oxygen Lander). This was equipped with three incubation chambers and a profiling module. The profiling module was modified to allow the use of Custom-built Clark type oxygen microelectrodes. The electrodes had tip diameters of 10-20 μm, a stirring sensitivity of <1%, and output of around 200 pA in air-saturated seawater at 20 °C, and were furnished with a guard electrode to ensure stable output currents. The electrodes proved to give a very stable, low-noise signal for measurements made during PLG121 and PLG138.

The resisitivity data were provided in raw form. They were converted to the resistivity formation factor, defined as the ratio of the pore water resistivity at each depth to the resistivity of the overlying water.

Comment on Data Quality

The data originator notes that the oxygen profiles measured during cruise PLG109 were of lower quality than profiles from PLG121 and PLG138. Anyone wishing to use these data should contact the originator for further information.

Pore Water Solutes

Parameter Code Definitions

AMONAAD2 Dissolved ammonium
Colorometric autoanalysis (0.4/0.45 μm pore filtered)
Micromoles/litre

FEDVAAD2 Dissolved ferrous (divalent) iron
Colorometric autoanalysis (Ferrospectral 550nm) (0.4/0.45 μm pore filtered)
Nanomoles per litre

MNDVAAD2 Dissolved manganous (divalent) manganese
Colorometric autoanalysis (Formaldoxime 480nm) (0.4/0.45 μm pore filtered)
Nanomoles per litre

NTRIAAD2 Dissolved nitrite
Colorometric autoanalysis (0.4/0.45 μm pore filtered)
Micromoles/litre

NTRZAAD2 Dissolved nitrate + nitrite
Colorometric autoanalysis (0.4/0.45 μm pore filtered)
Micromoles/litre

PHOSAAD2 Dissolved phosphate
Colorometric autoanalysis (0.4/0.45 μm pore filtered)
Micromoles/litre

SLCAAAD2 Dissolved silicate
Colorometric autoanalysis (0.4/0.45 μm pore filtered)
Micromoles/litre

TCO2CAD2 Total dissolved inorganic carbon (TCO2)
Quantification of acid-liberated CO2 using a CO2 analyser
Micromoles/litre

UREAAAD2 Dissolved urea
Colorometric autoanalysis (0.4/0.45 μm pore filtered)
Micromoles/litre

Originator Code Definitions

Pelagia cruises PLG109, PLG121 and PLG138

11 Dr. Wim Helder NIOZ, Texel, the Netherlands

Originator Protocols

Dr. Wim Helder

Sediments were obtained by multicoring. See the section on Multicoring Protocols for details of the coring procedure and sample handling. The sediment was extruded from four multicores by a hydraulically operated core slicer, and samples from identical depth intervals were pooled and homogenised. The pore water was separated from the sediment matrix by centrifugation at 3000 rpm for 10 minutes, and subsequent filtration over 0.2 µm filters. Solutes were analysed, usually within 24 hours of sampling, using TRAACS 800+ autoanalysers.

Nutrients were analysed using the following methods:

Ammonium:	Phenol method
Phosphate:	Ammonium molybdate / ascorbic acid method
Nitrate / nitrite:	Sulphanylamide / naphthylethylenediamine method using a Cu/Cd coil (efficiency >98%) for reduction
Silicate:	Ammonium molybdate / ascorbic acid method

Samples were analysed from the surface to the bottom, to minimise the risk of cross-sample contamination.

Working standards were freshly prepared daily by diluting stock standards to the required concentration with natural, aged, low-nutrient seawater. The nutrient concentrations in this were determined by manual colorimetric analysis. The low-nutrient seawater was also used as a wash between samples. A second mixed nutrient stock, poisoned with 0.2% chloroform or 20 mg/l $HGCl_2$, was used as an independent check. Pipettes and volumetric flasks were calibrated before each cruise and standard batches were intercalibrated.

Accuracy of analyses is reported as about 1% of the full-scale value for nitrate, nitrite, and silicate and 2% of the full scale for phosphate and ammonium.

Divalent iron and manganese were determined colorimetrically. Iron was coloured with Ferrospectral and measured at 550 nm, following the protocol of Stookey (1970). Manganese was coloured by the Formaldoxime reaction and measured at 480 nm, following the method of Brewer and Spencer, 1971.

Sediment Erosion Resistance

Parameter Code Definitions

BESTCRXX Critical bottom erosion stress
Flume observations on sediment sample
Newtons per square metre

BSHVCRXX Critical bottom shear velocity
Flume observations on sediment sample
cm/sec

Originator Code Definitions

Pelagia cruise PLG109, PLG121 and Meteor M43_2.

96 Dr. Laurenz Thomsen GEOMAR, Kiel, Germany

Originator Protocols

Dr. Laurenz Thomsen

Sediment samples were collected using the NIOZ box corer. For the determination of the critical erosion stress, sub-cores of 20 cm diameter were taken and stored under *in-situ* temperatures. Critical erosion stress was obtained on board in an erosion chamber with controlled bottom stress, into which the 20-cm sub-core and *in-situ* seawater, of 10cm height, were inserted. The spatially homogeneous bottom stress was increased from a minimum value of τ = 0.01 N m^{-2} in increments of 0.001 N m^{-2}. Each step of constant stress exposure was maintained for a minimum of 10 minutes. The onset of sediment erosion for the disaggregated fine sediment fraction (<100 μm diameter) was determined by a NTU turbidity meter. Turbidity data were collected every 10 minutes, and water samples were taken for size analyses after sediment erosion had started (see section on Sediment Grain Size). The onset of sediment erosion for the aggregated fraction (>100 μm diameter, defined as 100^{+} aggregates) was determined by a particle camera with 20-fold magnification, focused on the water layers immediately above the sediment.

Sediment Redox Potential

Parameter Code Definitions

RPOTPRTX Redox potential
Redox electrode
Millivolts

Originator Code Definitions

Meteor cruise M43_2

185 João Curdia Universidade do Algarve

Originator Protocols

João Curdia

Sediments were sampled using a box corer. A reading of redox potential was taken from the core at a depth of 4cm using a hand-held electrode. The core was then sub-sampled into circular core. Redox potential profiles were then taken by placing the electode at the mid-point of five sections in the sediment profile. The electrode was held for two minutes before each reading was taken.

Box Coring Protocols

RV Pelagia cruises

The box corer consisted of a cylindrical (30 or 50 cm diameter) box equipped with a hydraulically dampened closing lid constructed in the NIOZ workshops. The entry speed of the corer may be adjusted based on the character of the sediment to be cored. Sub-samples of the core were taken by insertion of Plexiglas liners of various diameters after siphoning off the overlying water. All sub-core procedures were performed in a constant temperature laboratory maintained at sea floor temperature.

RRS Charles Darwin Cruises

The box cores were obtained using an IOS box corer (Peters et al. (1980)), which takes 50x50 cm square cores up to 0.5m in length. Sub-cores of various diameters were taken using plastic tubes and sectioned using a scheme appropriate to length of profile expected.

FS Meteor Cruise

The box cores were taken using the GEOMAR 'Giant Box Corer' (GKG) that takes 0.25 m^2 cores. The corer seal is good and samples of overlying water were usually preserved. Sub-cores were taken using plastic tubes, with the residue being sieved (0.5 mm) for macrofauna abundance determinations.

Kasten Coring Protocols

CD105A

The Kasten Corer (owned by Cambridge University) used was built to the specifications of Kuehl et al. (1985). The barrel (3m long and 15 cm square) had one removable side, which acted as a lid, and a mechanism to allow the core to be extruded sideways and sub-sampled into slabs of any desired size.

A sliding weight provided extra stability to keep the barrel vertical during penetration. During recovery, a perforated plate was fitted into the barrel and pressed onto the core surface with a rod before the barrel was brought on board to prevent slumping. This tended to destroy the integrity of the top 2cm of the core, but produced a better result than a slumped core.

The corer successfully produced cores up to 3.6m long. The large size of the core (15 cm square) provided adequate material for sub-samples to be provided for several research groups.

The core was sub-sampled by pressing square section PVC conduit (1m long and 6cm square) into the opened surface of the core. Samples (approximately 10 cubic centimetres volume) were taken, using a syringe, from the 4cm spaces between the conduit and stored in airtight containers for water content analysis.

The core was then raised by 6 cm and the conduit was detached from the core using a cheese wire. The samples were then closed, sealed and stored in wooden trays.

A layer of moulded styrene trays (33 cm by 15 cm and 2.5 cm deep) was then pressed into the core surface, the core raised again and the trays detached using the cheese wire. Bulk magnetic susceptibility measurements were made on the core. Following this, the trays were sealed in plastic at 2 °C. Further slicing (to 1cm) was carried out on the sub-sampled slabs back in the laboratory where necessary.

CD110A

The Kasten Corer used for sampling belonged to Research Vessel Services from Southampton Oceanography Centre. Only one core was successfully obtained. On board, it was described and then subsampled. The core was cut in the middle into two equal parts; one half was stored at 5 °C until X-ray analysis of internal structures was carried out, and the other was sub-sampled for chemical and granulometric analysis.

Multicoring Protocols

PLG cruises

The NIOZ multicorer used on Pelagia cruises was specially designed for gentle penetration of the sediment, and to obtain undisturbed core samples of the sediment surface. It is made of twelve tubes (four of 90 mm diameter and eight of 65 mm). The caps on top of the tubes close when the core starts to penetrate the sediment, and those on the bottom close when the corer is lifted from the sediment. When the corer is on the bottom, penetration takes approximately one minute. Because of this, multicoring could only be carried out in good weather.

CD110A

The multicorer used for sampling belonged to Research Vessel Services, Southampton Oceanography Centre. Four cores were sampled from each deployment of the multicore. One core was immediately sectioned into 1cm slices and frozen for amino-acid studies, and the others were stored in the cold room at 5 °C.

References

Andrews, D. and Bennett, A., 1981. Measurements of diffusivity near the sediment-water interface with a fine-scale resistivity probe. ***Geochim. Cosmochim. Acta*** 45, 2169-2175.

Brewer, P.G. and Spencer, D.W., 1971. ***Limnol. Oceanogr***., 16, 107-110.

Etcheber, H., 1981. Comparison des diverses méthodes d'evaluation des teneurs en matières en suspension et en carbone organique particulaire des eaux marines du plateau continental aquitan. ***Journ. Rech. Oceanogr., Paris*** VI, 2:37-42.

Kuehl, S.A., Nittrouer, C.A., DeMaster, D.J. and Curtin, T.B. 1985. A long, square-barrel gravity corer for sedimentological and geochemical investigations of fine-grained sediments. ***Marine Geology*** 62, 365-370.

Lindroth, P. and Mopper, K., 1979. High Performance Liquid Chromatographic determination of subpicomole amounts of amino acids by precolumn fluorescence derivatization with *o*-Phtaldialdehyde. ***Anal. Chem,*** 51(11), 1667-1674.

Lindsay, S., 1992. HPLC. ***John Wiley & Sons***, 337pp.

Manighetti, B., 1993. The Glacial to Holocene Sedimentary Regime in the Northeast Atlantic Ocean. ***PhD thesis, University of Cambridge***.

Nieuwenhuize, J., Maas, Y.E.M. and Middelburg, J.J., 1994. Rapid analysis of organic carbon and nitrogen in particulate materials. ***Marine Chemistry***, 45, 217-224.

Peters, R.D., Timmins, N.T., Calvert, S.E. and Morris, R.J., 1980. The IOS box corer: its design, development, operation and sampling. ***Inst. of Oceanogr. Sci., Wormley, England Report*** 106, 7pp.

Reyss, J.-L., Schmidt, S., Legeleux, F. and Bonté, P. 1995. Large, low-background well-type detectors for measurements of environmental radioactivity. ***Nuclear Instruments and methods in physical research A***, 357, 391-397.

Schrader, H.J., 1973. Proposal for a standardised method of cleaning diatom-bearing deep sea and land exposed marine sediments. ***Nova Hedwigia, Beihefte***, 45, 403-409.

Schrader, H.J. and Gersonde, R., 1978. Diatoms and silicoflagellates. ***Utrecht Micro-palaeontological Bulletins***, 17, 129-176.

Stookey, L.L.,1970. ***Analyt. Chem.***, 42, 779-781.

Strickland, J.D.H., Parsons, T.R. 1972. A practical handbook of seawater analysis. ***Fish. Res. Bd. Can***.,167-311.

Tahey, T.M., Duinveld, G.C.A., Berghuis, E.M. and Helder, W., 1994. Relation between sediment-water fluxes of oxygen and silicate and faunal abundance at continental shelf, slope and deep water stations in the North west Mediterranean. ***Marine Ecology Progress Series***, 104, 119-130.

Thomsen, L. and Ritzrau, W., 1996. Aggregate studies in the benthic boundary layer at a continental margin. ***Jour. Sed. Res.***, 36, 143-146.

Verardo, D.J., Froelich, P.N., McIntyre, A. 1990. Determination of organic-carbon and nitrogen in marine-sediments using the Carlo-Erba-NA-1500 Analyzer. ***Deep-Sea Research***, 37(1), 157-165.