Kasten Core Data Set

Introduction

This document covers the data obtained from a series of Kasten cores collected during Discovery 184. The data are held in a number of files.

File KASISO contains oxygen and carbon isotope data obtained from foramanifera tests.

File KASGEN contains dating, correlation, sedimentation rate, density, water content and magnetic susceptibility data.

File KASCHEM contains carbon and nitrogen chemistry data.

File KASSED contains a range of sediment grain size parameters.

Files KBFHEAD and KBFDAT contain species counts of benthic foraminifera.

Sampling

The Kasten Corer 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 subsampled 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 2.6m long, providing a sedimentary record from the present day back to the late Pleistocene. The large size of the core (15 cm square) provided adequate material for subsamples to be provided for several research groups.

The core was subsampled 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 plastic trays (33 cm by 15 cm and 2 cm deep) was then pressed into the core surface, the core raised again and the trays detached using the cheese wire. These were X-rayed on board (images included on the CD-ROM) and later used for bulk magnetic susceptibility determinations. Following this, the trays were frozen and stored. A further set of conduit subsamples was then taken.

The conduit samples were used for isotopic measurements and various size-fractionated determinations. The syringe samples were used to determine water content, dry bulk density and total and inorganic carbon.
Water Content and Dry Bulk Density

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/cm³, a salinity of 35 g/kg and a water density of 1.025 g/cm³ to calculate the salt-corrected particle weight (from dry mud weight) and the total sample volume. Detailed equations are given in Manighetti (1993).

Samples were taken at a 4cm spacing along the core. The 2cm resolution data set present on the CD-ROM was obtained by interpolation between measurements.

Carbon Dating by Accelerator Mass Spectrometry

Carbon dates were obtained on one of the BOFS cores (5K). Dates for other cores have been obtained by correlation techniques. The samples were dated using accelerator mass spectrometry (AMS) in which the \(^{14}\text{C}/^{12}\text{C}\) ratio in the sample was measured directly.

The dates were obtained from the tests of three species of planktonic foraminifera (G. bulloides, G. inflata in the Holocene sections and N. pachyderma (L) in the glacial). Over 1000 specimens were picked from each sample and sent to Gif-sur-Yvette for AMS analysis. The raw AMS ages are presented on the CD-ROM as the age models to be used for calibration are currently the subject of debate.

Oxygen and Carbon Isotope Determinations

Oxygen and carbon isotopes were determined on foraminifera tests taken from the conduit samples. The samples were disaggregated into distilled water, and washed through 150µm or 63µm 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.
Magnetic Susceptibility Determinations

Bulk magnetic susceptibility measurements were made on board ship using a Bartington Instruments MS2 meter with a probe-type detector. The measurements were made on the core slabs taken for X-Ray. 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.

Conduit samples were wet sieved to obtain coarse (63µm-1mm) and fine (<63µm) fractions. The magnetic susceptibility of the dried sediment fractions was determined using a Bartington MS2B sensor with an internal diameter of 36mm. The upper limit of the coarse fraction was restricted to 1mm to eliminate the influence of occasional large, ice-rafted pebbles.

Each sample was measured twice, with a blank container introduced between every sample to correct for drift. The various weight-compensated parameters presented on the CD-ROM were derived by dividing the averaged corrected magnetic susceptibility value by the appropriate fraction weight.

Carbon and Nitrogen Determinations

The method used 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 BOFS samples. Overestimation of total or residual nitrogen is a possibility in some samples due to the early effects of poor reduction (due to reduction reactor chemicals starting to run out) going undetected.

Carbon and nitrogen for the whole sample were determined on the syringed samples which were also used for water content and dry bulk density determinations. Conduit samples were wet sieved through a 63µm sieve to obtain coarse and fine fractions. The latter was analysed for carbon and nitrogen.

Particle Size Analysis

The conduit samples were subdivided into gross coarse and fine fractions by wet sieving at 63µm. The quantity of material in each fraction was determined by drying and weighing. The size distributions within the <63µm fraction were determined using a Micrometrics SediGraph particle size analyser.

Samples were processed by mixing approximately 1g of dry sediment with up to 60ml of sodium hexametaphosphate (calgon). Disaggregation was achieved by placing the samples on an agitating wheel for 24 hours and in an ultrasonic bath for 1-2 minutes immediately prior to analysis.

The size distribution of the non-carbonate fraction was determined by first acidifying the samples with 1M acetic acid and allowing to settle, before siphoning off the excess liquid. Further additions of acid were employed if required to ensure total destruction of the carbonate. To obtain the 1g of material required for SediGraph analysis, up to 5g of high carbonate sediment had to be treated.

Following acidification, the samples were washed several times in distilled water which was siphoned off after settling before the residue was mixed with calgon and agitated as above. Care was taken to ensure that errors did not result from deterioration of the SediGraph window or from variation in the sample suspended matter concentration.
Benthic Foraminifera Species Counts

The samples for the benthic foraminifera were slices 1cm thick separated by a 1 cm gap. The samples were disaggregated by soaking and gentle shaking in distilled water overnight. This was followed by washing through 63 micron sieves.

The coarse fraction was dried in an oven at 60°C and weighed. A single strewing in a picking tray was used to estimate the abundance (number per gram) of benthic foraminifera. From rarefaction curves (number of species against number of specimens), it was determined that at least 200 specimens needed to be picked to obtain a reasonable estimate of the species richness.

The samples were split, using a microsplitter, to obtain a split such that at least 200 specimens would be expected. All benthic foraminifera were picked from this split. If the number picked proved to be less than 200, an additional split was made and counted. This was repeated until a count of 200 had been exceeded or until the whole sample had been picked. For the vast majority of samples the target was achieved.

These data are discussed by Thomas et al (1994).

References


Thomas, E., Booth, L., Maslin, M. and Shackleton, N.J. (1994). Northeastern Atlantic benthic foraminifera during the last 40,000 years. Accepted for publication in Paleoceanography.