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Marine Geological Data Collected During Southern Surveyor Voyage 01/00: Eastern Bass Strait and Great Australian Bight

AGSO Research Cruise No. 224

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~ GEOSCIENCE AUSTRALIA ~

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Executive Summary

A cruise of the RV Southern Surveyor was undertaken during 4 April – 21 May 2000 by the CSIRO Division of Marine Research with AGSO Petroleum and Marine Division leading the geoscience component. The expedition was financially supported by the National Oceans Office in Hobart. AGSO provided scientific support for the field work together with post-cruise data analyses. This report contains a description of the geological data collected on the voyage with some preliminary interpretations and supplements the overall cruise report by Klosser et al. (2000).

A total of 128 sediment samples were collected, comprised of 108 Smith McIntyre Grabs, 10 Box Cores, 8 Gravity Cores and 3 Dredge samples. For each sample the surficial 0-2 cm was analysed in the laboratory for grain size (percent gravel, sand and mud), total organic carbon content and calcium carbonate content. Dried sand and gravel fractions were examined under the microscope and their composition and fossil content was estimated. Mini-cores taken from the Box core samples and the upper section of the gravity core samples were passed through gamma-ray (bulk density), P-wave velocity and magnetic susceptibility meters to generate down-core profiles of these variables.

In the eastern Bass Strait (Disaster Bay to Big Horseshoe) area, grain size data for the shelf sediments indicate a mean gravel content of 10%, mean sand content of over 80% and mean mud content of about 8%. Mean TOC content was 0.30% and the carbonate content has a mean of 54%, derived mainly from molluscs, bryozoans and benthic foraminifers. Microscope examination suggests that whereas up to 30% of the foraminiferal taxa from the shelf samples are relict, no relict foraminifera are found in the deeper water (>250m), continental slope samples.

Two box core samples (14 and 17) comprised an upper layer of massively bedded, gravely muddy-sand overlying a coarser, shelly muddy sand. This layered sedimentary structure is represented in the magnetic susceptibility log by an increase from around 0 to over 10 cgs at a depth of around 8 to 10 cm down-core. The generally low magnetic susceptibility values are attributed to the non-ferrous, quartzose and calcareous nature of the sediments. The basal shelly unit also exhibits a higher bulk density (1.75 g/cc) and higher P-wave velocity (1575 m/s) than the overlying unit.

In the Great Australian Bight Marine Protected Area, gravity cores collected in a down-slope transect from 480 m to 5250 m water depth comprised mainly fine-grained hemipelagic, calcareous foram nanno-fossil ooze. Little change was detected in the P-wave velocity or bulk density measurements down-slope. The magnetic susceptibility curves for cores GC3, GC4, GC5 and GC8 exhibit significant down-core variability related to variations in sediment composition. These cores may contain palaeo-environmental records associated with changes in the rate of terrigenous sediment (aeolian dust?) influx to the core sites during Quaternary climatic variations. At abyssal depths, the Quaternary cores were unconformably underlain by Late Cretaceous detrital mudstones.

1. INTRODUCTION

A cruise of the RV Southern Surveyor was undertaken during 4 April – 21 May 2000 by the CSIRO Division of Marine Research and AGSO Petroleum and Marine Division. This report has been prepared as an output of the agreement between CSIRO Marine Research and the National Ocean's Office relating to Project OP2000-SE02. AGSO provided marine geological leadership for the project and scientific support for the field work together with post-cruise data analyses. This report contains a description of the geological data collected on the voyage with some preliminary interpretations. For details of the swath bathymetry and biological sampling work conducted by CSIRO, the reader is referred to the Southern Surveyor 01/00 cruise report by Kloser and shipboard party (2000).

The overall aims of the project were to examine in detail the benthos of a number of small critical areas on the slope and upper shelf, in eastern Bass Strait and in the Great Australian Bight Benthic Protected Area. These areas were surveyed during the cruise with a Simrad EM1002 high-resolution swath-mapping system capable of working in water depths up to 600 m. The bathymetric mapping work was followed by seafloor photography, video surveys, and bottom sampling. One objective was to compare the high resolution swath backscatter character with that recorded by the *L'Atalante's* much broader Simrad EM12D system in a few areas. A more general objective was to examine and evaluate the usefulness of the backscatter from the Simrad EM1002 in characterising benthic habitats over each of the areas surveyed.

The Voyage was divided into three legs, as follows:

Leg 1: Hobart-Eden, 4 -14 April
- 'Darcy's patch' off eastern Tasmania (mapped on Austrea 2)
- The 'Little Horseshoe': northern end of Gippsland canyon mapped on Austrea 1
- Disaster Bay/Howe Reef area, south of Eden

Leg 2: Eden-Hobart, 15 April - 2 May
- Eastern Bass Strait
- Southeastern Tasmania (East Tasmania Saddle)

Leg 3: Hobart-Fremantle, 3 May – 21 May
- Otway Shelf
- Lacepede Shelf, east of Kangaroo Island
- Great Australian Bight Marine Park

AGSO and University of Melbourne marine geologists were involved in this cruise primarily to study the sedimentology of the benthic samples to better understand relationships between sediment facies, acoustic backscatter and benthic habitats. It was also envisaged that some micropalaeontology research would enhance our knowledge of the sedimentary history of the swath-mapped, deeper part of the GAB Benthic Protected Area, using grab samples and cores

2. METHODS

The geological sampling equipment deployed on the voyage included a Smith-McIntyre grab, gravity corer, light box corer, and a heavy rock dredge. At sea, cores and grab samples were collected using previously agreed protocols, as set down in Appendix A. Maps with the locations of seabed sediment samples collected on the voyage are given in Figure 1.

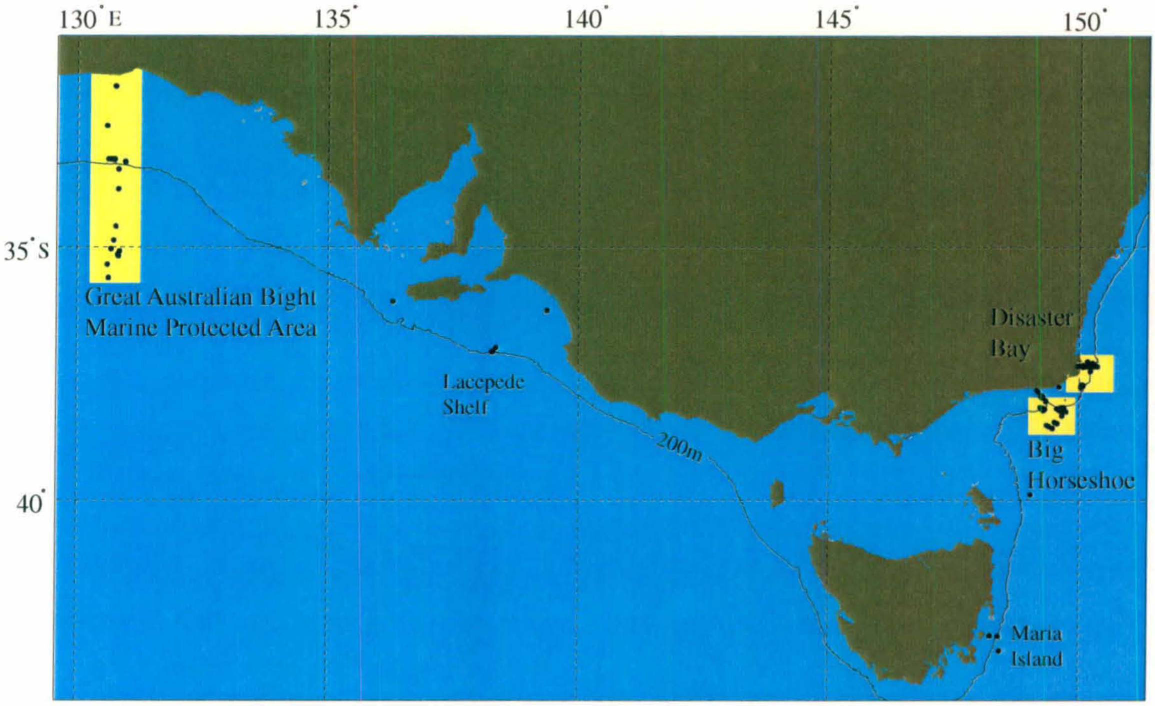

Figure 1. Seafloor sample locations of the present study, southeastern Australia.

After the cruise, work carried out on mini-cores and gravity cores post-cruise included non-destructive multi-sensor logging as well as conventional visual descriptions, photography and sub-sampling of the cores for later analyses in the laboratory. Photographs of 20 cm core sections were taken using a digital camera. Images were stored on disc as JPEG files for later reference. Subsamples were taken at 5 to 10cm intervals for most cores. Details of core lithology and sampling are shown on the core log sheets in Appendix B.

Surface grab and core sub-samples were analysed for grain size (percentage gravel, sand and mud), carbonate content and total organic carbon content. Under the microscope, samples were assessed for their colour, bioclast types and fossil content. Details of the analyses carried out are outlined in the following sections.

2.1 Grain Size Analysis

Wet sieving was carried out using nested 2mm and 63µm analytical sieves. Approximately 50g of sediment is placed in the top sieve and gently washed through with distilled water. Once all of the particles on the top sieve are larger than 2mm (i.e. particles will not pass through the mesh easily), this top sieve is removed and the process is repeated for the 63µm sieve. Material retained in the 2mm sieve is *gravel*, that in the 63µm sieve is *sand* and that collected in the beaker is *mud*. The sand and gravel fractions are washed into beakers, oven dried and weighed by analytical balance (to ±0.0001g). The beaker containing the mud fraction is spun in a centrifuge at 4000 rpm, and the water decanted. The mud is washed into a small beaker, oven dried at <50°C and weighed as above. The percentage of gravel sand and mud is reported as percentage dry weight.

2.2 Carbonate Analysis

Calcium carbonate content was determined by the vacuum-gasometric technique, using a device constructed at the Antarctic CRC according to the plan of Jones and Kaiteris (1983). The method was as follows: Place approximately 1 cm^3 of sediment in an appropriately labelled jar or beaker and dry in oven overnight at < 50°C. Weigh the dried sample using a weighing pan and record the weight. Transfer the sample into a mortar and grind it up with a pestle until it is well broken down. After re-weighing, transfer the sample into an appropriately labelled vial. Before beginning the next sample wipe the mortar and pestle, paper and weighing pan with a dry tissue and flick the brush to remove any remaining sample and therefore prevent contamination.

Weigh 300-700mg of crushed sample and place it in the reaction chamber, add concentrated Orthophosphoric acid to the side arm. Secure the reaction chamber with an o-ring and its reaction cap (WITH STOPCOCK OPEN) and screw clip, screw the clip firmly (to make the assembly pressure tight). Quick-connect the reaction chamber to the pressure measurement manifold and evacuate to –70kPa(exactly); record the pressure. CLOSE STOPCOCK, and ensure the stopcock o-ring is flattened. Disconnect the reaction chamber set-up and tip the acid from the side arm. Place all reaction tubes in the water bath. Continue reaction for 1 and one quarter hours, agitating every 20 minutes. Measure and record the temperature at the end of the reaction time. WITH STOPCOCK STILL CLOSED, quick-connect the reaction vessel to the pressure manifold. Re-evacuate the manifold to –70kPa. Isolate the manifold form the vacuum pump. Slowly open the stopcock on the reaction vessel and record the pressure on the gauge, taking care to read the minor and major increments correctly.

Put the reaction vessel caps (covered with foil), the O-rings and U clips away. The washing up phase consists of rinsing the reaction tubes with hot water and a brush. Ensure that the tube and the side arm are clean of debris. Soak in diluted Decon for 10^+ min. rinsing thoroughly in hot water. Rinse in distilled water and dry in an oven (in a rack) at 60°C or 100°C. When drying at the lower temperature, you can rinse the inside of the tube in Methanol, in order to hasten the drying.

$$\%\ \text{carbonate in the sample} = \frac{\text{weight of carbonate detected}}{\text{total sample weight}}$$

To determine the weight of carbonate detected, a linear regression of a calibration data set is used for the weight of carbonate versus the measured pressure, corrected for volume and temperature. The volume correction is associated with the normalisation of volumes between the reaction bombs (determined experimentally) and the temperature correction is a normalisation to a standard temperature of 25°C. The final calculation is thus:

$$\%\ \text{carbonate in sample} = \frac{(CO_2\ \text{pressure})\text{x}(\text{Vol. corr})\text{x}(\text{Temp corr}) - \text{intercept}}{\text{slope x sample weight}}$$

2.3 Microscope Descriptions of Sand and Gravel Fractions

The sediment sample was digitally photographed in colour immediately after removal from cold storage, and then appraised for any anisotropy of fabric that may have been either inherent in the sediment, or developed in transit to the laboratory. Any large biota were noted. The average sediment colour was recorded against the Munsell Soil Chart. The sample was bisected, normal to any observed textural variation. On the basis of particle size range, the sample weight necessary for a representative sample was determined. In this study, sample weights were standardised at 50 grams.

A representative thin sliver of sediment of approximately 20 grams was taken from across this central cut. This smaller sample was designated for bulk analyses such as chemical, mineralogical, TOC, TIC and Total $CaCO_3$. Salts were removed from the sediment by repeated washing in distilled water, allowing the sediment to settle, decanting the supernatant, and repeating the procedure several times before drying at 40°C, crushing and powdering.

Two subsamples of approximately 50 grams were cut as representative segments from the mirror faces of the remaining sediment.

a) Sample for description.

The first subsample was treated with dilute peroxide and allowed to stand overnight to bleach organics and to assist disaggregation of the material. The sediment was then wet sieved using water sprays so as not to damage delicate bioclasts, and the gravel and sand fractions separated.

b) Sample for analysis of size fractions

The second subsample was wet sieved directly as above but without the peroxide bleaching treatment. The mud, sand, and gravel fractions were then dried, crushed and powdered. These samples are designated for future $CaCO_3$ or XRD analyses etc. of the individual size fractions (see analytical procedures, above).

Any remaining sample was reduced to about 200grams, repackaged and returned to cold store as an archive sample.

2.3.1 Colour

The colour of the size fraction was determined by direct comparison with colour charts (Munsell, 2000). Where the colour was strongly variegated, the extreme hues were recorded. Where there was lesser colour variation, the average hue was determined on the blurred image when the sample was moved to and fro. For rock samples such as in the dredged material, the GSA rock-color chart (Geological Society of America, 1963) was used.

2.3.2 Microscopic Examination

A Leitz MZ12 stereozoom microscope was used with a side-mounted Olympus DP11 digital camera. Representative views of the sediment were photographed at the lowest magnification possible where individual particles remained identifiable. Unusual bioclastic components were also photographed.

The abundance of the various bioclast types were estimated visually as weight percent. Such an appraisal is extremely difficult because of the variable size, shape and density of particles and consequently high error margins are to be expected. The abundance of major components was most difficult to estimate, especially when more than two dominant types were present in the sample.

Estimation errors exceeding 100% are probable. There was a tendency towards overestimation of minor components. However, because only one observer was involved, it is felt that estimation biases are consistent throughout this study.

2.3.3 Recording observations

An attempt was made to document mollusc types where identifiable, using the list of genera documented by Jones & Davies (1983). However as the observations progressed, the diversity of molluscs proved far greater than documented by this previous work, and generic or family identification could not be sustained consistently given the time limitations on the study. Where genera were identified they were recorded, but the inconsistent nature of documentation may prove to be misguiding.

For bryozoa, the main zoarial types were noted, following the descriptive terminology defined by Wass *et al.*(1970). Specific features of preservation are recorded in an abbreviated notation that follows an abbreviation key included in the sample data sheet (Table 1).

2.3.4 Estimation of modern and relict components of sediment

Preservation of the skeletal components gives an indication of the their comparative age, especially where there is variation within the one bioclast type. An expected order of change with time might include disarticulation of the skeleton, and devitrification of the surface of the bioclast. The probability of inorganic staining increases with time as does the precipitation of glauconite internally within tests under some conditions. Fragmentation, microboring and encrustation should also increases with time. Clearly, all features of bioclast preservation need to be considered collectively as each type of bioclast is prone to degradation at different rates. The cumulative alteration of a bioclast is profoundly dependent on the mechanical abrasive energy in the ecosystem, and the influence of encrusting and microboring biota. An additional complication is that features of ageing may be variably erased by the mechanical abrasion.

Even with these cumulative uncertainties, an attempt is made to categorise bioclasts on the basis of age — modern, intermediate and relict.

Modern components tend to retain vitreous surfaces and the original shell colouration, but may or may not remain articulated. The degree of fragmentation is not generally a consideration because, as well as the period of exposure of the bioclast, both mechanical abrasion and bioerosion in the system can be variable.

Relict bioclasts generally have major modification by mechanical abrasion, alteration to the microstructure, microboring and bioerosion, and/or inorganic staining. The extreme result of these processes may be a nondescript carbonate particle of indeterminate origin that is macroscopically indistinguishable from carbonate intraclasts.

Between these extremes of preservation are many intermediate stages and combinations, where even relative age is difficult to estimate. Consequently only the modern and relict categories are considered to be acceptably indicative.

Previous regional sedimentological studies undertaken in parts of this southern continental shelf highlighted this problem (Davies,1979; Jones & Davies,1983).

Jones & Davies (1983) stated:

> " The distinction between relict and modern sediments is not always easily made, and this too may introduce uncertainties in interpretation. Relict sediments are easily recognisable where they consist of shallow-water organic remains now in deep water, and particularly where the effects of subaerial exposure are evident. But the difference between modern and relict sediments is by no means clear for the fine-grained deposits in central Bass Strait, off southeastern Victoria, and along much of the middle and outer shelf of eastern Tasmania."

2.4 Foraminifera studies

The samples were obtained using a Smith/McIntyre Grab, which yields approximately 0.1m^3 of undisturbed seabed sample. The samples were preserved in ethanol upon collection, and later washed in a water/Rose Bengal solution following the technique outlined in Walton (1952). Rose Bengal stains the protoplasm of living foraminifera, providing valuable information about the live/dead ratios within different assemblages (Murray, 1991). Foraminifers interpreted to have been alive at time of collection showed consistent staining of the protoplasm within their chambers. Foraminifera were interpreted to be relict or fossil forms if they showed evidence of alteration due to diagenesis or weathering. Most relict forms were found to have been ferruginized, with a limonite staining.

2.5 Multi-sensor Core Logger

Mini-cores taken from box-core samples and the top section of gravity cores were sent to Gavin Dunbar at the School of Earth Sciences, James Cook University of North Queensland, for logging using a Geotech Model 36 multi-sensor core logger (MSCL). This device is an automated, non-destructive system for acquisition of physical property data on full and split sediment cores. Sensors on the MSCL log the sediment bulk density and the P-wave velocity. From the combination of these parameters it is possible to obtain the fractional porosity and the acoustic impedance of the sediment, information which is useful for constructing synthetic seismograms. The data acquisition is software controlled, and the data are automatically correlated. Logging is carried out in the horizontal plane to reduce the effects of trapped air or water that can be present on the top of the sediment.

2.5.1 Gamma Ray Log (Bulk Density)

The gamma ray log is used to determine the bulk density, and knowing the grain density, an estimation of porosity may be derived. The Geotech system uses a gamma ray source and a detector, mounted vertically on a sensor stand that aligns them with the centre of the core. A narrow beam of gamma rays (photons) is emitted from a Caesium 137 source with energies principally at 0.662 Mev. These photons pass through the core and are detected on the other side. At this energy level, the primary mechanism for the attenuation of gamma rays is by Compton scattering. The incident photons are scattered by electrons with a partial energy loss. The attenuation, therefore, is directly related to the number of electrons in the gamma ray beam (core thickness and electron density). By measuring the number of unscattered gamma photons that pass through the core unattenuated, the density of core material can be determined. To differentiate between scattered and unscattered photons, the gamma detector system only counts those photons that have the same principal energy of the source. Conversion from counted gamma rays and bulk density is done through an equation with experimental parameters that are measured during calibration using a known density core. In the present case, water and aluminium core standards were used. Fractional porosity (100% water = 1, 100% sediment =0) was calculated assuming mineral density of 2.65 g/cc and water density of 1.024 g/cc.

2.5.2 P-wave log

The Geotech P-Wave logger consists of two, rolling transducers (transmitter and receiver). The active element is a piezoelectric crystal mounted on the central spindle of the rolling transducer, filled with castor-oil encapsulated in a soft epoxy sheath. This configuration provides a good acoustic coupling between the transducers and the core. A 250 kHz P-wave pulse is produced by the transmitter that propagates through the core and is detected by the receiver. The distance travelled is measured as the outside of the core diameter, corrected for core temperature. The calculated p-wave velocity through the sediment, corrected to 20 degrees C.

2.5.3 Magnetic susceptibility

At the AGSO sedimentology laboratory in Canberra, we used a Bartington MS2 10 cm diameter loop sensor, which has a 3 cm horizontal resolution, to log all of the unsplit gravity cores and mini-cores (sub-sampled from the Smith Macintyre Grab). In the laboratory, whole cores were passed through the loop sensor at 2 cm increments and logged onto a computer. The data were corrected for instrument drift and end-of-core effects.

Magnetic susceptibility (k) is a parameter used for stratigraphic correlation between cores and in frequency analyses of temporal series to detect sedimentary cycles. The magnetic susceptibility is a parameter related to the sediment's capability of magnetizing and produced a noise in the inducing fields. Knowing the magnetic susceptibility k (adimensional) and the density, it is possible to determine the mass susceptibility. The mineral could be diamagnetic ($k < 0$) paramagnetic ($k > 0$) or ferrous-magnetic ($k >> 0$). Paramagnetic minerals are iron and nickel. Ferrous-magnetic minerals include the iron oxides (magnetite, hematite, ilmenite, magnetite) hydroxides (limonite, goethite) and sulphides (pyrite).

3. RESULTS & DISCUSSION

The data derived from the laboratory analyses are listed in Table 1 (grain size, carbonate and total organic carbon content) and in Tables 2 and 3 (visual estimates made under the microscope). For convenience, the results will be presented here related to the regions of most intense sampling in the Disaster Bay, Big Horseshoe and the Great Australian Bight Marine Park. This will be followed by the presentation of down-core, bulk-density, P-wave velocity and magnetic susceptibility logging results.

A total of 52 stations were occupied in the Disaster Bay area, ranging in water depth from 30 to 590m, in the Big Horseshoe area 33 samples were collected between 103 and 2009m, and in the GAB Marine Park 26 stations were occupied between 55 and 5250 m water depth. A small number of stations were also occupied in the Maria Island and Lacepede Shelf areas (Fig. 1).

3.1 Disaster Bay Area

3.1.1 Grain Size, TOC and Biogenic Carbonate Content

Grain size data for the Disaster Bay area indicate that gravel content ranges from 0.3 to 100% with a mean value of 10.1% (n = 52), sand ranges from 0 to 99.5% with a mean of 82.8% and mud ranges from 0 to 30% with a mean of 7.1%. TOC content ranges from 0.04 to 1.08% with a mean of 0.30% (n = 46).

The distribution of gravel in the study area (Fig. 2) shows elevated levels in local patches. A similar pattern is seen for sand (Fig 3) and mud content (Fig 4). Jones and Davies (1983) also found that fine sediments (muds and silty sands) occur only in pockets along the east Tasmanian shelf and in the deeper water of the Bass Basin. The rest of the shelf is covered by sand and gravel. Jones and Davies (1983) carried out settling column analyses of the sand fraction; the results indicate that fine sand is distributed along the inner shelf of Victoria and off Tasmania. There is a general trend of coarsening seaward into medium grained sand, with pockets of coarse sand at the shelf edge. Moderate and well sorted sands tend to be confined to the near shore zone. The rest of the shelf is covered by poorly to very poorly sorted sediment. The "reverse grading" (coarsening seawards) trend noted by Jones and Davies (1983) is not obvious in

Table 1. List of stations, grain size, total organic carbon and carbonate data determined.

Sample No:	Water Depth	Latitude	Longitude	%Gravel	%Sand	%Mud	%TOC	$\%CaCO_3$ Mud	$\%CaCO_3$ Sand	%CaC0$_3$ Total
Disaster Bay Area										
SM 09	113	-37.95	149.27	8.427	88.76	2.81	0.2	78.3	57.9	62.0
SM 10	112	-37.94	149.27	9.595	89.08	1.33	0.19	77.4	55.0	59.6
SM 11	112	-37.95	149.27	57.83	41.63	0.54	0.18	76.9	66.9	86.1
SM 12	112	-37.95	149.27	20.21	74.66	5.13	0.2	78.2	64.2	72.2
SM 13	116	-37.96	149.27	3.832	88.37	7.8	0.24	77.1	58.5	61.6
SM 14	116	-37.97	149.27	1.988	88.64	9.38	1.08	78.8	62.4	64.7
SM 19	75	-37.85	149.18	12.77	84.37	2.86	0.17	60.4	20.0	31.3
SM 20	50	-37.82	149.15	4.513	94.78	0.71	0.15	52.0	13.3	17.5
SM 21	137	-37.72	150.07	2.367	92.55	5.08	0.18	70.6	60.4	61.8
SM 22	119	-37.72	150.05	15.1	83.39	1.51	0.15	65.9	60.2	66.3
SM 23	120	-37.72	150.05	8.9	89.09	2	0.17	67.3	61.7	65.2
SM 24	136	-37.72	150.05	100	0	0				
SM 25	136	-37.72	150.05	17.99	80.43	1.59	0.21	67.7	61.2	68.3
SM 26	138	-37.74	150.07	7.902	86.34	5.75	0.25	68.4	61.0	64.5
SM 27	130	-37.35	150.26	11.31	85.14	3.54	0.24	59.6	47.9	54.2
SM 28	108	-37.35	150.18	4.28	94.57	1.15	0.11	51.5	41.9	44.5
SM 29	99	-37.25	150.17	4.632	95.09	0.28	0.12	47.9	44.3	46.9
SM 30	128	-37.45	150.22	3.963	93.79	2.25	0.16	55.0	52.1	54.0
SM 31	112	-37.35	150.21	3.594	93.7	2.71	0.15	54.9	41.8	44.2
SM 32	113	-37.35	150.19	11.93	86.73	1.34	0.18	52.0	44.6	51.3
SM 33	118	-37.31	150.24	7.447	90.93	1.62	0.13	56.1	51.1	54.8
SM 34	124	-37.29	150.27	7.758	91.63	0.62	0.13	55.6	50.5	54.3
SM 35	112	-37.33	150.08	0.9476	82.24	16.82	0.58	45.8	40.0	41.5
SM 36	90	-37.37	150.07	4.925	90.27	4.8	0.3	47.3	31.0	35.2
SM 37	94	-37.35	150.1	6.424	90.31	3.26	0.26	48.0	36.0	40.5

Table 1. continued.

Sample No:	Water Depth	Latitude	Longitude	%Gravel	%Sand	%Mud	%TOC	%CaCO$_3$ Mud	%CaCO$_3$ Sand	%CaC0$_3$ Total
SM 38	87	-37.35	150.07	1.805	82.93	15.27	0.57	46.0	36.8	39.4
SM 39	30	-37.35	149.97	0.509	99.49	0	0.04			
SM 40	55	-37.35	150	14.1	85.9	0	0.08			
SM 41	104	-37.35	150.13	5.644	90.29	4.07	0.17	50.8	41.8	45.5
SM 42	147	-37.35	150.29	10.31	86.88	2.8	0.14	60.5	53.6	58.6
SM 43	250	-37.35	150.33	25.11	63.09	11.8	0.35	67.1	79.4	83.1
SM 44	350	-37.35	150.34	4.029	82.88	13.09	0.38	65.8	71.0	71.5
SM 45B	450	-37.35	150.36	1.008	75.26	23.73	0.68	67.2	70.8	70.2
SM 46	58	-37.35	150.01	5.87	83.08	11.03	0.07	49.0	4.28	14.8
SM 48	590	-37.35	150.36	5.391	65.09	29.52	0.55	71.1	76.4	76.1
SM 48 B	135	-37.73	150.07	4.719	91.66	3.62	0.28	68.3	66.3	68.0
SM 49	136	-37.77	150.03	8.89	88.51	2.6	0.2			
SM 68	115	-37.95	149.24	9.472	83.51	7.02	0.3	76.6	52.9	59.0
SM 69	114	-37.95	149.25	1.701	93.43	4.87	0.3	77.6	51.8	53.9
SM 70	115	-37.94	149.27	3.037	93.45	3.51	0.18	77.6	50.6	53.0
SM 71	115	-37.96	149.28	2.566	89.52	7.91	0.26	79.4	56.6	59.5
Big Horseshoe Area										
SM 01	240	-38.19	149.28	6.08	81.88	12.04	0.31	81.6	82.2	83.2
SM 03	220	-38.23	149.28	1.111	75.92	22.97	0.4	79.6	85.4	84.3
SM 04	270	-38.2	149.3	1.087	75.75	23.16	0.43	80.2	86.6	85.3
SM 05	205	-38.19	149.28	21.9	66.17	11.93	0.34	79.9	81.5	85.3
SM 06	230	-38.19	149.29	8.288	79.01	12.7	0.4	80.4	85.4	86.0
SM 07	165	-38.18	149.26	0.08865	84.45	15.46	0.34	80.9	79.1	79.4
SM 16	124	-38.05	149.34	7.798	91.82	0.38	0.14	78.0	74.2	76.2
SM 17	124.3	-38.05	149.34	7.374	92.15	0.48	0.16	79.1	75.8	77.6
SM 18	122	-38.03	149.34	3.57	91.93	4.5	0.18	79.2	74.2	75.3

Table 1. continued.

Sample No:	Water Depth	Latitude	Longitude	%Gravel	%Sand	%Mud	%TOC	$\%CaCO_3$ Mud	$\%CaCO_3$ Sand	%CaC0$_3$ Total
SM 51	1498	-38.48	149.56	1.166	88.62	10.21	0.32	66.3	84.8	83.1
SM 52	1500	-38.45	149.51	0.002303	57.85	42.15	0.42	73.4	86.0	80.7
SM 53	1977	-38.57	149.47	0.02224	41.1	58.88	0.61	70.7	86.6	77.2
SM 54	1963	-38.51	149.35	0.198	55.12	44.68	0.45	58.9	83.8	72.7
SM 55?	77	-37.76	149.6	1.783	95.62	2.59				
SM 55	2009	-38.54	149.41	0.1983	59.77	40.03	0.58	46.5	12.8	26.5
SM 56	540	-38.25	149.7	12.49	53.67	33.84	0.52	69.9	83.5	81.0
SM 56A	540	-38.25	149.69	1.363	68.56	30.08	0.53	79.4	77.3	78.2
SM 57	540	-38.25	149.69	0.8454	72.52	26.64	0.46	79.4	77.1	77.9
SM 58	259	-38.16	149.7	1.684	78.87	19.44	0.33	80.0	87.1	85.9
SM 59	245	-38.17	149.63	4.795	74.97	20.23	0.39	80.5	86.7	86.1
SM 60	586	-38.25	149.74	0.42	67.69	31.89	0.44	79.9	87.1	84.8
SM61	548	-38.25	149.67	0	72.34	27.66	0.74	79.4	87.5	85.2
SM 62	550	-38.23	149.62	3.498	75.59	20.91	0.4	80.0	65.5	69.7
SM 64	366	-38.21	149.59	1.055	58.98	39.96	0.68	80.6	86.6	84.4
SM 65	377	-38.21	149.68	1.054	60.13	38.82	0.68	81.7	87.3	85.3
SM 66	103	-38.2	149.32	0.9568	71.85	27.19	0.6	79.8	86.4	84.8
SM 67	152	-38.17	149.24	0.65	73.2	26.15	0.51	80.5	84.2	83.4
SM 74	370	-38.19	149.56	7.2	69.13	23.67	0.62	78.6	86.0	85.2
SM 75	980	-38.33	149.66	0.6217	80.18	19.2	0.31	66.3	78.2	76.1
SM 76	1500	-39.89	149.04	0	37.55	62.45	0.47	65.2	82.2	71.6
BC 05	220	-38.23	149.29	6.843	72.61	20.54	0.48	79.5	82.4	83.0
BC 06	165	-38.18	149.26	1.652	80.24	18.11	0.35	82.8	81.5	82.0
BC 07	154	-38.16	149.23	1.375	62.37	36.25	0.55	81.6	84.8	83.9
BC 09	112	-37.94	149.27	24.01	73.73	2.26	0.23	77.7	62.0	71.5
BC 11	137	-37.72	150.07	36.24	63.29	0.46				

Table 1. continued.

Sample No:	Water Depth	Latitude	Longitude	%Gravel	%Sand	%Mud	%TOC	$\%CaCO_3$ Mud	$\%CaCO_3$ Sand	$\%CaCO_3$ Total
BC 14	85	-37.33	150.07	1.775	76.71	21.51	0.7	47.0	43.6	45.3
BC 15	89	-37.33	150.08	2.73	87.89	9.38	0.46	48.0	34.8	37.8
BC 17	87	-37.35	150.07	0.4989	82.5	17	0.62	47.5	39.8	41.4
BC 19	73	-37.35	150.04	2.841	67.04	30.12	0.92	46.1	47.6	48.6
BC 21	58	-37.35	150.01	7.342	82.34	10.32	0.45	48.1	28.4	35.7
Maria Island Area										
SM 77	1500	-42.97	148.44	0.001012	95.55	4.45	0.1	64.8	76.8	76.2
SM 78	97	-42.67	148.25	3.433	77.51	19.06	0.5	64.7	80.1	77.8
SM 79	97	-42.67	148.24	5.741	79.75	14.51	0.51	63.0	81.0	79.5
SM 80	151	-42.68	148.41	23.06	65.93	11.01	0.22	71.3	85.7	87.4
Lacepede Shelf Area										
SM-294	80	-36.98	138.34	13.28	86.7	0.02	0.09	93.5	73.0	76.6
SM-303	40	-36.24	139.35	0.06191	99.94	0	0.05	38.7	20.2	20.3
SM-307	40	-36.24	139.36	0.1271	99.82	0.05	0.06	46.7	26.6	26.7
SM-308	40	-36.25	139.36	25.37	74.52	0.11	0.09	49.4	53.9	65.6
SM-309	40	-36.25	139.36	32.39	67.61	0	0.13		52.6	
SM-311	40	-36.25	139.36	40.3	59.65	0.04	0.09	46.7	50.8	70.6
SM-316	120	-37.06	138.27	10.14	89.2	0.66	0.25	79.5	89.4	90.4
SM-319	120	-37.06	138.28	21.96	77.79	0.25	0.1	76.7	84.3	87.7
SM-320	120	-37.06	138.28	0.6994	98.64	0.66	0.13	83.0	87.2	87.2
SM-321	120	-37.06	138.28	8.002	91.87	0.12	0.11	73.0	88.9	89.7
SM-322	120	-37.06	138.26	55.09	44.27	0.64	0.17	86.0	75.4	89.0
SM-325	0	-36.07	136.29	46.95	52.51	0.55	0.16	81.1	84.6	91.8
GAB Marine Park Area										
SM-340	138	-33.28	130.73	6.019	89.72	4.26	0.1	92.1	84.7	86.0
SM-341	140	-33.27	130.73	8.915	90.01	1.08	0.09	88.0	74.4	76.9

Table 1. continued.

Sample No:	Water Depth	Latitude	Longitude	%Gravel	%Sand	%Mud	%TOC	%$CaCO_3$ Mud	%$CaCO_3$ Sand	%$CaC0_3$ Total
SM-342	136	-33.26	130.74	7.554	88.5	3.94	0.14	89.5	83.0	84.5
SM-344	142	-33.26	130.67	2.437	67.96	29.6	0.23	90.7	92.1	91.9
SM-345	141	-33.26	130.67	5.98	84.23	9.79	0.12	88.4	75.9	78.6
SM-347	144	-33.27	130.63	1.471	84.73	13.8	0.21	89.6	88.9	89.1
SM-348	144	-33.27	130.62	2.994	74.77	22.23	0.26	89.8	90.6	90.7
SM-349	144	-33.26	130.61	2.671	78.18	19.15	0.23	89.3	90.2	90.3
SM-359	0	-33.32	130.95	3.101	86.35	10.54	0.12	90.1	82.5	83.9
SM-360	138	-33.31	130.95	9.34	88.75	1.91	0.13	90.0	82.1	83.9
SM-372	55	-31.83	130.75	0.3655	99.48	0.15	0.08	82.3	76.5	76.6
SM-375	55	-31.84	130.75	2.782	96.88	0.34	0.1	86.4	78.4	79.0
SM-376	55	-31.84	130.75	13.93	85.63	0.43	0.21	83.8	81.4	84.0
SM-377	55	-31.83	130.75	0.3275	99.62	0.05	0.11		77.7	
SM-386	90	-32.61	130.58	10.98	88.97	0.05	0.1		62.5	
SM-388	90	-32.61	130.58	4.987	94.9	0.11	0.1		68.5	
GC1 0-2cm	480	-33.47	130.81	0	33.4	66.6				
GC2 0-2cm	999	-33.85	130.81	0	21.4	78.6				
GC3 0-2cm	1506	-34.58	130.76	0	36.45	63.55				
GC4 0-2cm	2010	-34.86	130.72	0	28.07	71.93				
GC5 0-2cm	2518	-35.03	130.67	0	38	62				
GC6 0-2cm	2666	-35.07	130.84	0	29.31	70.69				
GC7 0-2cm	3278	-35.17	130.82	0	21.42	78.58				
GC8 0-2cm	5250	-35.6	130.62	0	2.657	97.34				
DR 01	3220	-35.13	130.8	0	21.11	78.89	0.17	87.9	90.8	88.5
DR 02	4320	-35.33	130.6	0	6.554	93.45	0.33	79.6	90.9	80.3
DR 03	5248	-35.6	130.62	0	0.2595	99.74	0.29	76.6		

Table 2. Results of microscope analyses of sand and gravel fraction, showing general categories of sediment types.

Sample	Intra-Clasts	Modern	Inter-mediate	Relict	Molluscs	Bryozoa	Benthic	Other CaCO3	Non CaCO3	Terrigenous
Disaster Bay Area										
SM 09	5	19.9	28.7	41.4	51.2	15.3	8.68	14.6	0.0867	10
SM 10	5	22.9	11.4	55.8	42.2	16.8	18.1	12.5	0.451	9.98
SM 11	3.58	30.5	12.4	53.7	58.6	12.1	4.19	21.7	0	3.35
SM 12	0.426	24	30.9	41.1	71.3	14.4	3.93	6.03	0.393	3.93
SM 13	5.62	17.1	21.8	54.5	59.5	10	9.58	13.7	0.479	6.71
SM 14	0	29	12.8	48.4	72.1	4.73	2.93	10	0.489	9.78
SM 16	0.235	25.5	41.8	27.7	53.8	22	9.61	9.54	0	5.07
SM 17	0	26.3	16.7	57	50.9	31.9	8.48	8.81	0	0
SM 18	9.63	15.9	20.6	58.2	43.2	15.5	19.3	16.2	0.481	5.37
SM 19	0	16.7	4.03	8.49	19.1	6.2	1.8	2.09	0	70.8
SM 20	0	8.63	11.4	11.7	18.6	5.14	4.77	3.24	0	68.2
SM 55	2.95	15.2	18.3	9.02	19.2	8.18	5.89	8.26	0.982	57.5
SM 21	0	13.8	17.6	57.6	67.7	10.4	5.85	4.61	0.488	11
SM 22	0	10.2	20.6	43.9	41.6	20	5.93	6.73	0.423	25.3
SM 23	13.6	11.7	10	55.6	35.5	12.7	4.64	24.4	0	22.7
SM 24	0	50	5.5	44.5	47	30	5	8	10	0
SM 25	12.3	9.1	21.4	52.3	30.1	29.5	2.54	20.3	0.409	17.2
SM 26	0	18.6	4.09	52.2	30.8	15.4	4.58	23.7	0.458	25.1
SM 27	0	7.35	12.5	32.5	21.5	6.77	17.7	5.97	0.441	47.7
SM 28	0	8.39	9.82	17.1	20.6	5.3	6.7	2.74	0	64.7
SM 29	0	14.4	12.4	23	30.6	7.46	6.67	4.09	0.954	50.2
SM 30	0	13.8	18.3	45.7	42.8	19.8	6.8	8.04	0.48	22.1
SM 31	0	10.9	23.9	21.9	32.9	3.63	14.6	5.07	0.482	43.4
SM 32	0	8.24	10.6	22	25	6.4	4.4	4.68	0.44	59.1
SM 33	0	12.4	14	43.6	28.6	10	4.7	26.6	0	30.1

Table 2. Continued.

Sample	Intra-Clasts	Modern	Inter-mediate	Relict	Molluscs	Bryozoa	Benthic	Other CaCO3	Non CaCO3	Terrigenous
SM 34	2.77	14.9	24.6	26.9	32	14.3	9.22	10.5	0.461	33.5
SM 35	0	34.2	5.01	0	15.2	2.99	14.3	5.68	0.989	60.8
SM 36	0	16.9	18.6	7.59	19.2	13.4	2.84	7.14	0.578	56.9
SM 37	0	5.92	14.1	46.3	35.9	13.7	6.54	10.2	0	33.7
SM 38	0	40.1	0.17	0	11.9	6.87	6.85	14.2	0.489	59.7
SM 39	0	3	0	0	0.899	0	0.497	1.6	0	97
SM 40	0	3.15	10.7	9.24	13.7	5.42	0.859	3.12	0	76.9
SM 41	0	11.1	16.4	28.8	34	14.4	4.71	3.12	0	43.8
SM 42	17.9	16.6	2.87	53.1	26.3	14.7	7.15	24	0.447	27.4
SM 43	0	44.9	14.5	36.7	27.4	47.8	10.7	9.08	1.07	3.86
SM 44	0	24.5	27	48.2	27.1	32.5	28.6	11	0.477	0.325
SM 45B	0	38.8	40.7	17	40.3	20.7	19.7	15.4	0.493	3.45
SM 46	0	2.73	6.79	2.46	8.85	2.53	0	0.599	0	88
SM 48	0	32.9	37.1	28.2	40.6	24.1	18.5	14.5	0.462	1.85
SM 48 B	0	15	18	59.3	35.3	16.8	9.61	30.6	0.19	7.61
SM 49	7.91	11.4	26.6	56.7	45.6	20.2	9.09	19.4	0.454	5.27
Big Horseshoe Area										
SM 01	0	11.1	15.7	73.1	53.4	24.7	14	6.92	0.931	0.0931
SM 03	0	32.2	8.59	59.2	22	61.7	4.93	10.9	0.493	0
SM 04	0	84.4	3.38	12.3	30.4	30.1	19.7	18.9	0.986	0
SM 05	0	29.6	48.6	21.8	29	27.3	11.3	31.6	0.876	0
SM 06	0	26.8	47.2	26	27.8	32.7	17.8	21.7	0	0
SM 07	5.01	12	51	35	26	19	29	21	3	2
SM 51	0.0389	98.4	0.231	0	0.777	0	2.96	94.6	0.247	1.4
SM 52	0	96	3	0	4	0	3	90	2	1
SM 53	0	99.5	0.532	0	0.532	0	5	94.5	0	0

Table 2. Continued.

Sample	Intra-Clasts	Modern	Inter-mediate	Relict	Molluscs	Bryozoa	Benthic	Other CaCO3	Non CaCO3	Terrigenous
SM 54	0	93.7	6.21	0	2.08	0.0716	4.06	93.7	0	0
SM 55	0	97.7	2.19	0	0.997	0	2.19	95.7	0.997	0.132
SM 56	0	64.5	23	3.21	36.1	8.64	20.3	24.5	1.22	9.31
SM 56A	0	39.5	35.9	14.7	28.1	13.4	14.7	32	1.96	9.9
SM 57	0	20.9	70	9.07	34.4	17.2	9.88	36.6	1.98	0
SM 58	0	27.6	27.1	45.4	24.8	20	17.6	35.6	1.96	0
SM 59	0	38.7	42.7	18.6	35.7	27.8	20.8	15.7	0	0
SM 60	2.98	66.5	15	15.6	28.6	15.1	16.9	31.5	4.97	2.98
SM61	6	53.5	35.5	6	23	6.5	20	42.5	3	5
SM 62	1.91	33.8	41.1	20.2	34.5	22	12.7	24.9	0.956	4.91
SM 64	4.91	65.7	27.4	6.88	34.3	14.5	13.8	33.5	3.93	0
SM 65	0	89.1	0.258	10.7	20.8	0.344	9.83	64.1	4.91	0
SM 66	0	56.4	34.5	9.01	24.6	15.2	14.8	42.4	2.96	0
SM 67	0	9.34	30.1	55.6	23.3	10	19.8	40.8	0.991	4.96
SM 68	8.98	24.2	19.1	47.2	39.4	14.9	13.5	22.2	0.449	9.53
SM 69	0.358	25.8	11.5	40.1	36.3	10	9.82	20.3	0.982	22.6
SM 70	0.378	17.2	19.8	53.4	40.9	18.6	6.78	24.1	0	9.69
SM 71	0	27.3	27.5	35	42.3	14.6	19.4	12.5	0.972	10.2
SM 74	0.283	31.8	25.9	42.3	24.4	38.1	13.6	23	0.906	0
SM 75	4.96	76.9	8.86	9.05	10.3	1.61	6.95	75.7	0.298	5.15
SM 76	0	94	0	0	0	0	1	92.5	0.5	6
BC 05	24.1	15.7	35.3	46.3	16.5	11.7	14.1	54.5	0.457	2.69
BC 06	10	24.3	32.4	41.4	27.3	19.2	20.6	28	2.94	1.96
BC 07	14.7	53.6	13.5	31.8	35.3	5.04	19.6	37.2	1.96	0.978
BC 09	4.25	12.4	25.1	52.5	52.5	16	8.28	12.2	1	10.1
BC 11	8.64	18	13.5	64.4	54.8	15	11.4	12.2	2.46	4.13

Table 2. Continued.

Sample	Intra-Clasts	Modern	Inter-mediate	Relict	Molluscs	Bryozoa	Benthic	Other CaCO3	Non CaCO3	Terrigenous
BC 14	0	67.5	0.226	0	19.5	4.93	0	42.3	0.977	32.3
BC 15	0	33.6	4.85	0	14	5.09	10.7	7.2	1.45	61.6
BC 17	0	41.2	5.01	4.07	17.2	6.05	16.9	8.15	1.99	49.7
BC 19	2.88	42.4	0.0203	0	14.1	4.82	9.59	11	2.88	57.6
BC 21	0	38.3	0.959	5.61	21.8	9.19	4.59	7.39	1.84	55.2
Maria Island Area										
SM 77	0	94	1	0	4	5	2	83.5	0.5	5
SM 78	3.96	38.4	24.6	36.9	25.1	36.1	14.4	21.6	2.87	0
SM 79	4.7	17.7	61.4	20.9	19.2	48.5	13.1	18.8	0.466	0
SM 80	0	49.7	36.3	14	8.7	67.3	11.1	12.1	0.741	0
Lacepede Shelf Area										
SM-294	10.7	17.8	38.1	34.7	36.3	16.4	7.6	30.3	0	9.34
SM-303	0	9.82	3.01	12.5	15	4.03	4	2.3	0	74.7
SM-307	0	9.5	11	12	15	10.1	4.99	2.5	0	67.4
SM-308	0	14	29.9	49.8	40.9	34.4	2.98	15.4	0	6.27
SM-309	0	5.07	14.6	69.2	57.3	14.7	2.03	14.8	0	11.1
SM-311	0	2.4	10.6	67.6	55.1	14.2	1.79	9.56	0	19.4
SM-316	0	45.9	49.6	4.56	25.1	62.3	2.74	9.4	0.449	0
SM-319	4.84	10.1	59.4	28.7	40.9	41.4	2.34	13	0.61	1.76
SM-320	0	34.1	55.9	9.98	31.9	48.2	4.98	14	0.993	0
SM-321	1	28.7	64.2	7.08	18.6	70.8	2.84	6.84	0.92	0
SM-322	7.77	28.1	41.2	25.1	33.4	32.5	11.4	16.7	0.446	5.55
SM-325	7.36	20.8	26.8	50.9	25.7	45.4	7.75	19.1	0.528	1.53
GAB Marine Park Area										
SM-340	16.9	34.8	30.8	34.4	10.6	52	11.4	25.6	0.469	0
SM-341	39.1	14.8	15.7	69.5	16.7	27.3	11.5	44.1	0.455	0

Table 2. Continued.

Sample	Intra-Clasts	Modern	Inter-mediate	Relict	Molluscs	Bryozoa	Benthic	Other CaCO3	Non CaCO3	Terrigenous
SM-342	39.2	14.8	15.7	69.5	16.5	27.2	11.6	44.2	0.461	0
SM-344	0.552	97.6	2.36	0.0692	12.8	41.6	13.6	25.3	6.76	0
SM-345	20.1	33.6	30.8	35.6	16.7	47.7	7.6	28	0	0
SM-347	7.31	69.1	7.75	22.1	23.7	20.3	18.7	31.4	4.91	0.983
SM-348	4.42	65.8	28.3	5.92	7.75	74.4	5.85	10.9	1.04	0
SM-349	7.33	50.1	27.1	22.8	11.6	49.7	11.6	27.2	0	0
SM-359	25.5	23.7	20.1	55.7	30.3	29.4	9.69	30.1	0	0.483
SM-360	49	28.5	6.29	65.2	15.5	17.8	7.43	59.3	0	0
SM-372	49.8	17	10.2	67.8	20.2	5.09	9.96	59.8	0	4.98
SM-375	47.6	19.6	20	57.5	22	15.8	7.78	51.5	0	2.92
SM-376	13.9	32.8	24.1	39.4	44.4	18.7	12.9	19.4	0.86	3.72
SM-377	66.8	16.3	9.97	66.8	11.3	1.01	7.97	71.8	0.997	6.98
SM-386	61.1	16.1	5.03	73	12	5.75	8.9	67.5	0	5.89
SM-388	48.3	15.8	9.62	72.7	15.3	4.9	17.9	60	0	1.9
GC1	0	100	0	0	10	0	5	75	10	0
GC2	0	100	0	0	2	0	2	95	1	0
GC3	0	100	0	0	0	0	2	98	0	0
GC4	0	100	0	0	0	0	2	98	0	0
GC5	0	100	0	0	0	0	2	98	0	0
GC6	0	99	0	0	0	0	1	98	0	1
GC7	0	97	0	0	0	0	0.5	96.5	0	3
GC8	0	93.3	0	0	0	0	1	91.3	1	6.7
DR 01	0	96.8	0.2	0	0	0	0.5	96.5	0	3
DR 02	1	100	0	0	0	0	1	99	0	0
DR 03	0	77.5	0	0.5	0	0	1	76.5	0.5	22

Table 3. Results of microscope analyses of sand and gravel fraction, showing bioclastic fossil groupings.

Sample	Pelec-ypods	Gastro-pods	Bryozoa	Benthic Forams	Plank. Forams	Porif-era	Echin. oids	Brach-iopods	Corals	Serpulids	Arthro-pods	Ostra-cods	Other Bioclasts
Disaster Bay Area													
SM 09	32.6	18.7	15.3	8.68	1.83	0.0867	3.13	1.76	0.173	0	0.913	1.83	0
SM 10	23.1	19.1	16.8	18.1	1.81	0.451	2.9	0.194	0.292	0.0486	0.951	0.903	0.451
SM 11	48.8	9.86	12.1	4.19	0.837	0	1.58	0	0.209	0	0.581	0.419	14.5
SM 12	52.1	19.2	14.4	3.93	1.57	0.393	1.43	0	0.639	0	0.393	1.57	0
SM 13	49.8	9.75	10	9.58	2.88	0.479	3	0	0.0831	0	0.979	0.958	0.208
SM 14	55.9	16.2	4.73	2.93	1.96	0.489	1	0	0.665	0.489	0.5	0.489	4.9
SM 19	8.62	10.5	6.2	1.8	0	0	0.566	0.263	0	0.566	0	0.434	0.263
SM 20	15.4	3.18	5.14	4.77	0	0	0.477	0	0	0.477	0	0.191	2.09
SM 55	10.1	9.11	8.18	5.89	0	0.982	1	0	0	2.02	0.491	0.982	0.824
SM 21	40.1	27.6	10.4	5.85	1.95	0.488	0.562	0	0.612	0.0249	0.975	0.488	0
SM 22	27.4	14.2	20	5.93	2.54	0.423	2.15	0	0.766	0.847	0	0.423	0
SM 23	30	5.45	12.7	4.64	2.27	0	7.73	0	0.0454	0.0908	0.182	0.455	0
SM 24	42	5	30	5	0	10	5	0	0	3	0	0	0
SM 25	20.1	10	29.5	2.54	0	0.409	5.91	0	0.183	1.82	0.0914	0	0
SM 26	26.3	4.5	15.4	4.58	2.75	0.458	2.83	0	0.419	0.916	0.458	0.458	15.8
SM 27	17.6	3.82	6.77	17.7	4.41	0.441	1	0	0.117	0	0	0.441	0
SM 28	14.6	6.04	5.3	6.7	1.91	0	0.0866	0	0.0866	0.0433	0	0.478	0.13
SM 29	24.6	5.95	7.46	6.67	2.86	0.954	0	0	0.0464	0	0	0.954	0.232
SM 30	32.9	9.88	19.8	6.8	0	0.48	2.12	0	0.0405	0	0.959	0.959	3.96
SM 31	18.4	14.5	3.63	14.6	1.93	0.482	2.04	0	0	0.482	0.0739	0.482	0.0739
SM 32	17.6	7.36	6.4	4.4	0.879	0.44	1.76	0	0.121	0	0.879	0.44	0.605
SM 33	18.6	10	10	4.7	2.77	0	3	0.454	0.336	0.151	0.924	0.277	18.6
SM 34	17.4	14.6	14.3	9.22	2.77	0.461	1.84	0.156	1.92	0	0.156	0.922	0
SM 35	10.3	4.94	2.99	14.3	1.98	0.989	0.989	0	0	0.0228	0	1.98	0.718
SM 36	12	7.16	13.4	2.84	0.474	0.578	0.948	0	0.0259	1.05	1.92	0.474	2.24
SM 37	21.9	14	13.7	6.54	1.87	0	0.666	0.483	0.0332	1	1.13	0	4.98
SM 38	7.04	4.89	6.87	6.85	3.91	0.489	0.979	0	0	0.489	0.489	1.47	6.81
SM 39	0.863	0.0356	0	0.497	0	0	0.995	0.356	0	0	0	0.249	0
SM 40	8.28	5.42	5.42	0.859	0	0	0.853	0.705	0	0.859	0	0	0.705
SM 41	23.9	10.1	14.4	4.71	0	0	1.06	0	0.177	0	0.529	0.471	0.883

Table 3. continued.

Sample	Pelecypods	Gastropods	Bryozoa	Benthic Forams	Plank. Forams	Porifera	Echinoids	Brachiopods	Corals	Serpulids	Arthropods	Ostracods	Other Bioclasts
SM 42	17.3	9.04	14.7	7.15	0.894	0.447	0.947	0.106	0.447	1.79	0.5	0.447	0.947
SM 43	19.1	8.29	47.8	10.7	0.715	1.07	0	0	0.285	4.15	1.43	1.07	1.43
SM 44	15.2	11.9	32.5	28.6	1.91	0.477	1.91	0.954	0	1.91	0.477	1.91	1.93
SM 45B	20.4	19.9	20.7	19.7	4.93	0.493	2.04	0	0	1.97	1.97	1.48	2.96
SM 46	5.99	2.86	2.53	0	0	0	0.467	0	0	0	0.066	0	0.066
SM 48	20.6	20	24.1	18.5	4.62	0.462	1.85	0	0	4.69	1	1.39	0.924
SM 48 B	19.8	15.5	16.8	9.61	1.9	0.19	1.05	0.294	0	1.9	0.951	0.19	24.3
SM 49	25.9	19.7	20.2	9.09	0	0.454	4.55	0.909	0.274	3.18	1.82	0.454	0.274
Big Horseshoe Area													
SM 01	14.7	38.8	24.7	14	4.65	0.931	0.486	0	0.0276	0.0346	0.0931	0.0931	1.53
SM 03	9.51	12.5	61.7	4.93	4.93	0.493	2.96	0	0	0.5	0.493	1.97	0.00721
SM 04	20	10.4	30.1	19.7	11.8	0.986	1.97	0	0	1.13	1.97	1.97	0
SM 05	21	8.01	27.3	11.3	7.51	0.876	2.5	14.2	0.124	0	0.751	2.25	4.25
SM 06	18.6	9.19	32.7	17.8	1.81	0	2	2.83	0.0475	1	2.72	1.81	9.53
SM 07	21	5.01	19	29	4	3	5.99	0	0	2	1.03	2	0.999
SM 16	25.4	28.4	22	9.61	0.922	0	3.16	0	0.0783	1	1.84	0.461	1.84
SM 17	34.7	16.1	31.9	8.48	1.85	0	4.85	0	0.537	0.5	0.463	0.463	0.148
SM 18	28	15.2	15.5	19.3	2.89	0.481	2	0	0.519	0	0	0.963	0.187
SM 51	0.13	0.647	0	2.96	93.3	0.247	0.496	0	0.0649	0	0.197	0.494	0
SM 52	4	0	0	3	70	2	3	0	0	0	0	2	15
SM 53	0.532	0	0	5	90	0	0.999	0	0	0	0	0.5	3.02
SM 54	2.08	0	0.0716	4.06	76.7	0	3.99	0	0	0	0	2.99	9.96
SM 55	0.997	0	0	2.19	89.7	0.997	1.99	0	0	0	0	0.997	2.99
SM 56	12	24.1	8.64	20.3	16.2	1.22	5	0	0	0	0	0.811	2.43
SM 56A	14.8	13.3	13.4	14.7	14.7	1.96	4.92	0.49	0	0	0.981	0.981	9.84
SM 57	17.1	17.3	17.2	9.88	23.7	1.98	5.95	0	0	0	1.99	1.98	2.98
SM 58	15.3	9.44	20	17.6	10.8	1.96	14.7	4.94	0.105	2.94	0	1.96	0.209
SM 59	26.4	9.36	27.8	20.8	8.46	0	5.76	0.18	0.0601	0.12	0	0.94	0.18
SM 60	6.96	21.6	15.1	16.9	16.9	4.97	5.03	0	0	0	0.154	1.49	4.97
SM61	10	13	6.5	20	13	3	10	1.5	0	3	0	5	4
SM 62	11	23.4	22	12.7	13.4	0.956	2.87	0	0	1.04	0	0.956	4.78

Table 3. continued.

Sample	Pelecypods	Gastropods	Bryozoa	Benthic Forams	Plank. Forams	Poriferа	Echinoids	Brachiopods	Corals	Serpulids	Arthropods	Ostracods	Other Bioclasts
SM 64	16.7	17.6	14.5	13.8	17.7	3.93	5.89	0	0	1.07	0	0.982	3
SM 65	9.83	11	0.344	9.83	42.3	4.91	10	0	0	0.983	0.491	2.46	7.9
SM 66	11.9	12.7	15.2	14.8	24.7	2.96	11.8	0.987	0.493	0	0.493	0.987	2.96
SM 67	15.1	8.21	10	19.8	9.91	0.991	2.01	0	0	2.11	0	0.991	25.8
SM 68	22.6	16.8	14.9	13.5	0.898	0.449	4.49	0	0.0509	0.898	0.898	0.898	5.09
SM 69	26.2	10.1	10	9.82	4.91	0.982	4.96	2.96	0.00894	0	2	1.96	3.13
SM 70	25.4	15.5	18.6	6.78	0	0	3.06	3.06	0	0	2	0.969	14.6
SM 71	30.2	12.1	14.6	19.4	9.72	0.972	1.25	0.0279	0	0.486	0	0.972	0.0279
SM 74	12	12.4	38.1	13.6	6.79	0.906	9.34	0.453	0	3.91	0	0.453	1.81
SM 75	4.96	5.33	1.61	6.95	67.5	0.298	2.01	0	0.229	0	0	0.992	0.0308
SM 76	0	0	0	1	84.5	0.5	2	0	0	0	0	1	5
BC 05	12	4.46	11.7	14.1	13.7	0.457	9.4	0.914	0	4.74	0.715	0.457	0.457
BC 06	21.8	5.5	19.2	20.6	9.31	2.94	2.98	1.08	0.51	1.49	0.161	1.96	0.49
BC 07	16.6	18.7	5.04	19.6	9.78	1.96	6.02	0.0647	0.0216	1.51	1	2.94	1.13
BC 09	34.5	17.9	16	8.28	0	1	4.25	0.246	0.983	0.246	1.51	0.754	0
BC 11	41.5	13.3	15	11.4	0.636	2.46	0.818	0.364	0.546	0.182	0.318	0.318	0.364
BC 14	14.7	4.89	4.93	0	29.3	0.977	2	0.489	0	0	0.489	4.89	5.11
BC 15	10	4	5.09	10.7	1.45	1.45	1.94	0	0	0.485	0	0.97	2.35
BC 17	10.2	7.04	6.05	16.9	1.99	1.99	4.97	0	0.0481	0	0	0.994	0.15
BC 19	10.2	3.87	4.82	9.59	2.88	2.88	2.88	0	0	0	0	2.4	0
BC 21	9.38	12.5	9.19	4.59	1.84	1.84	4.63	0	0	0	0	0.918	0
Maria Island Area													
SM 77	2	2	5	2	72	0.5	5	0.3	0	0.2	0	1	5
SM 78	15.3	9.79	36.1	14.4	0	2.87	9.7	1.13	0	2.96	1	0.958	1.92
SM 79	12.2	7	48.5	13.1	0	0.466	4.87	1.13	0	2.07	1	1.87	3.2
SM 80	5.19	3.52	67.3	11.1	2.22	0.741	3.7	0	0	4.81	1	0.37	0
Lacepede Shelf Area													
SM-294	25.7	10.7	16.4	7.6	0	0	9.07	0	0.0664	1.87	0	0	8.67
SM-303	13	2	4.03	4	0	0	0.999	0.3	0	0.5	0.5	0	0
SM-307	10	5	10.1	4.99	0	0	2	0	0	0.499	0	0	0
SM-308	36.9	4.02	34.4	2.98	0	0	2.25	2	0	0	0	0	11.2

Table 3. continued.

Sample	Pelecypods	Gastropods	Bryozoa	Benthic Forams	Plank. Forams	Porifera	Echinoids	Brachiopods	Corals	Serpulids	Arthropods	Ostracods	Other Bioclasts
SM-309	43.9	13.4	14.7	2.03	0	0	3.7	1	0	0	0	0	10.1
SM-311	50.9	4.19	14.2	1.79	0	0	0.597	3	0	0	0	0	5.97
SM-316	15.1	10	62.3	2.74	0	0.449	1.95	0	0.102	2.1	0.102	0.898	4.24
SM-319	30.1	10.8	41.4	2.34	0.78	0.61	4.12	0.78	0.11	1.32	0.22	0	0.83
SM-320	24.9	7.01	48.2	4.98	4.96	0.993	5.96	0.993	0	0	0.0141	0.993	1.03
SM-321	10.4	8.16	70.8	2.84	0	0.92	3.92	0	0	1	0.92	0	0
SM-322	22.4	11	32.5	11.4	0.891	0.446	1.45	0.777	0	2	0.446	0.223	3.11
SM-325	16.1	9.64	45.4	7.75	1.06	0.528	2	0.472	0.472	6.22	1	0.106	0.422
GAB Marine Park Area													
SM-340	5.13	5.44	52	11.4	0.937	0.469	1.31	0.469	0	1.03	3	0.937	1.06
SM-341	11.1	5.63	27.3	11.5	1.82	0.455	0	0.0901	0	1.09	1	0.455	0.545
SM-342	10.9	5.55	27.2	11.6	1.84	0.461	0	0.0786	0	1.08	1	0.461	0.539
SM-344	9.65	3.1	41.6	13.6	6.28	6.76	8.72	0	0	1.97	1.95	1.93	3.93
SM-345	12.5	4.13	47.7	7.6	0.934	0	1.93	0	0	1.87	1.6	0.467	1.07
SM-347	18.7	5	20.3	18.7	4.91	4.91	5.09	0.983	0.0853	1.02	0.662	1.97	9.34
SM-348	5.08	2.67	74.4	5.85	0.962	1.04	1	0.0385	0	2	1.04	0.481	1
SM-349	7.26	4.3	49.7	11.6	2.9	0	2.03	0	0	2.1	1.17	0.967	10.7
SM-359	20	10.3	29.4	9.69	0.965	0	1.1	0	0	1.03	0.0693	0.483	0.965
SM-360	11.9	3.67	17.8	7.43	1.81	0	2.71	0	0.0476	1.95	1	0.905	1.81
SM-372	17.2	3.03	5.09	9.96	0	0	7.97	0	0	0	0	0.996	0.996
SM-375	17	5	15.8	7.78	0	0	1.94	0.014	0	0.486	0.972	0.486	0
SM-376	33.7	10.7	18.7	12.9	0	0.86	2.29	0.07	0	0	0.93	0.43	1.84
SM-377	10.3	1.02	1.01	7.97	0	0.997	2.99	0	0	0	0	0.997	0.997
SM-386	9.32	2.66	5.75	8.9	0.89	0	2.89	1.54	0	0	0	0.178	0.89
SM-388	15.1	0.25	4.9	17.9	1.9	0	7.7	0	0	0	0.0499	0.19	1.9
GC1	5	5	0	5	54.5	10	15	0	0	0	0	0.5	5
GC2	2	0	0	2	88	1	3	0	0	0	1	1	2
GC3	0	0	0	2	94.5	0	0	0	0	0	0	0.5	3
GC4	0	0	0	2	93.5	0	1	0	0	0	0	0.5	3
GC5	0	0	0	2	95.5	0	1	0	0	0	0	0.5	1
GC6	0	0	0	1	97	0	0.5	0	0	0	0	0.2	0.3

Table 3. continued.

Sample	Pelec-ypods	Gastro-pods	Bryozoa	Benthic Forams	Plank. Forams	Porif-era	Echin. oids	Brach-iopods	Corals	Serpulids	Arthro-pods	Ostra-cods	Other Bioclasts
GC7	0	0	0	0.5	94	0	0.5	0	0	0	0	0	2
GC8	0	0	0	1	86	1	2	0	0	0	0	0	3.3
DR 01	0	0	0	0.5	95.8	0	0.5	0	0	0	0	0.2	0
DR 02	0	0	0	1	94.8	0	3	0	0	0	0	0	0.2
DR 03	0	0	0	1	73	0.5	2	0	0	0	0	0.5	1

the present maps, presumably because the non-uniform distribution of the sampling sites does not yield an easily interpreted spatial pattern to be defined. Merging the present data set with previously collected data would probably enhance trends and patterns in the textural distribution.

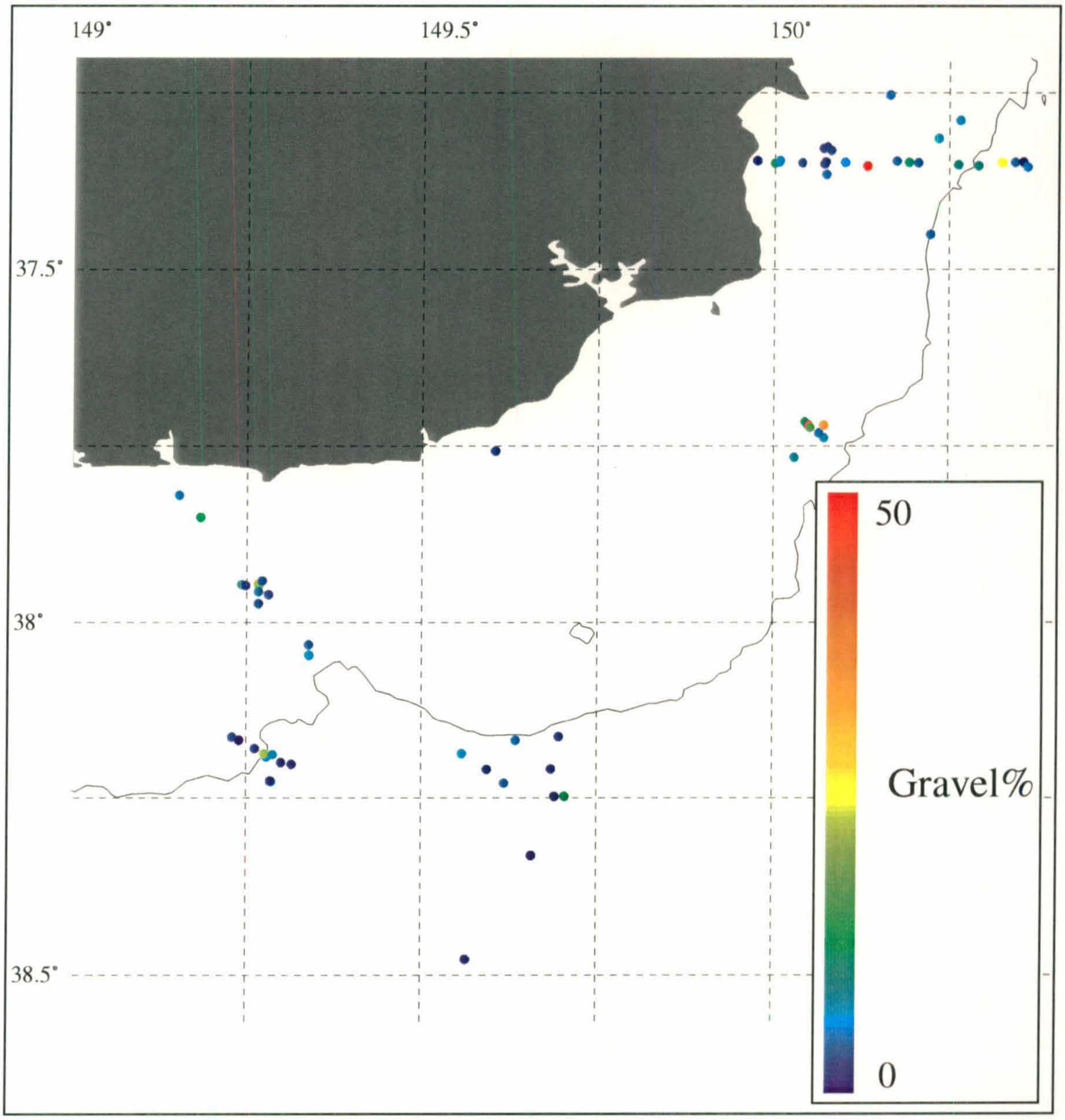

Figure 2. Distribution of gravel in surficial sediments.

Understanding textural distribution patterns is of particular concern in the present study because of the known relationship between sediment grain size and acoustic response (eg Hamilton 1980). In this context, the distribution of coarse (gravel) sediments should be mapped to better understand and interpret sonar backscatter data.

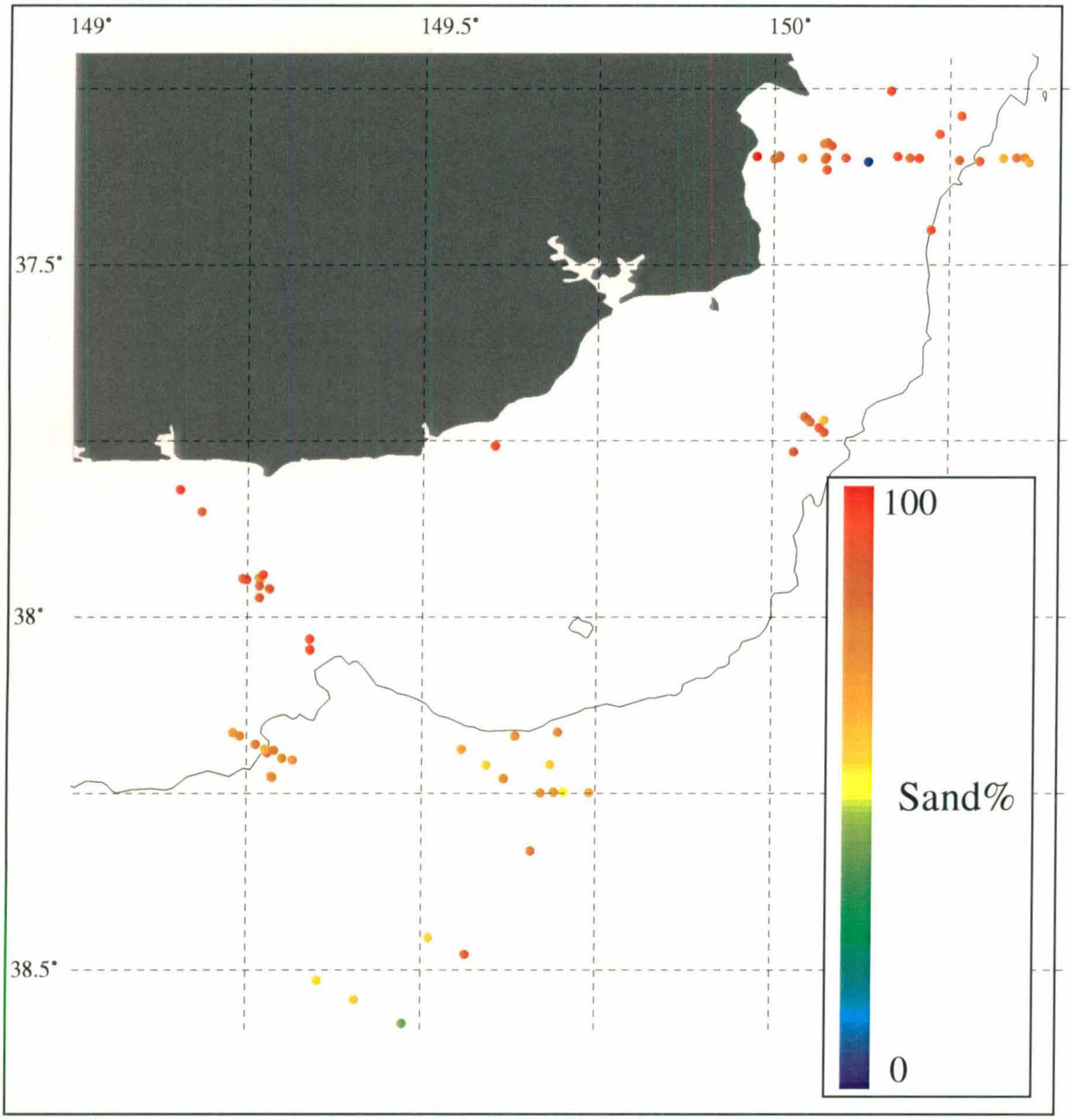

Figure 3. Distribution of sand in surficial sediments.

Carbonate content measured in the laboratory ranged from 15 to 86% with a mean of 54% (n = 43). Based on microscope analyses, it appears to be derived mainly from molluscs (1 to 72%, mean of 32%), bryozoans (0 to 48%, mean of 13%) and benthic foraminifers (0-29%, mean of 9%). Carbonate content of the mud fraction was from 46 to 79%, with a mean value of 62%. Although some of this may be attributed to fine-grained foraminifer tests, a large component is probably derived from the break-down of coarse calcareous material into fine fragments. Such a process has been documented from several areas around Australia by Harris (1994).

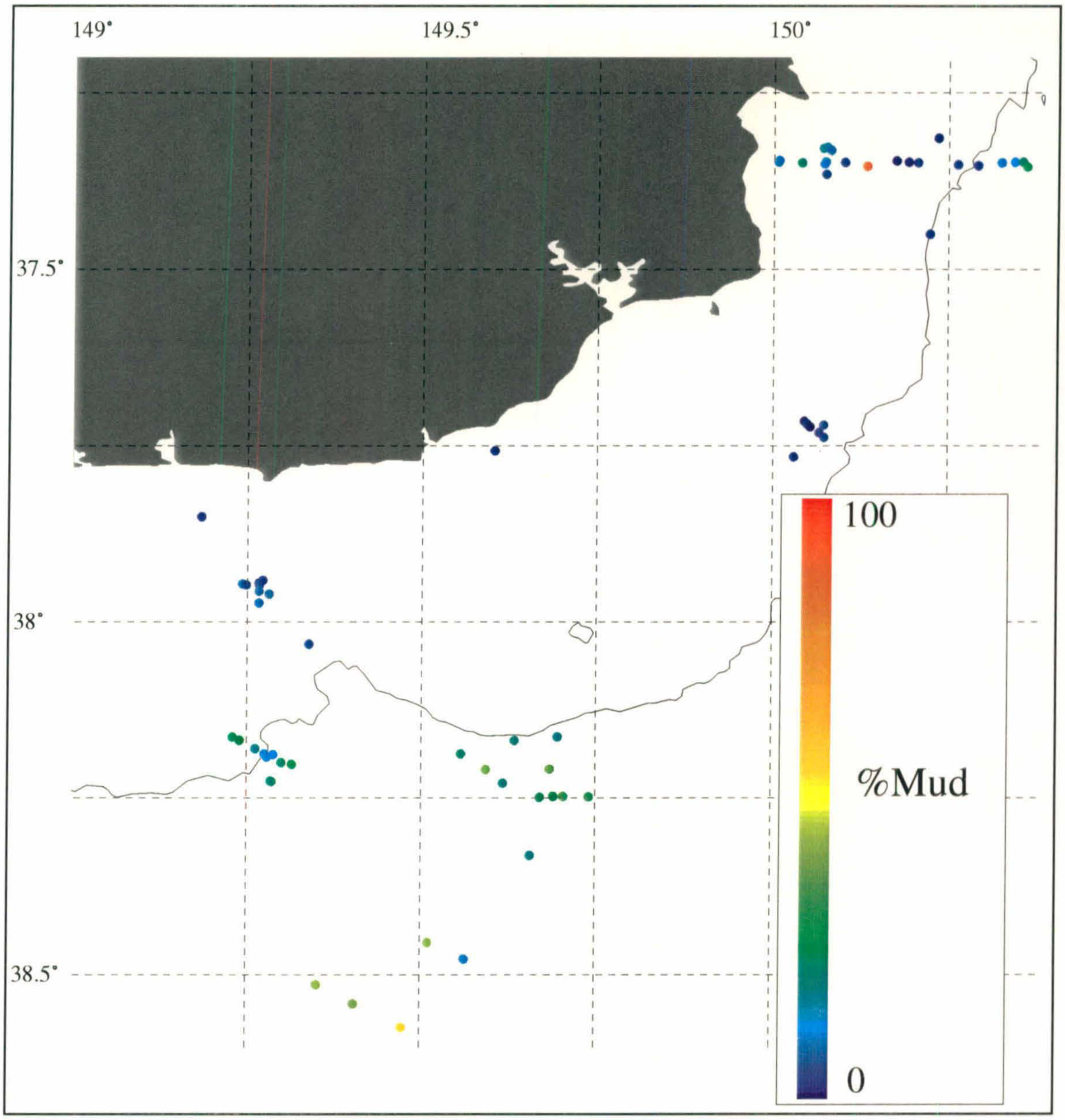

Figure 4. Distribution of mud in surficial sediments.

3.1.2 Distribution of Foraminifera

The Disaster Bay - Howe Reef samples range in depth from 30m in the inner shelf to 590m in the upper slope. The inner shelf (0-50m) sample is dominated by Miliolinids and benthic Rotaliids, with *Quinqueloculina* the most common genus (Fig 5). The mid shelf (50-100m) is dominated by benthic Rotaliids (60%) with *Cibicides mediocris* the most common species. Miliolinids are common (20%) while Textulariids make up between 7-13%. The outer shelf (100-200m) is dominated by benthic Rotaliids (53-66%), with planktonic foraminifera making up between 12-24%, Textulariids 9-12% and Miliolinids 10-15%. The upper slope (>200m) samples show a continued increase of planktonic foraminifera with increased depth (32-42%) with *Globorotalia inflata* and *Globigerina bulloides* the dominant species. A relative decrease is also shown with Miliolinids (5-9%) and Textulariids (5-10%).

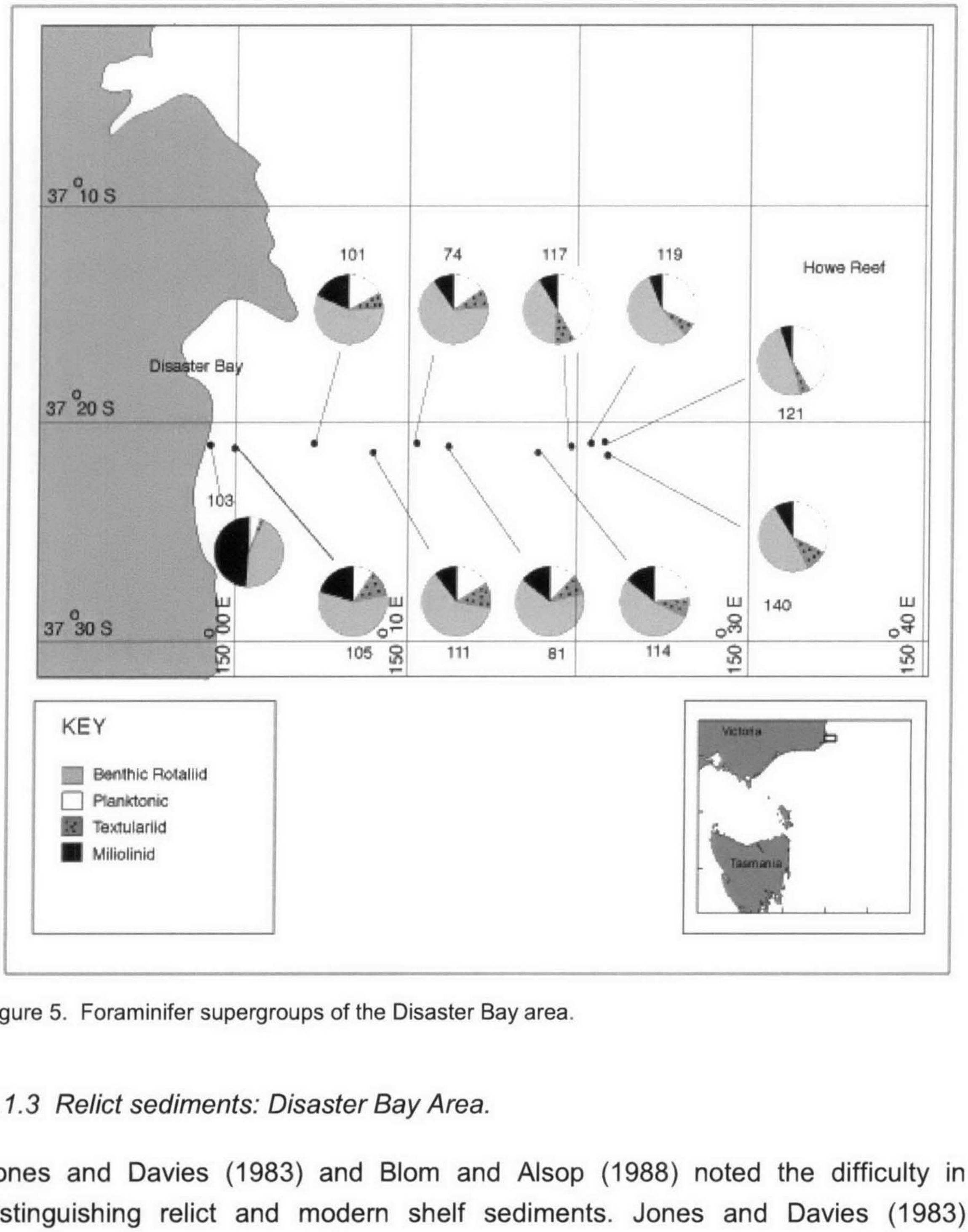

Figure 5. Foraminifer supergroups of the Disaster Bay area.

3.1.3 Relict sediments: Disaster Bay Area.

Jones and Davies (1983) and Blom and Alsop (1988) noted the difficulty in distinguishing relict and modern shelf sediments. Jones and Davies (1983) concluded that the quartz sands of the near shore and the Bass Basin margin were modern, and at equilibrium with the present environment. Their argument is based on the fact that the sediments are unimodal (suggesting a single transport mechanism) and that the carbonate component consists of fresh shell material. The sediments are probably derived from erosion of Pleistocene beach and barrier sands that were transported landward during the post-glacial sea level rise. The muddy sediments of the central Bass Basin and the east coast of Tasmania are also considered to be modern (Jones and Davies, 1983; Blom and Alsop, 1988). The occurrence of modern pollen in the samples is evidence that deposition is happening at present. However, the coarse gravely material that is sometimes observed in the muds is considered by Jones and Davies (1983) to have been deposited when sea level was lower, and it has since been bought to the surface by bioturbation.

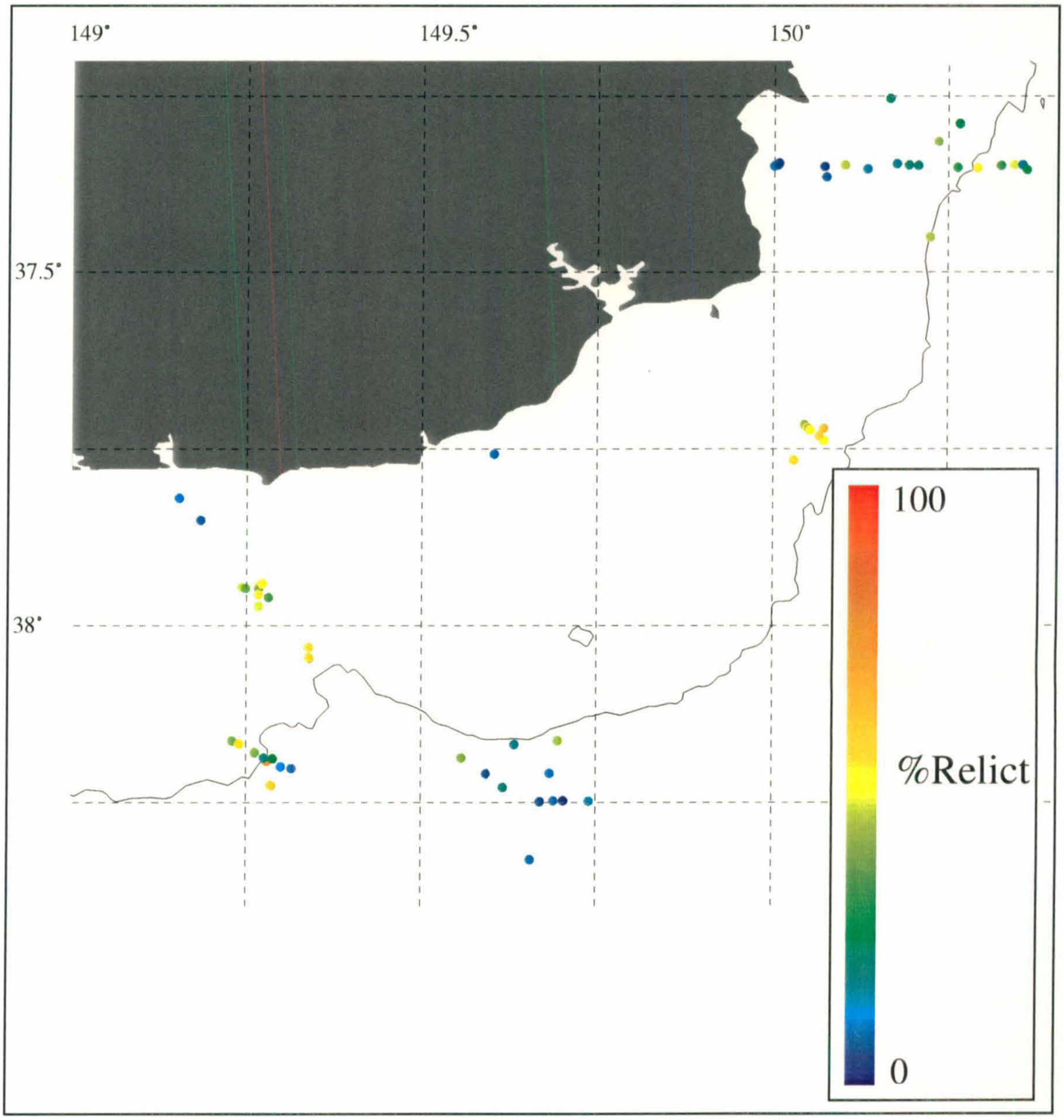

Figure 6. Distribution of relict sediments.

In contrast to this, the sediments of the middle and outer shelf, which are mainly bryozoan sands and gravels, show clear evidence of being relict. They are polymodal, have limonitic surface coatings, and glauconitic infilling of cavities. Such a distribution pattern is consistent with the results of the present study (Figs. 6 and 7) which clearly shows the sediments with the highest relict content are located on the mid- to outer-shelf. Modern sediments are found both inshore and offshore of this outer-shelf, relict sediment zone.

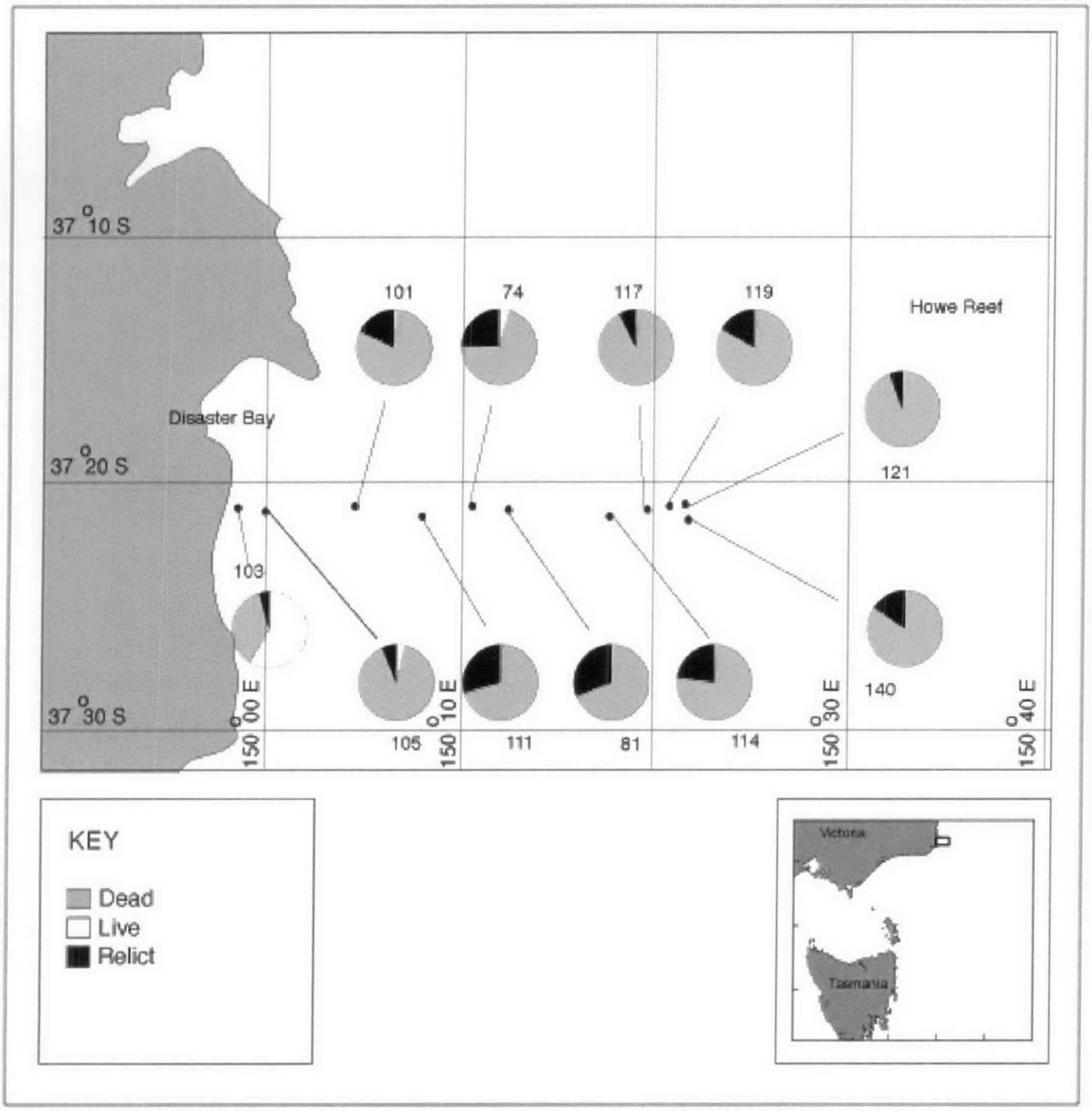

Figure 7. Foraminiferal live/dead ratios for the Disaster Bay area.

The shelf samples contain up to 31% relict foraminifera, while the upper slope contain up to 16% relict foraminifera (Fig 7). These values represent a sample bias in shallow water environments where more relict foraminifera are expected compared to deeper water facies since the deeper areas remained below sea level during Pleistocene glaciations when sea-level was up to 120m lower than at present (Li *et al*, 1996). Deeper water samples may contain foraminifera which are the same age as the relict forms and from the same depositional regime. However, these will not be identified as relict due to a lack of alteration. The supergroups with the most relict forms are the Miliolinids, with *Quinqueloculina, Miliolina* and *Triloculina* the most common relict genera. These taxa inhabit normal marine lagoon to inner shelf environments (Murray, 1991). It is suggested, therefore, that the relict foraminifera found in the deeper samples are transported.

3.2 Big Horseshoe Area (Head of the Bass Canyon)

3.2.1 Grain Size, TOC and Biogenic Carbonate Content and Distribution

In the Big Horseshoe area, gravel content ranges from 0 to 21.9% with a mean of 3.3% (n = 33), sand ranges from 37.5 to 92.1% with a mean of 71.0% and mud content ranges from 0.4 to 62.5% with a mean of 25.8%. TOC content ranges from 0.14 to 0.74% with a mean of 0.44%.

Carbonate content ranges from 26 to 86% with a mean of 80% (n = 31) and is derived mainly from molluscs (0 to 54%, mean of 24%), bryozoans (0 to 67%, mean of 18%), and benthic foraminifers (1-29%, mean of 13%). Calcareous mud comprises from 47 to 83% of the total mud content, with a mean of 77%.

3.2.2 Distribution of Foraminifera.

The Broken Reef - Big Horseshoe samples range in depth from 112m in the shallow outer shelf to 2009m in the lower slope. The outer shelf samples are dominated by benthic Rotaliids with relative abundances of between 55 and 68% (Fig 8). The most common species are *Cibicides mediocris, Parrellina imperatrix, Uvigerina bassensis, Hoeglundina elegans* and *Lenticulina cultrata*. Miliolinids account for between 9-15%, Textulariids 6-12% and planktonic foraminifera 8-24% of the total fauna.

The upper slope samples (200-1000m) are dominated by planktonic foraminifera, (from 63% at 205m water depth increasing to 85% at 586m) with *G. inflata, G. bulloides, Globorotalia truncatulinoides, Orbulina universa, Globorotalia hirsuta* and *Globoquadrina dutertrei* all common. Benthic Rotaliids decrease with depth, from 30% at 205m to 14% at 586m. Miliolinids account for between 0-3% with Textulariids from 0-4%. The lower slope samples (>1000m) are dominated by planktonic foraminifera, from 94-99%, typical of the planktonic oozes that are deposited in low energy pelagic environments.

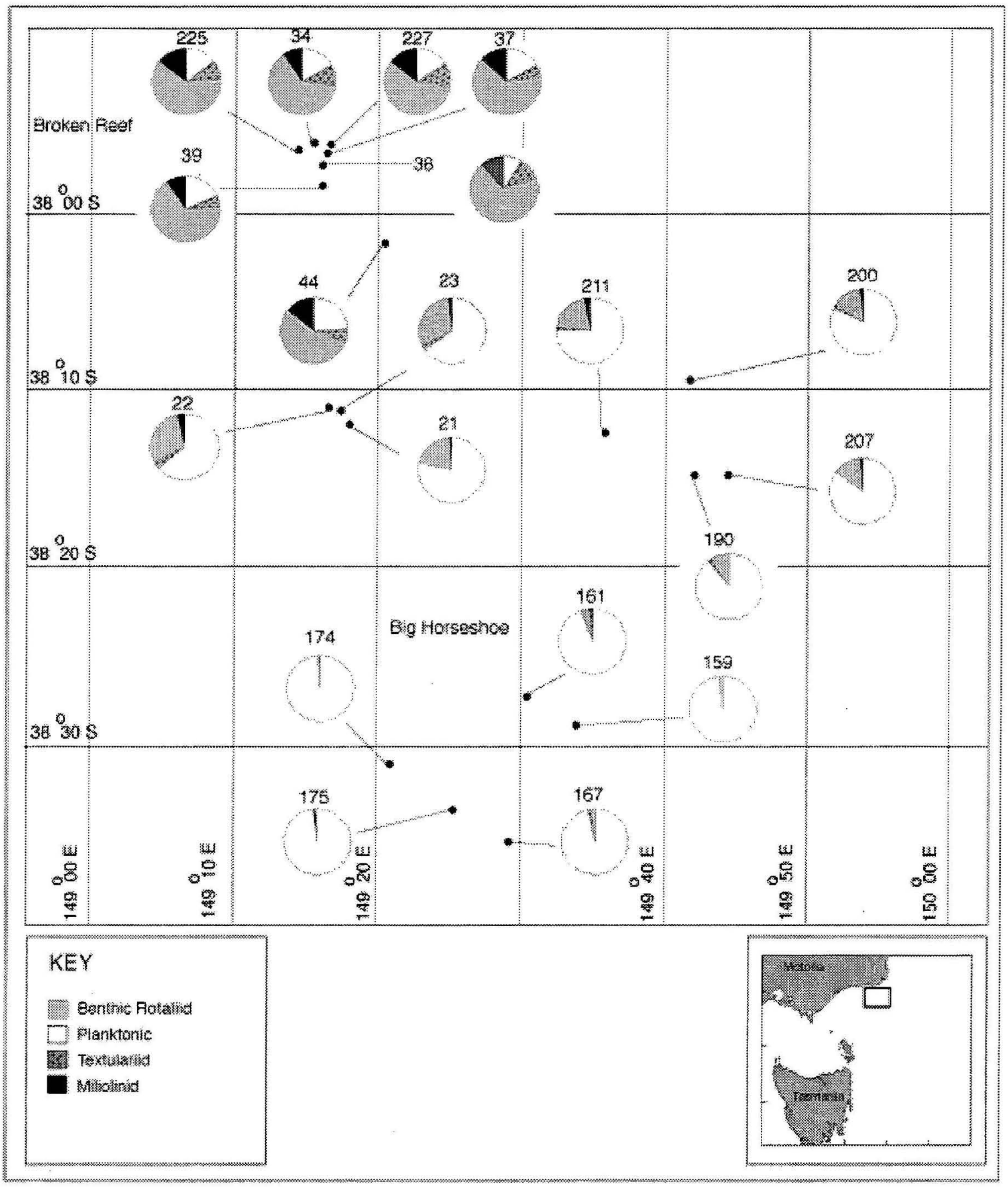

Figure 8. Foraminifer supergroups of the Big Horseshoe area.

3.2.3 Relict Sediments:.Big Horseshoe Area

Microscope examination of the coarse, bioclastic fraction (sand and gravel) of 37 samples suggests that relict content of the surficial sediments ranges from 0 to 73% with a mean of 23% in the Big Horseshoe area (Fig. 9). Up to 30% of the

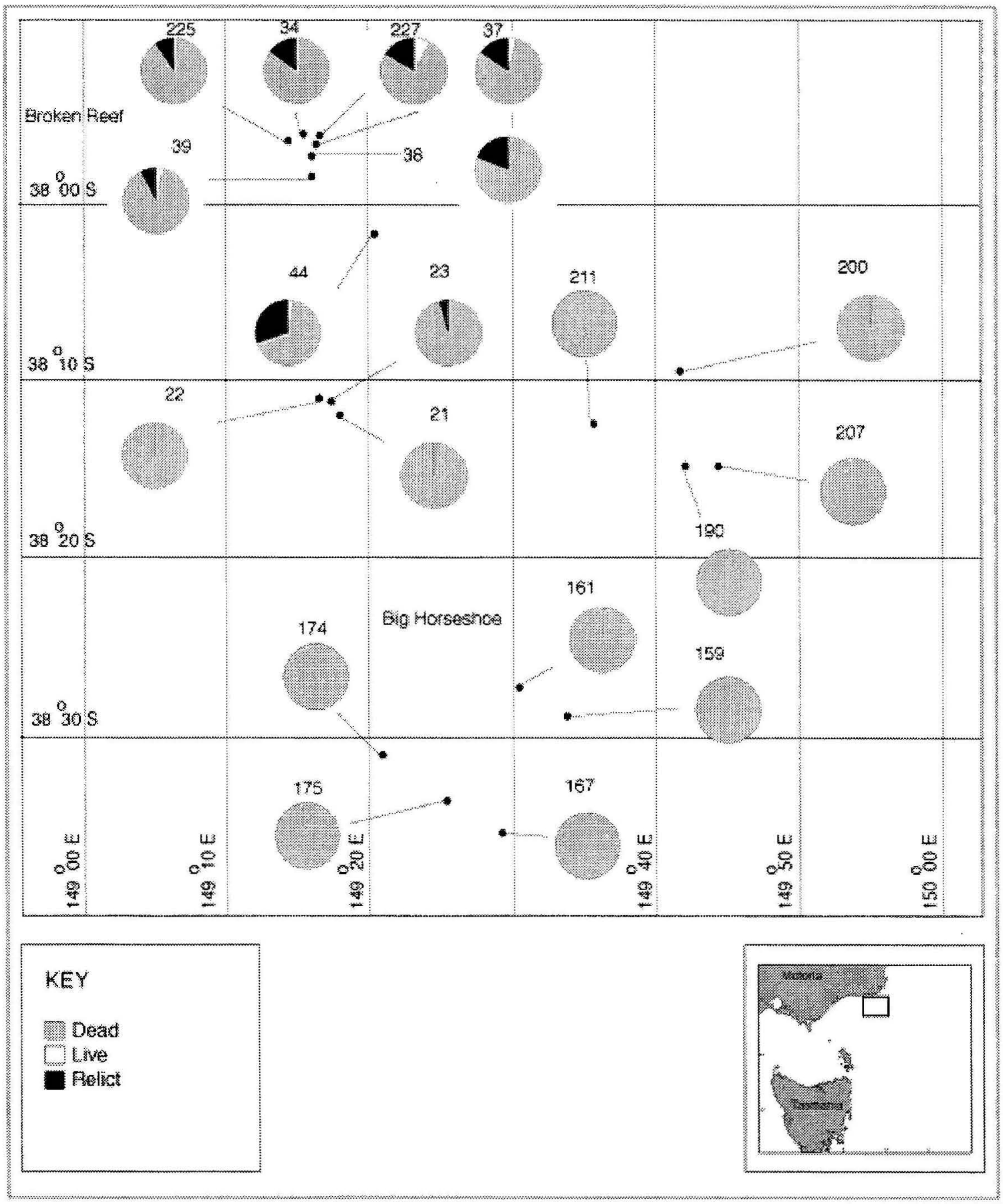

Figure 9. Foraminiferal live/dead ratios for the Big Horseshoe area.

foraminiferal taxa from the shelf samples are relict (Fig 9). By contrast, 4% relict foraminifera are found at 230m water depth (Station 23), with no relict tests found in the deeper samples.

This pattern suggests that transportation is not as active on this part of the slope as elsewhere. Live forms are most commonly found in the shallower samples, with up to 8% found, while a maximum of 1% are found in samples at greater than 250m. This may however be a product of the ecology of the different assemblages, with many of the shelf forms benthic, thus providing a greater likelihood, via the sampling procedure, of collecting live forms. This is as opposed to the slope, where most of the taxa are planktonic and would generally only be collected after they have died and settled on the sea floor.

3.3 Great Australian Bight Marine Protected Area

3.3.1 Grain Size, TOC and Biogenic Carbonate Content and Distribution

In the GAB MPA, gravel content ranged from 0 to 14% with a mean of 3%, though gravel content was zero at stations located in water depths greater than 150m. Sand content ranged from 0.3 to 99.6% with a mean of 60.6% and mud content ranged from 0.1 to 99.7% with a mean of 36.3%. Sand was present in all samples but this dropped off with increasing depth and was virtually absent from the top of core GC8; mud content is the inverse of sand and increases with increasing depth (Table 1).

Total organic carbon (TOC%) content ranges from 0.08 to 0.33% with a mean of 0.16% (n = 19) in the samples analysed. There is no apparent trend associated with water depth, though there is a fair correlation (R = 0.75) between TOC and mud content.

Carbonate content ranged from 77 to 92% with a mean of 84% (n = 15) and is derived mainly from molluscs (1 to 54%, mean of 26%), bryozoans (0 to 62%, mean of 16%), and benthic foraminifers (2-29%, mean of 14%). Calcareous mud comprises from 76 to 92% of the total mud content, with a mean of 89%.

3.4 Down-core bulk-density, P-wave velocity and magnetic susceptibility

All down-core profiles are attached to this report in Appendix C and visual descriptions of the sediments are given in Appendix D.

Box core #7 was located in the Big Horseshoe area. The core was a massively bedded, bioturbated, olive, slightly gravelly, muddy-sand. Gamma-ray bulk density and P-wave velocity measurements were not successful for this core, due to dewatering of the sediment during transit up to Townsville. Magnetic susceptibility values were low, ranging from 0 to 9 cgs, indicative of a biogenic sediment, which is consistent with the total $CaCO_3$ content of 83.8%.

Box cores 14, 17 and 19 were collected from the Disaster Bay area. Box core 14 comprised an upper 8cm thick layer of massively bedded, olive gray, slightly gravelly muddy-sand overlying a coarser, shelly muddy sand. The sediment is comprised of about 45% biogenic $CaCO_3$ with the remainder being mainly quartzose sand. The layered sedimentary structure is represented in the magnetic susceptibility log by an increase from around 0 to over 10 cgs at a depth of around 8 to 10 cm down-core. The generally low magnetic susceptibility values are attributed to the non-ferrous, quartzose and calcareous nature of the sediments. The basal shelly unit also exhibits a higher bulk density (1.75 g/cc) and higher P-wave velocity (1575 m/s) than the overlying unit (1.55 g/cc and 1560 m/s, respectively).

Box core 17 was very similar in structure and composition to box core 14 and had similar bulk density, P-wave velocity and magnetic susceptibility profiles to that core. The sediment in box core 17 consists of an upper layer of massively bedded, olive gray, slightly gravelly muddy sand (over 80% sand) overlying a coarser, shelly muddy sand. The sediment is about 41% biogenic $CaCO_3$ with the remainder being mainly quartzose sand. The magnetic susceptibility log increases from around 0 at the core top to nearly 20 cgs at a depth of around 15 cm down-core. The basal shelly unit exhibits a bulk density of around 1.8 g/cc) and a P-wave velocity >1510 m/s.

Box core 19 exhibited a more vague stratification pattern than box cores 14 and 17. Box core 19 is massively bedded, olive gray, slightly gravely muddy sand. The sediment is about 49% biogenic $CaCO_3$ with the remainder being mainly quartzose sand. The magnetic susceptibility log increases from around 0 at the core top to nearly 25 cgs at a depth of around 10 cm before decreasing to around 12 cgs at the base of the core. The bulk density and P-wave velocity do not show significant down-core variation. The bulk density is around 1.7 g/cc and a P-wave velocity is around 1555 to 1560 m/s.

Gravity cores were collected in the GAB MPA in a down-slope transect starting from a water depth of 480 m (GC1) on the upper slope down to a depth of 5250 m (GC8) on the continental rise and abyssal plain. The cores are all comprised mainly of fine-grained hemipelagic, calcareous foram nanno-fossil ooze derived from the overlying water column. Preliminary palaeontological studies show that these sediments are Quaternary, and that the dark mudstones at the bases of some of the deeper cores are Late Cretaceous in age (see also Appendix D).

The top of core GC1 is light olive gray foram-nanno ooze, 33% sand and 66% mud. It has a low magnetic susceptibility value close to zero, which is characteristic of non-terrigenous, biogenic sediments. The bulk density of the core-top is around 1.64 g/cc and the P-wave velocity is around 1512 m/s.

With increasing depth down-slope there was little change in the P-wave velocity or bulk density in the surface sediments. These were only determined for the upper section of each core due to financial constraints on the project, and because the project's main focus was on the high-frequency (>12 kHz) acoustic response of the seabed.

The magnetic susceptibility curves for cores GC3, GC4, GC5 and GC8 exhibit significant down-core variability related to variations in sediment composition. These cores may contain palaeo-environmental records associated with changes in the rate of terrigenous sediment (aeolian dust?) influx to the core sites during Quaternary climatic variations.

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References

Blom, W. M., and Alsop, D. B. 1988. Carbonate mud sedimentation on a temperate shelf: Bass Basin, southeast Australia. Sedimentary Geology, 60, 269-280.

Davies, P.J., 1979. Marine geology of the continental shelf off southeast Australia. Bulletin 195, Bureau of Geology and Geophysics, Canberra, 51p.

Geological Society of America, 1963 - Rock-Color Chart. Geological Society of America, New York

Hamilton, E. L., 1980. Geoacoustic modelling of the seafloor. J. Acoust. Soc. Am., 68(5), 1313-1340.

Harris, P. T., 1994. Comparison of tropical, carbonate and temperate, siliciclastic tidally dominated sedimentary deposits: examples from the Australian continental shelf. Australian Journal of Earth Science, 41, 241-254.

Jones, G.A., and Kaiteris, P., 1983. A vacuum-gasometric technique for rapid and precise analysis of calcium carbonate in sediments and soils. Journal of Sedimentary Petrology, 53: 655-660.

Jones, H.A., and Davies, P.J., 1983. Superficial sediments of the Tasmanian continental shelf and part of Bass Strait. Bulletin 218, Bureau of Mineral Resources(Geology and Geophysics), Canberra, 25p.

Kloser, R. and shipboard party, 2000. Cruise Report Southern Surveyor 01/00 April 4 – May 21, 2000, CSIRO Division of Marine Research, Hobart, Tasmania, 37pp.

Li, Q., McGowran, B., James, N.P. and Bone, Y. and Cann, J.H., 1996. Mixed Foraminiferal Biofacies on the Mesotrophic, Mid-Latitude Lacepede Shelf, South Australia. Palaios, 11: 176 - 191

Moore, R.C. (ed.), 1971. Treatise on Invertebrate Palaeontology. The Geological Society of America and The University of Kansas.

Munsell Color, 2000. Munsell Soil Color Charts. Gretag Macbeth, New Windsor, NY, washable edition.

Murray, J. W. 1991. Ecology and Palaeoecology of Benthic Foraminifera. Longman Scientific and Technical (London), 1-397.

Walton, W.R., 1952. Techniques for Recognition of Living Foraminifera, Contributions of the Cushman Foundation for Foraminiferal Research, 3: 56-60.

Wass, R.E., Conolly, J.R., and Macintrye, R.J., 1970. Bryozoan carbonate sand continuous along Southern Australia. Marine Geology, 9, p. 63-73.

APPENDIX A

SAMPLING PROTOCOL: SOUTHERN SURVEYOR CRUISE, 01/00

GENERAL

Sample labelling

Sample containers and outer bags should be labelled using permanent markers. Samples placed in ziplock bags should also have an aluminium tag (labelled using biro to indent the metal) inserted into the outer bag. Aluminium tags should be included ***inside*** bottled samples.

Each sample type (box core, dredge etc) should be labelled using a sequential numbering system with the following format:

SS01/00	DR001
Cruise no	dredge sample number

Sample codes are:

BC	box core
DR	dredge
GC	gravity core

All samples should be stored in coolroom conditions (2 - 4 C) ***NOT*** frozen.

Sample Data

Samplė collection information should be filled out at the time of collection, using the sheets provided. It is important that latitude/longitude, water depth and subsamples taken be recorded. For box cores a description of the sediment surface (e.g. disturbed/undisturbed, macrofauna in situ) is also useful.

DREDGE SAMPLES

Surface samples

Collect 2x samples using 250ml bottles. Half-fill bottles, approximately. Decant any seawater carefully, so as not to lose fine sediment. Cover each sample with 100mls ethanol (approximately), shake gently, to ensure that ethanol is distributed around the sample. Insert aluminium tag, labelled with sample number, into the sample bottle, seal bottle and wrap lid with insulation tape. Label the outside of the bottle, using permanent marker. Store in cool room.

Bulk sample

Half-fill large ziplock bag (approximately 1kg of sediment). Decant seawater, taking care not to pour off too much fine sediment. Seal bag. Place in second ziplock bag, together with aluminium tag, labelled with sample number. Label outer bag with permanent marker. Store in cool room.

BOX CORES

Syringe minicore

NOTE: the aim of these "minicores" is to study the depth to which benthic organisms live in the sediment, so it is important to minimise disturbance of the sediment as much as possible.

Collect three syringe samples from each box core. Remove plunger from syringes and insert carefully into the corner of the box core. Leave in place while taking all other samples. When other sampling is completed, remove each syringe, being careful to keep sediment in place, undisturbed. Label each syringe with way-up direction. (*This might be easier to do **before** the sample is taken. If so, ensure that the syringe is inserted the correct way!*) Cap tops of syringe with plungers and place each syringe in small ziplock bag, so that the bag holds the sediments in place. Place in second ziplock bag, with labelled aluminium tag. Label outer bags with sample number using permanent marker. Store in cool room.

Surface samples

Collect 2x samples using 250ml bottles. Half-fill bottles with sediment, taking sediment from surface 0-2cm as much as possible. Decant any seawater carefully, so as not to lose fine sediment. Cover each sample with 100mls ethanol (approximately), shake gently, to ensure that ethanol is distributed around the sample. Insert aluminium tag, labelled with sample number, into the sample bottle, seal bottle and wrap lid with insulation tape. Label the outside of the bottle, using permanent marker. Store in cool room.

Bulk sample

Half-fill large ziplock bag (approximately 1kg of sediment). Decant as much seawater as possible, taking care not to pour off too much fine sediment. Seal bag. Place in second ziplock bag, together with aluminium tag, labelled with sample number. Label outer bag with permanent marker. Store in cool room.

GRAB SAMPLES

Two grab samples are to be taken: one for acoustic properties samples and the second for sampling of sediment and benthic organisms. The acoustic properties grab is to be subsampled using minicores. The requirements for these samples will be similar to the protocol for taking syringe minicores: i.e, that disturbance of the sediment be kept to a minimum and the way-up of each sample needs to be indicated.

Syringe minicore

NOTE: the aim of these "minicores" is to study the depth to which benthic organisms live in the sediment, so it is important to minimise disturbance of the sediment as much as possible.

Where the sediment is reasonably undisturbed, collect at least two syringe samples from each grab. Remove plunger from syringes and insert carefully into the corner of the grab. Leave in place while taking all other samples. When other sampling is completed, remove each syringe, being careful to keep sediment in place, undisturbed. Label each syringe with way-up direction. (*This might be easier to do **before** the sample is taken. If so, ensure that the syringe is inserted the* *correct way!)* Cap tops of syringe with plungers and place each syringe in small ziplock bag, so that the bag holds the sediments in place. Place in second ziplock bag, with labelled aluminium tag. Label outer bags with sample number using permanent marker. Store in cool room.

Surface samples
Collect 2x samples using 250ml bottles. Half-fill bottles with sediment, taking sediment from surface 0-2cm as much as possible. Decant any seawater carefully, so as not to lose fine sediment. Cover each sample with 100mls ethanol (approximately) and shake gently, to ensure that ethanol is distributed around the sample. Insert aluminium tag, labelled with sample number, into the sample bottle, seal bottle and wrap lid with insulation tape. Label the outside of the bottle, using permanent marker. Store in cool room.

Bulk sample
Half-fill large ziplock bag (approximately 1kg of sediment). Decant as much seawater as possible, taking care not to pour off too much fine sediment. Seal bag. Place in second ziplock bag, together with aluminium tag, labelled with sample number. Label outer bag with permanent marker. Store in cool room.

APPENDIX B

CORE LOG SHEETS

Core Number: SS001/26 BC 7 Location: Big Horseshoe (west) Core Length: 12 cm

Latitude: 38° 09.775 Longitude: 149° 13.802 Date Core Taken: 8-4-00 Water Depth: 154m

Depth (cm)	Sub-Sample: Grain size	CaCO$_3$, TOC	^{14}C		Visual Log	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
12 cm	0 8 11	2 6 12				5Y5/3								Worm tubes	7	Olive muddy shelly sand
																Bottom of core

Core Number: SS01/92 BC 14 Location: Disaster Bay Core Length: 11.5 cm

Latitude: 37° 19.698 Longitude: 150° 04.241 Date Core Taken: 12-4-00 Water Depth: 85

Depth (cm)	Sub-Sample: Grain size	CaCO$_3$, TOC	^{14}C		Visual Log	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
11.5	[illegible]	[illegible]				5Y4/4								[illegible]	7	Olive-grey muddy sand. Shell hash in muddy sand
																Bottom of Core

Core Number: SS01/102 BC17 Location: Disaster Bay Core Length: 14cm

Latitude: 37° 21.018 Longitude: 150° 04.317 Date Core Taken: 12/4/00 Water Depth: 87

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: CaCO3, TOC	Sub-Sample: 14C		Visual Log	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
14cm	0-2, 5-6, 13-14					5Y4/3								Molluscs		Olive shelly muddy sand
																Bottom of Core

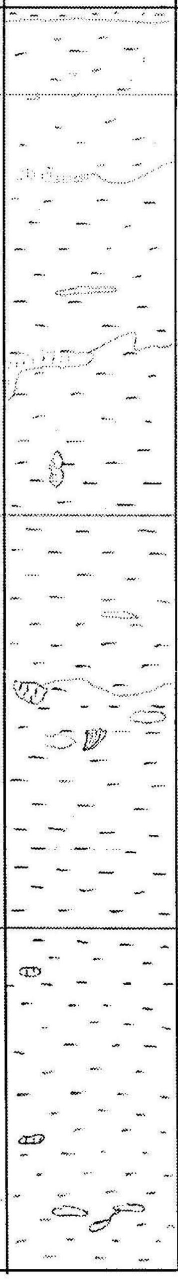
Core Number: SS01/106 BC19 Location: Disaster Bay Core Length: 20cm

Latitude: 37° 20.922 Longitude: 150° 02.371 Date Core Taken: 12/4/00 Water Depth: 73

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: CaCO3, TOC	Sub-Sample: 14C		Visual Log	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
20.5cm	0-2, 5-6, 10-11, 19-20					5Y4/2								Molluscs Bryozoans Worms	≠	Encrusted bioclast (bryozoans?) Serpulid worms Vague stratification
																Bottom of Core

Core Number: GC001 Location: GAB Marine Park Core Length: 5.22 m

Latitude: 33°27.9549 Longitude: 130°48.79'E Date Core Taken: 16/5/00 Water Depth: 480



Depth (cm)	Sub-Sample: Grain size	Sub-Sample: $CaCO_3$, TOC	Sub-Sample: 14C	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Part F (0–20)	0–2, 4–5, 7–8, 12–13, 16–18			5Y7/2, 5Y6/2										Light olive grey foram-nano-ooze. 3cm thick oxidised layer at surface
Part E (20–120)	40–41, 60–61, 80–81, 100–101, 120–121			5G7/2, 5Y6/2, 2.5Y7/2, 5G7/2								Gastropod		Slight greenish discolouration. Light olive grey foram-nano-ooze. Mottles of slightly darker pale yellow. greenish discolouration of diffuse boundaries. Reacts with HCl
Part D (120–220)	140–141, 160–161, 180–181, 200–201			5Y7/2, 5G7/1								Brachiopod fragment		Light grey foram-nano-ooze with darker mottles.
Part C (220–)	220–221, 240–241, 260–261, 280–281			5G7/2, 5Y7/2, 5Y4/1										Light grey foram-nano ooze with dark mottles. Mottles of greenish colour

Core Number: GC001	Location: GAB Marine Park	Core Length: 5.22 m
Latitude: 33° 27.954'S Longitude: 130° 48.73' E	Date Core Taken: 16/5/00	Water Depth: 480 m

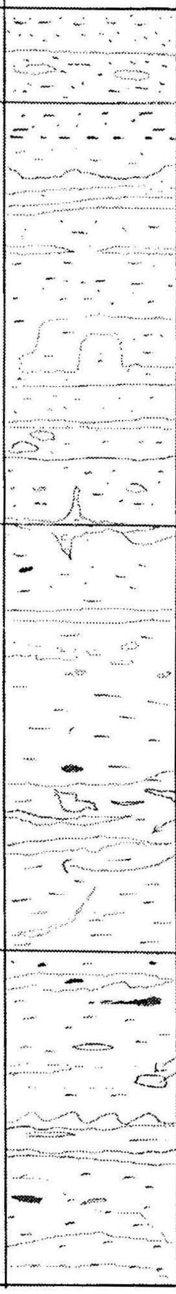
Depth (cm)	Sub-Sample: Grain size	Sub-Sample: CaCO3, TOC	Sub-Sample: 14C		Visual Log	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Part 7	300-301					5Y7/2		X								Light grey foram-nano ooze
319 ↑ Part 8 ↓	320-321, 340-341, 360-361, 380-381, 400-401, 420-421					5G7/2		X						Abundant fossils include scaphopods, worm tubes, echinoid spines(?) and foram debris	J, J	Light grey foram-nano ooze with pale green mottles. Under hand lens sediment appears to be comprised of detrital carbonate material
419 ↑ Part 9 ↓ 512	440-441, 460-461, 480-481, 500-501					5Y7/2		X							7, J	Light grey nano-bearing foram ooze. Reacts with HCl
512																Bottom of Core

Core Number: SS001 / GC002 Location: GAB Marine Park Core Length: 4.17 m

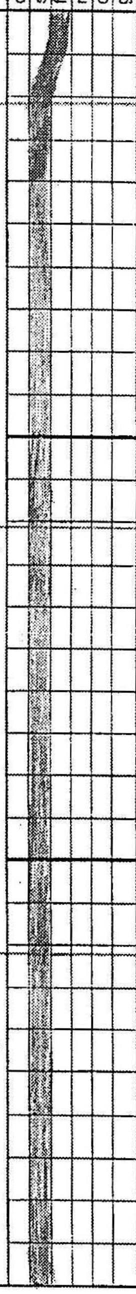
Latitude: 33° 51.131 Longitude: 130° 48.645 Date Core Taken: 16/5/00 Water Depth: 999 m

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: CaCO3, TOC	Sub-Sample: 14C	Colour	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Part E (0–22 cm)	0–2cm, 5–6, 10–11, 20–21	2cm, 6, 11, 21		10YR 8/2, 10YR 8/3		Abundant forams		Very pale brown foram sandy silt massively bedded at surface with mottles below 10cm.
Part D (22–122)	40–41, 60–61, 80–81, 100–101, 120–121	41, 61, 81, 101, 121		5Y 7/1, 5Y 5/2, 5Y 8/1		Abundant Planktonic Forams		Light grey slightly sandy nano-foram ooze. Disrupted horizontal lamination with darker olive grey mottles + burrow structures. Large olive grey layer with burrow structures. Sharp change in colour @ 105 cm White – Pale Yellow slightly sandy foram-nano ooze with mottles.
Part C (122–222)	140–141, 160–161, 180–181, 200–201, 220–221	141, 161, 181, 201, 221		5Y 5/2, 5Y 7/1, 5Y 6/1, 10GY 6/1, 5Y 8/1				Bioturbated light grey nano-foram slightly sandy ooze. Complex mottles + streaks of different colours. Black (iron sulphide?) ~5mm spots. Light greenish-gray tinge in some areas. Numerous burrow structures.
Part B (222–300)	240–241, 260–261, 280–281, 300–301	241, 261, 281, 301		5Y 7/1, 5Y 8/1, 10GY 8/1, 5Y 6/3, 5Y 6/2, 5Y 7/1				Increased number of black (iron-sulphide) spots and elongate streaks. Bioturbated white to light gray nano-foram ooze slightly sandy. Interesting wavy surface

Visual Log:



Grain size (clay <4µm, silt 4-63µm, f. sand .063-.25mm, m. sand .25-.5mm, c. sand .5-2mm, gravel >2mm):



Core Number: SS001 / GC002 Location: GAB Marine Park Core Length: 4.17 m

Latitude: 33° 51.131' Longitude: 130° 48.645' Date Core Taken: 16/5/00 Water Depth: 999 m

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: CaCO$_3$, TOC	Sub-Sample: 14C	Sub-Sample:	Visual Log	Colour	Grain size: clay <4µm	Grain size: silt 4-63µm	Grain size: f. sand .063-.25mm	Grain size: m. sand .25-.5mm	Grain size: c. sand .5-2mm	Grain size: gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
322	320-321					5Y8/1 5Y7/1									═	laminae preserved alternating white and light gray [illegible] ooze.
	340-341					5Y7/1									≠	Massively bedded
	360-361															Numerous mottles Folded laminae
	380-381															Large 10cm burrow structure
417	400-401 417-418															Alternating white and light gray very cohesive nano-foram ooze.
																Bottom of Core Note: cloth rag removed from bottom of core appears to have produced a spike in the mag. sus. log for this core.

Core Number: SS001 / GC003 Location: GAB Marine Park Core Length: 3.27

Latitude: 34° 35.067 Longitude: 130° 45.80 Date Core Taken: 16/5/00 Water Depth: 1506 m

Depth (cm)	Sub-Sample: Grain size, $CaCO_3$, TOC	Colour	Fossils	Sed. Structures	General description and Remarks
Part D (0–34)	0-2	2.5Y8/3	Forams worm tube		Pale Yellow to Yellow bioturbated nano-foram ooze
	4-5				
	10-11	2.5Y8/2			
	20-21	5Y6/2			Light olive grey mottles
		2.5Y7/6			
Part C (34–134)	40-41	2.5Y8/2	Abundant forams		Pale yellow nano-foram ooze with numerous burrows
	60-61	5Y6/1			Grey burrows of light grey and grey
	80-81	2.5Y8/2			
		5Y7/2			
		10YR3/2			Very pale brown
	100-101	2.5Y7/6		=	Yellow laminae w/ dark pale olive yellow
	120-121	2.5Y7/1			Light grey
		2.5Y8/1			white
Part B (134–231)	140-141				
	160-161	2.5Y8/1			White to light grey bioturbated nano-foram ooze.
	180-181	2.5Y7/2			Light grey
	200-201				
	220-221	5Y8/1			
Part A (231–)	240-241	5Y8/1			Dark grey to black laminae
	260-261	5Y7/1			Light grey
	280-281	5Y8/1			
	300-301				

Core Number: SS 001 / GC003	Location: GAB Marine Park	Core Length: 3.27
Latitude: 34°35.067 Longitude: 130°45.80´	Date Core Taken: 16/5/00	Water Depth: 1506 m

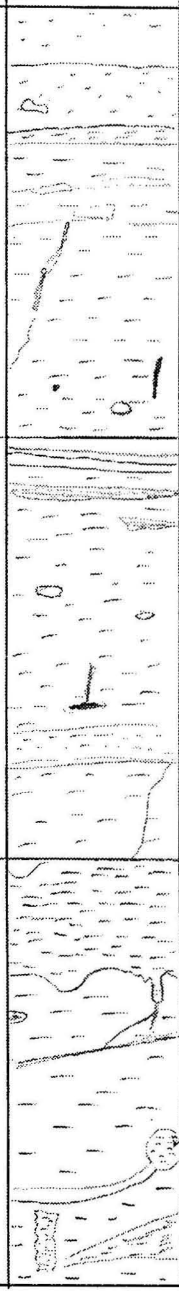
Depth (cm)	Sub-Sample: Grain size	CaCO$_3$, TOC	14C		Visual Log	Colour	Grain size: clay <4µm	silt 4-63µm	f. sand .063-.25mm	m. sand .25-.5mm	c. sand .5-2mm	gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Pct A	320-324					5Y8/1								Forams		White, massively bedded very cohesive nano-foram ooze
																Cloth rag removed. Bottom of Core

Core Number: SS001 / GC004 Location: GAB Marine Park Core Length: 4.94m

Latitude: 34° 51.403 Longitude: 130° 43.28 Date Core Taken: 16/5/00 Water Depth: 2012

Depth (cm)	Sub-Sample: Grain size, $CaCO_3$, TOC	^{14}C	Colour	Fossils	Sed. Structures	General description and Remarks
0–100 (Part E)	0-2, 5-6, 10-11, 20-21, 40-41, 60-61, 80-81, 100-101		10YR8/3, 5Y6/3, 5Y7/2, 5Y7/2	Forams	≠, J, J	Light gray foram-nano ooze with numerous bioturbation structures. Numerous black to dark gray mottles throughout core. Large burrow w/ black infill
100–200 (Part D)	120-121, 140-141, 160-161, 180-181, 200-201		5Y6/1, 5Y3/1, 5Y7/1, 5Y6/2, 5Y7/1		=, J, J	Laminated ooze. Lithology as above. Black burrow structure. Slightly darker bed w/ gradational boundaries
200–300 (Part C)	220-221, 240-241, 260-261, 280-281, 300-301		5Y6/2, 5Y7/1, 5Y6/2	Forams	≠, J, J	Bioturbated light olive gray to light gray nano-foram ooze with black (iron sulphide?) streaks + spots. Large (10cm) burrow structures

Visual Log:



Grain size: clay <4µm; silt 4-63µm; f. sand .063-.25mm; m. sand .25-.5mm; c. sand .5-2mm; gravel >2mm. Sorting/roundness.

Core Number: SS001 / GC004 Location: GAB Marine Park Core Length: 4.94 m

Latitude: 34° 51.403 Longitude: 130° 43.28 Date Core Taken: 16/5/00 Water Depth: 2012

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: CaCO3, TOC	Colour	Fossils	Sed. Structures	General description and Remarks
Part B			5Y8/1			Bioturbated light gray to light olive gray nanno-foram ooze.
	320-321	320-321				
	340-341	340-341	5Y6/2			Micro faulting ?
	360-361	360-361				
	380-381	380-381	10GY7/1	Forams		Slight greenish tinge (10GY7/1) associated with black streaks and spots
400	400-401	400-401				
Part A			5Y7/1	Forams		
	420-421	420-421	5Y8/1			Bioturbated light gray to white nanno-foram ooze
	440-441	440-441	10GY7/1			slight greenish tinge to many beds with gradational upper + lower boundaries associated with black streaks + spots.
	460-461	460-461				
	480-481	480-481	5Y6/1			Convoluted laminae
						Bottom of Core

Core Number: SS001 / GC005 Location: GAB Marine Park Core Length: 4.44 m

Latitude: 35°01.788 Longitude: 130°40.082 Date Core Taken: 17/8/00 Water Depth: 2518

Depth (cm)	Sub-Sample: Grain size / CaCO3, TOC	14C	Visual Log	Colour	Grain size	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Part E (0–46)	0-2, 4-5, 13-14, 20-21, 40-41			10YR8/3, 10YR7/4			Forams		Very pale brown sandy Foraminiferous ooze, decreasing sand content down-core. ↓ Bioturbated darker colour as above but lesser sand content.
Part D (46–146)	60-61, 80-81, 100-101, 120-121, 140-141			10YR7/3, 10Y6/1, 10YR6/4, 10YR8/3, 10YR7/8, 10YR8/2, 10YR6/4					Laminated / bioturbated very pale brown to light yellowish brown foram nano ooze with greenish gray burrows. Yellow/pale brown laminae. White massively bedded to faintly laminated ooze, finer grained (?). Wavy laminae light yellowish brown to pale brown, sandier than above?
Part C (146–244)	160-161, 180-181, 200-201, 220-221, 240-241			2.5Y7/1, 2.5Y7/1, 10GY5/1			Forams		Light gray nano-foram ooze with black laminae. Intensely laminated. Slight greenish tinge.
Part B (244–)	260-261, 280-281, 300-301			2.5Y7/1					Numerous black streaks + spots. Light gray nano-foram ooze

Core Number: SS001/GC005 Location: GAB Marine Park Core Length: 4.44 m

Latitude: 35° 01.788 Longitude: 130° 40.082 Date Core Taken: Water Depth:

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: $CaCO_3$, TOC	Sub-Sample: 14C		Visual Log	Colour	Grain size	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
						2.5Y7/1					
	320-321										
						10GY8/1					
344	340-341										
	360-361										White to light grey nano-foram ooze with black laminae and some mottles.
	380-381										
	400-401					2.5Y8/1					
	420-421										
	440-441										
											Bottom of Core

Core Number: SS001/GC06 Location: GAB Marine Park Core Length: 0.47m

Latitude: 35° 04.401 Longitude: 130° 50.357 Date Core Taken: 17/5/00 Water Depth: 2666

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: $CaCO_3$, TOC	Sub-Sample: 14C		Visual Log	Colour	Grain size	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
	0-2, 4-5, 10-11					10YR7/3					Very pale brown sandy foram-nano ooze with mottles
	20-21								Foram		
	40-41					5GY7/1					Reacts with HCl
47cm											Bottom of Core

54

Core Number: SS001 / GC007 Location: GAB Marine Park Core Length: 0.13 m

Latitude: 35° 10.134 Longitude: 130° 37.03 Date Core Taken: 16/5/00 Water Depth: 3278

Depth (cm)	Sub-Sample: Grain size	Sub-Sample: $CaCO_3$, TOC	Sub-Sample: 14C	Sub-Sample	Visual Log	Colour	Grain size: clay <4µm	Grain size: silt 4-63µm	Grain size: f. sand .063-.25mm	Grain size: m. sand .25-.5mm	Grain size: c. sand .5-2mm	Grain size: gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Part A	0-2 11-13					7.5YR 7/3									≠	Pink slightly sandy clay with planktic forams
13cm																Bottom of core Some rxn with HCl

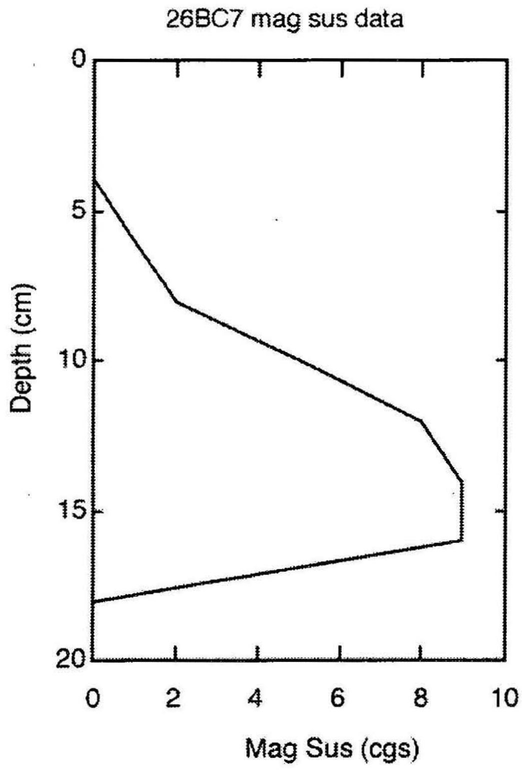
Core Number: SS001 / GC08 Location: GAB Marine Park Core Length: 1.53 m

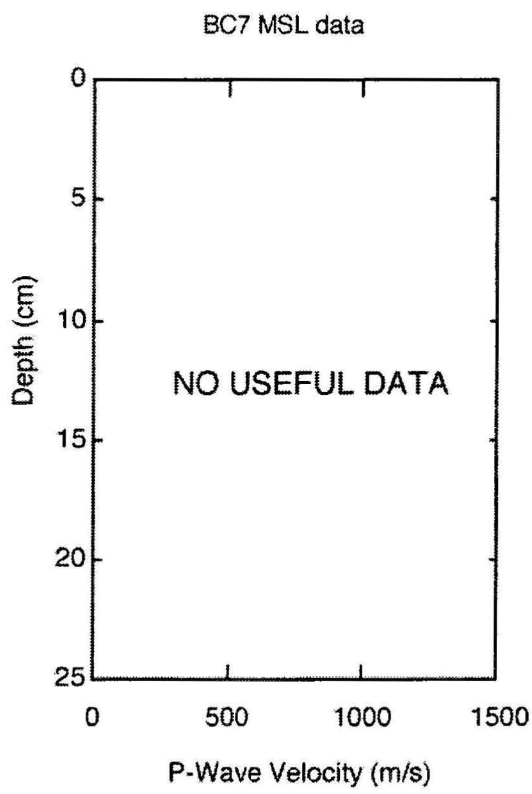
Latitude: 35° 35.895 Longitude: 130° 37.072 Date Core Taken: 17/5/00 Water Depth: 5250 m

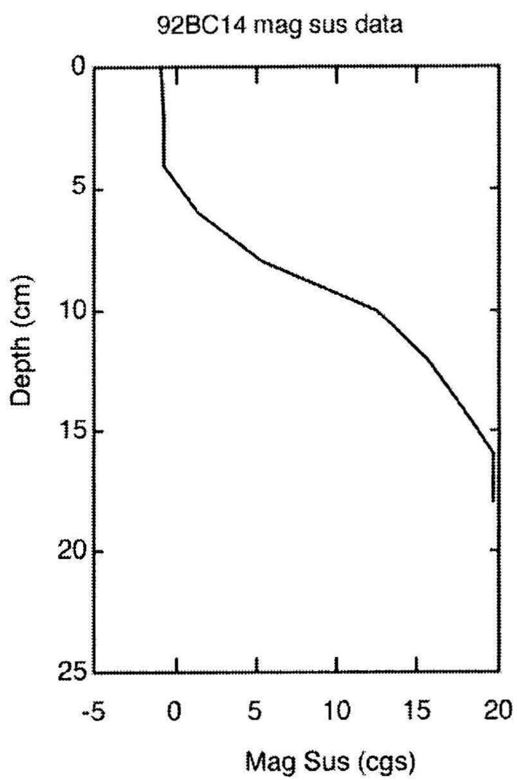
Depth (cm)	Sub-Sample: Grain size	Sub-Sample: $CaCO_3$, TOC	Sub-Sample: 14C	Sub-Sample	Visual Log	Colour	Grain size: clay <4µm	Grain size: silt 4-63µm	Grain size: f. sand .063-.25mm	Grain size: m. sand .25-.5mm	Grain size: c. sand .5-2mm	Grain size: gravel >2mm	Sorting/roundness	Fossils	Sed. Structures	General description and Remarks
Part B	0-2 5-6 10-11 20-21 40-41 60-61				Disturbed	10YR5/3 Gradational 10Y 7/1								? Forams	≠ ∪ ≠	Brown nano-foram ooze VERY DISTURBED slight reaction to HCl
64															≠	
Part A						N3 10YR6/2 N3									= J	Intensely laminated (turbidite?)
						10YR7/2									J =	Horizontal burrows in a light gray to pale brown foraminiferous ooze. laminated lenses
						N3 10Y5/1 10Y7/1									J	Black iron-sulphide spots & clasts.
153																
																Bottom of Core

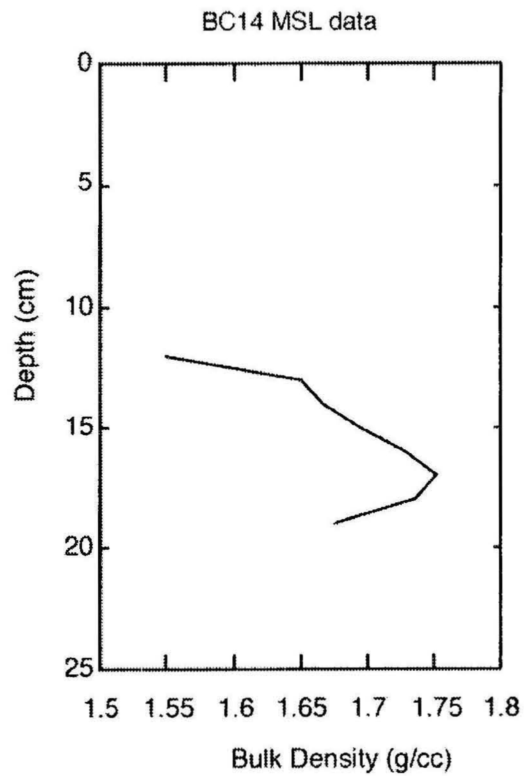
APPENDIX C

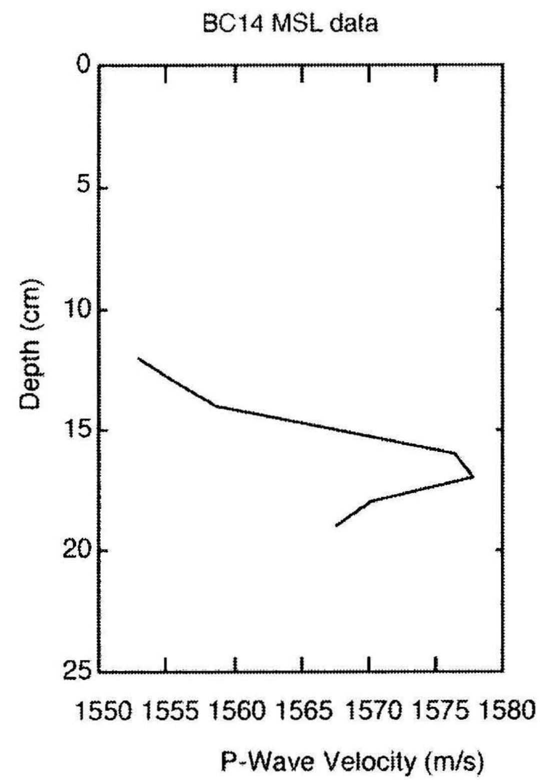
GAMMA-RAY BULK DENSITY, P-WAVE VELOCITY AND MAGNETIC SUSCEPTIBILITY LOGS OF CORES

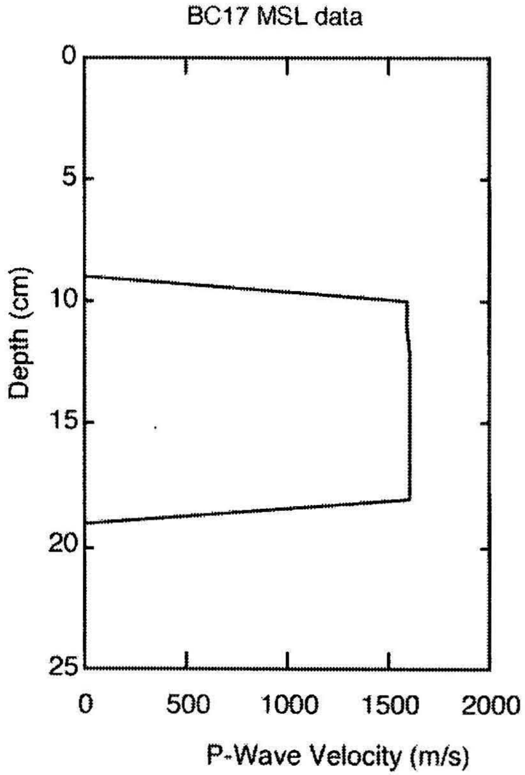


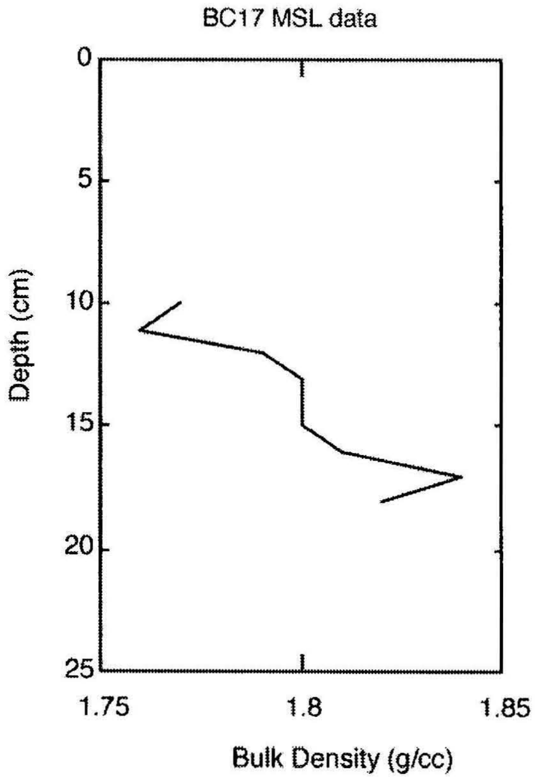


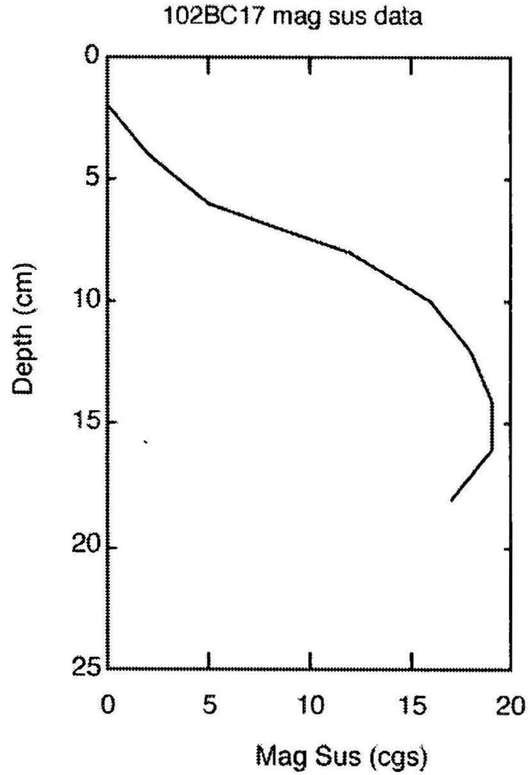

92BC14 mag sus data
Depth (cm)
0
5
10
15
20
25
-5
0
5
10
15
20
Mag Sus (cgs)

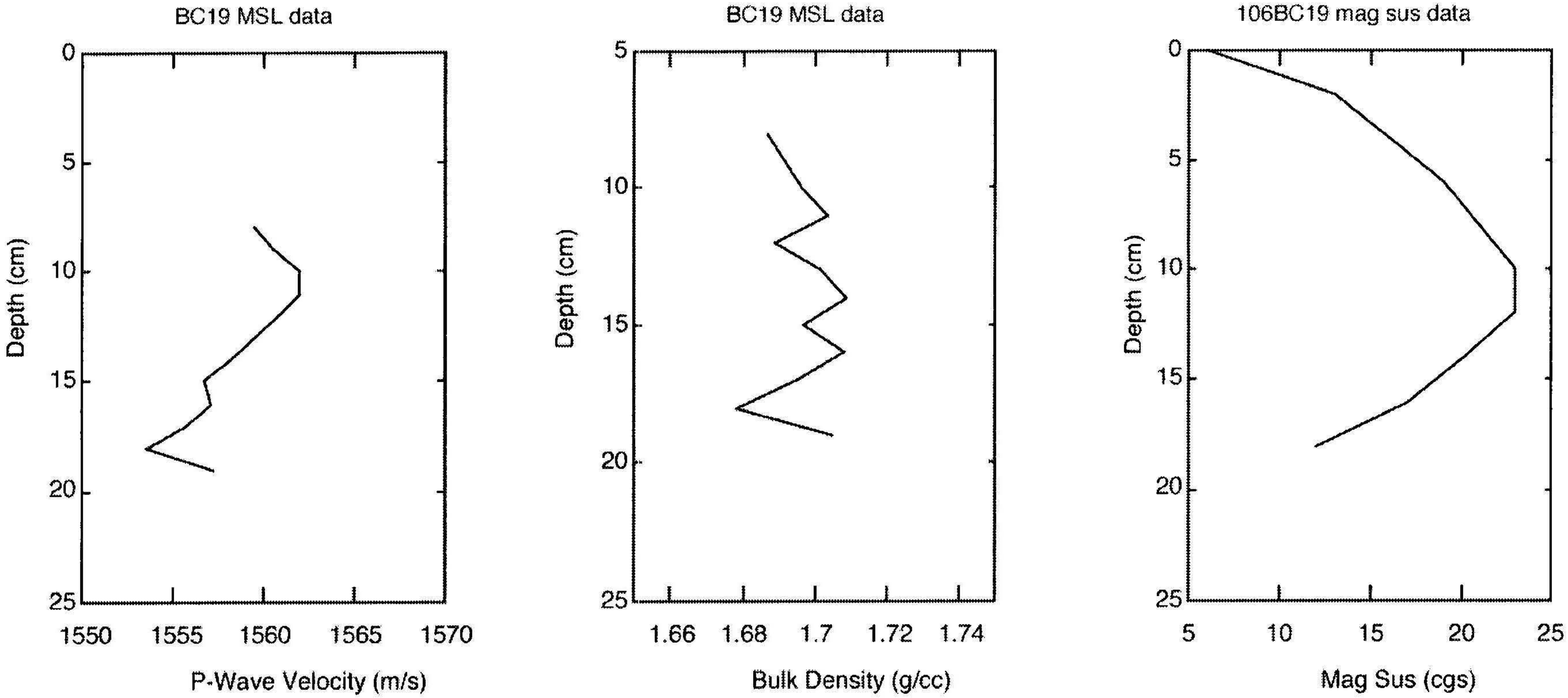

BC14 MSL data
Depth (cm)
0
5
10
15
20
25
1.5
1.55
1.6
1.65
1.7
1.75
1.8
Bulk Density (g/cc)


BC14 MSL data
Depth (cm)
0
5
10
15
20
25
1550
1555
1560
1565
1570
1575
1580
P-Wave Velocity (m/s)

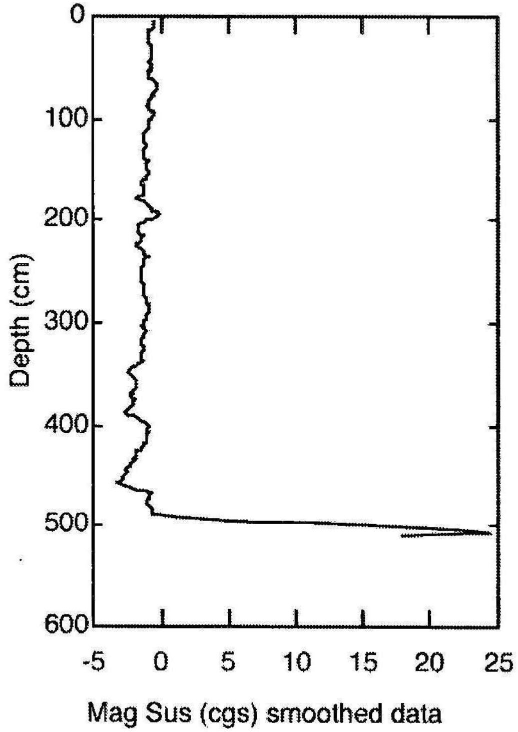

BC17 MSL data
Depth (cm)
0
5
10
15
20
25
0
500
1000
1500
2000
P-Wave Velocity (m/s)


BC17 MSL data
Depth (cm)
0
5
10
15
20
25
1.75
1.8
1.85
Bulk Density (g/cc)

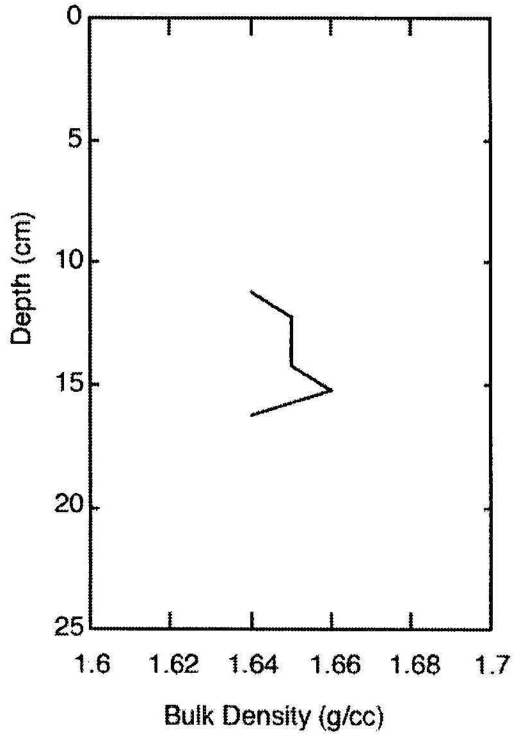

102BC17 mag sus data
Depth (cm)
0
5
10
15
20
25
0
5
10
15
20
Mag Sus (cgs)


BC19 MSL data
Depth (cm)
P-Wave Velocity (m/s)
BC19 MSL data
Depth (cm)
Bulk Density (g/cc)
106BC19 mag sus data
Depth (cm)
Mag Sus (cgs)

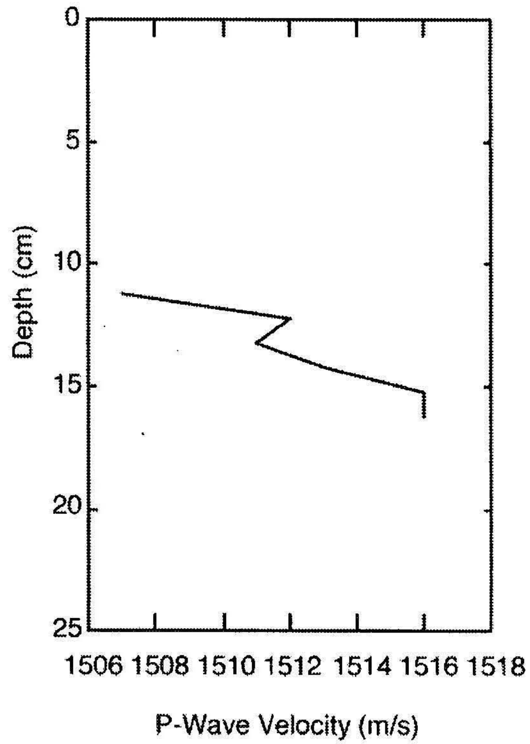
392GC01 Mag Sus Data

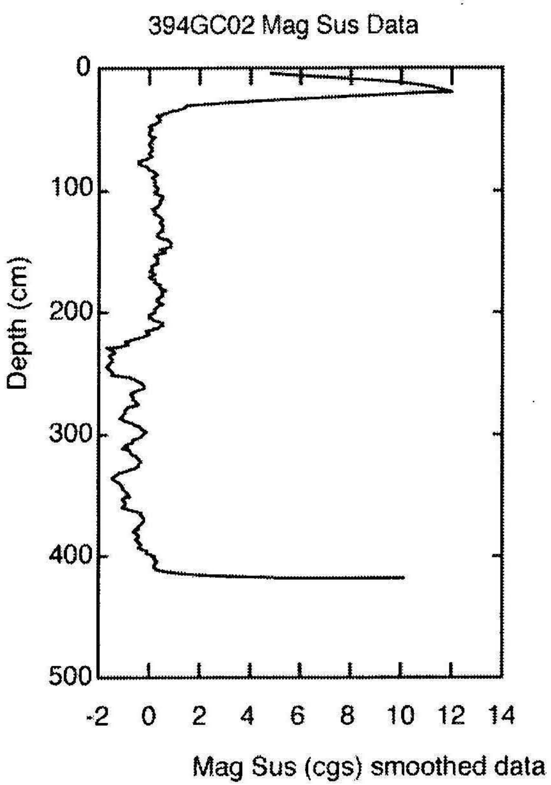


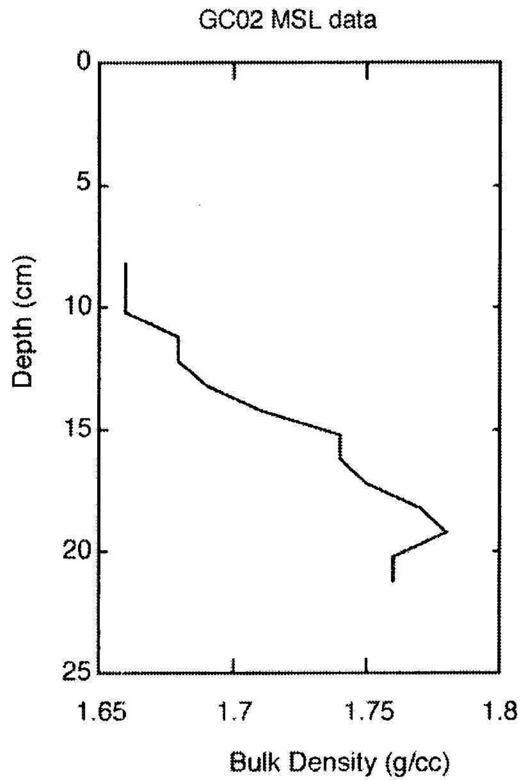
GC01 MSL data

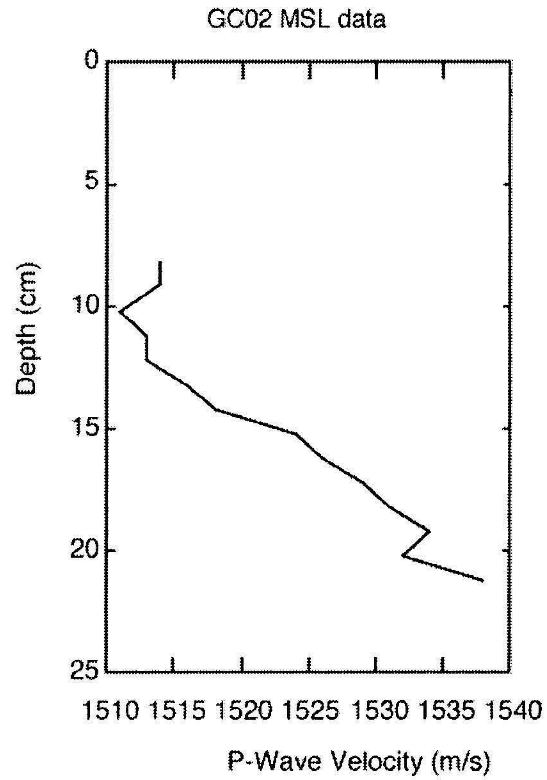


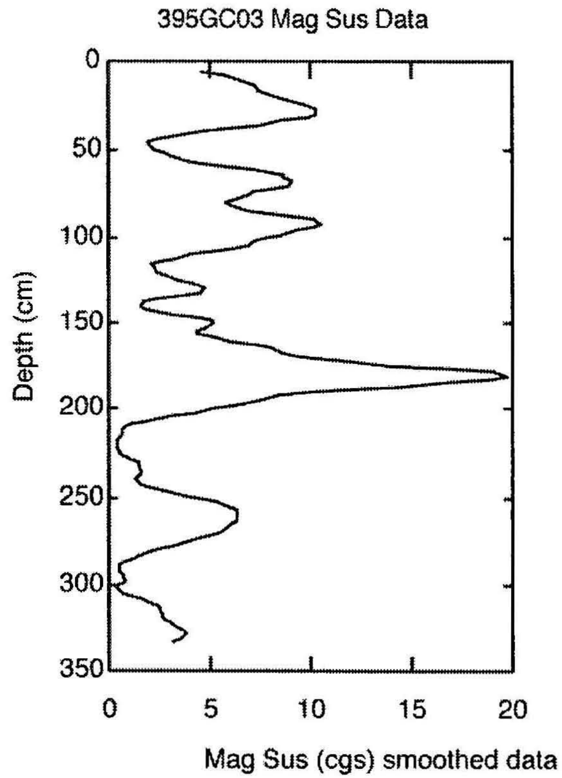
GC01 MSL data

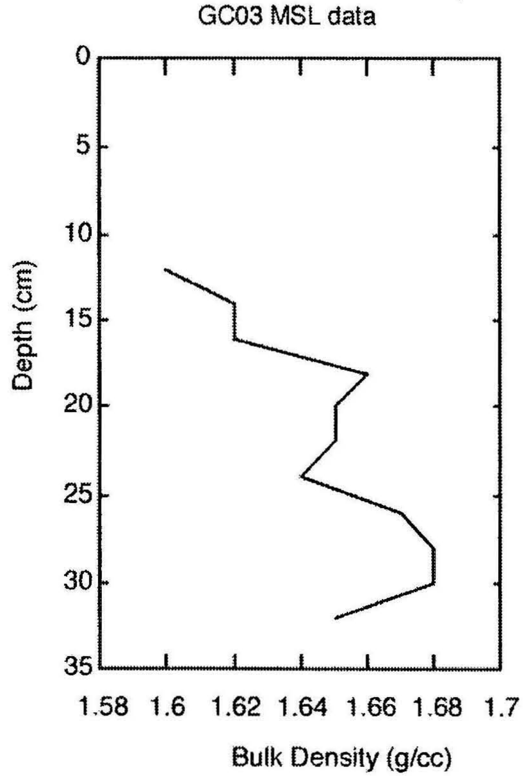


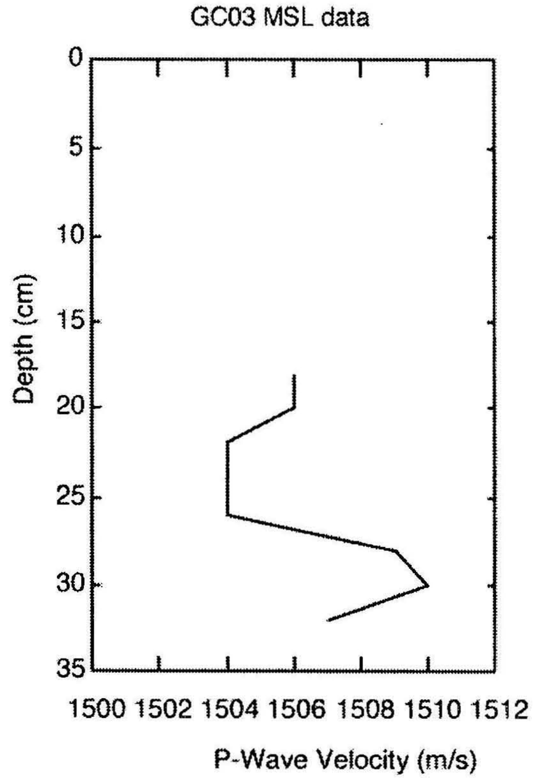

394GC02 Mag Sus Data
Depth (cm)
0
100
200
300
400
500
-2 0 2 4 6 8 10 12 14
Mag Sus (cgs) smoothed data

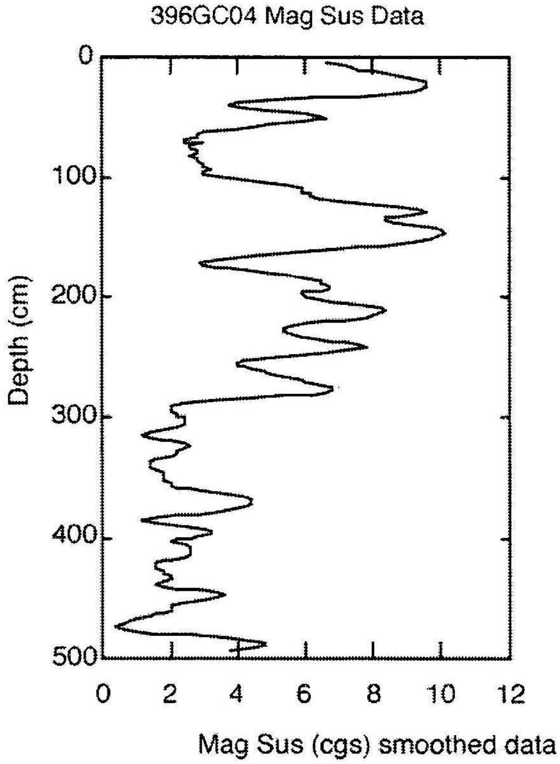

GC02 MSL data
Depth (cm)
0
5
10
15
20
25
1.65 1.7 1.75 1.8
Bulk Density (g/cc)

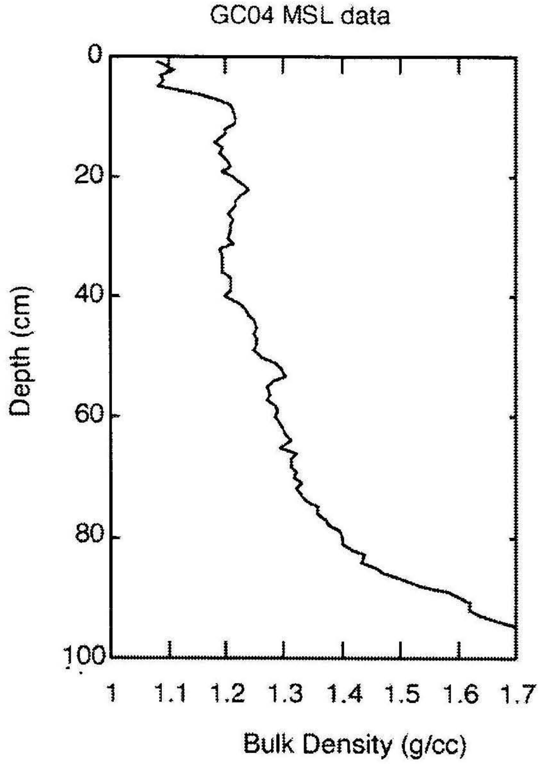

GC02 MSL data
Depth (cm)
0
5
10
15
20
25
1510 1515 1520 1525 1530 1535 1540
P-Wave Velocity (m/s)

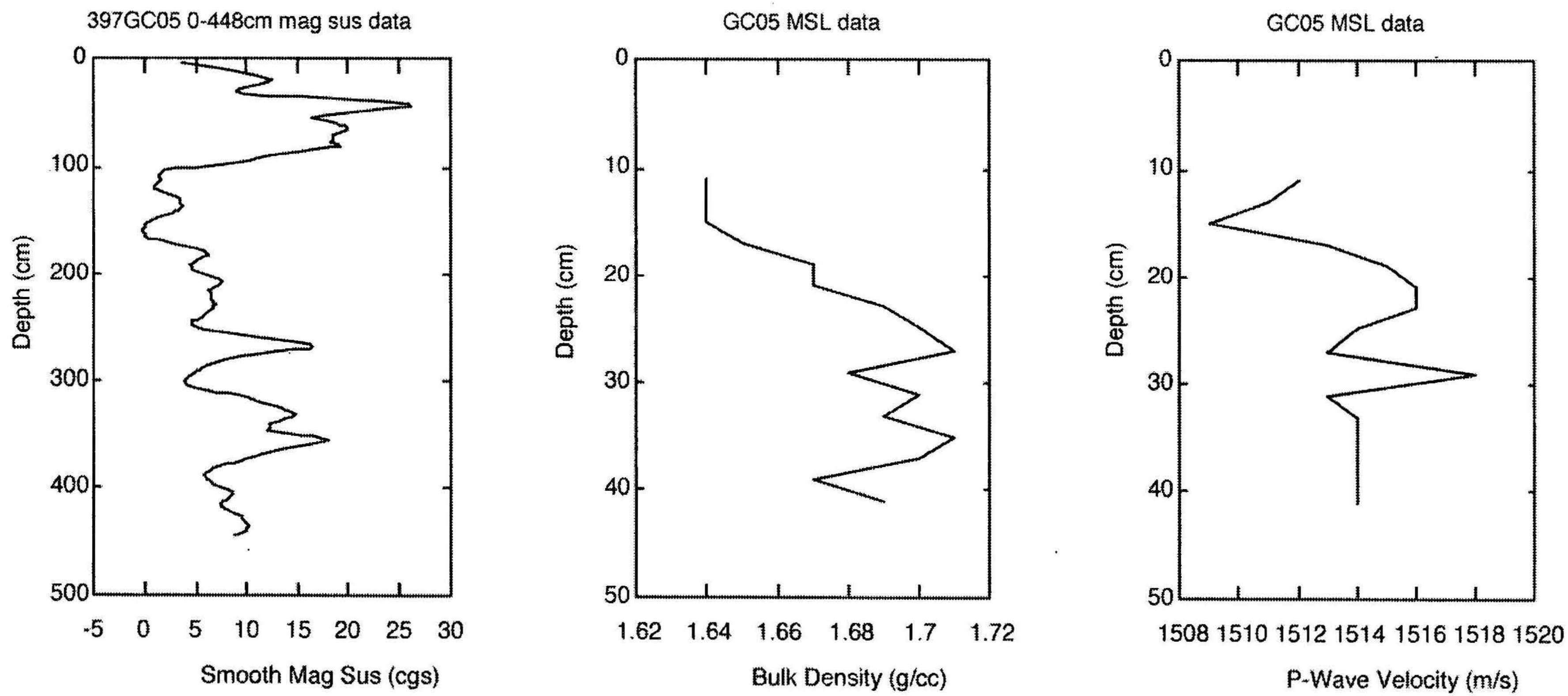

395GC03 Mag Sus Data
Depth (cm)
0
50
100
150
200
250
300
350
0
5
10
15
20
Mag Sus (cgs) smoothed data

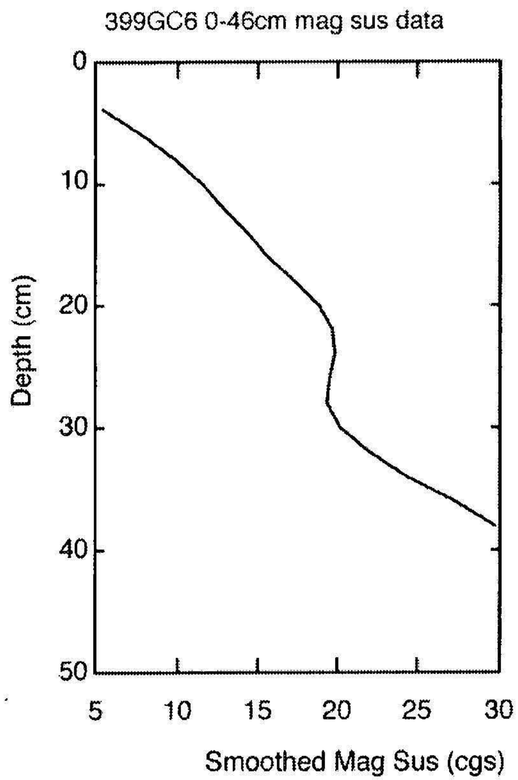

GC03 MSL data
Depth (cm)
0
5
10
15
20
25
30
35
1.58
1.6
1.62
1.64
1.66
1.68
1.7
Bulk Density (g/cc)

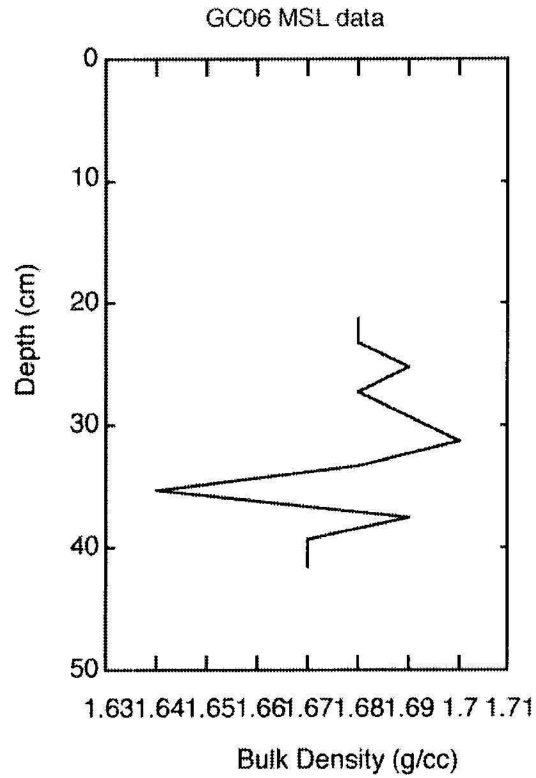

GC03 MSL data
Depth (cm)
0
5
10
15
20
25
30
35
1500
1502
1504
1506
1508
1510
1512
P-Wave Velocity (m/s)

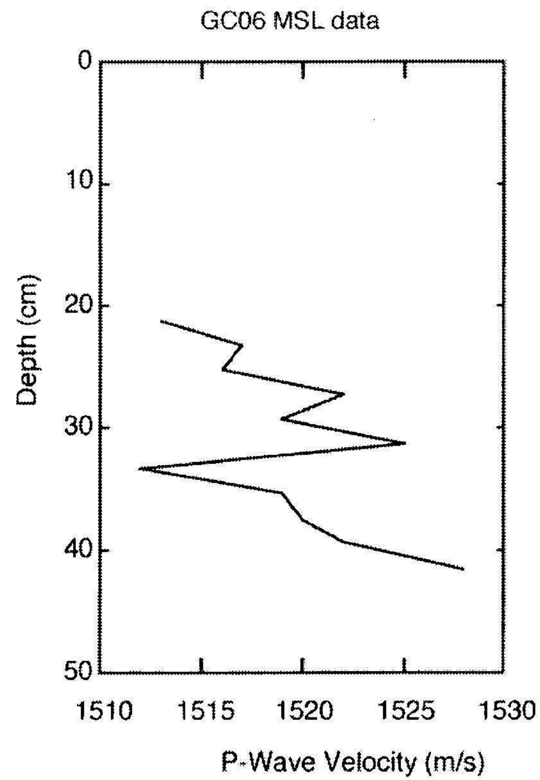

396GC04 Mag Sus Data
Depth (cm)
0
100
200
300
400
500
0 2 4 6 8 10 12
Mag Sus (cgs) smoothed data

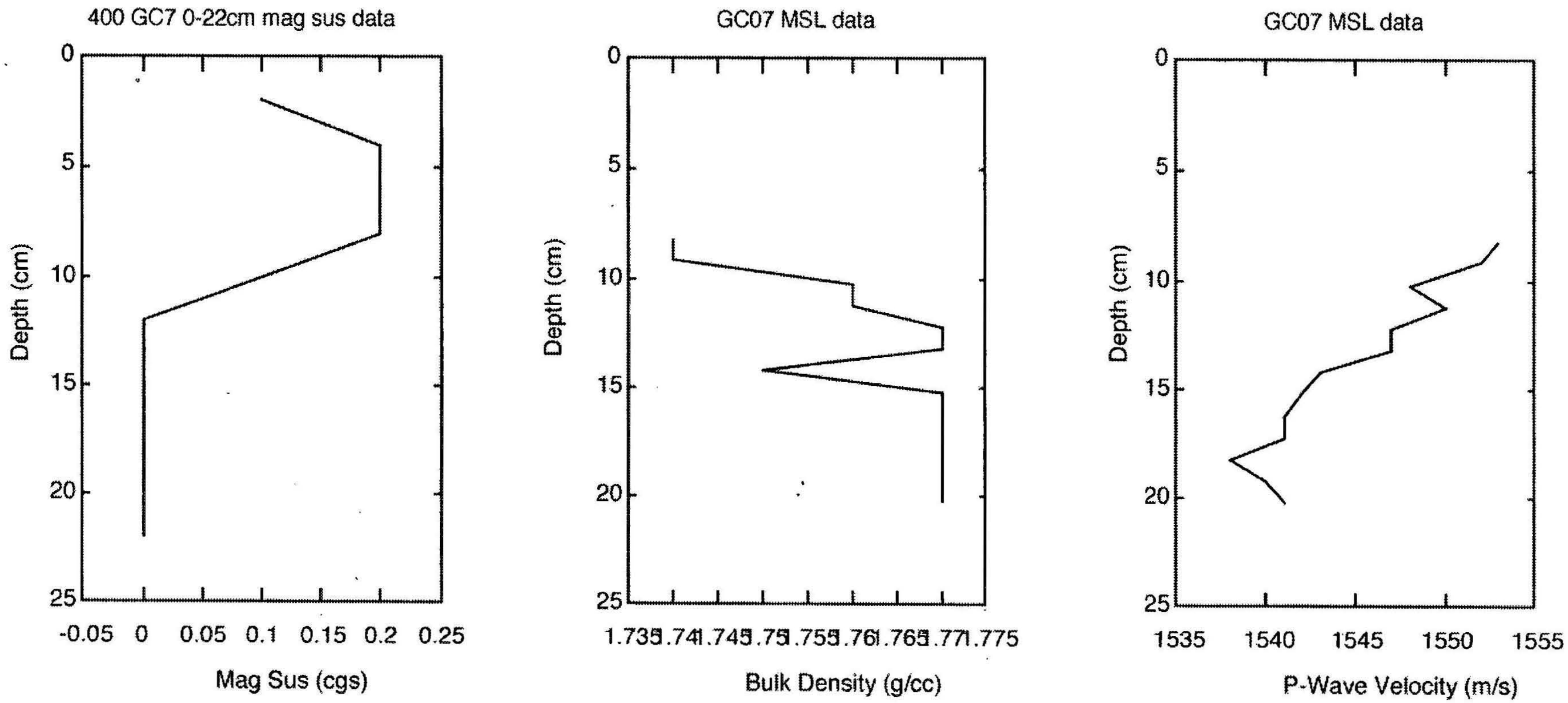

GC04 MSL data
Depth (cm)
0
20
40
60
80
100
1 1.1 1.2 1.3 1.4 1.5 1.6 1.7
Bulk Density (g/cc)

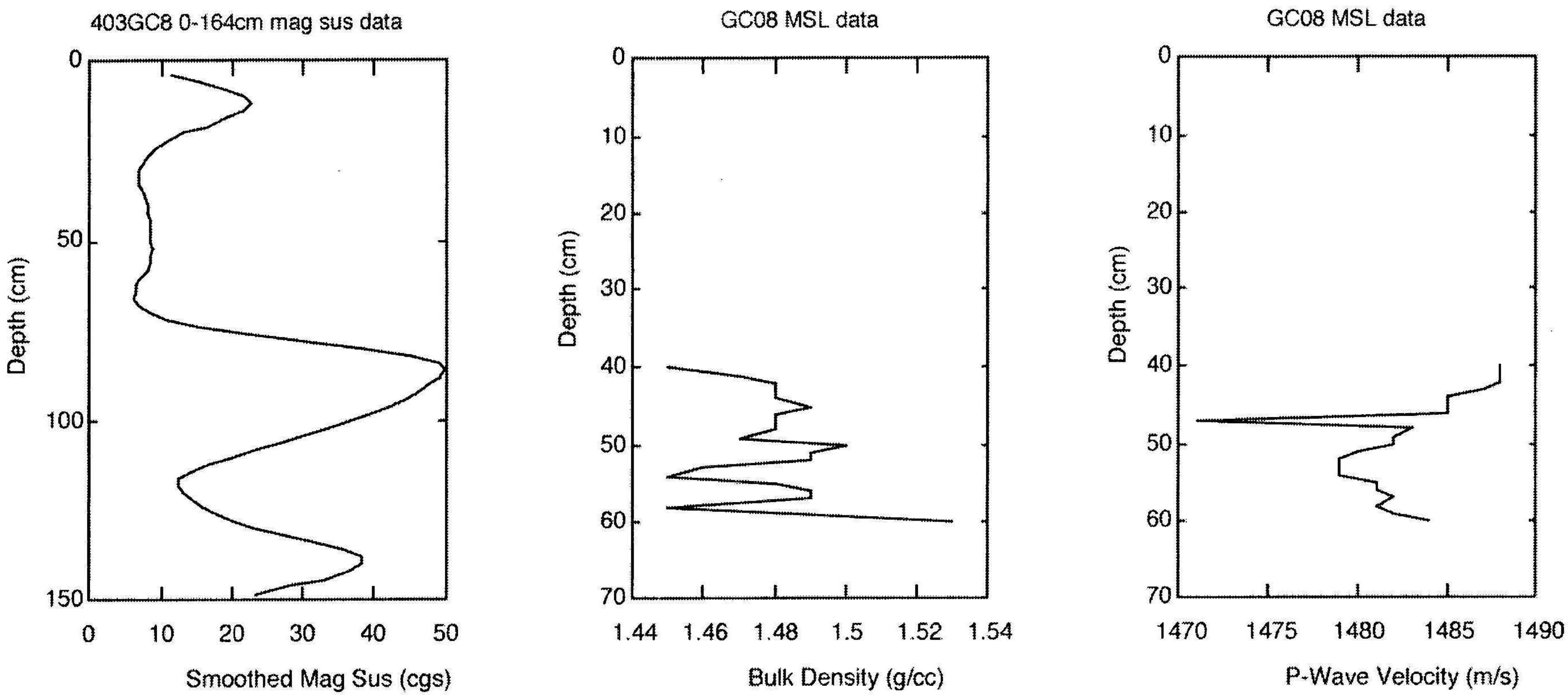

397GC05 0-448cm mag sus data
Depth (cm)
Smooth Mag Sus (cgs)
GC05 MSL data
Depth (cm)
Bulk Density (g/cc)
GC05 MSL data
Depth (cm)
P-Wave Velocity (m/s)


399GC6 0-46cm mag sus data
Depth (cm)
0
10
20
30
40
50
5
10
15
20
25
30
Smoothed Mag Sus (cgs)


GC06 MSL data
Depth (cm)
0
10
20
30
40
50
1.631.641.651.661.671.681.69 1.7 1.71
Bulk Density (g/cc)


GC06 MSL data
Depth (cm)
0
10
20
30
40
50
1510
1515
1520
1525
1530
P-Wave Velocity (m/s)


400 GC7 0-22cm mag sus data
Depth (cm)
0
5
10
15
20
25
-0.05
0
0.05
0.1
0.15
0.2
0.25
Mag Sus (cgs)
GC07 MSL data
Depth (cm)
0
5
10
15
20
25
1.735
1.74
1.745
1.75
1.755
1.76
1.765
1.77
1.775
Bulk Density (g/cc)
GC07 MSL data
Depth (cm)
0
5
10
15
20
25
1535
1540
1545
1550
1555
P-Wave Velocity (m/s)


403GC8 0-164cm mag sus data
Depth (cm)
0
50
100
150
0
10
20
30
40
50
Smoothed Mag Sus (cgs)
GC08 MSL data
Depth (cm)
0
10
20
30
40
50
60
70
1.44
1.46
1.48
1.5
1.52
1.54
Bulk Density (g/cc)
GC08 MSL data
Depth (cm)
0
10
20
30
40
50
60
70
1470
1475
1480
1485
1490
P-Wave Velocity (m/s)

APPENDIX D

Descriptions of Sediment Samples (B Radke)

SS01/2000 Site134

Sample Number 134DR01

Water Depth 100m

Photograph Number 134DR01

Macroscopic Description

Cobble, 210mm D long axis, has a brownish black (5YR2/1) outer algal-oxide? Coating, and has adherent v c quartz and bioclastic sands carbonate-cemented to the underside. The cobble lithology is igneous.

The cobble surface is encrusted with biota. The lighter coloured underside has serpulids, soft hydrozoans, encrusting bryozoa, sponges, and some centimetre-sized cavities from bioerosion. On the upper surface, sponges are predominant with minor soft worm tubes, barnacles and minor bryozoa.

The traces of adherent shelly sandstone are speckled pale brown (5YR5/4) and contain moldic pores from complete *Pecten* and *Mytilus*? Valves. Component quartz particles are rounded, subequant, and clear to translucent red.

Comment: The moldic porosity after shells implies subaerial weathering and implies the cementing sediment is Pleistocene or older.

SS01/2000 Site 138

Sample Number 138 DR3

Water Depth 120 m

Photograph Number 138DR03under, upper

Macroscopic Description

One cobble-sized fragment of outcrop or float (230 x 130 x 90 mm deep). Both upper and lower surfaces of the fragment are encrusted. The upper surface has a darker, dusky brown hardened ferruginous crust on a convoluted and burrowed surface. The ferruginous crust is absent from previous high points where the softer sandstone of the clast core (dark yellow brown – 10YR4/4) is now exposed in erosional depressions.

The under surface is very porous, convolute, with large solution/bioerosion? -enhanced cavities (centimetre to decicentimetre-sized). Thin tubed serpulid encrustations are very dense locally on the underside, and there are some bryozoal encrustations.

The host sandstone is speckled dark yellow orange (10YR5/6 – 10YR5/4), comprises m-c quartz sand, shell hash, and carbonate matrix. The rock has a laminar fabric from aligned pelecypod valve fragments. Speckled colour and moldic porosity are linked dissolution of gastropod and pelecypod fragments.

Comments: Evidence of subaerial weathering (moldic porosity and variegated oxidation) indicates an age older than Pleistocene.

SS01/2000 Site 139

Sample Number 139DR04

Water Depth 112m

Photograph Number 139DR04

Macroscopic Description

Two lithotypes were sampled:

1. Four pebble-sized fragments of coke with minor to negligible surface encrustation, and
2. Two fragments of outcrop or large float.

The latter fragments comprise moderate yellow brown (10YR5/4) speckled, very coarse bioclastic and quartzose grainstone with carbonate cement. Coarser bioclasts are millimetre (dominant) to centimetre-sized (minor) fragments of pelecypods and bryozoa. Porosity exceeds 20-30%, with significant moldic pores after the coarse bioclasts. Coarse to very coarse quartz sand is rounded, clear to opaque.

Textural variation in the grainstone is enhanced in weathered surfaces which are moderately encrusted by ? stromatoporoid, hydrozoa, stalked and encrusting bryozoa, stalked solitary corals, serpulids and tubular sponges.

Comment: Moldic porosity and speckled weathering indicates subaerial exposure and a minimum age of Pleistocene.

SS01/2000 Site 141

Sample Number 141 BS01

Water Depth 261- 338m

Photograph Number 141BS01

Macroscopic Description

Two lithotypes differentiated:

1. Moderate yellowish brown (10YR5/4) to light brown (5YR5/4) porous and moderately friable platy clasts of calcareous ferruginous sandstone. The clasts have pervasive 5mm-sized vertical to subvertical tubes. These boring tubes are about 30% lined with encrusting bryozoa. Minimal surface encrustation is by serpulids and bryozoa.

2. 50 – 60 mm sized clasts of bluish black (5b2/1) metallic fissile material (marine weathered and exfoliating steel?) with cemented medium to coarse quartz grains. High density of low relief surface encrustation by encrusting sponges, serpulids and oysters (disarticulated).

SS01/2000 Site 143

Sample Number 143 DR05

Water Depth 135m

Photograph Number 143DR05

Macroscopic Description

Very irregular thin platy fragments.

3 clasts of encrusted and marine-weathered steel.

One clast of dark yellowish brown (10YR4/4) ferruginous carbonate is a coarse to very coarse bioclastic grainstone with about 50% porosity, predominantly moldic. Carbonate cement predominates. Bryozoan and pelecypod fragments are identifiable, and medium to fine sands of quartz are present. The irregular rock surface is darkened, and has about 40% encrustation by sponges, serpulids, corals and worm tubes.

SS01/2000 Site 150

Sample Number 150BS03

Water Depth 392m

Photograph Number 150BS03

Macroscopic Description

Three lithotypes are differentiated:

1 clasts of coke and furnace slag
2 fragments of coal with surface encrustation
3 calcareous sandstone (photo)

3. Thin flake fragment (20 x 20 x 7 mm) of brownish black (5YR3/1) medium to coarse grained well sorted sandstone with rounded opaque particles (dark brown), fine lithics and quartz in white carbonate cement. This sandstone has a surface mould of a planar bryozoan fragment.

Comment: Colour suggests an older sandstone comprising lag deposit sands.

SS01/2000 Site 152

Sample Number 152TR

Water Depth 995 – 1007m

Photograph Number 152TR

Macroscopic Description

Consolidated but unindurated fine sandy mud with pyritised rare pelecypod fragments, mud clasts of centimetre to decimetre size, and about 3% glauconitic pellets (medium sized). The upper exposed surface is bored subhorizontally (cm sized) and vertically (millimetre-sized), and has a more oxidised sediment colour of very light olive grey (5Y7/1). This colour darkens to a light greenish grey at about 80 mm depth. This colour change is due predominantly to oxidation of pyrite which replaces some sediment particles.

SS01/2000 Site 154

Sample Number 154BS04

Water Depth 1500 m

Photograph Number 154BS04

Macroscopic Description

a) A 200 x 200 x 50mm sized fragment of outcrop or float has surface erosional features and horizontal borings (centimetre-sized diameters and partially filled with comminuted shell hash) but little encrustation except for some coral holdfasts. The undersurface has uniformly distributed millimetre-sized blind depressions. The semi-indurated very light olive grey (5Y6/2) very fine to fine labile sandstone has faint lamination and identifiable small echinoid spines and foraminifera. Vertical jointing in the rock has manganiferous dendritic concretions along the partings.

b) Light olive grey (5Y6/1) friable to semi-indurated very fine sandy mudstone with foraminifera and minor bryozoan fragments. A silt-sized to very fine sand of a black mineral is present at about 1%. The surface of the fragment of outcrop has centimetre-sized diameter blind boring tubes with surface iron and manganese? Staining.

c) A fragment of outcrop or float, 130mm x 40mm thick flagstone has a ferruginous (or algal) stained upper surface with an erosionally-smoothed appearance. Medium grey (N4) to olive grey (5Y5/1) finely laminated, very fine grained sandstone has rodlike mud clasts (photo), and about 1% of very fine black mineral sand.

d) small fragment of faceted subvitreous coal (N1)

Comment: The lithotypes are comparable to 158BS08

SS01/2000 Site 158

Sample Number 158 BS08

Water Depth 1518 – 1540m

Photograph Number 158BS08

Macroscopic Description

As well as the predominant mud four lithotypes are recognised.

a) Dark green grey (5G4/1) to moderate greenish grey (5GY5/1) muddy fine sand, sublithified with articulated but open molluscs and foraminifera?

Pelecypod shells have chalky alteration or are indicated by solution molds, indicating subaerial exposure.

b) Surface staining of moderate brown (5YR3/4), dark yellow brown (10YR4/2), light olive grey (5Y5/2), is on a case hardened irregular surface. Irregularities are from centimetre-sized borings by molluscs and other organisms, and subsequent erosional enlargement. Encrustation of about 5% of the upper surface is by branching corals, thin and much thicker serpulid tubes. Underside surface is uniformly pockmarked with millimetre-sized boring depressions.
The host clast is a sublithified soft clayey fine quartzose sandstone with a clay matrix. The dusky yellow (5Y7/4) colour is modified by darker iron oxidation liesegang rings.

Uniform very fine sandy mud attached to this large fragment is yellowish grey (5Y7/1) with minor iron stains of moderate brown (5YR3/4) to greyish orange (10YR7/4). Minor porcellaneous tests (forams? or gastropods??). This sediment may be the unlithified equivalent of the described cobble.

c) Black coal, fissile with vitreous and dusky coal macerals.

d) A broken pebble, 18 x 40 mm, which is well rounded and ellipsoidal (originally), dark brownish grey (5YR3/1), of a phenocrystic acid volcanic with free quartz and unweathered pinkish feldspar and siliceous matrix.

SS01/2000 Site 165

Sample Number 165BS09

Water Depth 11438 - 1520 m

Photograph Number 165BS09

Macroscopic Description

a) missing.

b) missing

c) Grey black (N2) to dark brownish grey (5YR3/1) surface staining on the cobble with about 5% of the surface encrusted by holdfasts of solitary corals and very thin serpulid tubes.
Cobble subequant, about 130mm D, rounded, smoth but irregular surface with shell moulds.

d) Medium greenish grey (5GY5/1) plastic uniform very sandy mud containing rare small fragments of chalky pelecypod valves and very small gastropods? or ostracods?

e) Outcrop of fragment of float. Solution-enhanced irregular surface with dark staining (ferruginous or algal?) and encrustation on 2% of surface by serpulids and solitary corals. Mottled (weathered) coquina with variegated colour ranging from unaltered olive grey (5Y4/1) to oxidised pinkish grey (5YR7/1). The coquina comprises shell hash of pelecypods, bryozoa, serpulids in boundstone fabric. Pelecypod fragments are devitrified, disarticulated, and exfoliating. Probable foraminifer and gastropod fragments.

f) Pebbles 50 – 60 mm D, subequant and well rounded, with dark surface staining. Grey black (N2) and speckled dark brownish grey (5YR3/1) with white to pink phenocrysts in translucent siliceous volcanics.

g) Pinkish grey (5YR7/1) large *Ostrea* fragment, 50 mm D, thick walled, bored, and weathered with exfoliating lamellae of the valve.

Comment: Subsamples c) and e) are the same lithotype

SS01/2000 Site 172

Sample Number 172 BS11

Water Depth 1809 - 1964m

Photograph Number 172BS11

Macroscopic Description

Three lithotypes were differentiated:

a) Plastic light olive grey (5Y6/1) homogeneous, calcareous cohesive mud with millimetre-sized vertical and branching meandroid tubular borings. Smaller borings are infilled with mud pellets. Foraminiferal? Ostracod? Tests.

b) coke

c) coke and smelting slag

SS01/2000 Site 180

Sample Number 180BS12

Water Depth 990 – 1006 m

Photograph Number 180BS12

Macroscopic Description

Two lithotypes are differentiated.

1. Cobble-sized fragment of outcrop. Sublithified very light olive grey (5Y7/1) very fine to fine (calcareous) sandstone with minor small shell fragments. Possible lithic and quartz grains. Joint fractured surfaces have manganiferous dendrite development. The upper ferruginous surface is case hardened and has centimetre-sized borings.

2. Two pieces of a fractured semi-indurated cobble. The surface is plastic, subindurated, with small borings by sponges? And minor serpulid encrustation. The muddy (calcareous) micrite contains pyritised small gastropods and trace ostracod? and bryozoan bioclasts. The pyrite is oxidised throughout. The cobble is fractured with oxidised sulphides of bioturbation? that intercepts fracture partings.

SS01/2000 Site 181

Sample Number 181BS13

Water Depth 1054m

Photograph Number -

Macroscopic Description

Eight lithotypes were sampled from this dredging.

1. coal
2. smelter slag
3. cobbles to boulders of igneous rocks
4. cobbles of schist
5. cobble of milky quartz
6. brachiopod? coquinoid sandstone with moldic porosity after the shells
7. bioturbated carbonate mud crust
8. carbonate crust

Components 1 to 5, and possibly 6, are most probably detritus from older shipping.

SS01/2000 Site 183

Sample Number 183 TR

Water Depth 379 – 439m

Photograph Number 183TR

Macroscopic Description

Semi-consolidated very light olive grey (5Y7/1) slightly calcareous muddy sand with foraminiferal? tests. The upper surface of the sediment has very fine millimetre-sized borings and large centimetre-sized borings with remnant shells that resemble linguloid forms. The surrounds to the larger borings have oxidation (ferruginisation). The upper surface has trace encrustation by serpulid tubes and coral holdfasts.

SS01/2000 Site 292

Sample Number 292

Water Depth 120m

Photograph Number 292

Macroscopic Description

Four lithotypes are differentiated, showing two progressions:
from cherty outcrop (292.1) to encrusted cherty outcrop (292.2), and
from porous bryozoan boundstone (292.3) to coralline algal and bryozoan boundstone (292.4).

292.1 fragments of outcrop? Have an irregular concretionary shape. The chalky surface of pinkish to yellowish white (5YR/1 to 5Y/1) covers a fresh very light olive grey (5Y7/1) carbonate which has calcareous black (N4) chert centres. Bryozoan fragment textures are preserved in the chert. Moldic porosity after scaphopods present in the carbonate. Minor geopetal cemented sediments of bioclastic hash are preserved in some of the solution tubes on the irregular sample surface.

292.1 Rocktype comparable to that above but with larger proportion of the very light olive grey (5Y7/1) carbonate. The outer surface is comparably irregular with karstic morphology on the chalky exterior. The surface has approx. 50% old encrustations of serpulids, coralline algae, and bryozoa. Incorporated on this encrusted surface are rounded quartz sand and iron stained rounded carbonate and quartz sand particle. The upper surface? is highly pigmented with coralline algal encrustation. The lower? surface is more pallid with predominantly sponge and bryozoan encrustation, and agglutinated sand-granule burrow casings of worms?

292.1 Platy clasts, 30-50 mm thick, vari sized from 110-50 mm D, with older vesicular, highly porous appearance. Entirely boundstone (encrustation) carbonate. An iron-stained moderate yellowish orange (10YR6/4) carbonate core (with high shelter-framework porosity) is encrusted with a later generation of bryozoa, coralline algae, and minor serpulids and sponges. Smaller cobbles approach rhodolith appearance as below.

- Iron-stained dense to porous brown carbonate, moderate yellowish brown (10YR5/2) to pale brown (5YR5/4), has encrustation by coralline algae and minor serpulids.

SS01/2000 Site 297

1. Sample Number 297

Water Depth 40m

Photograph Number 297a,b,c,d *(note number error on annotation of photos)*

Macroscopic Description

Four lithotypes are recognised within the dredged material.

a) 140 - 46 mm D clasts of moderate brown (5YR3/4) to pale greyish brown (5YR4/2) ferruginous crust (goethitic? Nodule) with centimetre-sized solution and bioenhanced vesicular texture. A thin encrustation covers 10-40% of the upper surface and comprises calcareous worm tubes, coralline algae, fenestrate bryozoa, benthic forams, boring pelecypods. This encrustation is varicoloured, white, grey (N7), moderate pinkish orange (10R7/6), pale yellowish green (5GY8/4), and pale red (10R6/2). The undersides of clasts have bryozoan and very fine serpulid tubule encrustation of v pale orangeish brown (10YR7/2).

b) Relict subrounded carbonate cobbles (80-125mm D) of slight variegated colour (10YR6/4, 5Y8/1, N8 & N9). Consist of porous ? bioclastic boundstone? where gastropod fragments are bound by bryozoans. Cobble surfaces are variably vesicular from mollus, sponge? and/or worm borings. Surface encrustation is by coralline algae or encrusting forams (ie *Homotrema*), soft sponges and worm tubes. One cobble resembles a whale bone.

c) 81-150mm D pieces of 20-60mm thick crust that has a dark stained weathered surface with chalky texture. Surfaces are highly irregular in form, rounded and with large cavities. Cobble surface mimics internal dark grey (N3) chert concretions that grade outwards to light grey (N8-N7) chalky carbonate. Very minor encrustation on the chalky surface that is greyish orange (10YR7/4) to very pale orange (10YR8/2).

d) Fragments up to 130mm of 50-60mm thick slabs of highly irregularly shaped chert. Outer surface is pinkish to yellowish white (5YR9/1-5Y8/1). Internally, chalky carbonate (N8,N9) grades to central black calcareous chert (N3). Cobble shapes closely follow that of chert replacement in precursor limestone. Cobble surfaces are only partly encrusted by clusters of chitinous worm casings, encrusting bryozoa (*Homotrema*?), coralline algae and serpulids.

SS01/2000 Site 367

Sample Number 367G

Water Depth 90m

Photograph Number 367

Macroscopic Description

Variegated white (N8) (bivalves) to yellowish grey (5Y7/1) older bryozoan bioclastic hash. Sample comprises:

15% pelecypods: pectens, ostreacea, new but disarticulated; *Melosia*? (very old fragments)
70.4 % bryozoa; abundant encrusting forms and minor fenestrate (old), encrusted by forams; free cap-shaped colonies
0.1% foraminifera; encrusting ie *Homotrema*?, sessile,
10% gastropods, *Fascioria*? and turritellid fragment.
2% echinoids, regular and irregular
0.5% brachiopods, terebratuloid, articulated but broken
0.5% corals, branching
0.5% serpulid boundstone
1% arthropods, spiny disarticulated segments encrusted in bryozoa (old, calcified)

Discussion:

Bioclasts comprise mixture of older and fresh material of pelecypods and bryozoa, as well as that of less abundant brachiopods, corals and serpulid boundstone. Unable to recognise any relict (ie Pleistocene or older) component on the basis of extensive staining etc.

SS01/2000 Site

Sample Number DR01 (AGSO)

Water Depth 3220 – 2735m

Photograph Number DR01, DR01sieved

Macroscopic Description

The predominant sediment is uniformly pale yellow brown (10YR7/2) sandy foraminiferal mud. Random millimetre-sized indurated black flakes (oxide crust fragments?) are present.

Homogeneous mud lumps, centimetre-sized, are dark brownish black with fracture-controlled partings of oxidised ferruginous stains, dark brownish grey (5YR3/1).

One clast, 50 mmD, has a uniform black (N1) iron-manganese oxide surface crust about 1 mm thick, with an outer surface texture that appears microcolliform and dendritic. This crust has an inner gradational transition through goethitic colours to the core of indurated sandstone that is dark yellow brown (10YR4/2). The sandstone is quartzose with a carbonate, possibly dolomitic, matrix. The oxide crust is absent in places where millimetre-sized subspherical depresssions expose the host sandstone. The regularity of depression size indicates probable origin from bioerosion.

SS01/2000 Site

Sample Number DR02 (AGSO)

Water Depth 4350 - 3850 m

Photograph Numbers DR02a, DR02b, SS01DRO2zeolite
XRD file of DR02 mudlump SS01DR02 (AGSO no. 2000580002)

Macroscopic Description

The dominant sediment is a greyish brown (10YR7/2) foraminiferal mud with thixotropic properties (photo DR02a). Additional material comprised coherent dark mud lumps and black concretions.

Dark olive grey (5Y/3) mud occurs as coherent plastic lumps and lump aggregates that range from 5 to 40 mm D, predominantly centimetre-sized. This coherent sediment is more compact than the foraminiferal mud. Most lumps contain nonindurated to indurated millimetre-sized flakes of earthy oxidised ferruginous material, dark brownish grey (5YR3/1). Subrounded centimetre-sized areas within these lumps resemble porous friable laminar clasts. The laminar areas have clear euhedral prismatic crystals (about 500 microns long) that extend into the laminar vugs. These clear crystals contain numerous inclusions and are substrate to very small subspherical red-brownish clusters that resemble oxidised pyrite framboids. Laser spectroscopy of these prismatic crystals (Figures 3,4) indicated a possible zeolite and presence of brookite. XRD analysis of the laminar porous sediment which includes the prismatic crystals, confirms zeolite (possibly heulandite), quartz, ordered feldspar and albite, mica (possibly muscovite) and possible illite, nacrite, kaolinite, smectite, illite-montmorillonite, nontronite, chlorite, clinochlore, edingtonite (zeolite) and siderite.

Centimetre-sized black fragments have a delicate porous and sintery to cellular gossan appearance resulting from intersecting planes of manganese? and iron sesquioxides (dendrites?).

Comment: The predominant sediment is a planktonic ooze.

The coherent mud lumps are considered outcrop of Cretaceous paralic sediments which contain probable alteration and vug mineralisation. It is unresolved as to the timing and degree of pervasiveness of the zeolite/pyrite? occurrence.

The black sintery fragments also included in the dredge sample have a cellular gossanous structure indicating sesquioxide precipitation along millimetre-spaced conjugate and intersecting planes.

The association of the sesquioxide concretions and the zeolite/pyrite? occurrence indicate an alteration phase that followed tectonic fracturing of the Cretaceous host formation.

SS01/2000 Site

Sample Number DR03 (AGSO)

Water Depth 5248 – 4850m

Photograph Numbers
DR03agso, DR03clast, SSO1leg3DR03a, SSO1leg3DR03b

XRD file of DR03clast SS01DR03 (AGSO no. 2000580003)

Macroscopic Description

Two sediment types, and a large clast constitute the DR03 sample.

The predominant sediment is a pale yellowish brown (10YR7/2) foraminiferal mud with a thixotropic, sucrosic to plastic appearance. Silt to v f sand-sized black particles, with mostly tabular shape, comprise about 1% of the sediment. This component looks like haematite.

The minor sediment is coherent sandy silty mud to muddy sand, with weakly developed fissility. Colour ranges from dark yellow brown (10YR5/2) to dusky yellowish brown (10YR2/2) and fissility increases with the darkness of the sediment. The fissility is from subparallel partings with relatively oxidised ferruginous stains.

The clast, dimensioned 40 – 60mm, has a faceted appearance with concentric spheroidal outer layers of goethite, some layers incomplete. These weathered bands, liesegang bands in microstructure, are of alternating light to moderate brown colour

(5YR5/4 – 5YR4/4), and constitute a weathered rind of about 1 centimetre thickness. The unaltered clast lithology is a medium olive grey (5Y5/1) sideritic quartzose-feldspathic sandstone. XRD of this lithology indicates dominant siderite, quartz, feldspar (albite and microcline), and possible traces of halloysite, smectite, montmorillonite, nontronite, saponite, haematite, muscovite, chlorite, and clinochlore. PIMA analysis indicates Halloysite and nontronite at a ratio of (49:2). The subtle and variable colour of this host sediment results from the abundance of black wisps (pyritised particles). In some laminae, these pyritic components (unconfirmed) are oxidised to goethitic stained pores.

Comment: The sample is interpreted to be a planktonic ooze with an minor aeolian haematitic component. The weathered clast and darker mud are considered outcrop of semilithified Cretaceous paralic sediments.

The weathered and indurated clast has faceted form from tectonic jointing. The siderite is probably slowly dissolving as a result of the water depth (below carbonate compensation depth), with the concentric skins of orange goethitic material accumulating as a residual of this dissolution and oxidation of scattered pyrite within the host lithology.

SS01/2000 Site

Sample Number GC007 (AGSO)

GC07 had the least recovery of all gravity cores 1 to 8. Only 13 cm of Quaternary pinkish white mud was intercepted over compact dark green grey sediments which blocked the core catcher. Preliminary dating (Clinton Foster, pers. comm.) indicates this lithology to be Cenomanian-Santonian in age.

These Cretaceous sediments are sandy muds and muddy sands that include considerable plant and coal fragments. Some of the sand particles have a light to dark green colouration, and finely disseminated framboidal? sulphides appear closely associated with the plant remnants. Chalky fragments of bivalves, benthic foraminifera and small gastropods are disseminated in this lithology, and thin spicule-like pores may be diatom remains or moulds after diatoms. The combined bioclasts, plant material (SS01GC07mm22, and poorly sorted sediments are compatible with a marginal marine estuarine or deltaic environment.

Within these sediments are very small planar vugs of unknown origin that contain an euhedral assemblage of scattered sulphides on tabular white to clear bladed gangue (photos SS01leg3GC07, SS01GC07mm2, SS01GC07m2m). Some of this gangue also has the dark green staining. Laser Raman spectroscopy (Figures 5-7) indicated the sulphides to be ubiquitously arsenopyrite, some crystals having apparent compositional intermixtures of arsenopyrite-pyrite, and arsenopyrite-marcasite. The bladed crystals in the gangue gave signatures of feldspar, anatase and brookite. The extreme sensitivity of this spectroscopy to the titanium oxide polymorphs could indicate a detrital component. The repeated detection of feldspar spectra with the euhedral bladed crystals indicates an authigenic feldspar. The orientation of the mineralised vugs has not been ascertained from preliminary examination. However, the observation of fractures perpendicular to bedding laminae in some dredged material, as well as the cellular appearance of associated oxide fragments would suggest the probability of tectonically-induced fracture porosity.