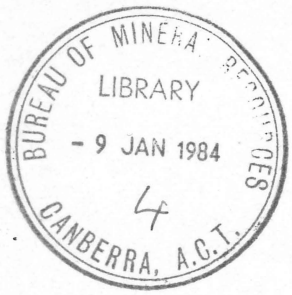

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD 83/21

RECORD

DESCRIPTION OF SUBSURFACE SEDIMENTS

FROM THE

EAST AUSTRALIAN CONTINENTAL SHELF

("SONNE" CRUISE SO–15)

by

J.B. COLWELL & P.S. ROY[1]

1. Geological Survey of New South Wales

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CONTENTS

ABSTRACT

Examination of the large number of cores and cuttings obtained during the 1980 east-Australian shelf cruise of the research vessel "SONNE" reveals the presence of nine major depositional units in the areas studied. In general, the most-complete section intersected consists of a thin Holocene marine sand sheet overlying paralic sediments of the Postglacial Marine Transgression which in turn overlie Pleistocene terrestrial to marine sediments.

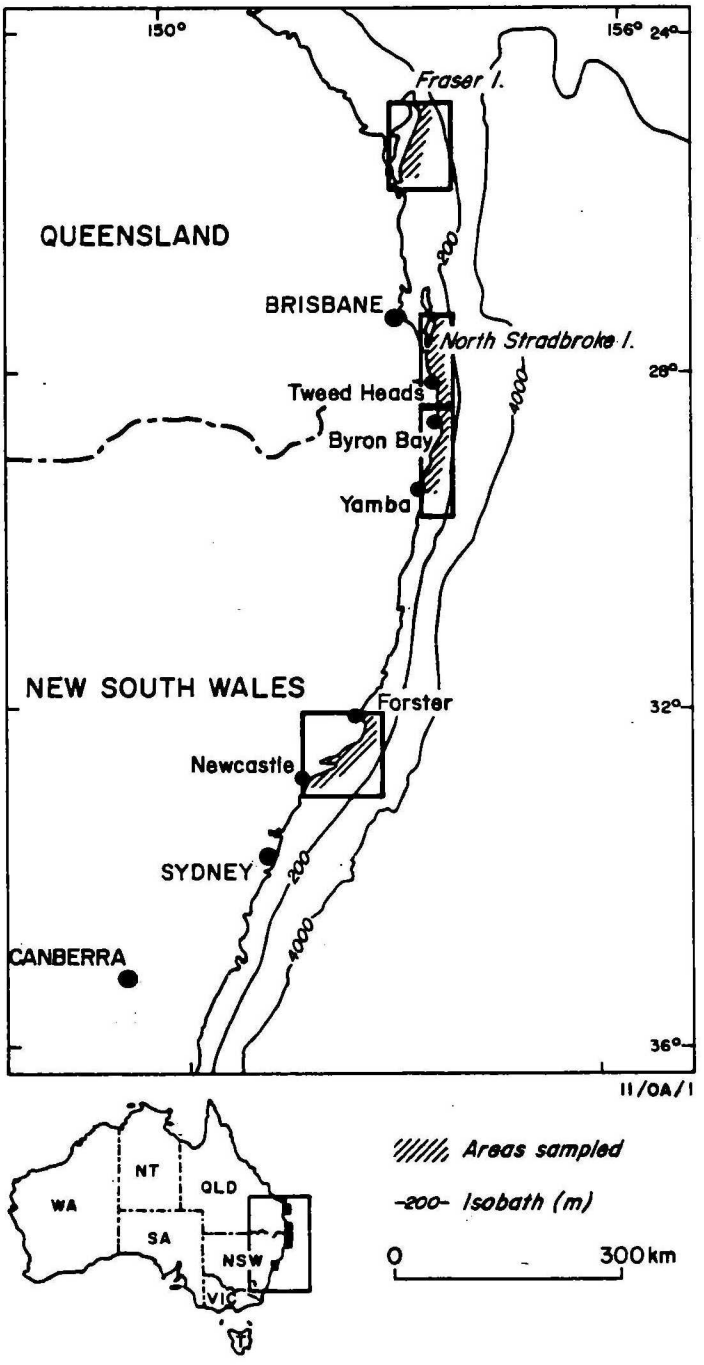

Fig. 1 Location of areas sampled during cruise SO-15

INTRODUCTION

The east Australian shelf is an example of an "Atlantic-type" margin (Heezen, 1974). Following the formation of the Tasman Sea about 60 to 80 Ma ago, the shelf has developed mainly by upbuilding of sediments on a subsiding basement (Hayes & Ringis, 1973; Marshall, 1979; Davies, 1975). Cainozoic sediments on the southeastern part of the shelf form a seaward-thickening wedge over the outer continental shelf, thinning and becoming less continuous on the inner and middle shelf (Davies, 1979). At present very little terrigenous material appears to be supplied to most of the shelf, due to the trapping of sediments in estuaries behind coastal barriers and to the northward movement of sediment via littoral drift (Roy & Crawford, 1977; Roy & Thom, 1981).

Morphologically, the shelf between Newcastle and Fraser Island (Fig. 1) - the area covered by this report - can be divided into three zones: the nearshore (shoreface) slope, the inner shelf apron and the middle and outer shelf plain (Jones & Kudrass, 1982). In general it shallows to the north, possibly due to the northward movement of sediment by littoral drift during Quaternary sea-level changes (Roy & Thom, 1981).

Prior to 1980, little subsurface sampling had been carried out on much of the east Australian shelf. However, from September to November 1980, a programme of shallow vibrocoring and counterflush drilling was carried out in four areas of the shelf between Newcastle and Fraser Island (see Fig. 1). This work formed part of a joint reconnaissance investigation of the heavy-mineral potential of the shelf undertaken by the Bundesanstalt für Geowissenschaften und Rohstoffe, Hannover, West Germany (BGR); the Bureau of Mineral Resources (BMR); and the New South Wales and Queensland Geological Surveys (von Stackelberg & Jones, 1982). This investigation used the 3800-tonne West German research vessel "SONNE" and was made under the auspices of the Australian-West German Science and Technology Agreement. Funding was largely supplied by the West German Government.

This Record provides results of the vibrocoring and drilling, and largely aims to provide a data base for subsequent publications. The results supplement the initial results given by Colwell and others (1981), and von Stackelberg (1981); and the subsequent work undertaken by Kudrass (1982), Friedrich and others (1982) and Riech and others (1982).

Previous work

Previous work on the sediments of the shelf between Newcastle and Fraser Island consists of the work of Shirley (1964), Conolly (1969) and Boyd (1974); reconnaissance surveys by BMR (Davies, 1979; Marshall, 1980), detailed studies of certain inshore areas by the New South Wales and Queensland Geological Surveys (Gordon & Roy, 1977; Roy & Crawford, 1980); the work of Delft Hydraulics Laboratory off the Gold Coast (Delft, 1970); the work of von der Borch (1970) and Cook & Marshall (1981) on phosphate and iron-rich nodules on the outer continental shelf; and the work of mining companies in close inshore areas in the search for heavy-mineral deposits and construction materials (Brown, 1971;

Jones & Davies, 1979). In all cases, except for the mining company activity, sampling was generally limited to the upper few centimetres of the sedimentary pile.

METHODS USED IN THE SUBSURFACE SAMPLING

Subsurface sampling was achieved using Geodoff and Kiel vibrocorers, subsequent to extensive shallow seismic reflection profiling (von Stackelberg & Jones, 1982). The sampling was generally limited to water depths of between 20 and 80 m because of the ship's draught and the length of its anchor chains - it was necessary for the ship to anchor during vibrocoring and drilling.

The Geodoff vibrocorer, which is an electrically-powered hydraulically-operated unit weighing approximately 6 tonnes, was used at 51 stations (Figs 2-4)(277 m of core recovered; maximum penetration approximately 10 m), and the much lighter Kiel vibrocorer (electrically operated) was used at 69 stations (116 m of core recovered; maximum penetration approximately 4 m). The Geodoff vibrocorer was also used at 34 stations as a counterflush drill which permitted penetration down to approximately 11.5 m.

Navigational control throughout the cruise was provided by a Decca Trisponder distance measuring system operated by the Australian Survey Office using four mobile land stations. This system generally gave the ship's position to better than 10 m. Navigational backup (only used in a few cases) was provided by the ship's Magnavox satellite navigation system supported by radar.

The vibrocorers were split, in many cases photographed, and together with the counterflush-drill samples, described and subsampled for textural and mineralogical studies. Some of these studies, made at BMR and the New South Wales Geological Survey, form the basis of this report.

Because of the technique used in the counterflush drilling, the depths recorded to changes in lithology in the counterflush holes are approximate only. This does not apply to the vibrocore holes. Fairly extensive mixing, and possibly sorting, may have occurred in some cases during the counterflushing leading to further problems with descriptions of the counterflush sediments. These should therefore be treated as approximate only.

In addition to the vibrocoring and counterflush drilling, an extensive program of grab sampling of surface sediments was undertaken. The results of this program confirm earlier evidence (Shirley, 1964; Davies, 1979; Marshall, 1980; Roy & Crawford, 1980) that fine to coarse-grained sands are predominant on the inner shelf and that fine-grained commonly muddy sands are predominant on the mid shelf (Colwell, 1982; Stephens, 1982a).

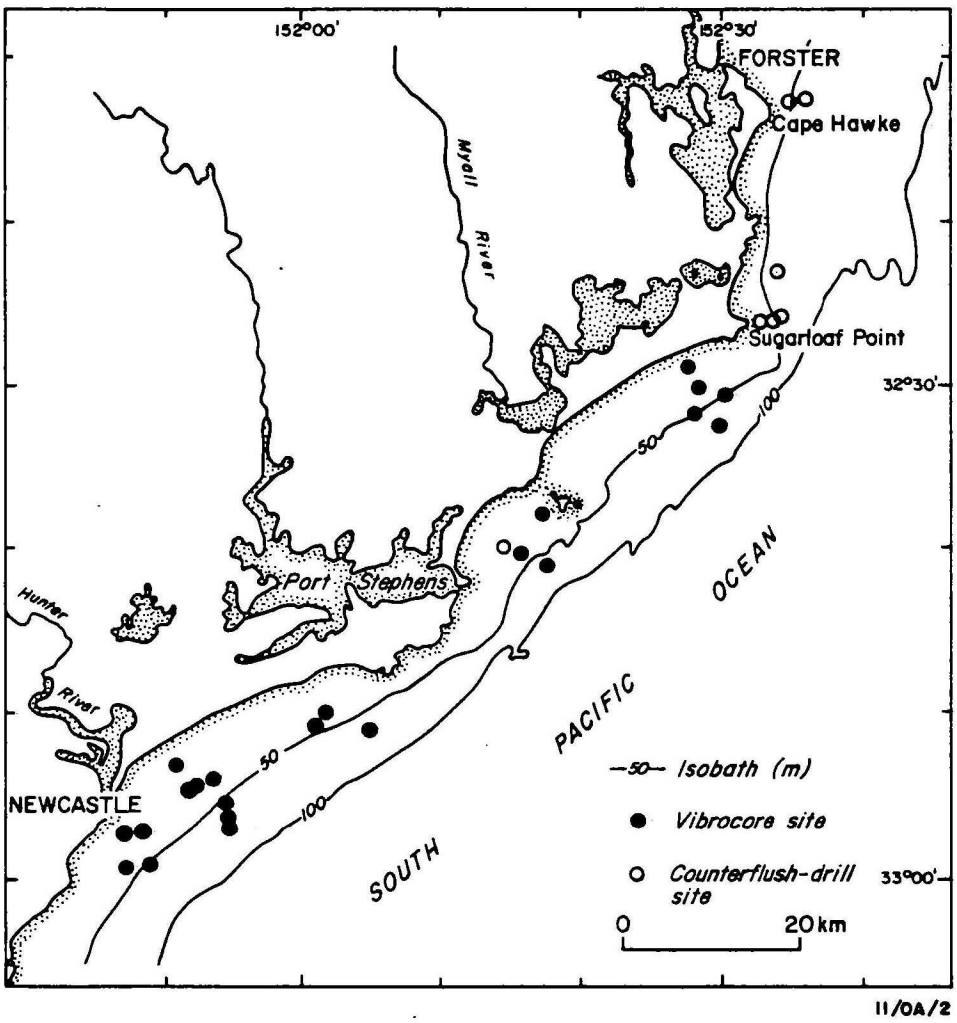

Fig. 2 Location of the vibrocore and counterflush drillholes between Newcastle and Forster. The intersected stratigraphy is given in Figures 6-8.

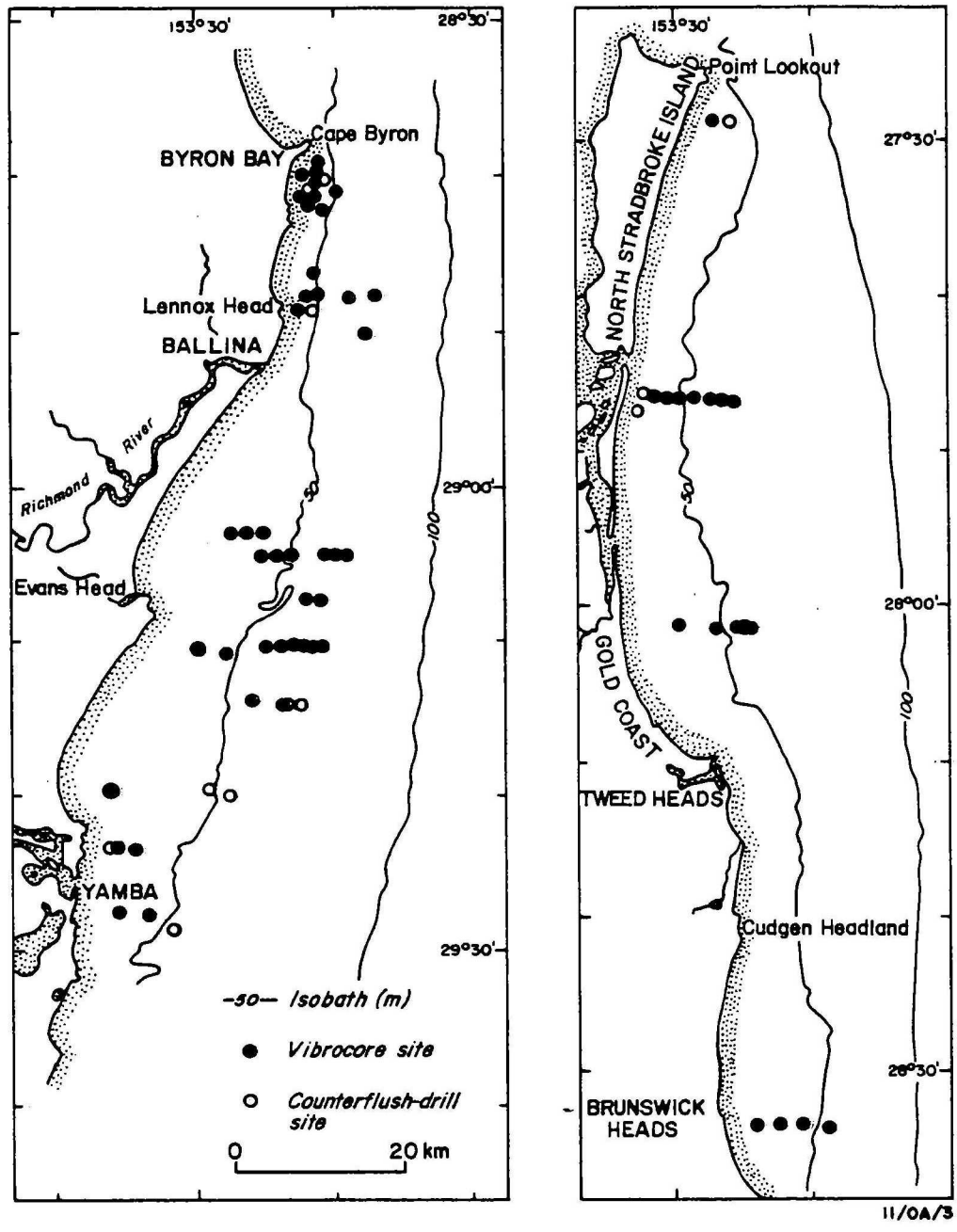

Fig. 3 Location of the vibrocore and counterflush drillholes between Yamba and Point Lookout. The intersected stratigraphy is given in Figures 9 – 13

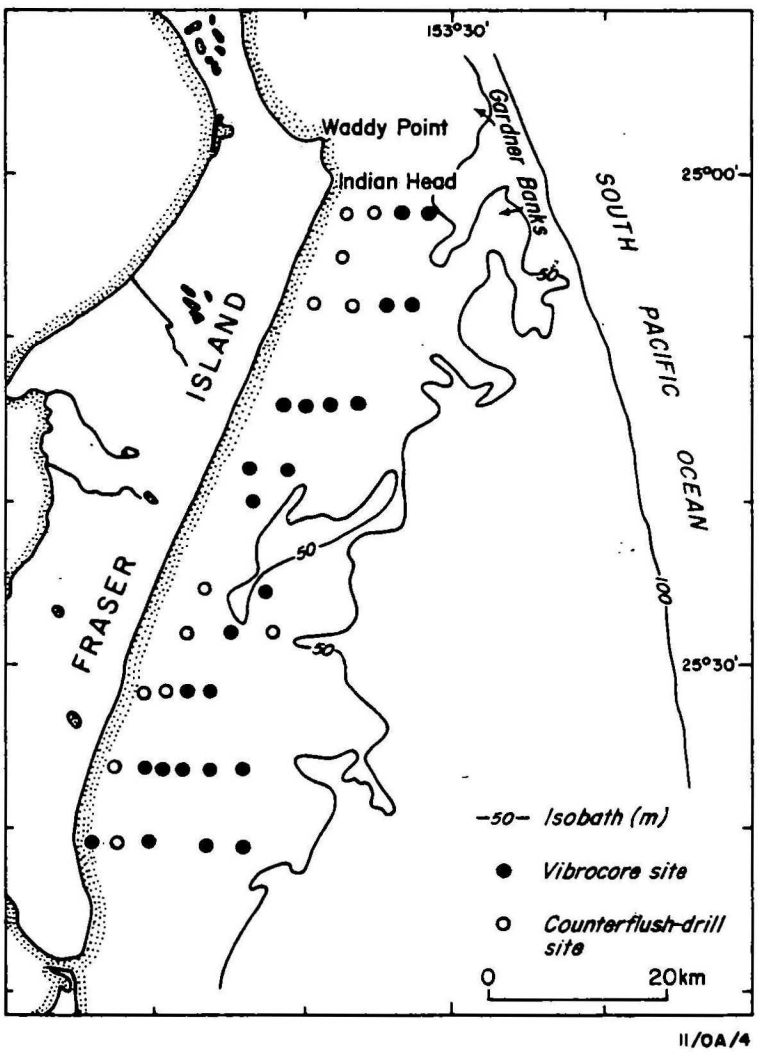

Fig. 4 Location of the vibrocore and counterflush drillholes off Fraser Island. The intersected stratigraphy is given in Figures 14 and 15

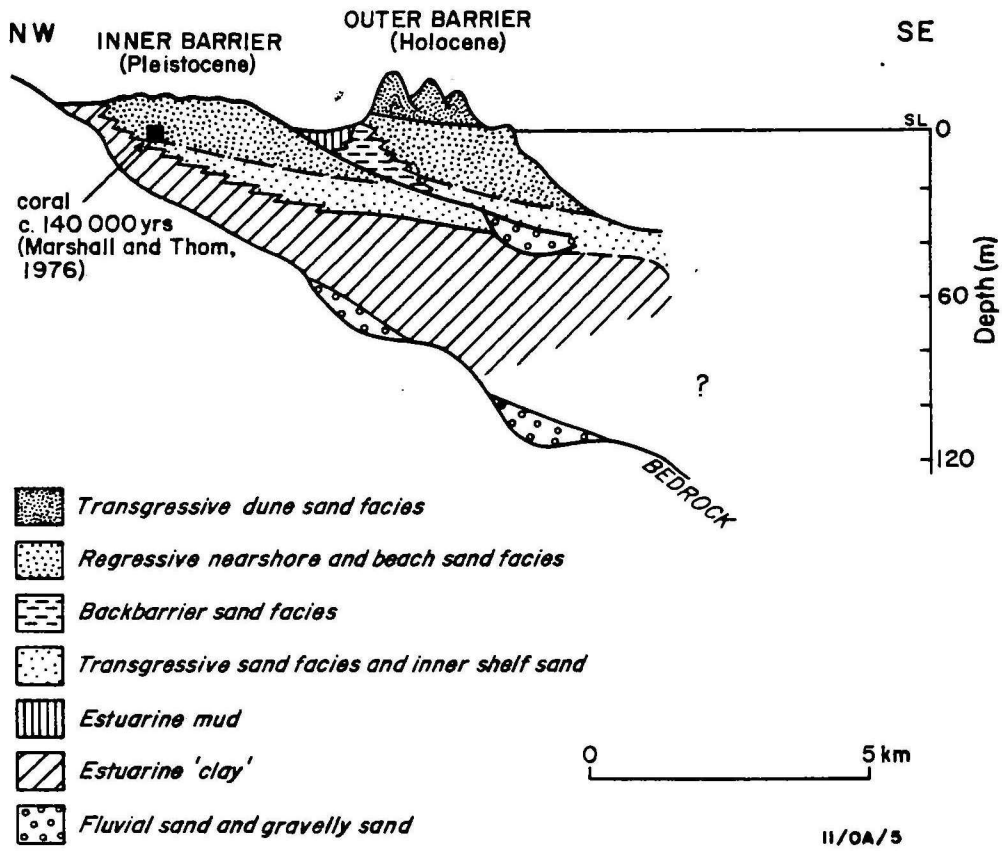

Fig. 5 Generalised facies relationship for dual barriers on the central NSW coast based upon drilling at a number of sites (from Roy and Thom, 1981, Figure 4)

ONSHORE QUATERNARY COASTAL GEOLOGY

Because of the possible similarity between the modern coastal environments and those that existed on the shelf during the Pleistocene, a brief description of the onshore Quaternary coastal geology and environments is given here*.

The present-day coast between Newcastle and Fraser Island is typically a high energy type, characterised by zeta-shaped or arcuate bays consisting of sand barriers bordering fluvio-deltaic plains. The plains are backed typically by either Palaeozoic rocks of the New England, Yarrol or Lachlan Fold Belts; Permo-Triassic rocks of the Sydney Basin; of Mesozoic rocks of the Clarence-Moreton and Maryborough Basins. Areas of Tertiary rocks, mainly basaltic lavas, occur along the coast in the Clarence-Moreton Basin and on Fraser Island.

The coastal sand barriers, which are the principal features of the coastal geology, commonly form two systems (the inner barrier of last interglacial age (Marshall & Thom, 1976) and the Holocene outer barrier) separated by inter-barrier swamps and lagoons, and flanked at either end by bedrock headlands. The modern beach and foredune form the seaward margin of the Holocene barrier.

The Quaternary sediments on the coast display a wide range of facies. These include transgressive dunes regressive nearshore and beach sands back-barrier sands and estuarine muds. A typical section through the dual barrier coastal system is shown in Figure 5.

Large transgressive dunes extend over beach deposits in a number of areas. These are particularly pronounced in southern Queensland where the majority of the coastal sediments constitute large isolated or attached sand islands (e.g. Stradbroke, Moreton, Bribie and Fraser Islands) rising in some cases to elevations of over 200 m. Several phases of dune formation that are possibly related to changes in climate, sea level or coastal alignment can be recognised in these areas (e.g. Laycock, 1978).

The generally increasing volume of Quaternary sediments northwards probably reflects the northward movement of sediments in the littoral zone, a movement produced by the oblique orientation of the coastline with respect to the predominant southeasterly swell. To a large extent, the sand islands of Queensland resulted from this northward movement of sand, coupled with aeolian activity and shore-normal movement of sand during sea-level change (Roy & Thom, 1981).

DESCRIPTION OF THE OFFSHORE SEDIMENTS.

The sediments penetrated by vibrocoring and drilling can be divided, on the basis of lithology and age, into nine major units (Table 1, Figs 6-15). These range in age from Pleistocene to Holocene and represent deposition prior to (units D1-D3), during (units B, C1 and C2) and after

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* Based upon the work of Langford-Smith & Thom (1969), Coaldrake (1962) Bird (1973), Laycock (1978), Ward (1978), Thom and others (1978,1981), Thom (1978), Roy and others (1980), Roy & Thom (1981), Roy (1980), and Stephens (1982b).

TABLE 1. DEPOSITIONAL UNITS

UNIT		AGE
A1	Nearshore fine sands (A1' very fine and muddy)	Post PMT (mainly Holocene stillstand)
A2	Inner-shelf medium-coarse sands (A2' mixed qtz-carb. shelf sands & gravels)	
A3	Mid-shelf fine sands and muddy sands.	
B	Shelly and pebbly deposits of the basal transgressive zone	Postglacial marine transgression (PMT)
C1	Nearshore sands	
C2	Estuarine/backbarrier deposits (mainly muds and muddy sands)	
D1	Leached barrier sands. Humate cemented in places	Pleistocene interstadials and ?last interglacial
D2	Estuarine, backbarrier and interdune swamp deposits. Commonly weathered.	
D3	Calcareous, partly-cemented marine, shallow marine and barrier sands	

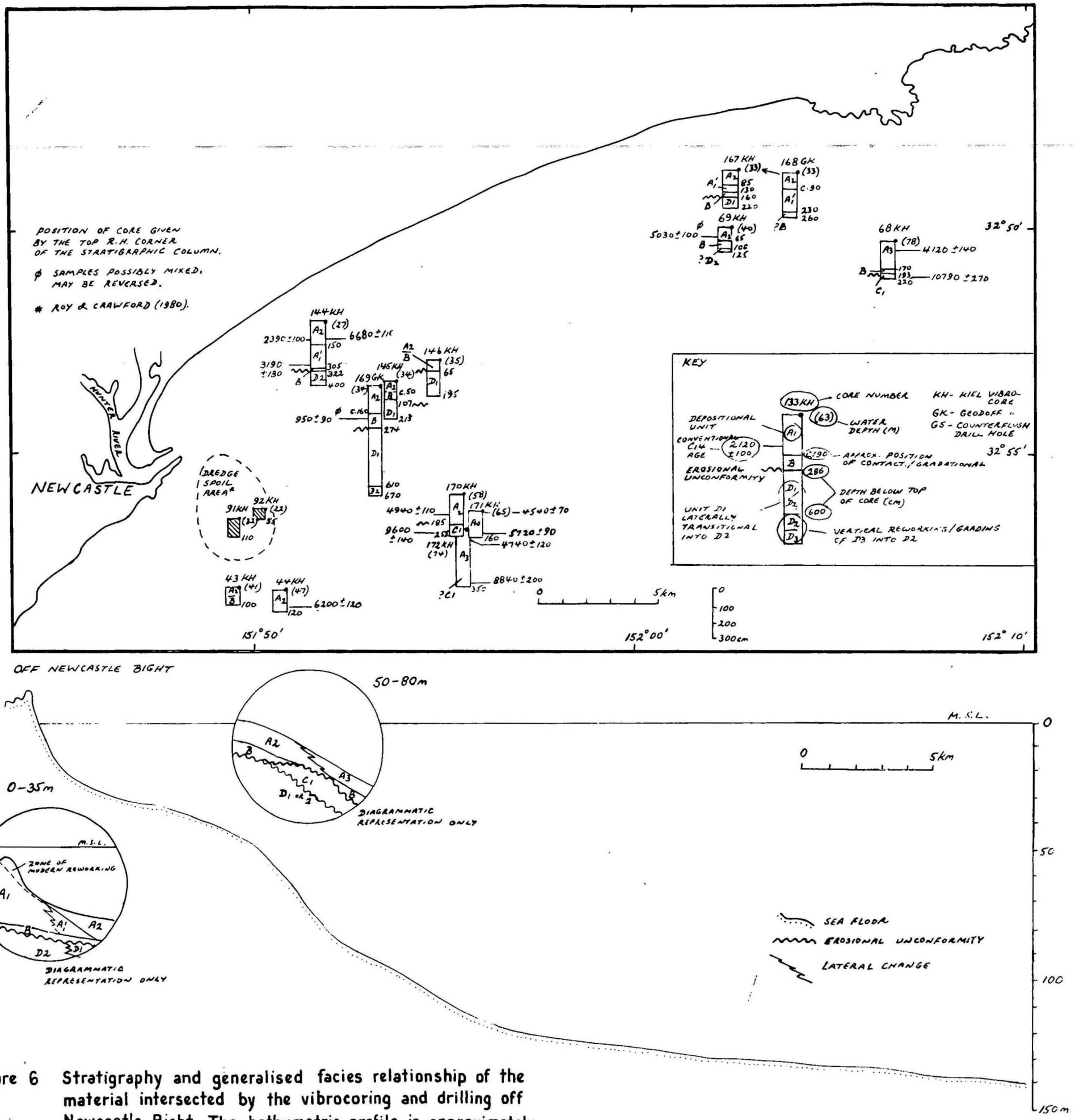


Figure 6 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off Newcastle Bight. The bathymetric profile is approximately shore normal.

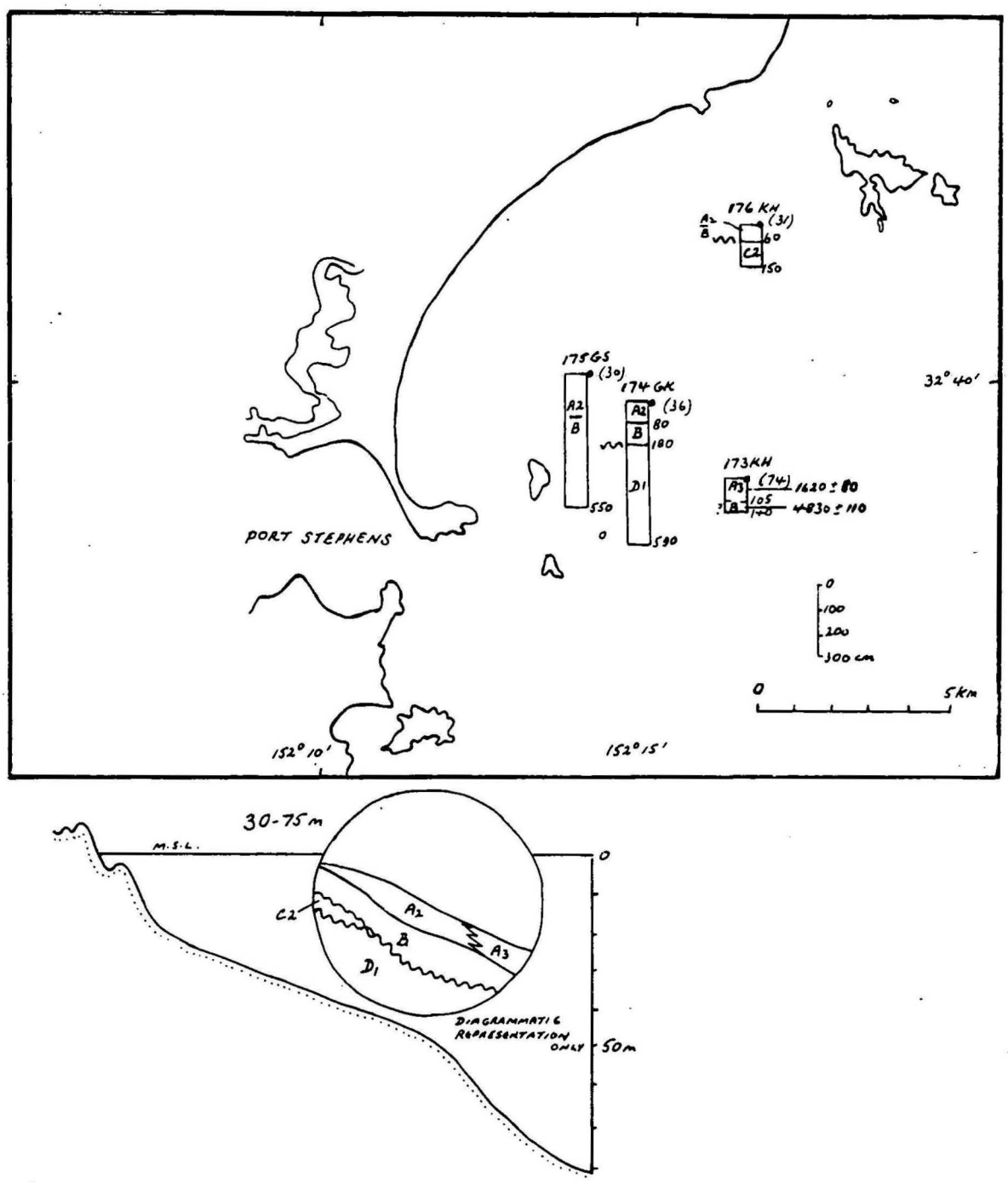
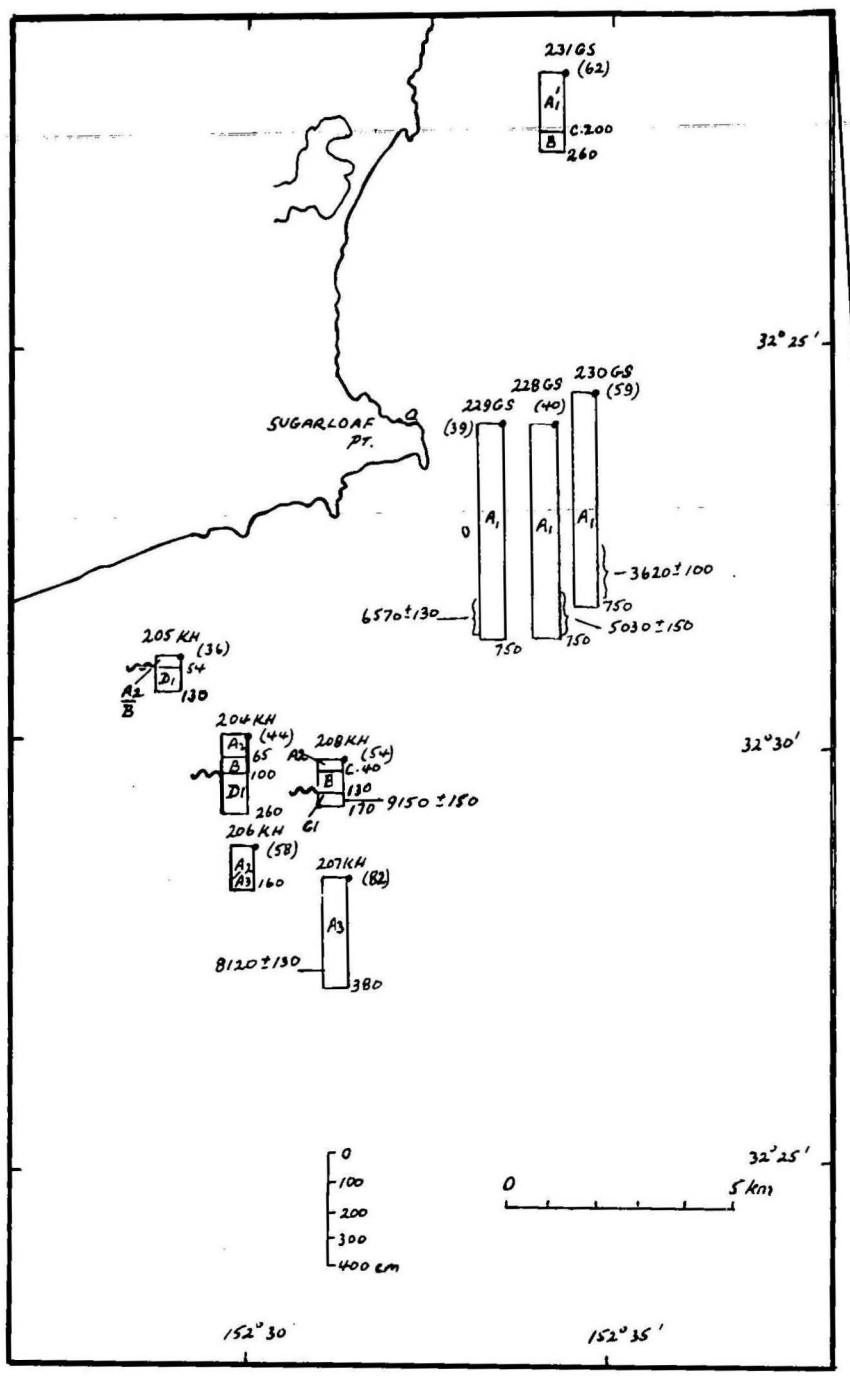
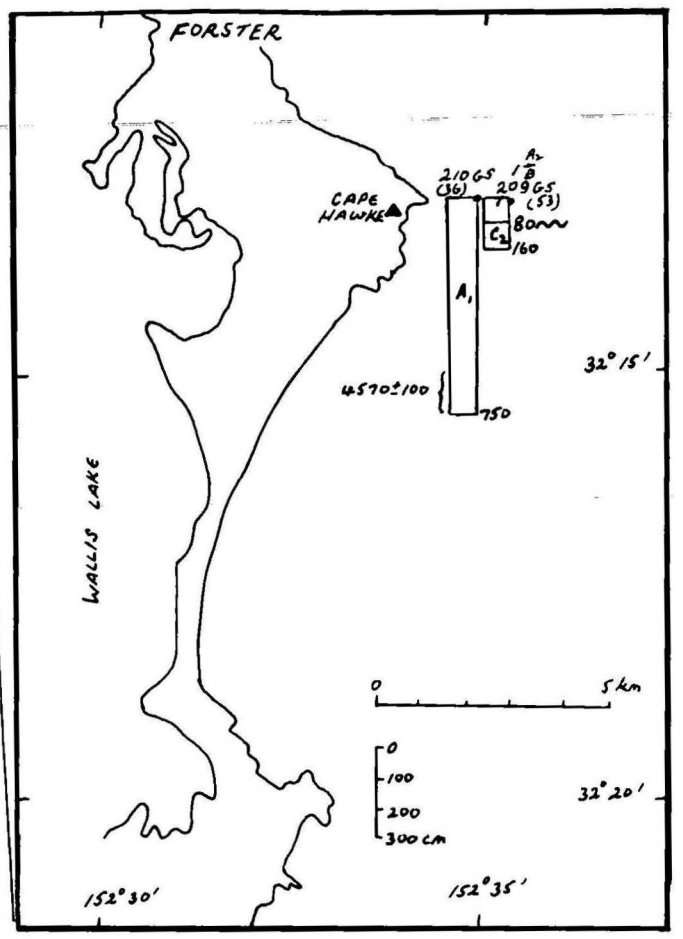
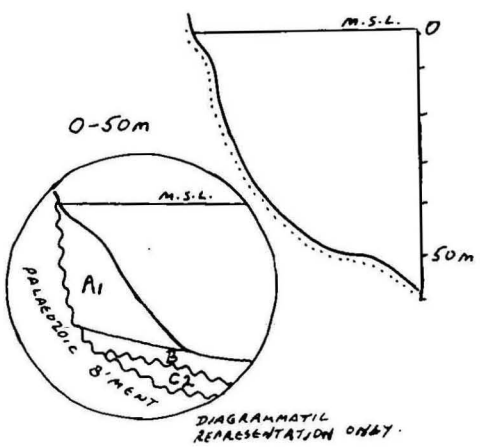


Figure 7 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off Port Stephens. The bathymetric profile is approximately shore normal.







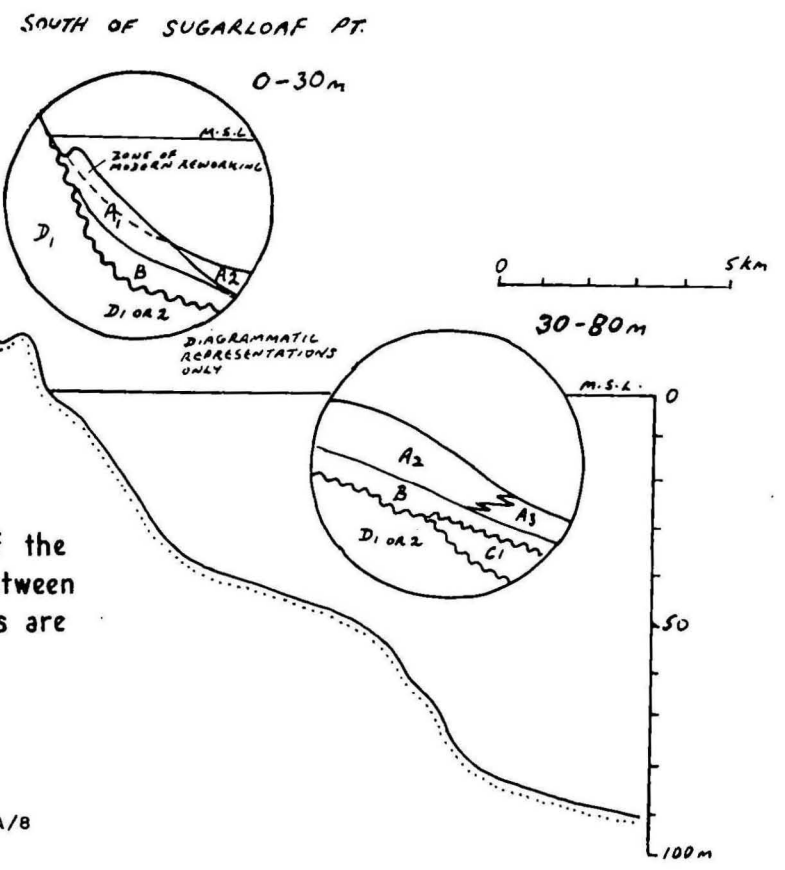


Figure 8 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling between Sugarloaf Point and Forster. The bathymetric profiles are approximately shore normal.

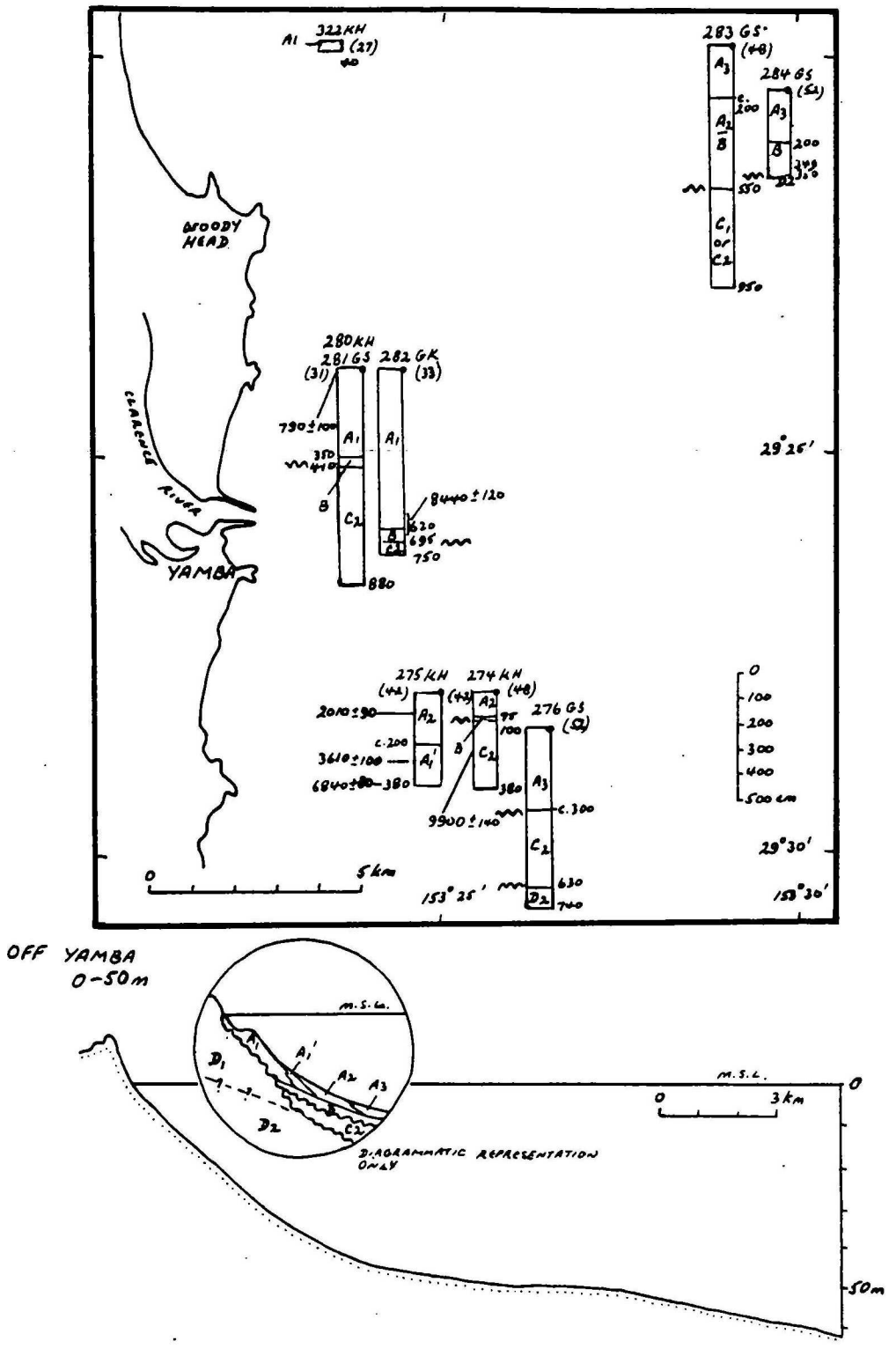


Figure 9 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off Yamba. The bathymetric profile is approximately shore normal.

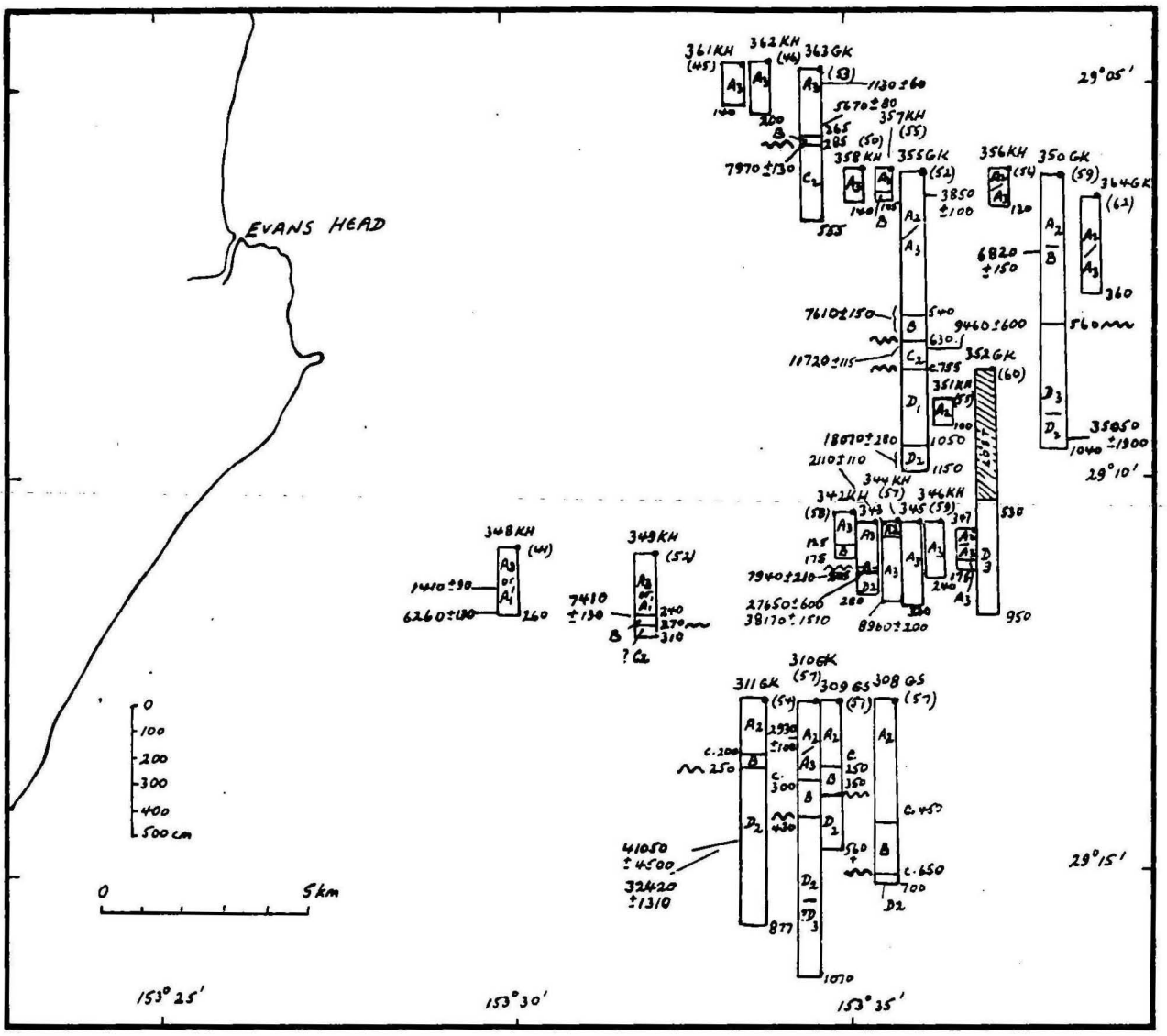


Figure 10 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off Evans Head. The bathymetric profile is approximately shore normal.

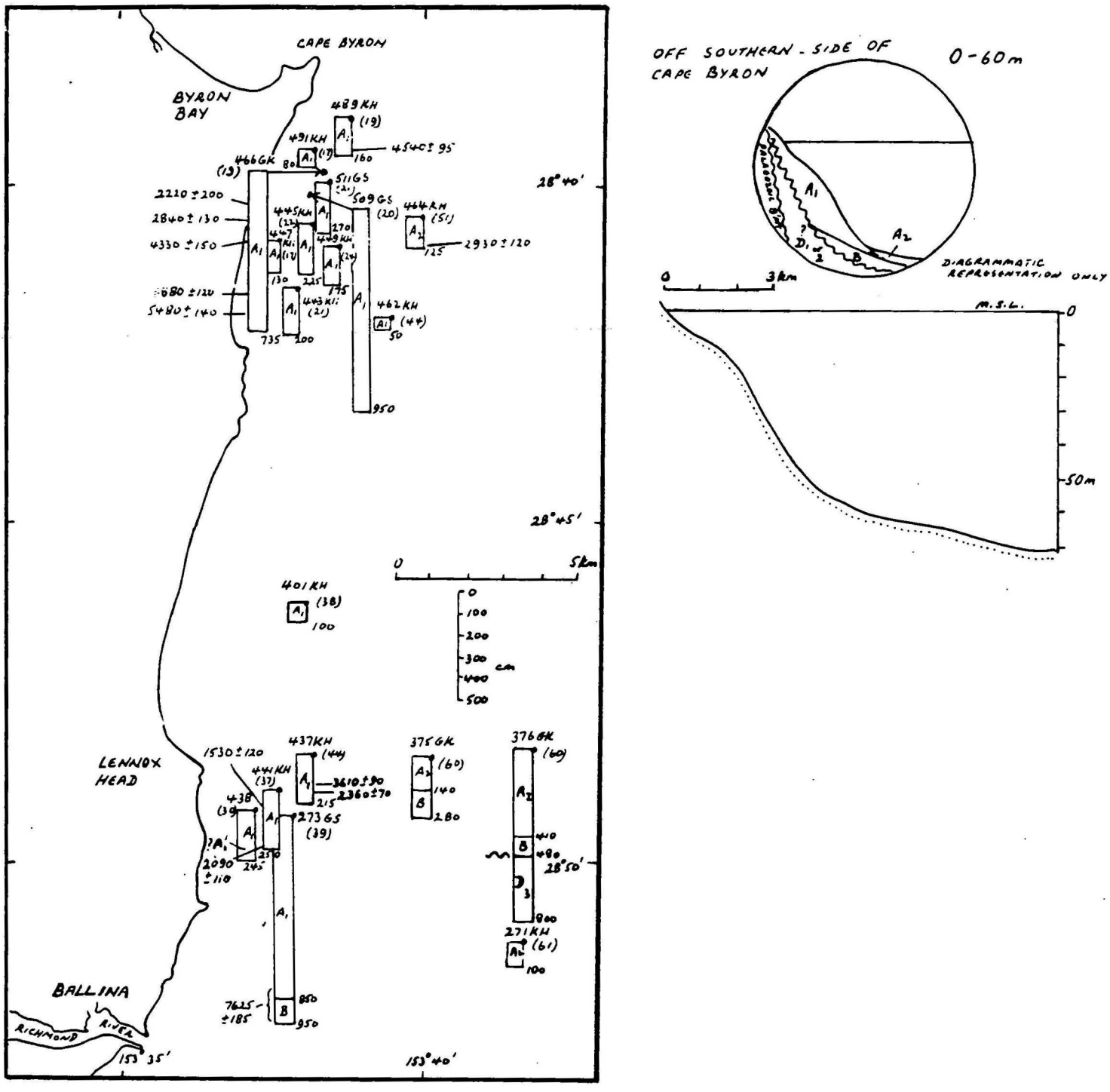


Figure 11 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling between Ballina and Byron Bay. The bathymetric profile is approximately shore normal.

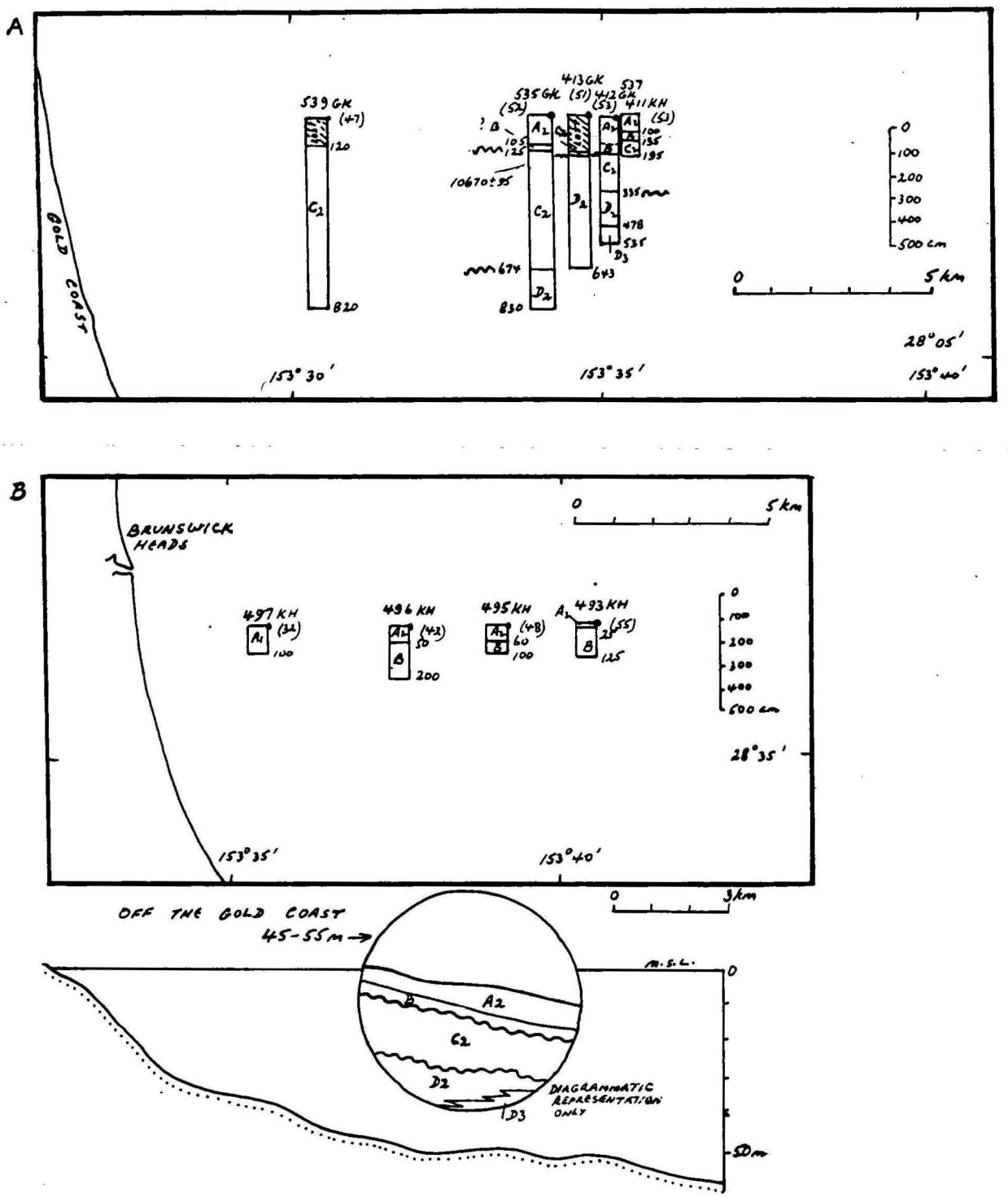


Figure 12 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off Brunswick Heads and the Gold Coast. The bathymetric profile is approximately shore normal.

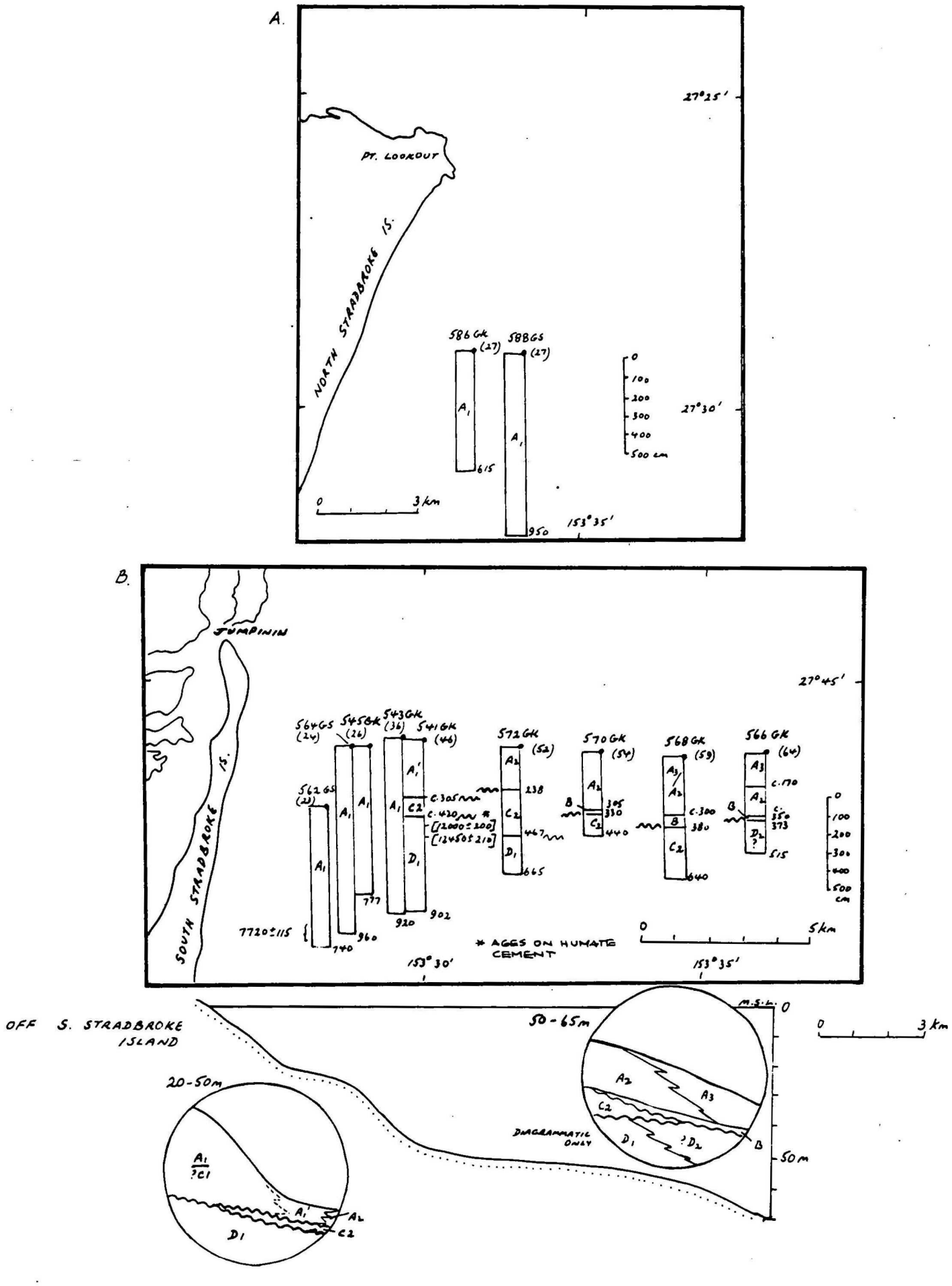


Figure 13 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off North and South Stradbroke Islands. The bathymetric profile is approximately shore normal.

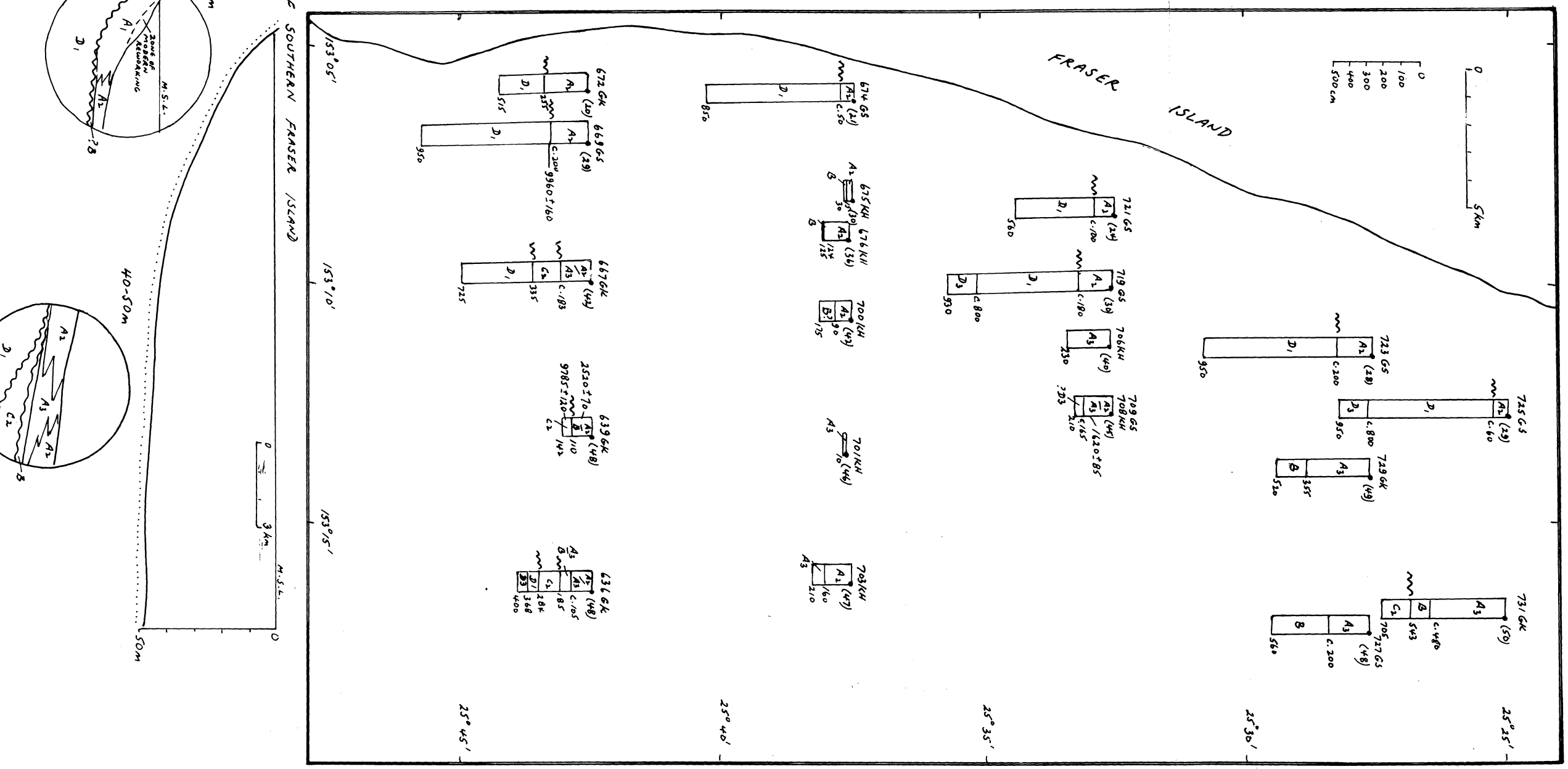


Figure 14 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off southern Fraser Island. The bathymetric profile is approximately shore normal.

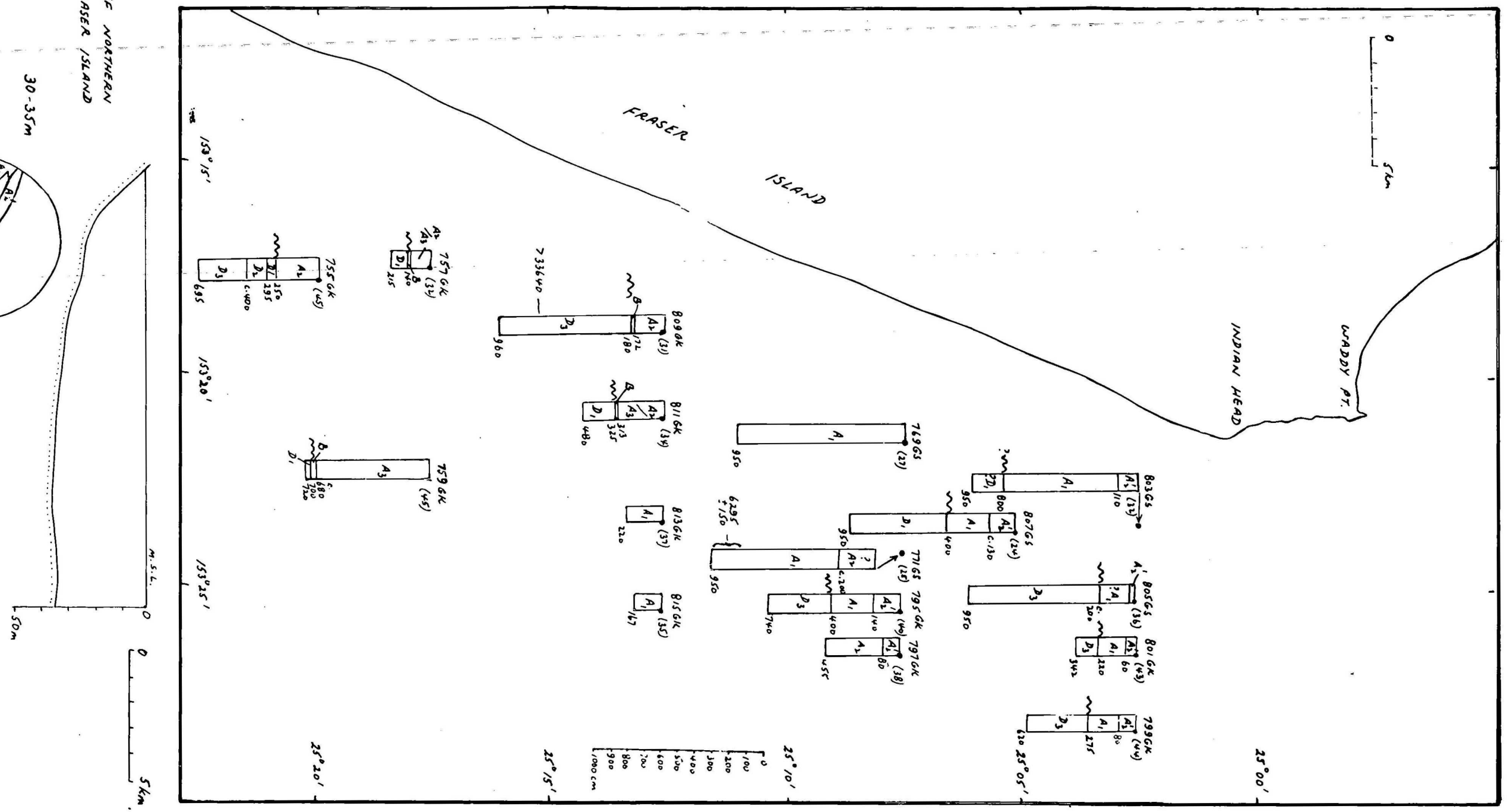


Figure 15 Stratigraphy and generalised facies relationship of the material intersected by the vibrocoring and drilling off northern Fraser Island. The bathymetric profile is approximately shore normal.

(units A1-A3) the Postglacial Marine Transgression (approximately 18000-6000 yr B.P.: Frakes, 1979; Thom & Chappell, 1975). A full description of all cores is given in Appendix 1.

The depositional environments interpreted for the various depositional units are based primarily upon a direct comparison between the lithologies and faunas (mainly shall faunas) of the intersected sediments, and those known to occur in the modern coastal environments.

Deposits predating the Postglacial Marine Transgression (units D1-D3)

These sediments form the basal part of most of the longer cores. They basically represent the land surface over which the Postglacial sea transgressed. In lithology they range from calcarenite limestones to weathered clays and sandy clays. Typically they show evidence of diagenetic alteration and/or weathering: leaching, iron-oxide layers and concretions, soil development and cementation. Non-cement radiocarbon ages range from approximately 18 000 to 41 000 yr B.P. (see Table 2).

The sediments appear to have been deposited under marine, shallow marine, estuarine, backbarrier and continental dune conditions. As noted above, they can be divided into three units.

D1. Leached barrier sands

These sediments were intersected fairly widely on the inner part of the shelf (see Figs 6-15). In general, they have similar composition, grainsize, sorting and skewness characteristics of the present-day beach/dune sands except that they (the D1 sediments) are commonly completely leached of carbonate[ø]. Dune crossbedding can be observed in places.

In a number of areas (notably off South Stradbroke and Fraser Islands), the sediments (generally fine-medium grained, well sorted and quartz-rich) are weakly cemented by humic compounds (humate) to form a dark maroon to black "sandrock" (Fig. 16), similar to that described from the last-interglacial inner barrier (Coaldrake, 1955; McGarity, 1956; Ward and others, 1979; Thompson, 1981). In both the onshore and offshore occurrences, precipitation of the organic cements from percolating rainwater to form the sandrock probably took place either due to changes in the physiochemical environment at the water table or to a critical saturation of organic complexes by Fe or Al[øø](see Ward and others, 1979; Seymour, 1981). Radiocarbon dating of the humate cements in Core 541 gives ages of approximately 12 000 yr B.P. (Table 2). These ages are most likely considerably less than the age of deposition of the sands (which were probably deposited during falling or stationary sea level) either due to a time break between deposition of the sand and cementation, or to remobilisation of the humic compounds (either totally or differentially) during soil profile development or movement of the water table.

ø By contrast, modern beach-dune deposits on the coast contain about 2-10% carbonate. This rapidly decreases with increasing age of the deposits inland.

øø Present in coatings on grains

TABLE 2. SONNE SO-15 RADIOCARBON AGES

Sample	Core/depth in core (cm)	Unit	Depth below M.S.L. (m)	Type of material dated[a]	Conventional* Age	Reservoir Corrected Age#	Source
SUA- 1556	44/ 100- 110	A2	48	Shell hash	6650± 110	6200± 120	1
SUA- 1635	68/ 60- 70	A3	79	Shell hash	4570± 140	4120± 140	1
SUA- 1557	68/ 200- 220	C1	80	Shell hash	11240± 270	10790± 270	1
SUA- 1636	69/ 40- 50	A2	40.5	Shell	5480± 90	5030± 100[ø]	1
SUA- 1637	144/ 120- 130A	A2	28	Shell	7130± 130	6680± 110	1
SUA- 1558	144/ 120- 130B	A2	28	Shell	2840± 90	2390± 100	1
SUA- 1559	144/ 280- 290	A1'	30	Shell	3640± 130	3190± 130	1
SUA- 1560	169/ 160- 220	B	36	Shell	1400± 80	950± 90[ø]	1
SUA- 1561	170/ 120- 127	A2	59	Shell hash	5390± 100	4940± 110	1
SUA- 1562	170/ 200- 250	C1	60	Shell hash	10050± 140	9600± 140	1
B - 6654	171/18-25	A3	65	Shell hash	5390± 70	4540± 70	1
B - 6655	171/148-158	A3	66.5	Shell hash	6170± 90	5720± 90	1
SUA- 1563	172/ 60- 70	A3	74	Shell hash	5190± 110	4740± 120	1
SUA- 1564	172/ 335- 345	?C1	77.5	Shell hash	9290± 200	8840± 200	1
B - 6656	173/40-60	A3	74	Shell hash	2070± 80	1620± 80	1
B - 6657	173/120-140	?B	75	Shells	5280± 110	4830± 110	1
SUA- 1591	207/ 350- 380	A3	85	Shell hash	8570± 130	8120± 130	1
B - 6658	208/138-165	C1	55.5	Shell hash	9600± 150	9150± 150	1
SUA- 1581	210/ 600- 750	A1	42	Shell hash	5020± 90	4570± 100	1
SUA- 1594	228/ 570- 750	A1	47	Shell hash	5480± 150	5030± 150	1
SUA- 1593	229/ 600- 750	A1	46	Shell hash	7020± 120	6570± 130	1
SUA- 1592	230/ 520-750	A1	66	Shell hash	4070± 90	3620± 100	1
HV -10778	273/ 780- 950	A1/B	48	Shells	8075± 185	7625± 185	2
SUA- 1565	274/ 200- 210	C2	50	Fresh shells inc. Anadara	10350± 140	9900± 140	1
B - 6659	275/70-80	A2	43	Shell hash	2460± 90	2010± 90	1
SUA- 1566	275/ 275- 290	A1'	45	Shells	4060± 100	3610± 110	1
B - 6660	275/370-380	A1'	46	Shell hash	7290± 80	6840± 80	1
SUA- 1567	280/ 18- 23	A1	31	Shells	1240± 90	790± 100	1
SUA- 1568	282/ 560- 670	A1/B	39	Shell hash	8890± 110	8440± 120	1
SUA- 1569	310/ 100- 150	A2/A3	58	Shell hash	3380± 90	2930± 100	1
SUA- 1570	311/ 500- 540	D2	59	Estuarine shells	41500±4500 2900	41050±4500	1
HV -10780	311/ 530	D2	59	Anadara shell	32870±1310 1130	32420±1310	2
HV -10781	343/ 180- 200	(D2)	61	Anadara shell	38620±1510 1270	38170±1510	2
SUA- 1571	343/ 185- 205	(D2)	61	Estuarine shell, mainly Anadara	28100± 600	27650± 600	1
B - 6661	343/485	A3/B	61	Shells	8390± 210	7940± 210	1
SUA- 1572	344/ 15- 30	A2	57	Shell hash	2560± 100	2110± 110	1
SUA- 1573	344/ 280- 305	A3	60	Shell hash	9410± 190	8960± 190	1
B - 6662	348/138-148	A1'	45.5	Shell hash	1860± 90	1410± 90	1
B - 6663	348/210-255	A1'	46.5	Shell hash	6710± 130	6260± 130	1
SUA- 1574	349/ 250- 260	B	55	Shell hash	7860± 120	7410± 130	1
SUA- 1575	350/ 240- 280	A2	61.5	Shell hash	7270± 150	6820± 150	1
SUA- 1576	350/ 992-1040	D3/D2	69	Shell hash	35500±1900 1500	35050±1900	1
SUA- 1577	355/ 50- 100	A2/A3	53	Shell hash	4300± 90	3850± 100	1
SUA- 1578	355/ 480- 590	A2/A3/B	57	Shell hash	8060± 150	7610± 150	1
SUA- 1579	355/ 630- 645	C2	58	Charcoal	9460± 600	9460± 600	1
HV -10782	355/ 640- 650	C2	58	Leaves+reed	11720± 115	11720± 115	2
HV -10783	355/1070-1140	D2	63	Root in situ	18070± 280	18070± 280	2
B - 6666	363/30-60	A3	53	Shell hash	1580± 60	1130± 60	1
B - 6667	363/200-250	A3	55	Shell hash	6120± 80	5670± 80	1
SUA- 1580	363/ 270- 288	B	57	Shell hasn	8420± 120	7970± 130	1
B - 6664	437/145-150	A1	45	Shell hash	4060± 90	3610± 90	1
B - 6665	437/170-180	A1	45.5	Shell hash	2810± 70	2360± 70	1

TABLE 2. (CONTD.)

Sample	Core/depth in core (cm)	Unit	Depth below M.S.L. (m)	Type of material dated[a]	Conventional* Age	Reservoir Corrected Age#	Source
SUA- 1604	441/ 80- 100	A1	38	Shell hash	1980± 110	1530± 120	1
SUA- 1605	441/ 240- 250	A1	39	Shell hash	2540± 100	2090± 110	1
SUA- 1630	464/ 100- 125	A2	52	Shells	3380± 110	2930± 120	1
SUA- 1631	466/ 115- 150	A1	20	Shells	2670± 200	2220± 200	1
SUA- 1632	466/ 185- 215	A1	21	Shells	3290± 120	2840± 130	1
SUA- 1633	466/ 280- 310	A1	22	Shells	4780± 150	4330± 150	1
SUA- 1641A	466/ 500- 540	A1	24	Shells	5330± 100	4880± 120	1
SUA- 1634	466/ 600- 650	A1	25	Shells	5930± 140	5480± 140	1
HV -10784	489/ 140- 160	A1	20	Shells	4990± 95	4540± 95	2
HV -10785	535/ 160- 170	C2	54	Anadara shell	11120± 95	10670± 95	2
NSW- 432	541/ 440- 460	[D1]	50.5	Humate cement (diagenetic)	12000± 200	12000± 200	3
NSW- 433	541/ 473- 503	[D1]	51	Humate cement (diagenetic)	12450± 210	12450± 210	3
HV -10786	562/ 600- 740	A1	30	Shells	8170± 115	7720± 115	2
HV -10787	639/ 70- 85	A2/B	49	Shells	2970± 70	2520± 70	2
HV -10788	639/ 120- 130	C2	49.5	Wood	9785± 120	9785± 120	2
NSW- 431	669/ 180- 200	[D1]	31	Charcoal layer on surface	9960± 160	9960± 160	3
HV -10789	708/ 90- 115	A2/A3	46	Shell hash	2070± 85	1620± 85	2
HV -10790	771/ 800- 950	A1	33.5	Shells	6745± 150	6295± 150	2
HV -10791	809/ 720- 760	D3	38	Shells	>34090	>33640	2

Sources: 1. P. Roy, NSW Geological Survey
2. Kudrass (1982)
3. BMR

ø Samples possibly mixed. May be reversed.

* Corrected for isotopic fractionation

\# Corrected for isotopic fractionation, and in the case of marine shell, for environmental factors (-450 yr)

a. Additional data on the material dated given by Kudrass (1982)

SUA - Sydney University radiocarbon lab.

HV - Hannover radiocarbon lab.

NSW - New South Wales University radiocarbon lab.

B - Beta Analytical radiocarbon lab.

( ) Reworked from D2 into unit B

[ ] Post-depositional material dated

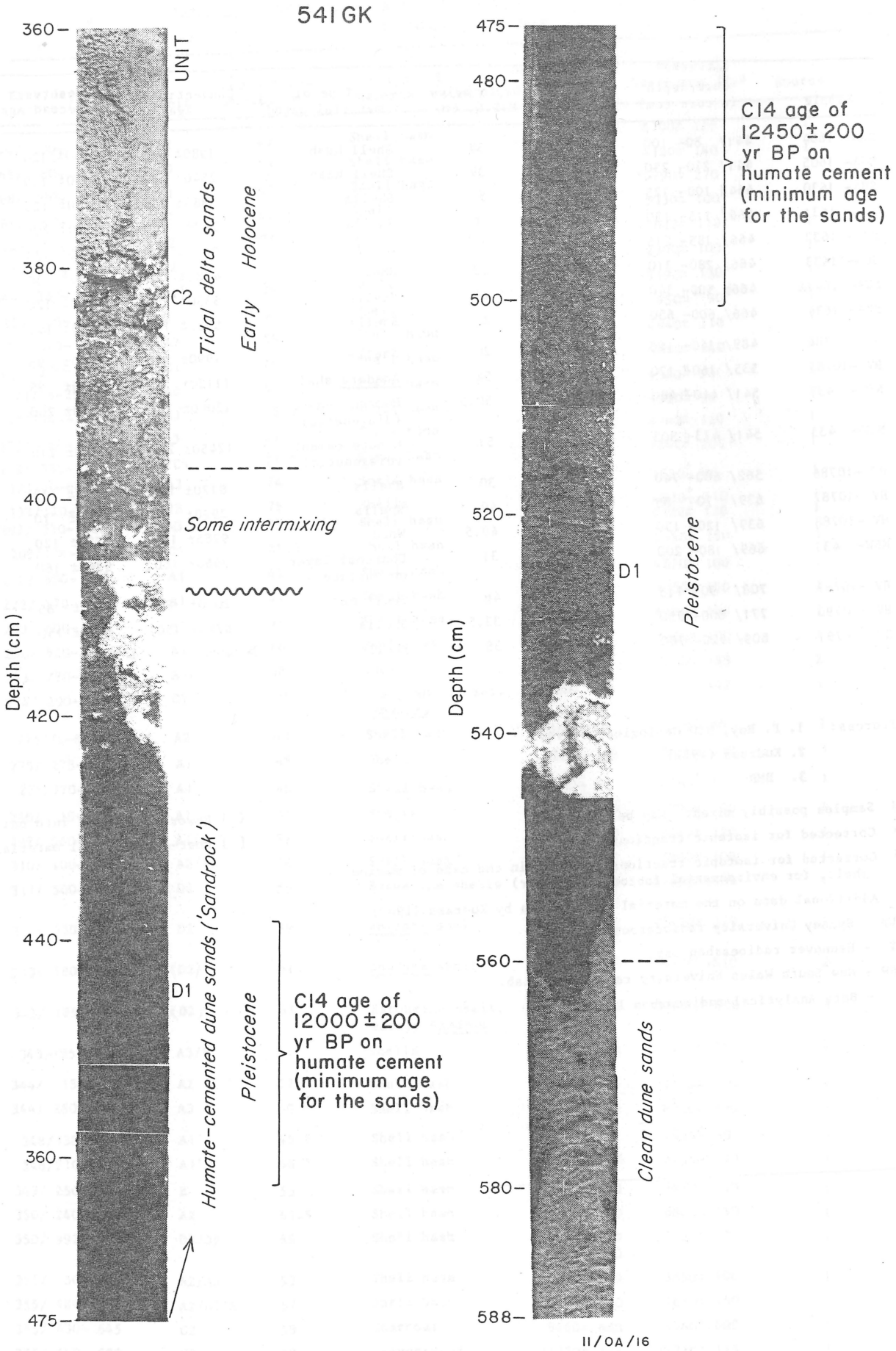


Fig. 16 Photograph of a section of core 541GK showing early Holocene tidal delta sands overlying leached humate – cemented dune sands ('sandrock')

Heavy-mineral abundances in the barrier (beach/dune) deposits were found to be low to very low (Riech and others, 1982). The reasons for this are discussed in a later section.

D2. Partly-weathered estuarine, backbarrier and interdune swamp deposits

Partly-weathered estuarine, backbarrier and interdune swamp deposits (organic-rich muds, weathered clays, clayey sands and sandy muds) occur in a number of areas (Figs 6-15 and Appendix 1). In several cases (e.g. cores 169, 355 and 755), they underlie D1 sands.

Evidence of weathering (mainly in clays and clayey sands) includes the presence of soil horizons (?yellow podzolic soils), iron-oxide concretions, and iron-oxide banding and mottling (Fig. 17). Unweathered units include compacted mud, organic mud, and sandy mud with estuarine shells (e.g. Anadara trapezia).

Radiocarbon ages for the deposits range from approximately 18 000 to 41 000 yr B.P. and indicate deposition prior to the last glacial maximum. Although most of the material was probably deposited behind barriers during interstadials and in places underwent extensive weathering during periods of lowered sea level, the young$^{\phi}$ radiocarbon age of 18 070 $\pm$ 280 yr B.P. on root material in the muds and muddy sands at the base of Core 355, indicates that this material was deposited well above contemporary sea level. In this case, the material, which is organic rich and carbonate free, was probably deposited in a perched interdune swamp which was subsequently at least partly infilled by dune sands blown in from the surrounding countryside (the overlying D1 sediments).

D3. Calcareous, partly-cemented, marine, shallow marine, and barrier sands

These sediments were intersected on the mid-shelf off northern New South Wales and southern Queensland (Figs 10, 11,12,14 and 15). They range in lithology from olive yellow - white quartzose calcarenites to olive grey, fine - coarse grained, shelly sands containing cemented "beachrock" layers and fragments (Fig. 17).

In general, the biogenic carbonate fraction (typically 30-60% of the sediment) consists of shell material and foraminifera with minor to trace amounts of echinoids, bryozoans and other debris. Locally, coralline algae form a significant part of the biogenic fraction.

The cements which occur in the "beachrock" and calcarenites range from acicular aragonite to sparry calcite. They are similar to the cements occurring in carbonate banks cropping out on the sea floor in 60-80 m of water off northern New South Wales and southern Queensland (Table 3) (Colwell, 1982; Stephens, 1982a; Marshall & Davies, 1978). These banks are interpreted from seismic (Schleuter, 1982; Searle, 1982) and geological evidence (Davies, pers. comm.) as coastal barriers which have been cemented subtidally and subaerially during the frequent shifts of sea level across the mid-shelf during the late Quaternary. Similarly, the D3 calcarenites and "beachrock" were cemented within both marine and subaerial environments

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$^{\phi}$ Compared to the sea-level curve of Chappell (1974)

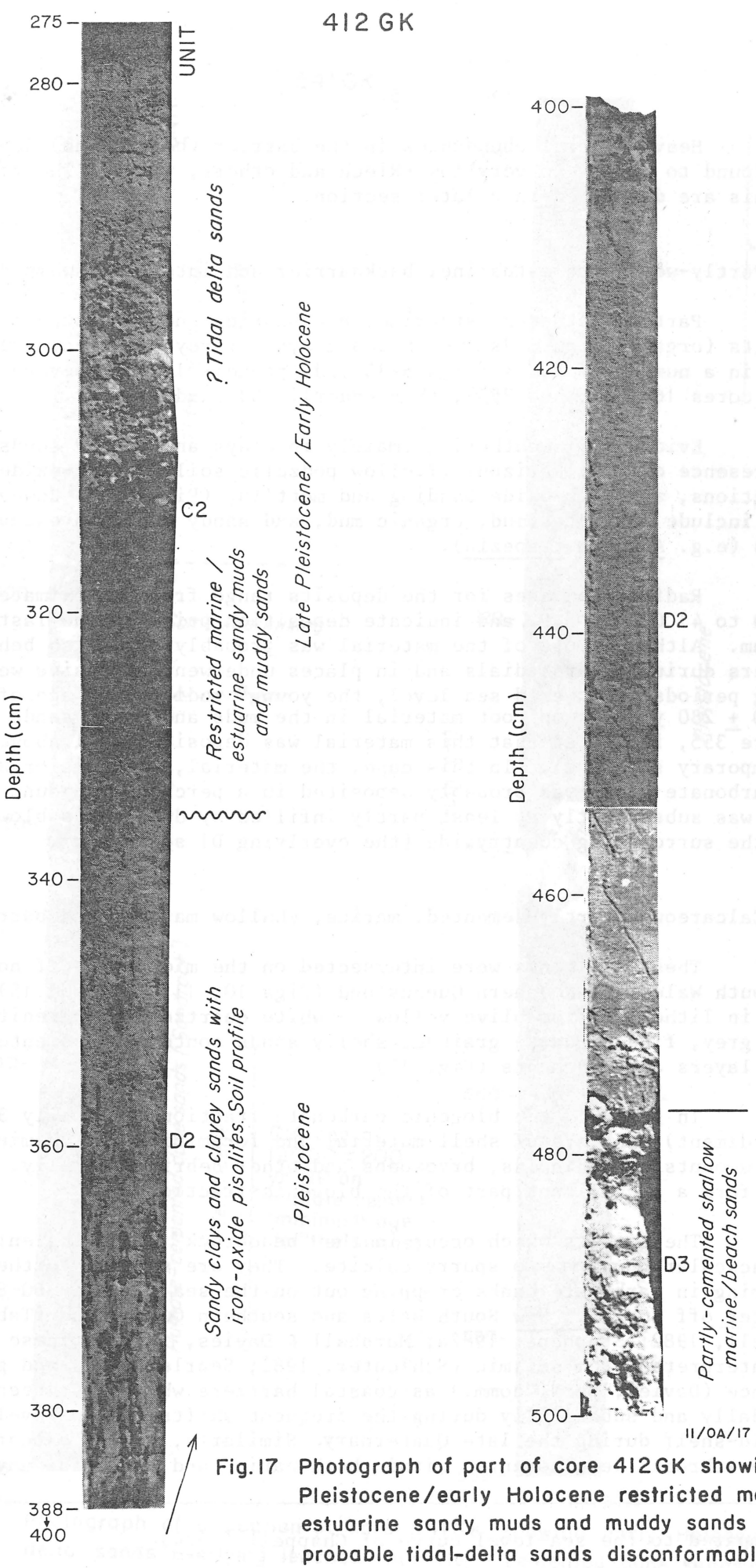


Fig. 17 Photograph of part of core 412GK showing late Pleistocene/early Holocene restricted marine/estuarine sandy muds and muddy sands and probable tidal-delta sands disconformably overlying Pleistocene weathered sandy clays and clayey sands and partly-cemented shallow-marine/beach sands

TABLE 3. THE NATURE OF THE CARBONATE CEMENTS IN MATERIAL FROM "SONNE" CRUISE SO-15

Sample		Unit	Cements			
			Aragonite and/or HMC fringes	Aragonite and/or HMC micrite. Peloidal in some cases	Sparry calcite infilling voids	Sparry calcite meniscus cements
Core No.	Depth in core (cm)					
310GK	1050	$D_2/?D_3$	-	-	A	-
350GK	650-690	D_3/D_2	-	-	A	-
375GK	Base ø	B	-	A	-	-
376GK 1a	400-470*ø	B	-	A	a	-
1c	400-470 ø	B	A	-	a	-
3a	600-670	D_3	a	A	-	-
411KH	100-135 ø	B	a	-	A	-
495KH	90 ø	B	A	-	-	-
795GK	730	D_3	-	-	A	-
799GK	10 ø	A_2^1	-	-	A	-
	400	D_3	-	-A	-	
Dredged samples from the mid-shelf carbonate banks (see Colwell and others 1981; Colwell, 1982)						
379KD 2/1		-	-	A	a	-
2/4		-	-	A	a	-
2/6		-	A	-	a	-
380KD		-	-	-	A	-
381KD 1		-	A	a	-	-
2		-	-	A	-	-
574KD		-	A	-	-	a

	MARINE	FRESHWATER

A : Major component
a : Minor component
HMC : High-Magnesium calcite

* : Coralline algae encrusting and binding the whole rock - rhodolith
ø : Reworked material

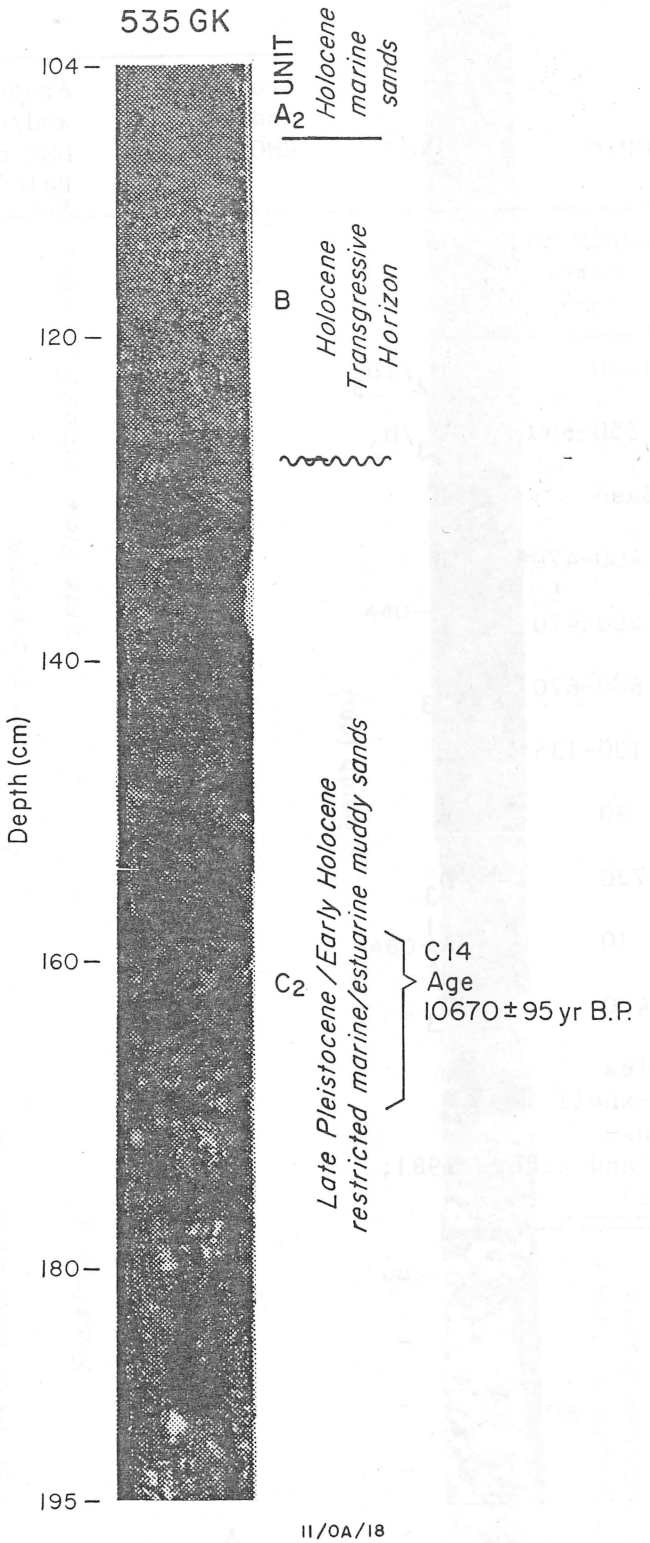


Fig. 18 Photograph of a section of core 535GK showing Holocene marine sands overlying a gravelly transgressive horizon disconformally overlying late Pleistocene/early Holocene muddy, partly-shelly sands

as a result of fluctuating sea levels. The large areas of carbonate cementation which occur off northern Fraser Island (Cores 795, 799, 801 and 803) are probably related to the formation of the Gardner Bansks.

Only one radiocarbon age has been obtained so far on D3 sediments (>33 640 yr B.P. on marine shells from Core 809, Table 2).

Deposits associated with the Postglacial Marine Transgression (units B, C1 and C2)

The "D" units are disconformably overlain by units C1, C2 and/or B which were deposited near the landward-migrating shoreline of the Postglacial Marine Transgression.

C1. Relict nearshore sands

This unit, which was intersected only in three cores (68, 170 and 208), consists of grey to greyish brown, fine-grained, well-sorted, clean to very slightly muddy, quartzose sands containing up to 10% shell material (mainly thin-walled nearshore and inner-shelf species). The sediments are very similar to those which occur in the present-day nearshore environment (sediments of Unit A1), and on this basis are interpreted as having been deposited in the nearshore environment during the Postglacial Marine Transgression. A radiocarbon age of 10 790 ± 270 yr B.P. on shell hash at the base of Core 68 supports this view.

C2. Estuarine/backbarrier deposits

These deposits, which occur fairly widely, consist of muds, muddy sands and sandy muds (see Figs 17 & 18). In situ estuarine shells (e.g. Anadara, Pyroses, Ostrea, Notospisula) are relatively common, especially in the estuarine muds. In the sandy muds, the shell material is commonly degraded (chalky). Wood fragments are common, and in one case (Core 639) the vibrocore bottomed in 20 cm of hardwood (Eucalyptus gummifera - J. Wilkes, Forestry Department, A.N.U., pers. comm.). The muds are generally fairly plastic and are organic rich in places. The sediments are time transgressive deposited throughout the Postglacial Marine Transgression.

In the area off the Gold Coast and South Stradbroke Island (Figs 12 and 13), the C2 deposits include fine-grained sands which appear from their lithology, faunas, and stratigraphic position to have been deposited under tidal delta (or ?tidal channel) conditions (Cores 411, 412, 535, 537, 539, 541, 568, 570 and 572).

B. Pebbly and shelly basal transgressive unit

This unit disconformably overlies either C1, C2 or "D" deposits. It consists of grey-brown fine to coarse-grained, poorly-sorted, shelly and commonly pebbly sands. The unit essentially forms a relict lag deposit at the base of the Holocene section. It is characterised by a mixed shell assemblage, dominated by marine shells (lower shoreface-inner shelf species) with large abraded estuarine shells (Anadara, Ostrea etc.) occurring in places.

The unit occurs mainly in the subsurface, but in areas of shallow basement or basement outcrop it may occur on the sea floor. It is generally less than 1 m thick with a sharp erosional contact at its base. The unit, which is time transgressive (Table 2), is believed to form erosionally at the base of the retreating shoreface (20-30 m below M.S.L.) with sediment coming partly from the underlying deposits with minimal lateral transport. Coarse material such as large shells from the beach and backbarrier (if available) is probably incorporated by slow downslope creep as the shoreface recedes landwards. In certain areas (e.g. in places off Fraser Island) where the underlying deposit consists of uniform fine-grained sediments (e.g. unit D1), the pebbly and shelly "B" horizon is absent. In these cases (e.g. Cores 572 and 672) a zone corresponding to the "B" horizon is present at the base of the "A" sand sheet.

In areas of present-day coastal erosion where the Postglacial Marine Transgression has continued into the stillstand period due to a sediment budget deficit, a basal transgressive unit is presumably still forming at the base of the shoreface. However, because of repeated storm reworking during the stillstand period, the unit is likely to have acquired characteristics more typical of inner-shelf sands (Unit A2) than of Unit B.

Deposits postdating the Postglacial Marine Transgression (Units A1-A3)

These deposits, which form a <1 to >9 m-thick sand sheet, generally overlie shelly and pebbly deposits of Unit B. Basically they represent marine deposition following the passage of the Postglacial Marine Transgression. They are time transgressive (presumably from the Last Glacial maximum onwards), although as shown by Table 2, most of the deposition has occurred during the Holocene stillstand (approximately 6000 yr B.P. to the present).

The sediments are typically sandy. They range in lithology from light yellowish-grey, clean, quartz-rich sands to dark olive-grey, muddy sands. They form three main units: A1 - nearshore sands; A2 - inner-shelf sands, and A3 - mid-shelf sands[ø].

A1. Nearshore sands

These deposits consist basically of light yellowish-grey to greyish-brown, fine or fine to medium-grained, well-sorted quartzose sands containing less than 10% biogenic carbonate (mainly thin-walled inner-shelf and nearshore molluscs - e.g. Bankivia). They occur mainly in two situations:

1. In embayments, as a continuation to the modern beach profile; depth range 0-30 m, occasionally extending to 50 m off large river mouths.

2. Off seaward protruding sections of the coast (e.g. off Cape Byron, Lennox Head and Sugarloaf Point, Figs 8 and 11) where the inner shelf is deep and steeply sloping; depth range 20-70 m. Here the nearshore sands form large lobate convex-upward accumulations up to 30 m thick orientated along the coast.

[ø] The surface distribution of these units is discussed by Colwell (1982) and Stephens (1982a).

Their distribution is essentially a product of fairweather conditions. Extensive reworking occurs during storms, in many cases (e.g. Cores 466, 489 and 491) procuding thin (less than 1 m thick) shelly lag deposits containing a few pebbles.

The nearshore sand in the large headland accumulations is derived in part from shoreface erosion. It is probably transported along-coast and offshore as a bed load by combined ocean currents and storm generated bottom flows. Deposition is probably partly related to the interaction of southward flowing ocean currents and northward littoral drift carrying sand to the end of the headlands (see Roy & Stephens. 1980).

Heavy-mineral values in the nearshore sands tend to be higher than in the more seaward of the "A" units (Riech and others, 1982).

Occasionally, a muddy, very fine sand sub-facies ($A1^1$) occurs at the base of the nearshore zone. In addition, a temporary thin mud layer is frequently deposited on the surface of the nearshore sands during prolonged calm periods but is reworked and dispersed by storms. More extensive and permanent accumulations of muddy sediment occur off large river mouths where the supply of fine fluvial sediment exceeds wave reworking (e.g. at Yamba off the Clarence River, core 275).

Other conditions conducive to the preservation of $A1^1$ deposits can apparently occur during barrier progradation. Here (cores 144, 167 and 168) fine sands and muds deposited at the base of the shoreface are buried before they can be reworked by waves.

The large accumulation of nearshore sahds which occurs off South Stradbroke Island (Fig. 13; Stephens, 1982a; Searle, 1982) is probably mainly related to the seaward movement of sediment through Jumpinpin Inlet during periods of high discharge, i.e. mainly during cyclonic weather (Stephens, op. cit.). If a similar inlet existed on the shelf during the latter stages of the Postglacial Marine Transgression, then the lower part of the sand accumulation is probably relict, i.e. made up of C1 sediments.

The nearshore sands are essentially stillstand deposits with accumulations spanning the mid to late Holocene. Rates of vertical accumulation are in the order of 1-2 mm $year^{-1}$.

A2. Inner-shelf Sands

The inner-shelf sands range in thickness from approximately 1-6 m (Figs 6-15). They generally consist of brown-grey, fine to coarse-grained, moderately to poorly-sorted quartzose sands. They are commonly ironstained, particularly in the upper 1-2 m. The carbonate fraction (mainly shell, forams, bryozoans, echinoid and, north of approximately 29^0S, coralline algal fragments) usually ranges in abundance from 5-30% but is higher in storm accumulations (see Fig. 19). Marine shells include Glycimeris and Placamen.

The sands appear, on the basis of texture, radiocarbon ages (Table 2) and the apparently low level of sand input at present from the coastal rivers (see e.g. Ford, 1963), to be mainly relict (palimpsest), principally stillstand deposits, subject to intermittent transport and reworking, mainly during storms. The sediments are generally confined

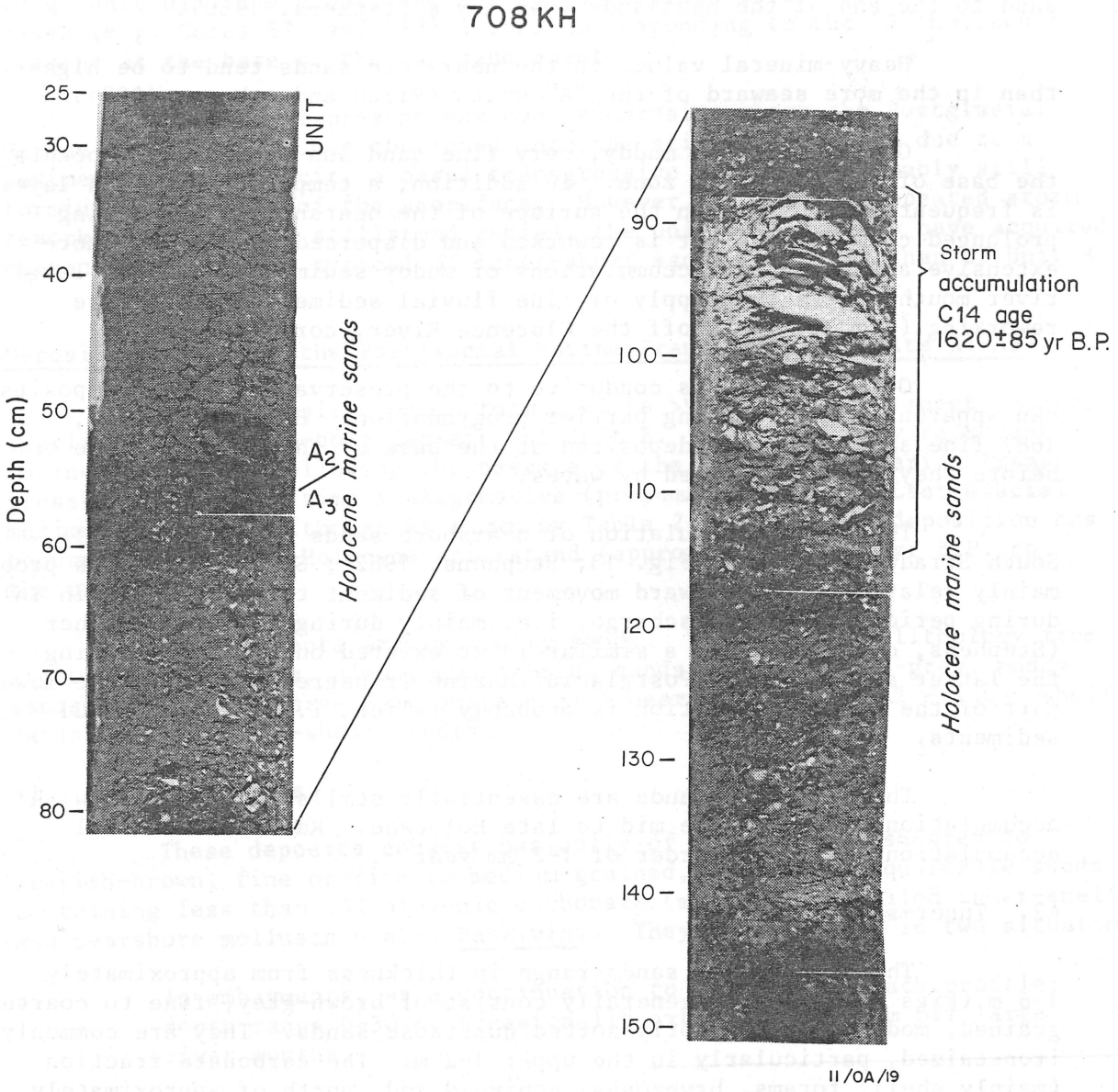


Fig. 19 Photograph of a peel from a section of core 708 KH showing Holocene marine sands including shelly storm layer.

to between 25 and 60 m of water. Modern additions to the sediment are probably mainly in the form of biogenic material. Minor mud and gravel occur in places, mainly towards the base of the unit grading into units below. In a number of places, erosion of the late Pleistocene/early Holocene and Pleistocene substrate during the Postglacial Marine Transgression has resulted in fragments of estuarine shell, calcarenite and other material (fine sand, mud, etc.) being incorporated into the Holocene sands, particularly into the basal part of the unit. Highly calcareous sands occasionally show evidence of marine cementation. Iron staining in the upper part of the unit essentially corresponds to the zone present-day reworking. Large low amplitude bed-forms (200-400 m wave length and 1-3+m amplitude) occur on the inner shelf (Jones & Kudrass, 1982), presumably in response to ocean current and storm wave action.

Off northern Fraser Island, the inner-shelf sediments are typically carbonate-rich and gravelly (mainly bivalves and coralline algae) ($A2^{1}$). The sediments are probably mainly related to the lithified carbonate banks and hardgrounds which form the Gardner Banks (Fig. 4). The extension of $A2^{1}$ sediments over part of a large lobe of A1 sediments south of Indian Head (see Fig. 15) is probably due to sediment movement by the East Australian Current.

A3. Mid-shelf Sands and Muddy Sands

The mid-shelf sands and muddy sands form a discontinuous surficial layer up to 4 m thick (Figs 5-16) which in places grades into the inner-shelf sands. They are typically dark olive-grey, (less commonly olive brown), fine to very fine-grained, well-sorted with a variable mud content. Sand grains are angular and include up to 50% carbonate. Surface sediments contain benthonic foraminifera and burrowing organisms, mainly polychaetes. Minor glauconite infills foraminifera tests. The mud content varies regionally, increasing southwards along the shelf in response to variations in bottom current velocities and possibly to variations in mud input from rivers along the coast. Muddy sediments are generally restricted to the area south of Cape Hawke (especially off the southern part of Newcastle Bight - Davies, 1979; Colwell, 1982) where the East Australian Current diverges from the shelf (see Cresswell and others, 1983).

The sediments occupy a depth range between 45 and 90+m on the mid shelf which corresponds to a low energy window between zones dominated by ocean currents on the outer shelf and wave action on the inner-shelf.

Sedimentation occurs episodically during storms when fine sediment is reworked seawards. Sediment sources include backbarrier/estuarine deposits exposed in the eroding shoreface and inner shelf as well as fine fluvial sediment transported to the coast during floods. Deposition spans the last 10 000 years (Table 2) and average rages of accumulation generally range from 0.1-0.4 mm $year^{-1}$.

DISCUSSION

Generally, the range of lithologies that occurs in the vibrocores and drill holes reflects a range of environments which can be readily observed on the present-day shelf and coast. These environments include dune, beach-face, estuarine and shallow marine. In some cases (e.g. cores 169, 535, and 667) a direct comparison can be made between the

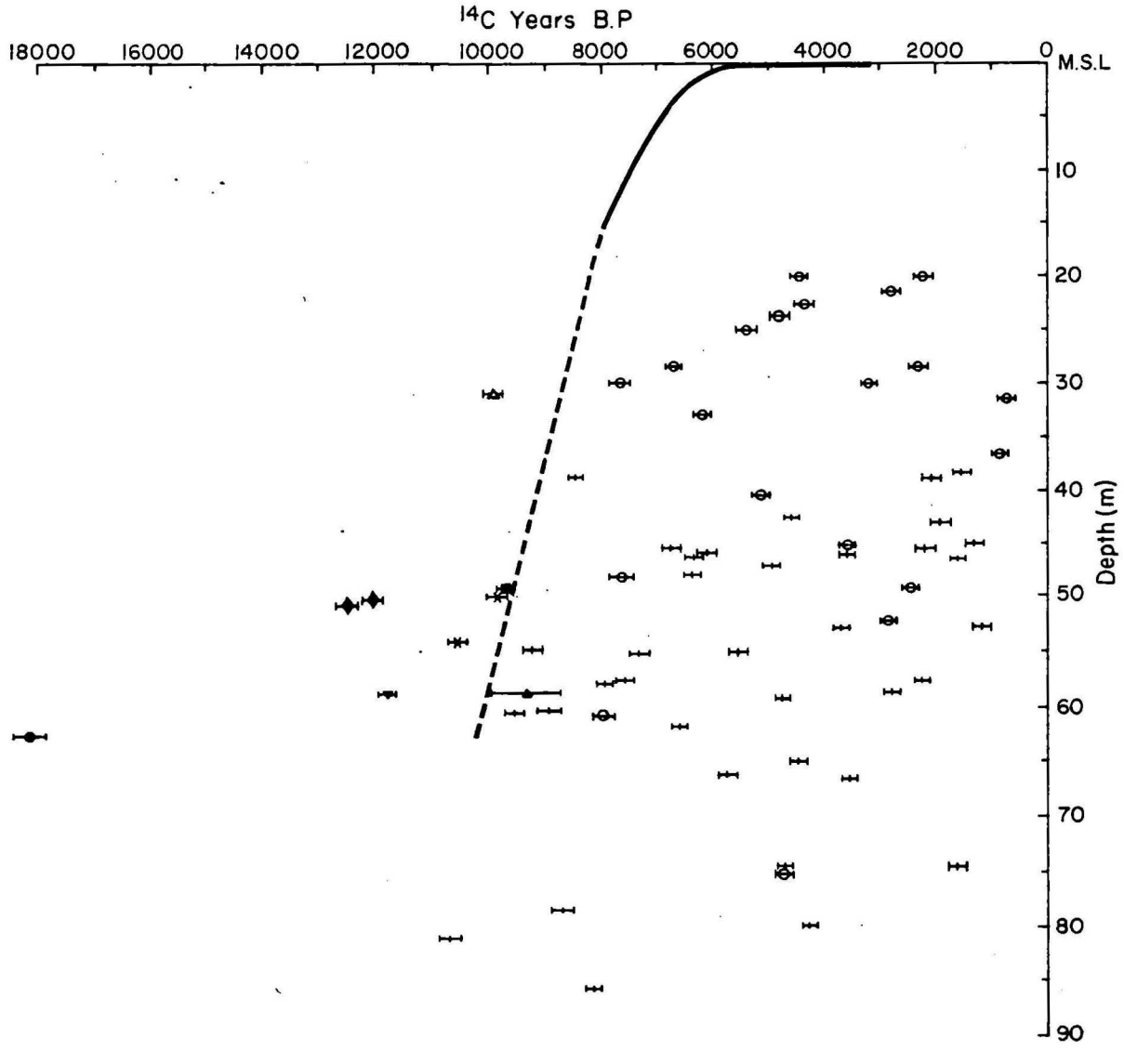
offshore sequence and parts of the onshore sequence. However, unfortunately, because of a lack of high-resolution shallow seismic data (to facilitate correlation between cores), a shortage of radiometric dates, and the rapid changes in lithology which typify coastal environments; detailed subdivision, correlation, and palaeogeographic mapping is impossible at present.

As noted by Roy & Thom (1981), the processes which took place on the shelf prior to sea level stabilising about 6000 yr B.P. are probably best described by the barrier migration model of Fischer (1961), Swift (1975) and others. This model involved landward movement of the beach/barrier system by washover and other (e.g. aeolian) processes during the marine transgression. The beach/dune system tends, as shown by the SONNE vibrocores and drill holes, to move landward across the relatively shallow and low gradient shelf over marine to continental sediments (Units D1-D3 in the SONNE cores), leaving behind remnants of the nearshore, estuarine and backbarrier systems (deposits of Units C1 and C2) and a trailing transgressive sand sheet (Units A1-A3 & B). Accumulation of the "A" sediments is continuing today. Reworking of the older (Pleistocene) marine to continental deposits (Units D1-D3) and the essentially-contemporaneous backbarrier, estuarine and nearshore tidal delta deposits (Units C1 and C2) contributed material to the transgressive horizon and to the overlying marine sands, and, ultimately to the onshore Holocene barrier system. The extent of this erosion is difficult to gauge (see Belknap & Kraft, 1981).

The rate of sea-level rise during the Postglacial Marine Transgression appears on the basis of Table 2 and previously published data (Thom & Chappell, 1975; Thom and others, 1969, 1978), to be in the order of 10-20 m per 1000 years, slowing markedly after about 7000 years B.P. (Fig. 20). This is similar to the rate recorded by Geyh and others (1979) for the Strait of Malacca but less than the rate recorded by Beiersdorf and others (1980) for the Mozambique Shelf.

Following the stabilisation of sea-level at about 6000 years B.P. (Thom & Chappell, 1975), sediment build-up began onshore, forming the Holocene outer barrier (Thom and others, 1978), and in the nearshore zone. Once bays became in-filled, littoral by-passing began (Roy & Thom, 1981). This produced the large accumulations of nearshore ("A1") sand off prominent headlands along the coast.

the generally low heavy-mineral values encountered during the SONNE cruise (except in parts of the nearshore zone - Riech and others, 1982) reflects the generally unfavourable depositional environments of many of the units for heavy-mineral concentrations, as well as, probably, the relatively small number of holes (25) which penetrated the most promising Unit, D1. In the onshore situation, individual heavy-mineral deposits which can be traced in some cases for a few thousand metres along the coast and for several tens of meters across strike (Jones & Davies, 1979), are surrounded by almost barren sand and often require detailed drilling to find and fully define their extent. Except for the fact that incident wave energy (i.e. the sorting energy in the beach zone) may have been less during lower sea levels (Roy & Thom, 1981, p.481), there seems no reason why similar heavy-mineral seams (but perhaps with a lower maturity) could not occur in the offshore beach/dune deposits of Unit D1. The well-sorted texture and generally low to zero carbonate content of the D1 deposits sampled indicate fairly minimal reworking of this material with the Postglacial Marine Transgression. This contrasts sharply with the upper parts of the barriers which were probably removed with the transgression and the sand moved landwards



SONNE SO-15 data (Table 3)

- Wood (E. gummifera) associated with black organic-rich clays and peat
- Organics (leaves + reeds) associated with estuarine clays
- Root material in black muds and muddy sands. In situ.
- Marine shell hash
- Marine shells
- Estuarine shells (Anadra etc) in restricted marine/estuarine muddy sands and mud.
- Charcoal associated with estuarine sands
- Humate cement in sandrock (cemented dune sands)
- Charcoal layer on dune sands
- Sea-level curve for the New South Wales coast for the last 8000 years (Donner and Jungner, 1981) based upon data published prior to 1980. Most of the data from Thom and Chappell (1975) and Thom and others (1969, 1978)

11/0A/20

Fig. 20 Plots of radiocarbon ages against depth of the sample below present-day mean sea-level

with the advancing shoreline to be largely incorporated into the onshore Holocene barrier. This movement of sand probably upgraded the maturity of the associated heavy-mineral suite due to differential sorting of the light (and largely uneconomic) heavy-minerals with respect to the heavier (and largely economic) heavy-minerals as outlined by Riech and others (1982). A similar upgrading may have taken place during each Pleistocene transgression.

SUMMARY AND CONCLUSIONS

1. The SONNE vibrocoring and counterflush drilling revealed the presence of nine major depositional units in the areas studied. These units range from dark grey muds to yellowish brown shelly sands. In general, the section consists of a thin Holocene marine sand sheet overlying paralic sediments of the Postglacial Marine Transgression that in turn overlie Pleistocene terresetrial to marine sediments. A significant amount of carbonate cementation and evidence of weathering is present in the Pleistocene section - this reflects the effects of previous sea-level changes.

2. Sea-level rise during the Postglacial Marine Transgression appears to have been at a rate of 10-20 m/1000 years for the period from approximately 10 000 to 7000 years B.P.. Although a considerable amount of erosion probably occurred during the transgression, mainly due to the generally high wave-energy conditions of the coast, in most areas at least part of the late Pleistocene/early Holocene section remains intact.

3. In general, the barrier migration model of Swift (1975) and others appears to apply to the areas studied. This involves large-scale movement of the barrier sand landwards with the Postglacial Marine Transgression.

4. Economically, the SONNE cruise showed that the likelihood of finding easily identifiable readily exploitable heavy-mineral deposits on the shelf is remote. The greatest potential for economic deposits seems to be in the nearshore zone or in Unit D1 of the Pleistocene section.

ACKNOWLEDGEMENTS

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REFERENCES

BEIERSDORF, H., KUDRASS, H.-R. & von STACKELBERG, U., 1980 - Placer deposits of ilmenite and zircon on the Zambezi shelf. Geolgisches Jahrbuch, Series D, 36, 85 pp.

BELKNAP, D.F. & KRAFT, J.C., 1981 - Preservation potential of transgressive coastal lithosomes on the U.S. Atlantic shelf. Marine Geology, 42, 429-42.

BIRD, E.C.F., 1973 - Australian coastal barriers. In Schwartz, M.L. (ed.), BARRIER ISLANDS, 410-26. Dowden, Hutchinson & Ross, Stroudsburg.

BOYD, R., 1974 - Marine geological investigations of the N.S.W. coast between Port Stephens and Norah Head. Hons. thesis, University of Sydney (unpublished).

BROWN, G.A., 1971 - Offshore mineral exploration in Australia. Underwater Journal and Information Bulletin, 3(4), 166-76.

CHAPPELL, John, 1974 - Geology of coral terraces, Huon Peninsula, New Guinea: A study of Quaternary tectonic movements and sea-level change. Bulletin of the Geological Society of America, 85, 553-70.

COALDRAKE, J.E., 1955 - Fossil soil hardpans and coastal sandrock in southern Queensland. Australian Journal of Science, 17, 132-3.

COALDRAKE, J.E., 1962 - The coastal sand dunes of southern Queensland. Proceedings of the Royal Society of Queensland, 72, 101-16.

COLWELL, J.B., 1982 - Sedimentology of surface sediments of the New South Wales shelf. Geologisches Jahrbuch, Series D, 56, 111-124.

COLWELL, J.B., JONES, H.A. & DAVIES, P.J., 1981 - Initial results of SONNE cruise 50-15 on the east Australian continental shelf, September-November, 1980. Bureau of Mineral Resources, Australia - Record, 1981/4 (unpublished).

COOK, P.J. & MARSHALL, J.F., 1981 - Geochemistry of iron and phosphorus-rich nodules from the east Australian continental shelf. Marine Geology, 41, 205-21.

CONOLLY, J.R., 1969 - Western Tasman sea floor. New Zealand Journal of Geology and Geophysics, 12, 310-43.

CRESSWELL, G.R., ELLYETT, C., LEGECKIS, R. & PEARCE, A.F., 1983 - Nearshore features of the East Australian Current System. Australian Journal of Marine and Freshwater Science, 34, 105-14.

DAVIES, P.J., 1975 - Shallow seismic structure of the continental shelf, southeast Australia. Journal of the Geological Society of Australia, 22, 345-59.

DAVIES, P.J., 1979 - Marine geology of the continental shelf off southeast Australia. Bureau of Mineral Resources, Australia - Bulletin, 195, 51 pp.

DELFT, 1970 - Gold Coast, Queensland, Australia. Coastal erosion and related problems. Report of Delft Hydraulics Laboratory, Amsterdam.

DONNER, J. & JUNGNER, H., 1981 - Radiocarbon dating of marine shells from southeastern Australia sa a means of dating relative sea-level change. Annales Academiae Scientiarum Fennicae, Series A (III), 131, 44 p.

FISCHER, A.G., 1961 - Stratigraphic record of transgressing seas in light of sedimentation of Atlantic coast of New Jersey. AAPG Bulletin, 45, 1656-66.

FORD, A.R., 1963 - River entrances of New South Wales. Journal of the Institute of Engineers of Australia, 35, 313-20.

FRAKES, L.A., 1979 - CLIMATES THROUGHOUT GEOLOGIC TIME. Elsevier, Amsterdam, 310 pp.

FRIEDRICH, G., MARTIN, J. & KUNZENDORF, H., 1982 - Geochemical studies on offshore sediment samples from the continental shelf of eastern Australia. Geologisches Jahrbuch, Series D, 56, 165-177.

GEYH, M.A., KUDRASS, H.-R. & STREIF, H., 1979 - Sea-level changes during the late Pleistocene and Holocene in the Strait of Malacca. Nature, 278, 441-3.

GORDON, A.D. & ROY, P.S., 1977 - Sand movements in Newcastle Bight. Third Australian Conference on Coastal and Ocean Engineering, Melbourne - Proceedings.

HAYES, D.E. & RINGIS, J., 1973 - Seafloor spreading in the Tasman Sea. Nature, 243 (5408), 454-8.

HEEZEN, B.C., 1974 - Atlantic-type continental margins. In BURK, C.A. & DRAKE, C.L. (eds.), THE GEOLOGY OF CONTINENTAL MARGINS, 13-24. Springer-Verlag, Berlin.

JONES, H.A. & DAVIES, P.J., 1979 - Preliminary studies of offshore placer deposits, eastern Australia. Marine Geology, 30, 243-68.

JONES, H.A. & KUDRASS, H.-R., 1982 - SONNE SO-15 cruise 1980 off the east coast of Australia - Bathymetry and sea-floor morphology. Geologisches Jahrbuch, Series D, 56, 55-67.

KUDRASS, H.-R. 1982 - Cores of Holocene and Pleistocene sediments from the east Australian continental shelf (SO-15 cruise 1980). Geologisches Jahrbuch, Series D, 56, 137-163.

LANGFORD-SMITH, T. & THOM, B., 1969 - New South Wales coastal morphology. In Packham, G.H. (ed.) - The Geology of New South Wales. Journal of the Geological Society of Australia, 16(1), 572-80.

LAYCOCK, J.W., 1978 - North Stradbroke Island. In Orme, G.R. & Day, R.W. (eds.), Handbook of recent geological studies in Moreton Bay, Brisbane River and North Stradbroke Island, University of Queensland Department of Geology Papers, 8(2), 89-96.

MARSHALL, J.F., 1979 - The development of the continental shelf of northern New South Wales. BMR Journal of Australian Geology & Geophysics, 4, 281-8.

MARSHALL, J.F., 1980 - Continental shelf sediments: southern Queensland and northern New South Wales. Bureau of Mineral Resources, Australia - Bulletin, 207, 39 pp.

MARSHALL, J.F. & THOM, B.G., 1976 - The sea level in the Last Interglacial. Nature, 263, 120-1.

MARSHALL, J.F. & DAVIES, P.J., 1978 - Skeletal carbonate variation on the continental shelf of eastern Australia. BMR Journal of Australian Geology & Geophysics, 3, 85-92.

MAYO, W., 1972 - A computer program for calculating statistical parameters of grainsize distributions. BMR Record 1972/146 (unpublished).

McGARITY, J.W., 1956 - Coastal sandrock formation at Evans Head, N.S.W. Proceedings of the Linnaean Society of New South Wales, 81, 52-8.

RIECH, V., KUDRASS, H.-R. & WIEDICKE, M., 1982 - Heavy minerals of the east Australian shelf sediments between Newcastle and Fraser Island. Geologisches Jahrbuch, Series D, 56, 179-195.

ROY, P.S., 1980 - Quaternary depositional environments and stratigraphy of the Fullerton Cove region, central New South Wales. Geological Survey of New South Wales - Record, 19(2), 189-219.

ROY, P.S. & CRAWFORD, E.A., 1977 - Significance of sediment distribution in major coastal rivers, northern New South Wales. Third Australian Conference on coastal and ocean engineering, Melbourne - Proceedings.

ROY, P.S. & CRAWFORD, E.A., 1980 - Quaternary geology of the Newcastle Bight inner continental shelf, New South Wales, Australia. Geological Survey of New South Wales - Record, 19(2), 145-188.

ROY, P.S. & STEPHENS, A.W., 1980 - Geological controls on process-response, southeastern Australia. Proceedings of the 17th International Conference on Coastal Engineering, Sydney, March 1980.

ROY, P.S. & THOM, B.G., 1981 - Late Quaternary marine deposition in New South Wales and southern Queensland - en evolutionary model. Journal of the Geological Society of Australia, 28, 471-89.

ROY, P.S., THOM, B.G. & WRIGHT, L.D., 1980 - Holocene sequences on an embayed high-energy coast : en evolutionary model. Sedimentary Geology, 26, 1-19.

SCHLEUTER, H.-U., 1982 - Results of a reflection seismic survey in shallow water areas off east Australia, Yamba to Tweed Heads. Geologisches Jahrbuch, Series D, 56, 77-95.

SEARLE, D.E., 1982 - Seismic reflection profiling off the east coast of Australia, South Stradbroke Island to Tweed Heads. Geologisches Jahrbuch, Series D, 56, 97-104.

SEYMOUR, J., 1981 - The dunes of Cooloola. Ecos, 30, 3-11.

SHIRLEY, J., 1964 - An investigation of the sediments on the continental shelf of New South Wales. Journal of the Geological Society of Australia, 11(2), 331-42.

STEPHENS, A.W., 1982a - Surficial sediments of the southern Queensland shelf, Southport - Point Lookout and Fraser Island areas. Geologisches Jahrbuch, Series D, 56, 125-135.

STEPHENS, A.W., 1982b - Quaternary coastal sediments of southeast Queensland. Geologisches Jahrbuch, Series D, 56, 37-47.

SWIFT, D.J.P., 1975 - Barrier-island genesis : evidence from the central Atlantic shelf, eastern U.S.A.. Sedimentary Geology, 14, 1-43.

THOM, B.R., 1978 - Coastal sand deposition in southeast Australia during the Holocene. In Davies, J.L. & Williams, M.A.G., LANDFORM EVOLUTION IN AUSTRALASIA, 197-214. A.N.U. Press, Canberra.

THOM, B.G. & CHAPPELL, J., 1975 - Holocene sea levels relative to Australia. Search, 6(3), 90-3.

THOM, B.G., HAILS, J.R. & MARTIN, A.R.H., 1969 - Radiocarbon evidence against higher postglacial sea levels in eastern Australia. Marine Geology, 7, 161-8.

THOM, B.G., POLACH, H.A. & BOWMAN, G.M., 1978 - Holocene age structure of coastal sand barriers in New South Wales. Dept. of Geography, Faculty of Military Studies, University of New South Wales, Duntroon, Canberra, 86 pp (unpublished).

THOM, B.G., BOWMAN, G.M., & ROY, P.S., 1981 - Late Quaternary evolution of coastal sand barriers, Port Stephens - Myall Lakes area, central New South Wales, Australia. Quaternary Research, 15, 345-64.

THOMPSON, C.H., 1981 - Podzol chronosequences on coastal dunes of eastern Australia. Nature, 291, 59-61.

VON DER BORCH, C.C., 1970 - Phosphatic concretions and nodules from the upper continental slope, northern New South Wales. Journal of the Geological Society of Australia, 16(2), 755-9.

VON STACKELBERG, U., 1981 - Fahrtbericht SO-15 Schwermineralkampagne auf dem Ostaustralischen Schelf mit MS Sonne. BGR cruise report, Hannover, West Germany, 73 pp.

VON STACKELBERG, U. & JONES, H.A., 1982 - Outline of Sonne cruise SO-15 on the east Australian shelf between Newcastle and Fraser Island. Geologisches Jahrbuch, Series D, 56, 5-23.

WARD, W.T., 1978 - Notes on the origin of Stradborke Island. In Orme, G.R. & Day, R.W. (eds.), Handbook of recent geological studies in Moreton Bay, Brisbane River and North Stradbroke Island, University of Queensland Department of Geology, Papers, 8(2), 97-104.

WARD, W.T., LITTLE, I.P. & THOMPSON, C.H., 1979 - Stratigraphy of two sandrocks at Rainbow Beach, Queensland, Australia, and a note on humate composition. Palaeogeography, Palaeoclimatology, Palaeoecology, 26, 305-16.

APPENDIX 1

DETAILED DESCRIPTION OF THE CORES

Abbreviations used:

GK: Geodoff vibrocore

GS: Geodoff counterflush drill hole

KH: Kiel vibrocore

WD: Water depth (m)

CORE 43 KH (lat.: 32°57'56.2"S, long.: 151°49'35.6"E)
WD = 41 m Recovery = 1.0 m

0-50 cm SAND, fawn-brown, quartzose (<1% lithics), clean, medium to very coarse, poorly sorted, rounded. Up to 30% of grains are lightly ironstained. Shell (5%) as large fragments and scattered whole shells of marine species.

(gradational contact)

50-100 cm SAND, white, quartzose (1% lithics), clean, medium grained, moderately well sorted subrounded, non-ironstained. 5% shells as fragments and large whole shells mainly marine species (eg Glycimeris) and occasional estuarine shells (eg Anadara).

CORE 44 KH (lat.: 32°57'59.2"S, long.: 151°50'50.2"E)
WD = 47 m Recovery = 1.2 m

0-120 cm SAND, light brown, quartzose (1% lithics), medium to coarse becoming very coarse at base, poorly sorted, rounded. 50-70% of grains are ironstained. Thin (1cm) layer of grey medium sand at 60 cm.
Scattered shell (10%) throughout, very shelly (>20%) with large shells and rare fragments of estuarine gastropods at base. Marine, inner shelf species; common whole valves oriented concave-up. Laminations in top 40 cm. Few coal fragments at 80 cm.

CORE 68 KH (lat.: 32°50'30.0"S, long.: 152°06'45.0"E)
WD = 79 m, Recovery = 2.20 m

0-170 cm SANDY MUD, grading down to MUDDY SAND, black to dark grey, 80% mud at top, 40% at bottom, top 70 cm is soft, strongly bioturbated (live burrowing organism found at 60 cm).
Sand fraction is quartz-lithic non-ironstained and coarsens down: very fine to fine, well sorted, angular in top 70 cm, becoming fine to very coarse and granular, very poorly sorted and angular to rounded in lower part. Coarser grains are composed of rounded, clear and multicoloured quartz and dark grey rock fragments. Shell content (10-15% of total sediment) comprises mainly Mollusca: whole, thin walled marine bivalves, minor gastropods (Bankivia), and angular fragments, common foraminifera.

(gradational contact)

170-193 cm GRAVELLY, SHELLY SAND, trace mud, dark grey, quartz-lithic, medium to very coarse, granular and pebbly, very poorly sorted, subangular to well rounded (coarse quartz and lithics are well rounded). Non-ironstained. Common multicoloured quartz, 40% lithic grains. Shell (20%) comprises mixed assemblage of thin walled marine shells and large abraded estuarine species (oyster, Anadara).

(Sharp contact)

193-220 cm, SAND, grey, mainly clean (trace mud at top), quartz-lithic, bimodal; mainly medium with minor coarse grains and granules of quartz and lithics, moderately well sorted, sub angular to sub rounded (coarse mode is rounded). Non-ironstained 5-20% shell (thin walled marine bivalves and rare Bankivia fragments) rare coralline algae, barnacle plates, common foraminifera. Sediment is bioturbated (mottled).

CORE 69 KH (lat.: 32°49'59.5"S, long.: 152°02'32.1"E)
WD = 40 m Recovery = 1.25 m

0-0.3 cm MUD, soft, brown with surface worm tracks.

0.3-100 cm SAND, gravelly in part, brown and ironstained to c. 65 cm; grey, non-ironstained below. Medium to coarse with scattered granules and pebbles especially from 40-65 and 90-100 cm. Very poorly sorted generally well rounded, especially coarse grains. Lithics increase from 1-8% downwards. Shell (3-8%) mainly abraded fragments of marine species, few large Glycimeris in gravelly layer at 40-65 cm; rare chalky degraded shell fragments in lower part.

(gradational contact)

100-125 cm GRAVEL with minor coarse sand, light grey, very slightly clayey, clay is white (leached). Very poorly sorted sub angular to well rounded, 15% lithic grains, no shell. (Sediment has weathered/leached appearance).

CORE 91 KH (32°56'25.2"S; 151°49'40.2"E) and probably core 92 KH (32°56'18.0"S; 151°50'18.0"E), encountered dredge spoil - useless for stratigraphic purposes.

CORE 144 KH (lat.: 32°52'06.7"S; long.: 151°51'57.2"E)
WD - 27 m Recovery 4.00 m

0-0.3 cm MUD, black soft (temporary surficial layer).

0.3-118 cm SAND, (fining down sequence) mainly clear, fawn, quartzose (2% lithics). Medium to coarse grained at top grading down to grey, more lithic-rich (6%) and fine grained at base. Generally well sorted and rounded to sub-rounded, slightly granular and poorly sorted at c. 30 cm. Slightly ironstained (5%), minor shell (<6% except in coarser layer - 12%) Thin muddy (organic?) layer at c. 90 cm.

(Sharp contact)

118-305 cms SAND, (fining down sequence) light grey, clearn, quartzose; coarse grained to gravelly at top grading down through dark grey, medium to fine sand into fine to very fine black, muddy sand and sandy MUD at base.
From 118-150 cm sand is fine to coarse and granular to pebbly, very shelly with abundant whole Glycimeris and Bankivia. Very poorly sorted, rounded. 3% lithic grains.
From 150-280 cm sand becomes finer better sorted and more angular. Some horizontal to gently dipping bedding. Abundant shell fragments (15-20%) and whole shells mainly shoreface species (Bankivia).
Below 250 cm sand is slightly muddy and contains thin shell layers (mainly Bankivia).
From 280-305 cm mud increased from 20% at top to 95% at base. Bioturbated at top. Sand fraction is fine to very fine grained, well sorted, angular. Shells are thin walled lower shoreface species (including Bankivia). Some mottling caused by variation in sand content - possibly indicates burrowing.

(Sharp contact)

305-322 cms GRAVEL, Sandy grey, composed of angular to very well rounded quartz and siliceous rock grains, poorly sorted, 12% chalky degraded shell fragments.

(Sharp contact)

322-400 cms SAND, clayey, light grey and yellow brown, slightly mottled. Clay content increasing down from 10-30%. Sand is fine to very fine with some medium (rounded) grains, moderately poorly sorted, generally sub angular to angular, up to 8% lithics (including feldspar and trace mica), trace wood fragments. Grains are iron coated (40%) in basal part, leached in upper part.
The overlying coarse shelly sand from 118 to 150 cm probably reflect a period of increased storminess. It may mark the initiation of a long-term phase of coastal erosion that terminated barrier progradation or it may reflect short term erosion followed by continued progradation (represented by the section from c. 70 to 118 cm). In the former case, inner shelf sands extent down to c. 150 cm; in the latter case they are thinner and only occupy the top 70 cm of the section.

CORE 145 KH (lat.: 32°53'23.8"S; long.: 151°53'30.4"E)
WD = 34 m Recovery = 2.13 m

0-107 cm SAND, clean, quartzose with <5% siliceous rock fragments, orange-brown to fawn grey, ironstained (30% of grains) at top decreasing down. Medium-fine and well sorted in top 50 cm coarsening down to medium to very coarse and gravelly from 50 to 80 cm, coarse to granular but less gravelly below 80 cm. Very shelly from 50-80 cm with common large Glycimeris shells, less than 10% shell elsewhere.

(moderately sharp contact)

107-213 cm SAND, quartzose (<2% lithics), yellow-fawn, very slight trace yellow mud, medium fine to medium-coarse with few scattered granules and rare pebbles especially near base, slight coarsening down sequence. Very rare trace shell in upper part (minor angular shell fragments at top reworked from overlying unit). Grains in upper half are lightly iron oxide coated (up to 50% of grains), few limonite cemented sand nodules (soft) in lower half. (sub aerially weathered and oxidised).

CORE 146 KH (lat.: 32°52'53.6"S; long.: 151°54'58.1"E)
WD = 35 m Recovery - 1.85 m

0-1 cm MUD, black, soft, (superficial calm weather deposit).

1-65 cm SAND, clear, gravelly, shelly, quartzose (3% lithics), medium to caorse sand with 50-70% gravel (up to 3 cm dia.), very poorly sorted, very well rounded to subrounded, iron stained (25% of grains) 10% shell fragments and abundant large, broken, abraded Glycimeris shells.

(grades down into:)

65-185 SAND, clean becoming muddy (<5%) in basal 20 cm, quartzose (1-4% lithics increasing down), light grey-white (leached), sharp colour change to brown (organic? grain coatings) below c. 160 cm. Medium-fine grained (subtle fining down trend), scattered granules and small pebbles throughout, thin coarse sand layers at 120 and 155 cm, well sorted sub-rounded to sub-angular grains. No shell.

CORE 167 KH (lat.: 32°48'42.8"S; long.: 152°02'42.9"E)
WD = 33 m Penetration - 2.80 m
Recovered 2.20 m (lost 60 cm out of bottom of corer).

0-85 cm SAND, clean, fawn-grey, quartzose (<2% lithics), medium to coarse with some granules towards base, moderately to poorly sorted, rounded grains, minor iron straining (5% of grains), 2% shell fragments (some chalky shell - ?estuarine).

(narrow gradational contact)

85-130 cm SAND/MUD (sand with interbedded mud layer in upper part overlying mud.)
From 85-100 cm SAND is very slightly muddy, dark to mid-grey, quartzose (3% lithics), medium-fine grained , well sorted, rounded to sub-rounded, slightly shelly except at c. 95 cm where a thin black mud layer contains abundant Bankivia. Very well bedded (non bioturbated).
From 100-130 cm MUD is black, greasy, organic rich, slightly sandy at top with thin Bankivia shell layer at c. 100 cm., non sandy elsewhere. No apparent bedding.

(Sharp contact)

130-160 SAND/GRAVEL, grey, clean, quartzose with well rounded pebbles and granules of quartz and siliceous rock types. Sand is medium to very coarse becoming less gravelly and fining downwards. Very poorly sorted, generally well rounded with some angular in lower part, almost no iron staining. Very shelly above 144 cm with large whole Glycimeris shells and shore-face species including abundant Bankivia; less shelly below 144 cm (sand-sized shell comprises 3-5%).

(Sharp contact)

160-220 SAND, light grey, clean, quartzose (<2% lithics), uniformly fine grained, very well (?-280+)sorted, subrounded to angular becoming more angular downwards. No shell, non-ironstained, leached.

CORE 168 GK (lat.: 32°48'43.7"S; long.: 152°02'42.7"E)
WD = 33 m Recovery = 2.6 m

0-90 cm SAND, fawn, clean, quartzose (<5% lithics) medium to coarse with some granules in upper part (slight fining down trend), poorly sorted, rounded to well rounded grains, 10-15% ironstained. Minor shell (<5%) increasing slightly below 60 cm. Some small whole shells (mainly bivalves) common. Bankivia fragments.

(gradational contact)

90-230 cm SAND, mid-grey, clean, quartzose with 2-8% lithics increasing downwards, very fine to medium grained, some coarse grains in upper part, rare granules, poorly sorted, well rounded to sub angular grains, generally non-iron stained, coarser mode is weakly iron-stained; 4-7% shell fragments (generally fresh, rarely, chalky), no whole shells. Thin black mud layer at c. 125 cm, slightly coarser sand layer at 180-190 cm.

(gradational contact)

230-260 cm GRAVEL/SAND mainly quartzose, gravel is partly lithic, dark fawn-grey, clean, strongly bimodal with fine angular sand mode as above and very coarse, granular and pebbly coarse mode. Gravel 60% in top 20 cm, 20% below 250 cm, very poorly sorted, pebbles and granules are very well rounded. Shell (10%) mainly large angular fragments and whole, slightly abraded, Glycimeris shells, occasional Bankivia fragments (no estuarine shells).

CORE 169 GK (lat.: 32°53'27.5"S; long.: 151°53'21.5"E)
WD = 34 m; Recovery = 6.7 m

0-274 cm SAND, (coarsening down sequence) Gravelly, clean, fawn in top 50 cm, grey-brown in lower part, quartzose (up to 6% lithics mainly siliceous rock types). Medium grained, well sorted in top 50 cm, very poorly sorted below coarsening down to medium-coarse grained with scattered granules and pebbles to 160 cm. Gravelly sand below 160 cm: coarse gravel (to 30 mm) with common large Glycimeris shells to 230 cm; finer gravel (to 15 mm) with rare

shell below 230 cm. Generally less than 5% sand sized marine shell throughout. Some ironstaining (<20%) above 160 cm, non-ironstaaned below.

(Sharp contact)

274-610 cm SAND, fawn to grey, clean, quartzose with lithic content increasing downwards from 1-7%. Uniformly fine to medium grained and well sorted to 500 cm, medium to coarse grained and less well sorted below 500 cm. Some granules in section 560-590 cm; medium-fine grained and well sorted at base.
Grains are rounded to sub angular, non-iron stained. No shell, leached.
Faint grey-grey brown mottling from 430 to 490 cms, some indication of layering immediately above mottled zone.

(Sharp contact)

610-670 cms SAND, Orange in top 10 cm, grey-brown to dark grey below, slightly muddy at top and bottom (up to 8%), quartzose with 5-10% lithic grains and trace mica, increasing to 25% in gravelly zone. Mainly fine grained and well sorted at top, poorly sorted sandy fine gravel layer at 650-655 cm, very fine to medium and very poorly sorted at base. Grains are angular to rounded, non-iron stained. No shell (leached). The upper most 10 cm of this unit contains minor yellow, oxidised mud.

CORE 170 KH (long.: 32°55'51.8"S; long.: 151°55'36.7"E)
WD = 58.5 m, Recovery = 2.55 m

0-0.5 cm MUD, brown, soft (surfical calm weather deposit).

0.5-185 cm SAND, shelly, trace muddy in basal part, orange-brown to 40 cm, olive-brown grading down to olive-grey below. Quartzose with lithic content increasing from 2% at top to 7% at base. Medium to coarse at top, slight fining downward trend becoming fine to coarse at base, poorly sorted, sub angular to rounded grains, iron stained (30%) at top decreasing downwards, non-iron stained at base. Very shelly (15-35%) mainly thin-walled, marine shell fragments, rare whole shells, common iron stained and abraded relict shell in upper part some foraminifera below 80 cm. Coarse shell layers at 80, 120 and 180 cms. Fragments of coal at 85 cm.

(Sharp contact)

185-255 cm SAND, clean, mid-grey, quartzose with 5% lithics, uniformly fine grained, well sorted, sub-rounded to sub-angular grains minor iron staining in upper part (<10%), non-iron stained at base. Trace glauconite and rare heavy minerals. Rare shell (<3%) comprising Bankivia, their walled bivalves etc. Trace wood fragments at base.

CORE 171 KH (lat.: 32°56'14.4"S; long.: 151°55'48.4"E)
WD = 65 m, Recovery = 1.60 m

0-0.5 cm MUD, soft, black.

0.5-160 cm SAND, slightly muddy (trace-5%), muddy sand patch at 40-50 cm, dark olive grey, quartz-lithic (c.10% lithics). Subtle fining down trend: very fine to coarse and very poorly sorted in upper part becoming fine grained and well sorted in lower part. Angularity increasing downwards from sub angular to rounded at top to angular at base. Non-iron stained. Slightly to very shelly (2-35%) comprising mainly angular fragments, some whole and broken shells of lower shore face (Bankivia) and thin walled inner-shelf species. Foraminifera common.

No bedding

CORE 172 KH (lat.: 32°56'40.4"S, long.: 151°55'42.7"E)
WD = 74 m, Recovery = 3.5 m

0-350 cm SAND, Shelly, slightly muddy (1%) in top 60 cm, more muddy (5-7%) below. Dark olive grey, quartz-lithic (10-15% lithic grains including trace mica). Uniformly fine to very fine grained, well sorted, angular grains, non-iron stained.
10-20% shell as angular fragments and scattered whole shells, mainly deep water (e.g. Placamen and Bedeva) and lower shoreface (e.g. Bankivia, common at base) species, few barnacle plates.

CORE 173 KH (lat.: 32°41'22.3"S; long.: 152°16'48.7"E)
WD = 74 m, Recovery 1.4 m

0-105 cm SAND, Calcareous, slightly muddy (1% increasing down to 5%), dark olive grey, quartz-lithic (up to 15%), trace mica. Very fine to fine grained (rare rounded medium grains of quartz), well sorted, angular to sub-angular.

10%-95% fine calcareous material (shell, bryozoa, algae etc): top c. 10cm and bottom c.45 cm comprise 50-95% calcareous sand, intervening section is quartzose with <15% calcareous sand. Up to 5% glauconite, trace wood in part replaced by pyrite.

(gradational contact)

105-140 cm SAND, shelly, slightly muddy (1-3%) increasing down, dark olive grey, quartz-lithic (20-30% lithic grains). Bimodal: fine grained angular sand mode throughout with coarser-grained mode ranging from granular sand at top to medium grained sand with scattered pebbles at base. Very poorly sorted at top, better sorted below.
25-35% shell comprising fine fragments, foraminifera, large angular fragments and whole shells, some intact at top. Mixed marine and estuarine (e.g. Ostrea angusi) species at base. Trace glauconite.

CORE 174 GK (lat.: 32°40'16.3"S, long.: 152°15'18.2"E)
WD = 36 m, Penetration 7.5 m
Recovery 5.9 m

0-1 cm MUD, dark grey-brown, soft.

1-80 cm SAND, fawn, clean, quartzose (1% lithic grains), medium to coarse moderately sorted, becomming slightly coarser and more poorly sorted downwards. Grains are rounded, 30% iron stained (mostly quartz). 5-10% angular shell fragments (Bankivia and shore face species).

(gradational contact)

80-180 cm SAND, gravelly in part, fawn-brown, bimodal: medium plus very coarse and granular, gravelly from in top 40 cm, poorly sorted. Rounded grains, 15% ironstained. 5% shell, some intact bivalves in gravelly layer, marine species. Shell decreasing below 120 cm, <1% shell below 150 cm.

(gradational contact)

180-305 cm SAND, fawn-brown at top grading down to grey-white at base, mostly clean, quartzose (2% lithics) medium-fine to coarse grained, some granular sand at base. Well sorted, becoming very poorly sorted at top and bottom. Rounded to angular grains.
No shell, non-ironstained (leached) faint orange (oxidised) mottling above 260 cm.

(Sharp contact)

305-590 cm SAND, Pale fawn-grey at top becoming grey white towards base, mainly clean, quartzose with 5-10% lithics (mainly feldspar). Uniformly fine to medium-fine grained with rare coarse grains at top (reworked down from overlying unit). Well sorted, sub-angular to rounded becoming slightly more angular at base.
No shell non-ironstained (leached). Trace dark grey, organic mud and organic grain coatings near top (?soil). Trace (<1%) leached white clay at base.

HOLE 175 GS (lat.: 32°39'52.3"S, long.: 152° 14'19.2"E) (Disturbed samples)
WD = 30 m, Recovery = 5.50 m

0-200 cm SAND, light brown medium-coarse grained, slightly shelly.

200-550 SAND, coarse and very coarse grained. 10% fragmented shell material 200-400 cm, 5% below. 10% granules 400-550 cm.

CORE 176 KH (lat.: 32°37'48.6"S, long.: 152°17'03.3"E)
WD = 31 m, Recovery = 1.5 m

0-60 cm SAND, coarsening down sequence, fawn-grey, clean, quartzose with up to 8% lithics. Medium grained, well sorted in top 10 cm becoming increasingly coarse and granular and poorly sorted downwards, subangular to well rounded. Virtually non-ironstained. 2-3% shell as hash, large fragments (including common Bankivia and one Velacumantis and whole, thin-walled, marine bivalves (inner shelf species). Trace heavy minerals. Scattered balls of black shelly mud (reworked) at top and below 40 cm.

(narrow gradational contact)

60-93 cm SAND, light grey, clean, quartzose with 4% lithics, uniformly medium - fine grained, very well sorted, subrounded to rounded grains. Extremely rare chalky shell fragment. Non-ironstained, leached.

(Sharp contact with signs of burrowing into underlying unit)

93-150 cm MUD, black, greasy, organic-rich, <5% fine sand. Burrows at top infilled with fine sand from overlying unit. Rare chalky estuarine shell.

CORE 204 KH (lat.: 32°30'01.1"S, long.: 152°30'02.3"E)
WD = 44 m, Recovery 2.6 m

0-100 cm SAND, grey-brown to fawn grey, mainly clear, trace mud (2%) at base, quartzose with up to 8% lithic grains (feldspar-rich in places). Medium to coarse grained, moderately well sorted, well rounded to angular grains (angularity increasing downwards).
Up to 4% shell fragments with scattered whole marine shells and large fragments especially at base, 5-30% ironstained grains (variable). Faint dark grey mottling (bioturbation) with trace of organic(?) mud from 40 to 60 cm.

(Narrow gradational contact - some evidence of reworking of lower unit)

100-260 cm SAND, Uniformly mid-grey, slightly muddy (1-3%), quartzose with 3-7% lithic grains, uniformly fine grained, well sorted, angular to subangular. Degraded wood (<1%) especially from 140 to 200 cm. No shell, non-ironstained (leached).

CORE 205 KH (lat.: 32°29'04.8"5, long.: 152°29'04.3"E)
WD = 36 m Recovery = 1.3 m

0-54 cm SAND, fawn at top becoming pale grey at base, clean, quartzose (lithics increasing from 2% to 5% downwards), medium to coarse grained, some dark grey patches of very fine sand (probably bioturbation). Poorly sorted, rounded to angular grains.
Minor shell (2%) becoming very shelly (25%) at base with large angular fragments and whole shells (including abundant Bankivia), mainly marine species.

(Narrow gradational contact, some reworking)

54-130 cm SAND, Uniform light grey, slightly muddy (2-3%) quartz-lithic (12-30% lithic grains, mainly feldspar, trace mica). Uniformly fine grained, very well sorted, angular to sub-angular grains. Up to 2% fine wood fragments throughout thin woody layer at 65 cm. No shell (one large Glycimeris at 100 cm is probably from overlying unit), non-ironstained (leached).

CORE 206 KH (lat.: 32°31'15.0"S, long.:152°30'06.0"E)
WD = 59 m, Recovery = 1.60 m

0-160 cm SAND, dark olive grey-brown (Karki), slightly muddy (<2%), quartzose with lithic content increasing from 2-7% downwards. Medium to coarse grained (rare granules), moderately poorly sorted, well rounded to subangular grains. 10-15% of grains are ironstained in top 30 cm, non-ironstained below. Scattered shell (5%) throughout, mainly fresh angular fragments of thin-walled mud-self species, some abraded, ironstained shell fragments. Faint mottling and slightly muddy from 100-200 cm. Faint layering in top 20 cm, none below.

CORE 207 KH (lat.: 32°31'39.5"S, long.: 152°31'18.9"E)
WD = 82 m, Recovery = 3.8 m

0-380 cm SAND, Dark olive grey, minor mud (2-10%) uniformly fine grained with minor medium and rare coarse grains near base. Quartz-lithic (10-25% lithic grains), well sorted, angular grains, few rounded medium quartz grains near base. Shell (5-25%) with scattered whole (deep water) shell and foraminifera throughout. Trace wood (1%) throughout, up to 5% green glauconite. Non ironstained.

CORE 208 KH (lat.: 32°30'15.8"S, long.: 152°31'17.0"E)
WD = 54 m, Recovery = 1.70 m

0-130 cm SAND, fawn grey, clean, quartzose (2-3% lithic grains), medium to coarse with some granules in upper part and fine pebbly layer at 110 cm, moderately poorly sorted, rounded grains.
Up to 3% shell as angular and abraded fragments (some relict, ironstained grains). Common whole shells of mixed inner shelf esturarine and shore face species (Velacumantis, Amesodesma, Glycimeris, Anadara) below c. 50 cm. 15-30% of grains are ironstained.

(narrow gradational contact)

130-170 cm SAND, light grey, clean to trace muddy at base, quartzose (2% lithic grains), mainly fine with minor medium and coarse grains at top, well sorted, well rounded to subangular grains.
Minor shell (1-2%) mainly angular to slightly abraded fragments and minor whole, thin-walled bivalves. 5-10% of grains are ironstained.

HOLE 209 GS (lat.: 32°13'00.5"S, long.: 152°35'30.7"E) (Disturbed samples)
WD = 53 m, Recovery = 1.6 m

0-80 cm? SAND, calcareous, orange-brown speckeled grey-white, clean?, quartzose with minor lithics. Medium to very coarse grained, very poorly sorted, very well rounded to subangular. 50% shell, bryozoan, algae etc. (mostly relict (ironstained and abraded)).

80?-160 cm SAND, muddy (20%?) shelly, mid-grey, quartz-lithic (12% lithic grains including common mica)., fine grained well sorted, angular grains.
Shell (30%) comprising angular fragments and whole shells of mainly mid shelf species (non-ironstained), also few estuarine species (mussel, Velacumantis, large Anadara stuck in base of drill tube). Common trace of wood fragments.

HOLE 210 GS (lat.: 32°12'59.9"S, long.: 152°34'55.4"E) (Disturbed samples)
WD = 36 m, Recovery = 7.5 m

0-750 cm SAND, uniform sequence, light grey, clean, quartzose (1-4% lithics ? increasing down), medium-fine grained, well sorted, sub-angular to sub-rounded grains. Minor shell thorughout (2-4%) comprising angular fragments and whole shells of inner shelf and shore face species (e.g. Bankivia). Non ironstained, rare trace heav y minerals.

HOLE 228 GS (lat.: 32°26'09.1"S, long.: 152°34'02.3"E) (Disturbed samples)
WD = 40 m, Recovery = 7.5 m

0-750 cm SAND, fawn grey at top light grey below, clean, quartzose with 2-5% lithics, including feldspar, fine to medium grained some coarse grains at top, rare sandstone pebble. Well to moderately well sorted, well rounded to subangular grains. Generally low shell (1-4%) except in upper most 100-140 cm (10-15%). Mainly inner shelf and shoreface (e.g. Bankivia) species except in upper part where shell is very coarse and includes abundant large blue barnacle fragments (from rocky coast). Non-ironstained.

HOLE 229 GS (lat.: 32°26'07.9"S, long.: 152°33'18.4"E) (Disturbed samples)
WD = 39 m, Recovery = 7.5 m

0-750 cm SAND, fawn grey in top 20 cm light grey below, clean, quartzose with up to 7% rock and feldspar. Medium-fine grained with minor coarse grains at top, well sorted, well rounded becoming less rounded at base, minor shell (1-3%), slightly more shelly at top (3-5%). Rare trace heavy minerals, non ironstained. (Shell as for 228).

HOLE 230 GS (lat.: 32°25'31.1"S, long.: 152°34'27.2"E) (Disturbed samples)
WD = 59 m, Recovery = 7.5 m

0-750 cm SAND, unformly grey (fawn grey at top), trace mud (1-2%), quartzose with 4% rock and felspar, medium fine to fine grained, well sorted, subangular to angular grains, non-ironstained. Moderately shelly (10-15%) modern fragments and common whole shells - inner shelf species, few barnacle fragments.

HOLE 231 GS (lat.: 32°22'03.6"S, long.: 152°33'53.7"E) (Disturbed samples)
WD = 62 m, Recovery = 2.6 m

0-?200 cm SAND, very muddy (up to 50%) calcareous, dark olive grey. Sand fraction is quartz-lithic with up to 20% lithic grains, very fine to fine grained, well sorted, angular. Shell (c. 35%) as fine fragments of thin-walled modern inner shelf species.

200-260 cm GRAVEL, Sandy, dark grey, quartz-lithic with 50% lithic grains and pebbles, fine sand and gravel up to 20 mm, probably bimodal, (gravel fraction is dominant), very poorly sorted. Gravel is well rounded, sand is angular to subrounded. Shell (decreasing down from 20 to 5%) as shell hash and large angular, reduced (grey), fragments.

CORE 271 KH (lat.: 28°51'08.0"S, long.: 153°41'40.6"E)
WD = 60.5 m, Recovery 1.0 m

0-100 cm, SAND, very calcareous, brown, fine to very coarse, some gravel (beachrock pebbles), very poorly sorted, shell is rounded, quartz is subangular. Calcareous material (90%) is mainly ironstained (brown-orange) abraded shell, Bryozoan, calcareous algae, foraminifera, some small intact bivalves (modern inner shelf species). Non-calcareous material (10%) is mainly quartz. 60% of grains are ironstained.

HOLE 273 GS (lat.: 28°49'15.7"S, long.: 153°37'50.0"E) (Disturbed samples)
WD = 39 m, Recovery = 9.5 m

0-950 cm SAND, slightly muddy (5-10%?), grey, quartz-lithic with 10-15% rock and feldspar grains, fine to very fine grained, well sorted, angular to subangular grains. Up to 4% shell fragments and common whole shells of inner shelf species. Up to 1% wood fragments in upper part, trace heavy minerals and glauconite. Few scattered round sandstone pebbles and large estuarine shells (Velacumantis with a rock oyster attached) at base.

CORE 274 KH (lat.: 29°27'54.9"S, long.: 153°25'42.8"E)
WD = 48 m, Recovery = 3.8 m

0-75 cm SAND, orange-brown, strongly iron stained (90% of grains), calcareous (90%), bimodal with minor fine to very fine angular quartz sand and major coarse to very coarse (calcareous) modes (shell up to 1 cm), very poorly sorted. 7% lithics. Carbonate is well rounded to surounded and ironstained orange. Common large angular fragments of marine (deep water) shell in lower part.

(gradational contact)

75-100 cm SAND, light olive grey, muddy (2-10%) mud increasing down, very shelly, mainly fine grained, bimodal at top with minor coarser calcareous mode from upper unit, poorly to moderately sorted (improving downwards as coarse mode decreases) quartzose with 8% lithic grains. Shell (25-45%) decreasing down; mainly large angular fragments of marine species c minor relict ironstained carbonate in upper part.
Common large estuarine shell at base (Anadara, oyster), few pebbles at base. Shells near base are infilled with fine muddy sand from underlying unit. 2% glauconite infilling foraminifera tests in lower part.

(Sharp contact)

100-380 cm MUD, dark grey, moderately stiff, slightly sandy at top (10%) decreasing down; sand is very fine grained, angular, quartz-lithic. Some mottles in upper part - bioturbation ranging from pure dark grey mud to light grey muddy sand.
Generally minor shell (<2%), chalky in part, shelly layer 250-260 cm, rare shell below.
Scattered whole esturaine shell above 150 cm (oysters growing on Velacumantis, intact Anadara).

CORE 275 KH (lat.: 29°27'53.5"S, long.: 153°24'57.6"E)
WD = 42.5 m Recovery = 3.8 m

0-120 cm SAND, calcareous (40-70%), olive-brown at top, olive grey below, trace mud, medium to coarse, poorly sorted, angular to rounded. <2% lithic grains. Ironstaining decreasing downwards; 25% at top (mainly abraded shell fragments), 5% at base. Shell (except at top) is mostly angular fragments, marine species.

(gradational contact)

120-380 cm SAND, dark olive-grey, muddy (1-10%) increasing down, calcareous (40-60%), medium to very fine grained, fining downwards, moderately to well sorted generally angular, with coarser grains in upper part subrounded. Slightly lithic in upper part increasing to 5-10% below 200 cm. Shells are thin-walled marine species, angular fragments and abundant whole shells, some intact bivalves. Common foraminifera and Bryozoan fragments. Non ironstained, 1-2% glauconite, trace pyrite in lower part.

HOLE 276 GS (lat.: 29°28'17.9"S; long.: 153°26'30.1"E) (Disturbed samples)
WD = 52.5 m, Penetration = 7.4 m

0-300 cm MUD, silty and sandy (10-20%? sand), dark grey, shelly (3-10%) increasing down. Sand is fine to very fine grained, moderately well sorted, angular, quartzose (2-3% lithic grains). Shell comprises shell hash, large angular fragments and whole bivalves and gastropods of mainly marine species with some estuarine species (Anadara and gastropods) below 200 cm.

gradational contact? (no sign of gravel at base).

300-630 cm MUD, sandy to muddy SAND, sand increasing from 10% at top to 60% at base. Sand is quartz-lithic (up to 10% lithics) with trace mica, fine to very fine grained, well sorted, angular. Shell is chalky in part, angular, increasing downwards from 3% to 20%: composed of estuarine species (mainly Notospisula). Common trace of wood fragments (up to 2%). Large Anadara and Conuber shells at base.

(Sharp contact)

630-740 cm CLAY, sandy, stiff, mottled karki (yellow, grey-brown) no shell, weathered.

CORE 280 KH (lat.: 29°23'47.9"; long.: 153°23'54.3"E).
WD = 31 m Recovery = 1.75 m

0-175 cm SAND, mainly mid grey, fawn grey (oxidised) in top 10 cm, clean, uniformly fine grained, well sorted, angular to subrounded, quartzose with 3-5% lithics (slightly more lithic downwards). Faint trace of dark grey mottling (bioturbation) from 40-90 cm. Generally slightly shelly (5%), thin shell layer (60% shell) at 20 cm. Shell is mainly marine species: fine angular fragments with common large broken thin walled bivalves. Rare Bankivia, Glycimeris, common Placamen mainly in shell layer (possible very rare fragments of Velacumantis).

HOLE 281 GS (lat.: 29°23'48.2"S; long.: 153°23'54.0"E) (Disturbed samples; same site as core 280)
WD = 31 m, Recovery = 8.8 m

0-350 cm SAND, outer nearshore sand (as in core 280)

(gradational contact?)

350-410 cm SAND, gravelly (20% gravel), mid grey, few mud balls, shelly, non ironstained. Sand is fine to coarse grained, bimodal, very poorly sorted, subangular to well rounded, lithic-rich (20% incl. gravel). Gravel is up to 3 cm, very well rounded igneous and siliceous rock types. Shell (10%) is large broken fragments of mixed marine and estuarine species (e.g. Anadara, Glycimeris).

(Sharp contact?)

410-740 cm SAND, mid grey, non ironstained, slightly muddy (mud lumps) at top, clean below. Sand is fine to medium (minor coarse) grained, slight coarsening down trend, moderately poorly sorted, subangular to angular, quartz-lithic (12-15% lithics). Minor angular shell fragments (2-5%) estuarine species (incl. mussel, Notospisula), few large (3 cm) very angular pebbles of igneous rock, common wood fragments.

(gradational contact)

740-880 cm SAND, muddy grading down into slightly sandy, greasy, black MUD below 850 cm. Sand is dark grey, 5-10% mud above 580 cm with thin mud layers near base of sand unit, fine grained, lithic rich (15%), well sorted, angular. Minor fine angular estuarine shell fragments (<3%) (e.g. Notospisula and small gastropods). Common wood fragments (2%), trace pyrite.

CORE 282 GK (lat.: 29°23'50.4"S; long.: 153°24'27.8"E)
WD = 33m Penetration 7.5 m
Recovery 8.95 m
(core was compressed to 7.5 by reducing arbitarily top section from 3.95 to 2.5 m).

0-620 cm, SAND, light to mid grey, uniformly fine grained, minor medium grains at top and very fine grains at base, clean, very well sorted, subangular to subrounded, quartzose with 5% lithics, less than 5% ironstained grains.
Shell: 2-5% angular small fragments of marine species, rare whole shells, (common Baukivia near top, few intact marine bivalves near base), byrozoa and foraminifera. Faint horizontal bedding.

(subtle gradational contact).

620-695 cm, SAND, clean to muddy (40%) at base, dark grey, quartzose with 6% lithics (incl. trace mica), fine to medium-fine grained, becoming coarse with minor gravel in basal 10 cm, moderately to very poorly sorted at base, angular to subrounded (pebbles are well rounded). 10% shell as fine fragments of mainly marine species in upper part, mixed marine and estuarine species (e.g. Notospisula, Velacumantis) in lower part, large, broken estuarine shell (e.g. Anadara, oysters) at base. Few large wood fragments.

(Sharp contact)

695-750 MUD/SANDY MUD, interbedded, dark grey to black, bioturbated in part, rare estuarine shell fragments. Minor sand fraction is quartz-lithic, very fine, fine grained, angular, very poorly sorted (fluvial), trace pyrite and wood.

HOLE 283 GS (lat.: 29°19'48.7"S; long.: 153°29'12.4"E) (Disturbed samples)
WD = 48 m Recovery = 9.5 m

0-200 cm SAND, fawn grey, quartzose, fine, mostly well sorted (slightly coarser and more poorly sorted towards base). Subangular to subrounded. 5% lithic grains, mostly non ironstained. 10-45% shell, increasing downwards, angular fragments and small whole bivalves, marine species.

200-550 cm SAND, Karki to grey, fine to medium. Few small "beachrock" pebbles in upper part, poorly sorted at top, improving downwards. Rounded to subrounded quartz and shell. 4% lithic grains, 20-30% of grains are ironstained. 15-25% shell as white to pale yellow (ironstained) fine to coarse fragments of mainly marine species. Some estuarine shells (e.g. Anadara) in upper part).

550-950 cm SAND, mid to dark grey, quartzose, clear, fine, uniform, well sorted, subangular. 6% lithics (including mica), 10% ironstained grains. shell (5-10%), mainly as fine angular fragments. Some large fragments and whole shells, mainly nearshore marine bivalves, foraminifera and estuary-mouth species (e.g. Bryozoa, barnacle plates, Velacumantis), common wood fragments.

HOLE 284 GS (lat.: 29°20'21.7"S; long.: 153°29'56.7"E) (disturbed samples)
WD - 51.5 m Recovered about 3.5

0-200 cm SAND, light grey, fine grained as in core 283.

200-350 cm SAND, fawn grey, fine sand with coarse shell, mixed shell assemblage.

350+ CLAY, Stiff greasy yellow (oxidised)

HOLE 308 GS (lat.: 29°12'45.1"S; long.: 153°35'36.1"E) (Disturbed samples)
WD = 57 m, Recovery = 7.0 m

0-300 cm SAND, light orange-brown, clean, 20% ironstained, Quartzose with 5% lithics, fine to medium (possibly coarsening down) poorly sorted, subangular to rounded. Shell (15-20%) as abraded fine fragments and large angular fragments of marine, inner shelf species.

300-450 cm SAND, grey, clean, quartzose with 10% lithics and trace of mica, less ironstained than above, fine grained and well sorted in upper part, minor coarse, rounded, granular mode towards base. Sand is mostly angular. Shell (5-10%) as fragments of thin-walled inner shelf species, few Bankivia fragments.

450-650 cm SAND, olive grey-brown, clean, 10-20% of grains are ironstained, fine grained, mostly well sorted, angular. <5% angular shell fragments. Scattered "beachrock" fragments especially near base. Some rounded (abraded), some insitu. Some "beachrock" is composed of coarse shelly sand.

650-700 cm CLAY, sandy, stiff, yellow, weathered.

HOLE 309 GS (lat.: 29°12'45.3"S; long.: 153°34'47.4"E) (Disturbed samples)
WD = 56.5 m, Recovery = 5.6 m

0-350 cm SAND, fawn brown, ironstained (25%), clean, fine to medium grained, fining downwards, scattered siliceous granules and pebbles (including common "beachrock") below about 250 cm, pebbly at base. Sand is quartzose (5% lithics), moderately to well sorted (improving downwards), subrounded grains. Shell (10%) is large angular fragments of marine species, few Bankivia in lower part.

(?Sharp contact).

350-560 cm SAND/PEAT/MUD.

350-400 cm SAND, fawn grey, slightly muddy, fine grained, quartzose (1% lithics), no shell, 10% ironstained (weathered) grading down to

400-450 cm SAND/PEAT. White fine quartzose sand, leached, interbedded(?) with black peat (fine wood fragments), trace pyrite, no shell.

450-560 cm MUD. Dark grey, moderately stiff, greasy, 5% very fine sand, trace estuarine shell.

CORE 310 GK (lat.: 29°12'40.0"S; long.: 153°34'37.3"E)
WD = 57 m Penetration 9.1 m
Recovery 10.7 m
(core is logged according to recovery)

0-300 cm SAND, fawn grey, clean, quartzose, mostly fine, minor medium grained, well sorted, subangular to subrounded, 3% lithic grains, 10-15% of grains are ironstained. Shell 10% at top and bottom, increasing to 25% between 100 and 250 cm, angular fragments and whole, thin-walled marine shells, mostly bivalves.

(gradational contact)

300-430 cm SAND, fawn-grey at top, yellow-brown at base quartzose, trace cream lime mud, mainly fine with minor meldum grains and small pebbles of quartz, siliceous rock and weakly cemented (insitu?) "beachrock". Moderately well sorted subangular to rounded grains. 3-5% lithic grains 5-25% ironstained quartz. Shell (<10% decreasing to <1% at base) mostly marine (upper shoreface) species, commonly larger fragments are abraded, some ironstained.

(Sharp contact but no evidence of erosional disconformity).

430-550 MUD/SAND, mottled brown-orange oxidised MUD with minor iron-oxide aggregates and no shell in upper part grading down into muddy (10-15%), shelly SAND. Sand fraction is fine to very fine grained, well sorted, angular quartz-lithic (trace mica). Variable shell below 470 cm, up to 15% at 500 cm, generally angular, chalky and degraded, some intact shells-estuarine species (Anadara, Pyrazus, Notospisula). Some sand patches in muddy sediments = bioturbation.

(very gradational contact)

550-1070 cm SAND light grey-brown, oxidised orange brown at base, clean, uniformly fine grained, well sorted, angular, minor subrounded and rounded quartz in upper part, quartzose (<4% lithics)
Shell (5-20%), uniform fine angular fragments, chalky and fresh, very rare large fragments estuarine species (Pyrazus, Notospisula, Parcanassus, Conuber, Anadara) mainly in upper part.
Trace bedding and few cemented sand aggregates at 700 cm. Abundant, insitu "beachrock" in weakly cemented layers below 980 cm especially in basal weathered zone.

CORE 311 GK (lat.: 29°12'36.5"S; long.: 153°34'12.1"E)
WD = 54 m, Recovery = 8.77 m

0-200 cm SAND, fawn, clean, quartz-calcareous, fine to medium, poorly sorted rounded to subangular. 2% lithic grains. Shell, 20% at top increasing to 40% downwards, mainly broken marine mollusc fragments, mostly angular. Common foraminifera, Bryozoan. 15-25% of shell and quartz are ironstained (ironstained shell fragments are usually abraded). Large shell fragments and whole shell very common from 110-160 cm.

(gradational contact)

200-250 cm SAND, gravelly, very shelly, fawn-grey, fine to very coarse and granular, very poorly sorted rounded. Common pebbles of abraded "beachrock", quartz and lithoclasts. Shell, 30-40%, comprises mixed assemblage of marine and estuarine species (estuarine shells include whole Notospisula, broken Anadara and Velacumantis; marine shells are commonly small, thin-walled and whole).
Bryozoa and benthic foraminifera are common. 15% of grains are ironstained.

(Sharp contact)

250-877 cm MUD/SAND
250-480, mainly brownish grey to olive grey sand with thin mud layers
480-740, mainly black-grey, organic-rich. Mud and sand mud with variable shell.
740-877, clean to slightly muddy, very dark grey sand, rare shell.
Sandy units are uniformly fine grained, well sorted, angular to subrounded quartzose with 5% lithics.
Sand in muddy units is very fine grained and quartz-lithic.
Shell is very rare or absent in sandy units. In muddy units it is generally chalky (estuarine species) less than 2%, up to 15% in sandy mud at 550 cm; trace wood throughout, up to 2% in sandy mud from 500-630 cm.

CORE 342 KH (lat.: 29°10'20.9"S, long.: 153°53'05.2"E)
WD = 57.5 m Recovery 1.75 m

0-125 cm SAND, dark olive grey and very slightly muddy in top 20 cm, fawn grey and clean below, shelly, sand is mainly fine grained with some very fine sand at top and minor medium sand below; poorly sorted angular to subrounded. Up to 8% lithic grains. 5-10% of grains are ironstained.
Calcareous material increases downwards from 20% at top to 50% at 100 cm; 10% in basal 20cm. Comprises angular fragments and whole shells of deep water species of molluscs, scaphopods Bryozoan and echinoid plates. Rare nearshore and estuarine shell fragments in basal 10 cm (Notospisula, Conuber, Bankivia).

(Sharp colour contact)

125-175 cm SAND, dark olive grey, non ironstained, clean, minor shell. Quartz-lithic (up to 10% lithics) fine to very fine grained, moderately well sorted, angular to subrounded. Shell (5-10% fine grey fragments, mainly marine species with rare estuarine fragments (Glycimeris, Anadara, mussel Cocullaea). Trace glauconite.

CORE 343 KH (lat.: 29°10'27.7"; long.: 153°35'24.4"E)
WD = 59 m Recovery = 2.8 m

0-180 cm SAND, light to dark olive, fawn-grey, shelly, trace mud in top 20 cm, clean below. Mainly fine grained, minor very fine and medium grained fraction, well sorted at top, poorly sorted below, mainly angular grains. 5-12% lithics. 5-10% of grains are lightly ironstained.
Calcareous material (20-40%) mainly as shell hash with abundant large shell fragments and some whole shells in layers 30-50 cm and 85-110 cm. Marine, inner shelf species, mainly thin walled bivalves non abraded, very rare chalky estuarine shells at base.
Trace layering in top 20 cm (gently dipping) and from 140-160 cm (sub horizontal)

(narrow gradational contact)

180-205 cm SAND, dark olive-grey, clean, quartz-lithic (13% lithic grains) mainly fine with rare coarse grains and rounded quartz granules, well sorted, angular to subangular, non ironstained. Up to 20% shell fragments, mixture of marine and estuarine species (inner shelf and upper shoreface, Anadara, oyster, barnacle plates, chalky Notospisula and estuarine gastropods). Fragments are angular and abraded. Few wood fragments.

(Sharp contact)

205-280 cm SAND, dark olive grey, clean, quartz-lithic (12% lithics) and calcareous, uniformly fine to very fine grained, well sorted, angular. Non-ironstained. Shell (25-30%) as small angular fragments of chalky estuarine shells (common Notospisula, some whole valves) common wood fragments.

CORE 344 KH (lat.: 29°10'27.2"S; long.: 153°35'45.2"E)
WD = 57 m Recovery = 3.05 m

0-50 cm SAND, (thin, 3mm thick, surficial mud layer with worm tracks at top). Sand is yellowish olive-grey, clean, quartzose, shelly; fine to medium moderately, well sorted, sub-rounded. 3% lithics. 30% of grains ironstained. 15-35% shell as angular fragments of mid shelf marine species, very shelly layer from 15-25 cm.

(gradational contact)

50-305 cm SAND, olive grey at top becoming light fawn grey at base. Calcareous - quartzose with less than 4% lithic grains. 5-10% ironstained grains. Fine grained with minor medium component in upper part (subtle fining down trend). Moderately well sorted, angular to well rounded (mainly subrounded). Trace pale calcareous mud 210-230 cm. Shell (30-50%) as white angular shell hash and larger fragments of marine, mid shelf, thin walled species. Common foraminifera some with glauconite infilling tests.

CORE 345 KH (lat.: 29°10'28.7"S, long.: 153°36'02.8"E)
WD = 58.5 m Recovery = 3.20 m

0-320 cm SAND, mid to light olive fawn-grey to 160 cm, dark olive grey below, minor dark grey mottling (bioturbation) in top 20 cm.
Minor ironstained grains (5%) except at top (15%), trace cream mud.
Quartz-lithic (5-7% lithics) (few coarser rock fragments at 150 cm), very fine to medium-fine grained (mainly fine grained) moderately well sorted, well sorted towards base, subrounded to angular (mainly subangular).

Shell is variable (15-25%) cream to light grey hash and angular fragments, scattered, whole, thin walled shells, common foraminifera. Only marine species. Distinct shell layers at 30 cm and 160 cm, very shelly 50-140 cm with some intact bivalves. Less shelly below 160 cm. Trace glauconite in foraminifera tests.

CORE 346 KH (lat.: 29°10'27.8"S; long.: 153°36'22.6"E)
WD - 58.5 m Recovery 2.4 m

0-140 cm SAND, clean, calcareous, olive fawn-grey becoming lighter downwards, ironstained (15%). Quartzose (3% lithics), very fine to medium-fine grained (mainly fine grained) slight coarsening down trend.
Well sorted at top becoming poorly sorted towards base because of increasing coarse shell, angular to subrounded.
Shell (25-70%) mainly fine hash in upper part including abundant orange ironstained fragments. Coarse (fawn cream) shell fragments increasing below 70 cm with common whole shells; very shelly in basal 10 cm. ONly marine shell.

(Sharp contact)

140-240 cm SAND, (Similar to above).
Clean, mid grey, calcareous, almost non-ironstained. Quartzose (2-5% lithics), fine to very fine grained, slight fining down trend, well to very well sorted, angular.
Shell (mainly 30% increasing to 70% in basal very fine sand) mainly grey hash (shell, forams, bryozoa), minor grey large fragments - only marine species.

CORE 347 KH (lat.: 29°10'33.6"S; long.: 153°36'45.2"E)
WD = 61 m Recovery 1.75 m

0-125 cm SAND, light olive fawn-grey (becoming slightly lighter downwards - like core 346), clean, calcareous, ironstained (15-20%).
Quartzose (3% lithics), fine to medium grained (?fining down) moderately well sorted, angular to rounded.
Shell (20-50%) mostly hash at top, large fawn fragments increasing down, especially shelly in bottom 30 cm.

(Sharp colour contact)

125-175 cm SAND, mid olive grey, clean, calcareous, almost non-ironstained. Quartzose as above (rare trace mica), fine to very fine grained and well sorted with some coarser well rounded quartz grains (poorly sorted) at base; some pink quartz. Mainly angular to sub-angular, Shell (30%) is light grey hash and large fragments (mainly in thin layers). Marine species (one Notospisula at base).

CORE 348 KH (lat.: 29°10'48.7"S; long.: 153°30'10.4"E)
WD = 44 m, Penetration = 3.0 m (possibly hit bedrock)
Recovery = 2.6 m

0-260 cm SAND, mainly dark olive-grey becoming grey at base some fawn layering around 125-145 cm, slightly muddy (<3%) above 205 cm, clean below, Quartz-calcareous, with varying lithics (10-15% lithics above 120 cm, 5% below). Generally non-ironstained except in shell layer at 140 cm and in layers in overlying 20 cm. Sand is fine to very fine grained with fine to coarse shell fragments, very minor gravel ("beachrock" and rare lithoclasts) below 190 cm. Well sorted except in coarse shelly layers. Sand grains are angular. Calcareous material (generally 30-50% increasing to more than 80% in zones 120-160, 180-205) mainly broken angular mollusca fragments, foraminifera, bryozoan and echinoid fragments, barnacle plates, ostracods etc; marine inner to mid shelf species. Shell is mainly fine to coarse angular fragments it is very fine shell hash in top 20 cm. Large, ironstained, thick-walled, shell fragments and whole shells in shelly layer at 138-145 and 190-205, scattered pebbles in lower shelly layer.

CORE 349 KH (lat.: 29°10'52.7"S; long.: 153°32'12.8"E)
WD = 52 m Recovery = 3.1 m

0-270 cm SAND, dark olive-grey, calcareous, trace mud (<1%) above 135 cm, non-ironstained. Quartzose with 7-12% lithic grains and trace mica. Sand is fine to very fine, moderately well sorted and angular with 20-70% fine to very coarse shell fragments and some whole shells. Uniformly fine shell hash in top 20 cm. Whole shells and coarse fragments mainly in poorly defined, very shelly zones (40-60, 135-160 and 220-260 cm). Shell is thin-walled marine (mid shelf) species.

Basal 30 cm contains angular fragments of estuarine shells including large Anadara fragments encrusted with coralline algae (sand matrix is five grained as above).

(Narrow gradational contact)

270-310 cm SAND, dark grey, quartose with 6% lithic grains and trace mica. Uniformly very fine to fine grained, very well sorted, angular, non-ironstained. Shell (5%) is mainly sand-sized, rare large fragments and few whole molluscs - estuarine species. Traces wood fragments.

CORE 350 GK (lat.: 29°06'05.0"s; long.: 153°38'02.9"E)
WD = 59 m Penetration = 9.5 m
Recovery = 10.4 m
(logged according to recovery).

0-200 cm SAND, fawn to fawn-grey, calcareous with 1-3% cream lime mud in upper part, quartzose and clean below 60 cm. 2-4% lithics; 10-20% of grains are ironstained. Sand is fine to medium, moderately poorly sorted, angular to subrounded.
Shell, >40% at top, 15% below 60 cm comprises mainly angular fragments of marine species with increasing ammounts of chalky (degraded and abraded) estuarine fragments downwards. Some whole marine bivalves in lower part.

(gradational contact)

200-560 cm SAND, fawn-grey, mainly quartzose as above, minor ironstaining, fine to coarse and very poorly sorted, bimodal: fine mode as above, coarse mode is composed of well rounded, coarse to granular quartz, lithoclasts and "beachrock"; pebbles occur in basal 30 cm. Coarse mode becomes increasingly dominant downwards.
Shell (c.10%) comprises approximately equal proportions of modern, angular marine shell fragments and relict chalky estuarine shell (chalky shell fragments occur in "beachrock" pebbles). Large fragments of chalky Anadara at base.

(Sharp contact)

560-700 cm "BEACHROCK"/GRAVEL, fawn-grey insitu "beachrock" composed of fine to coarse, poorly sorted, subangular to rounded pebbles (up to 2 cm). Shell (10%) is mostly chalky abraded fragments of estuarine and upper shoreface species (e.g. Anadara). "Beachrock" is cemented with sparry calcite infilling voids. Some layering in lower part. Red iron oxide mottling near base.

(Sharp contact)

700-988 cm SAND, fawn-grey, quartzose, mainly uniformly fine grained, well sorted, angular with well rounded coarse sand and granule mode below 970 cm. Scattered insitu "beachrock" layers throughout. Shell (45-40%) increasing downwards comprises fragments and small whole shells of mixed estuarine (chalky) and marine (fresh) species. Bankivia occurs in lower part.

(Sharp contact)

988-1040 cm Layered sequence: SAND, clean to slightly muddy grey-brown, grading down into brown organic sandy MUD below 1025 cm. Sand is quartzose with common multicoloured quartz. Generally fine grained with fine pebble and granule layers at top and at 1020 cm. Moderately well to very poorly sorted, mostly angular sand, rounded granules. Shell (25%) mainly abraded, marine (upper shoreface) species (e.g. Bankivia), rare estuarine shells in muddy layer. Muddy layer is mottled with red-brown, oxidised, and black, organic rich patches. Minor wood fragments in muddy layer.

CORE 352 GK (lat.: 29°08'30.7"S; long.: 153°37'00.6"E)
WD = 60 m Penetration = 9.5 m
Recovery = bottom 4.2 m
(Top 5.3 m lost during recovery)

530-940 cm SAND/"BEACHROCK", fawn-grey darkening to olive-fawn-grey downwards. Quartzose with 5-10% lithics (increasing down), fine to medium (fining down), bimodal below 850 cm. Mainly moderately well sorted, angular to subrounded with coarse mode comprising rounded, coarse sand and granules at base. 10-25% of grains are ironstained, decreasing down. Shell (5-10%) mostly small fragments, mixture of abraded, ironstained, chalky and fresh, angular fragments of mainly marine, shoreface species (e.g. Bankivia) "Beachrock" occurs in insitu layer at 570 cm and in scattered patches below. It contains both chalky and fresh shell fragments.

(Sharp contact)

940-950 cm SAND, dark olive-grey, quartzose with 5% lithics, fine grained well sorted, angular, minor ironstained, common fine wood fragments. Shell (10%) as small fragments of upper shoreface (Bankivia) and possibly, degraded estuarine species.

CORE 355 GK (lat.:29°06'01.6"S; long.: 153°36'12.4"E)
WD = 52 m Recovery = 11.55m

0-540 cm SAND, Cream fawn-grey darkening down to olive grey-brown. Mainly clean with trace lime mud below 350 cm. Quartzose with 5-10% lithics increasing down. Fine with minor medium grains in top 350 cm fine to very fine below, moderately well sorted, angular to subrounded 5-10% of grains are ironstained (decreasing down). Calcareous material (10-15%) as angular shell fragments and scattered whole valves foraminifera and Bryozoans; marine, mid-shelf species. Shell is fawn coloured above 375 cm, grey below. Shelly layer with common whole, thin-walled shells 350-370 cm.

(gradational contact)

540-630 cm SAND, Olive grey, clean, quartzose, with lithics increasing from 6-12% downwards, shelly. Fine to coarse, poorly sorted. Minor coarse, rounded mode with scattered pebbles and granules ("beachrock", lithoclasts and quartz) at base.
Non-ironstained. 15% shell as large fragments and whole shells of shoreface and rare estuarine (Notospisula) species; few barnacle plates.

(Sharp contact)

630-c.755 cm SAND/MUD, dark grey to black-brown: organic-rich MUD with wood and chalky estuarine shell fragments (Anadara, Notospisula etc) to 650 cm overlying SAND, muddy (<5%), layered, grey-brown at top, black below 740 cm. Sand is quartzose non-ironstained (leached?) fine grained, well sorted, subangular to subrounded. Trace estuarine shell, common wood fragments. Very organic-rich and slightly muddy at base.

(gradational contact)

C.755-1155 cm SAND, light grey, clean to slightly muddy, becoming very muddy at base, non-ironstained (leached). Quartzose (3-7% lithics increasing down), uniformly fine grained, above 1030 cm, medium-fine below, well to moderately well sorted, subangular to rounded. Thin muddy sand layers (up to 10% mud) mainly in lower part, black, organic-rich with roots 1095-1130 cm. Minor wood throughout (decayed roots?) no shell (leached). Trace dark grey mottling at top.

CORE 356 KH (lat.: 29°06'01.8"S; long.: 153°37'16.7"E)
WD = 57 m, Recovery = 1.2 m

0-120 cm SAND, clean, mostly grey-brown becoming olive-grey-brown in basal 20 cm. Fine to medium and moderately poorly sorted above 100 cm; fine grained and moderately well sorted below. Mainly quartzose with generally 5-10% calcareous material increasing downwards (fragments of mollusca, foraminifera, echinoids etc). Mainly shell hash in top 50 cm; shell size increasing downwards, very shelly from 90 to 100 cm with large fragments and whole valves. Sharp contact at base of shell layer. Underlying fine sand is moderately shelly with scattered whole shell valves.

CORE 357 KH (lat.: 29°06'01.9"S; long.: 153°35'34.8"E)
WD = 55 m, Recovery = 1.05 m

0-90 cm SAND, calcareous, brown, clean, fine to coarse, poorly sorted, rounded to subrounded clastic grains; most shell is angular. 3% lithic grains. Calcareous material (20-40%) mainly comprises molusc, bryozoan and echinoid fragments, common foraminifera and minor scaphopods. 15-25% of grains are ironstained orange.

(gradational lower contact)

90-105 cm SHELL GRAVEL & SAND (partly washed at base). Sand is similar to above but very poorly sorted with abundant (c.40%) whole bivalve shells and large, partly abraded fragments. Shell comprises mixture of marine and estuarine species (e.g. Anadara). Few pebbles of abraded "beachrock", rare rounded lithic pebbles.

CORE 358 KH (lat.: 29°06'01.6"S; long.: 153°35'08.9"E)
WD = 50 m, Recovery = 1.4 m

0-140 SAND, shelly, mid to dark olive grey, clean to very slightly muddy near base, fine to very fine grained, generally well sorted, subrounded to subangular at top, angular at base. Calcareous material (20-50%) increases downwards; comprises angular shell hash (bryozoan mollusc fragments and foraminifera) with scattered thin walled, deep water, whole shells throughout. Thin shell layer at 20 cm. Negligible ironstaining. Lithic content (2-7%) tends to increase downwards.

CORE 361 KH (lat.: 29°04'38.5"S; long.: 153°33'30.1"E)
WD = 45 m, Recovery = 1.4 m

0-140 cm SAND. Olive brown-grey, medium - fine grained and slightly iron-stained above 50 cm; dark olive-grey and fine to very fine grained below 50 cm. Moderately well sorted, subangular to subrounded (slightly more rounded above 50 cm). 10% shell fragments and rare, whole deep water shells. Shelly layers at 45 and 115 cm. Negligible ironstained below 50 cm.

CORE 362 KH (lat.: 29°04'34.6"S; long.: 153°33'51.2"E
WD = 46 m, Recovery = 2.0 m

0-200 cm SAND, dark olive-grey, fine to very fine grained, uniform, well sorted, mainly angular with some subrounded grains in upper part, 10-15% lithic grains. Slight trend downward of becoming finer, more angular and more lithic-rich (i.e. less mature). Less than 15% shell, mainly as fine shell hash, occasional whole thin walled bivalve, trace glauconite infilling foraminifera tests; non-ironstained.

CORE 363 GK (lat.: 29°04'35.4"S; long; 153°35'03.7"E)
WD = 53 m Recovery = 5.55 m

0-265 cm SAND, clean, calcareous, dark olive-grey, fine to very fine, moderately sorted, angular to subangular, 5-10% lithic grains. 20-40% calcareous material (shell hash and thin-walled whole shells) thin shell layer (80% shell) at 100 cm. Non-ironstained.

(gradational contact)

265-285 cm SAND/GRAVEL, grey, medium to very coarse sands plus shell and lithic granules and pebbles. Very poorly sorted, generally rounded grains. Rare ironstained quartz grains. Shells (10%) are abraded and of mixed estuarine and marine species.

(Sharp disconformable contact)

285-345 SAND, mainly clean, slightly muddy at base, dark grey, fine, well sorted, angular to subangular. 7% lithic grains, 10-15% small chalky shell fragments and foraminifera (estuarine species). Common pyrite aggregates, glauconite infilling foraminifera tests. Non ironstained.

(Sharp contact)

345-525 MUD, black to dark grey, moderately stiff (unoxidised), greasy, slightly sandy, some horizontal laminations, occasional thin sandy layers. Sand fraction is very fine, angular as above with minor chalky estuarine shell and wood fragments, trace pyrite aggregates.

(gradational contact)

525-555 cm SAND, muddy at top becoming less muddy down, very dark grey, very fine to fine, moderately sorted angular to subangular. 10-15% lithic grains; 10% fine, chalky shell fragments, trace pyrite aggregates.

CORE 364 GK (lat.: 29°06'20.9"S; long.: 153°38'33.8"E).
WD = 62 m Recovery = 3.6 m

0-360 cm SAND, mainly fine grained with three coarser sand and shell layers at 55-80, 150-165 and 255-282 cms.
Fine sand units are grey-brown (orange-grey-brown and sigihtly coarser at top, grey at bottom), fine grained, well sorted, generally uniform, angular to subangular, 5% lithic grains. Calcareous material, mostly less than 10%, comprising scattered marine shells and small fragments of mollusca, bryozoa, echinoid and foraminifera. 10-20% of grains are ironstained.
Coarse layers comprise very poorly sorted bimodal sand with fine mode as above and coarse mode of medium to very coarse, occasionally granular, rounded and ironstained quart and lithic grains. Shell (30-80%) is small to large fragments, some abraded and ironstained, marine species. Trace calcareous mud in top layer; rounded pebbles in bottom layer.
Coarse layers generally have gradational upper contacts and sharp lower contacts.

CORE 375 GK (lat.: 28°48'24.7"S; long.: 153°40'08.9"E)
WD = 60 m Recovery = 2.8 m

0-140 cm SAND, calcareous, clean, yellow-brown, fine to coarse (coarsening down), poorly sorted, angular to well rounded (rounding increasing down), 2-3% lithic grains. 25-30% calcareous

material as fine to very coarse fragments of mollusca, bryozoan etc, rare cemented sand aggregates. Up to 30% of grains are ironstained (mostly the coarser and more rounded grains).

(gradational contact)

140-280 cm SAND/GRAVEL, calcareous sand as above with shell and "beachrock" gravel. Calcareous sand as above; brown to 180 cm, grey below. Minor lime mud below 200 cm. Sand is composed to subangular to rounded grains comprising up to 60% calcareous material (foraminifera, mollusca, bryozoa etc); common whole shells of marine and estuarine species (e.g. Anadara and Pyrazus) estuarine shells weathered, marine shelly abraded, shell valves commonly infilled with cemented sand.
"Beachrock" pebbles, grey, well cemented and rounded at base. Composed of poorly sorted fine to coarse quartz-lithic sand and shells. Insitu "beachrock" probably occurs around - 3m but was not recovered in core.

CORE 376 GK (lat.: 28°48'15.8"S; long.: 153°41'46.4"E)
WD = 60 m, Recovery = 8.0 m

0-410 cm SAND, calcareous, grey-brown at top, olive-grey below 220 cm, very fine to coarse and very poorly sorted to 250 cm, fine to medium and somewhat better sorted below. Trace of mud at about 250 cm. Mostly bimodal: dominant fine mode is angular and generally non-ironstained; coarse mode is rounded and commonly ironstained. 5-7% lithic grains. 20-35% calcareous fragments (no whole shells) of mollusca, bryozoan, foraminifera and echinoid; fragments are more rounded in upper part of section. 20-30% of grains are ironstained (mostly coarse sand and shell mode) in upper part of section, less ironstained (10%) in lower part.

(gradational contact)

410-480 cm GRAVEL/SAND, mixture of light olive-grey, calcareous, fine, angular sand as above and gravel composed of rounded pebbles of siliceous and lithic rock types and "beachrock"; trace (<1%) lime mud. "Beachrock" is composed of calcareous and siliceous cemented aggregates of coarse shell and calcareous sand. Pebbles, some ferruginised, range from non-abraded to rounded, and strongly to weakly cemented; occasionally phosphatic; some are encrusted with serpulid worm tubes.

(Sharp contact).

480-800 cm SAND, calcareous with thin insitu "beachrock" layers at 530, 595, 630 and 680. Sand in top 20 cm is oxidised, mottled red and yellow, with patches of insitu oxidised "beachrock".

Sand is grey-brown, very fine to medium, poorly sorted, mostly angular with small to large, mostly angular, fragments of shell (20-70%). Shell is chalky (weathered) in upper part; very shelly layers occur from 570 to 590 cm and below 700 cm. Shell is shallow marine species with Pectin valves and Bankivia common.
"Beachrock" is composed of very poorly sorted mixture of sand and shell fragments, minor white lime mud and calcareous cement.

CORE 401 KH (lat: 28°46'06.5"S. long.: 153°38'02.0"E) Recovered 100cm. WD: 38 m.

CORE 411 KH (lat.:28°01'27.1"S; long.: 153°35'09.7"E)
WD = 53 m Recovery = 1.95 m

0-100 cm SAND, olive grey-light yellowish brown fine or fine to medium-grained well-sorted. Very shelly. Grains commonly ironstained, generally angular and subangular. Consists of approximately 60% quartz, 5% feldspar, 5% lithics and 30% biogenic carbonate. Biogenic carbonate made-up of a mixture of finely fragmented shell material, foraminifera, echinoid debris, minor calcareous algae and ostracods.

100-135 cm SAND, Yellowish brown fine to medium-grained, moderately-sorted. Approximately 30% of the grains (mainly carbonate and lithic components) ironstained. Made-up of approximately 55% quartz, ?feldspar, 5% lithics and 40% biogenic carbonate (mainly fragmented shell material and foraminifera). Fragments of cemented quartz/carbonate sand present. At base rounded 'beachrock' and other pebbles up to 10 cm diameter plus coarse shell material.

135-195 cm SAND, Light yellowish brown, fine to medium or fine-grained, moderately well-sorted. Grains commonly strongly ironstained, particularly in the upper part. Grains are mainly angular or subangular. Made-up of approximately 85% quartz, 5% lithics (mainly ironstained sand size material and 5-10% biogenic carbonate.

CORE 412 GK (lat.: 28°01'25.4"S, long.: 153°35'11.3"E)
WD = 53 m, Recovery = 5.35 m

0-90 cm, SAND, Olive grey-yellowish brown fine-grained well-sorted shelly. Uniform in upper part. Increasing carbonate downwards. At 10 cm approx. 30% carbonate (mainlyy finely fragmented commonly ironstained shell material, 25% foraminifera, minor pteropod, echinoid and other components.

90-158 cm, Olive grey (90-115 cm) to light yellowish brown below. Fine-medium-grained (coarser towards base) shelly quartz sand. Contains about 20% fragmented shell material. 135-158 cm, large (up to 8 cm across) rounded pieces of coarse-grained 'beachrock' and small rounded lithic (mainly quartzite) pebbles.

158-270 cm, SAND, Light yellowish brown fine-grained well-sorted, quartzone. 10-15% of grains significantly ironstained. Made-up of approximately 95% quartz and 5% biogenic carbonate. Colour grades to light olive grey with a slight mottling below 205 cm.

290-312 cm, SAND, shelly, medium and coarse-grained quartzose containing large bored Anadara shells including a couple of articulated shells. Shell fragments and small gastropods common.

312-325 cm, MUDDY SAND, Black, fine-grained, organic-rich. Peaty wood disseminated throughout. Comminuted shell throughout.

325-335 cm, MIXED ZONE, Olive grey mixed fine sand, silt and decomposing organics.

335-412 cm, SANDY CLAY/CLAYEY SAND, Olive grey with small brown iron-oxide pisolites. Weathered zone. Soil profile.

412-478 cm, SAND, Yellowish brown, weathered, slightly clayey composed of quartz. No carbonate.

478-513 cm, SAND, Yellowish brown, partly cemented (carbonate), fine to medium-grained. Approx. 30% biogenic carbonate-mainly finely fragmented shell material and foramanifera.

513-535 cm. Same as interval 478-513 cm but without cementation. Fine grained.

CORE 413 GK (lat.: 28°01'26.2"S, long.: 153°34'45.0"E)
WD = 51 m, Recovered = 6.43 m. Lost top 1.50 m during recovery.

150-178 cm, SAND, light yellowish grey in upper part; grey towards base. Fine-grained, well-sorted, quartzone. Less than 5% of grains ironstained. <5% carbonate-mainly very fine grained-mainly consists of shell material and foraminifera. ?Glauconite and/or pyrite.

178-184 cm, MUD, black, organic-rich.

184-266 m, SANDY CLAY, Grey containing brown iron-oxide concretions (pisolites). Weathered zone/soil profile development.

266-284 cm, CLAYEY SAND, very dark grey, fine-grained, clay ~20%. Grains typically clear. No carbonate.

284-470 cm, MUDDY SAND, Dark grey. Mud is 5-10%. Fine-very fine grained, well sorted, angular. Trace of carbonate. Some organics.

470-515 cm, MUDDY SAND, Dark grey (mud approx. 5%). Trace of carbonate?.

515-548 cm, SAND, Dark grey medium-coarse grained containing some shell debris. Faint evidence of horizontal bedding.

548-616 cm, MUDDY SAND, Dark grey fine-grained containing considerable carbonate. At 590 cm approx. 60% biogenic carbonate (mainly thin-walled bivalves, 15-20% foraminifera, 5% gastropods and 5% others).

616-643 cm, MUDDY SAND, Dark grey fine-grained containing Anadara, Cardium and oyster valves and whole gastropods.

CORE 437 KH (lat.: 28°48'22.7"S; long.: 153°38'12.2"E)
WD = 44 m Recovery = 2.15 m

0-215 cm SAND, quartzose clean, fine grained with shelly layer between 120 and 160 cm.
Sand above shelly layer is light grey to grey brown, mainly fine, well sorted and angular with very minor coarse quartz mode, bimodality increases downwards. Coarse grains are more rounded and ironstained. 10-15% generally small angular shell fragments. Up to 5% lithic grains. 25-30% of grains are lightly ironstained.
Shell layer comprises 20 to 60% (increasing down) large, angular to slightly abraded fragments of marine bivalves. Some insitu worm burrows in upper part of shelly layer. Matrix is fine sand. Some cementation of sand inside shell valves. Sharp contact at base of shell layer.

Sand below shell layer is dark grey, slightly finer than above, unimodal, very well sorted. Shell (15%) as small and large angular fragments. 8% lithic grains. 30% of grains are lightly ironstained.

CORE 438 KH (lat.: 28°49'12.0"S; long.: 153°37'22.0"E)
WD = 30 m Recovery = 2.45 m

0-245 cm SAND, with SHELLY layers and minor MUD.
Sand is grey, quartzose, fine, well sorted, angular with about 5% lithic grains and 10-15% fine, angular shell fragments. Grains are virtually non-ironstained.
Shelly sand layers at 135-170, 185-190 and 245-250 comprise small marine shells (mainly Bankivia), barnacle plates, crustacea fragments etc.
Minor mud (5-15%) occurs in lower part of core (below 75 cm) usually associated with shelly layers. It occurs as a thin layer capping the uppermost shelly layer, the lower most shelly layer contains 50% shells, 15% mud, 3% wood fragments and a very fine sand fraction.

CORE 441 KH (lat.: 28°40'56.3"S; long.: 153° 37'44.6"E)
WD = 37 m, Recovery = 2.5 m

0-250 cm SAND, dark grey, quartzose, clean, mainly fine (some very fine grains), uniform, well sorted, angular to subangular, 5-8% lithic grains, mainly 10% shell as fine, angular fragments of Bankivia and small, thin walled bivalves. Slightly finer, less well sorted and more shelly (up to 15%) below 185 cm. Generally <5% of grains are ironstained, non-ironstained at base; top 20 cm is fawn-grey and more ironstained (c. 25%). No shell layers.

CORE 443 KH (lat.: 28°41'27.4"S; long.: 153°37'58.1"E).
WD = 21 m, Recovery = 2.0 m

0-200 cm SAND, light to mid grey, quartzose, fine with minor very fine grains, well sorted, angular to subangular (rare coarser ironstained and rounded quartz grains in upper part). 3-5% lithic grains, trace heavy minerals. 10-15% of grains are lightly ironstained in upper part, non-ironstained below 100 cm.
Generally less than 10% calcareous material mainly as small broken fragments of thin walled bivalves. Shelly sand layer (20% shell) from 140-180 cm. Comprising slightly abraded to fresh whole shells and large fragments (Bankivia, Plebidonax, Vepricardium, Amesodesma) and foraminifera. Rare small rounded quartz pebbles. Fairly sharp upper contact on shell layer, gradational lower contact.

CORE 445 KH (lat.: 28°40'30.6"S; long.: 153°38'14.3"E).
WD = 22m, Recovery = 2.25 m

0-225 cm, SAND, light grey becoming darker downwards, quartzose, fine with minor very fine grains, well sorted, angular to subangular. 4% lithic fragments. Trace heavy minerals. Virtually non ironstained. Generally 5-10% angular shell fragments with shelly sand layer (up to 50% shells) from 135 to 180 cm comprising abundant Bankivia, marine bivalves, minor foraminifera. Trace of wood fragments and mud patches (worm tubes?) in shelly layer.

CORE 447 KH (lat.: 28°40'48.2"S; long.: 153°37'41.8"E.)
WD = 17 m, Recovery = 1.3 m

0-130 cm SAND, generally fine with SHELL/GRAVEL/SAND, layer from 75 to 100 cm.

SAND is grey, quartzose, fine with minor very fine grains, well sorted, angular to subangular. 3% lithic grains and generally less than 10% shell hash. Less than 10% of grains are iron stained. Fine sand below 100 cm is slightly more shelly, with rare rounded pebbles and wood fragments.

75-100 cm SHELL/GRAVEL/SAND, complete range of sizes; fine to very coarse and granular, angular to well rouned sand, lithic and quartz pebbles are well rounded and up to 3 cm diameter, sorting is very poor. Pebbles tend to be oriented horizontally. Shell (c.30%) as abraded fragments and whole shells (bivalves and Bankivia). Bivalves are oriented concave-up. Sharp contact at top of coarse layer. Basal contact is fairly sharp in terms of sand sizes but shell content is gradational across contact.

CORE 449 KH (lat.: 28°40'51.4"S; long.: 153°38'35.9"E)
WD = 24.5 m, Recovery = 1.75 m

0-175 cm, SAND, grey, quartzose, fine, well sorted, angular to subangular grains. 4% lithic grains. 5-10% of grains are lightly ironstained. Mainly less than 10% small shell fragments with thin shelly layers at 120 and 160 cm comprising 10-20% Bankivia and large bivalve fragments. Occasional worm burrows in upper part of section.

CORE 464 KH (lat.: 28°40'27.4"S; long.: 153°39'58.8"E).
WD = 51 m, Recovery - 1.25 m

0-125 cm SAND, quartzose at top becoming more calcareous downwards, yellow-brown (oxidised), graded sequence coarsening down from medium-fine and moderately well sorted at top to fine to very coarse, very poorly sorted and shelly at base. Sand grains are subangular to subrounded at top, well rounded at base. Less than 2% lithic grains. Calcareous material increases from 15% at top to 60% below 100 cm, comprises mainly mollusca and echinoid (modern whole bivalves and abraded, ironstained fragments) and foraminifera. Occasional rounded "beachrock" pebbles at base. 40-60% of grains are ironstained yellow and orange.

CORE 466 GK (lat.: 28°39'46.7"S; long.: 153°38'15.9"S)
WD = 19 m, Recovery = 7.35 m

0-735 cm SAND, grey, quartzose, fine with minor very fine grains, moderately well sorted, angular to subangular. 3-4% lithic grains, trace heavy minerals. Weakly ironstained (<5% of grains) in upper part, non-ironstained below 220 cm.
Mainly 5-10% small shell fragments; shelly layer from 180-220 cm comprised 25% shell (common Bankivia and thin walled marine bivalves and foraminifera. Sand in shelly layer is bimodal and poorly sorted with minor coarse sand, rare granules and small pebbles. Mud lumps (infilled worm burrows) are common in sand below shelly layer.

CORE 489 KH (lat.:28°38'57.2"S; long.: 153°38'35.4"E)
WD = 19 m, Recovery = 1.60 m

0-160 cm SAND, fawn-grey, quartzose, fine grained, well sorted, angular to subangular. 2-3% lithic grains. Minor ironstaining (<10%) in upper part. 5-10% shell fragments above 120 cm; abundant shell in fine sand below 120 cm. Shell is mainly non-abraded Bankivia, mostly 40%, increases to 80% from 140-150 cm. Few rounded lithic pebbles and rare wood fragments in Shelly layer. Common sub horizontal bedding throughout.

CORE 491 KH (lat.: 28°39'29.2"S, long.: 153°38'11.6"E).
WD = 17 m, Recovery = 0.8 m

0-80 cm SAND, light grey, fine grained, well sorted above 70 cm overlying a SHELLY, GRAVELLY SAND layer.

- The fine sand is quartzose, angular to subangular with 2% lithic grains and <10% shell fragments. 10% of grains are lightly iron stained.
The coarse layer comprises 40% fine to very coarse, poorly sorted, angular to well rounded quartz sand, 20% quartz and lithic rounded granules and pebbles (up to 5 cm diameter), and 40% coarse calcareous material, mainly borken bivalves, Bankivia and barnacle plates. Some shell is abraded and ironstained.

CORE 493 KH (lat.: 28°33'02.8"S; long.: 153°40'50.5"E)
WD = 54.5 m, Recovery = 1.25 m

0-25 cm SAND, yellow brown, quartzose, fine to medium, moderately well sorted, angular to well rounded. 1-2% lithic grains. 80% of grains are strongly ironstained. 20% shell fragments, mostly abraded (rounded) and sand size rare large fragments.

(gradational contact)

25-125 cm SAND, yellow brown, calcareous, comprising fine to coarse, very poorly sorted quartz and calcareous sand, subangular to well-rounded and heavily ironstained, and 20 to 30% non-ironstained and non-abraded small to large shell fragments and whole marine shells, rare scaphopods.
Basal 10 cm is very shelly with minor granules and lithic rounded pebbles and one large abraded (and bored) Anadara shell.

CORE 495 KH (lat.: 28°33'05.0'S, long.: 153°39'24.5"E)
WD = 48 m, Recovery = 1.0 m

0-60 cm SAND, yellow-brown, quartzose - calcareous, fine to coarse, moderately sorted, subangular to rounded, (becoming coarser, less well sorted and more rounded downwards). 60-70% of grains are ironstained. 20-30% calcareous material, becoming coarser and more shelly downwards, comprising both angular, non-ironstained and rounded, ironstained shell fragments and minor foraminifera and bryozoa.

(gradational contact)

60-100 cm SAND, yellow brown, calcareous grading down to fawn shell gravel at base. Sand is fine to coarse (slightly finer than overlying unit at top, coarser in lower part with quartz and lithic granules), very poorly sorted, subangular to rounded. 40% of sand sized grains are ironstained. Coarse, cream coloured, shell material increasing from 40% to 70% at base. Sand below 90 cm is cemented around some shell fragments; cemented aggregates are non-abraded.

CORE 496 KH (lat.: 28°33'08.3"S; long.: 153°37'48.1"E)
WD = 42 m, Recovery = 2.0 m

0-50cm SAND, yellow-brown, fine to medium (coarsening down), moderately sorted, subangular to rounded (rounding increasing down). 2-3% lithic grains. 30% of grains are ironstained. Shell (20%) as sand-sized, abraded and ironstained grains and larger, non-ironstained, angular fragments.

50-200 cm SAND, yellow-brown to fawn, fine to coarse, moderately well sorted with layers of poorly sorted, coarse, granular sand with "beachrock" pebbles and coarse shell fragments at 50-70 cm, 115-120 cm and below 185 cm. (Weakly cemented at 115-120 cm). Sand is slightly less iron stained than above. Calcareous material (c.15%) mainly comprises shell fragments rare whole shells (e.g. Pectin), minor foraminifera, echinoid, Bryozoa and Halimeda fragments. Occasional abraded estuarine shells (Anadara) occur below 120 cm.
Coarse sand layers are very poorly sorted and contain larger shell fragments and whole bivalves which are usually oriented concave-up. Some articulated valves at base.

CORE 497 KH (lat.: 28°33'08.3"S; long.: 153°35'31.9"E).
WD = 32.5m, Recovery = 1.0 m

0-100 cm, SAND, olive-grey, quartzose, fine with minor very fine grains, moderately well sorted, angular to subrounded. 4-8% lithic grains. Lightly ironstained at top, non-ironstained below. 10% fine sand-sized shell fragments with abundant large fragments (up to 45%) in fine sand matrix below 40 cm. Large fragments are of thin-walled marine bivalves, Bankivia, rare scaphopod, and Pinna fragments.

HOLE 509 GS (lat.: 28°40'12.4"' long.: 153°38'13.5"E).(Disturbed samples)
WD = 20 m, Recovery 9.5 m

0-950 cm SAND, light to mid grey, quartzose, fine with minor very fine grains, well sorted, angular to subrounded. 2-4% lithic grains, common heavy minerals. 5-10% fine, angular, thin walled shell fragments, minor Bankivia and foraminifera. Non-ironstained.

HOLE 511 GS (lat.: 28°40'02.6"S; long.: 153°38'25.3"E). (Disturbed samples)
WD = 21 m Recovery = 2.7 m

0-270 cm SAND, grey, quartzose, fine grained, well sorted, subangular to subrounded. 3% lithic grains, trace heavy minerals. 5-10% fine shell fragments. Virtually non ironstained.

CORE 535 GK (lat.: 28°01'28.1"S, long.: 153.: 153°34'08.5"E).
WD = 52 m Recovered = 8.30 m.

0-105 cm, SAND, yellowish brown, very shelly, fine grained with a few larger shell fragments, well sorted, angular and subangular grains. Grains commonly ironstained. At 10 cm approx. 25% carbonate - mixture of finely fragmented shell material, foraminifera, echinoid debris, trace of pteropod debris, sponge spicules etc. At 90 cm 20% thin-walled bivalve hash.

105-125 cm, MIXED ZONE, Brown shelly gravel intermixed with fine-grained sand. Fines upwards.

125-170 cm, MUDDY SAND, Very dark grey - dark olive grey, fine grained, containing abundant shell fragments including large pecten, Anadara and other shells. Rounded "beachrock" (calcarenite) pebbles up to 5 cm long. Decreasing coarse shell material downwards.

170-228 cm, SAND, Dark grey, slightly muddy, fine-grained moderately-poorly sorted, containing some organic material. At 200 cm: quartz-55%, feldspar ~5%, lithics 2-3% and biogenic carbonate 35% (finely fragmented shell material, foraminifera, a few small gastropods, etc).

228-280 cm, SAND, Similar to immediately above interval. Dark grey fine to medium grained containing some disseminated shell fragments.

280-320 cm, SAND, Dark greyish brown, medium-grained containing a few bivalve shells including a few articulatted Anadara shells.

320-674 cm, SAND, Greyish brown, fine-grained, very slightly shelly, moderately well-sorted, grading into greyish brown fine to medium-grained well-sorted slightly shelly quartz sands consisting of approximately 90% quartz, 1-2% feldspar, 2-3% lithics and 5% biogenic carbonate (mainly finely fragmented shell material and foraminifera with occasional larger shell fragments).

674-690 cm, SANDY MUD AND MUD, Dark grey.

690-820 cm, SANDY CLAY, mottled grey and yellowish brown, stiff in places. Couple of chalky shell fragments at 780 cm. Partial carbonate cementation at 780 cm. Weathered zone. XRD on the carbonate cement indicates calcite with a trace of aragonite.

CORE 537 GK (lat. 28°01'26.9"S, long.: 153°35'04.3"E)
WD = 52 m, Recovery = 6.65 m

sited on the same site as 411 and 412 GK. Penetrated same stratigraphy as 412 GK. At 505 cm into the weathered zone.

CORE 539 GK (lat.: 28°01'26.8"S, long.: 153°31'44.1"E)
WD = 47 m, Recovery = 8.20 m

0-120 cm, Lost during deck operations.

120-160 cm, SAND, light yellowish brown, oxidised and partly-cemented, fine to very fine-grained, well-sorted, very slightly muddy. 50% of the grains significantly iron sttained. At 130 cm: 50% quartz, 50% biogenic carbonate; at 150 cm, 20% quartz, 80% biogenic carbonate - mainly foraminifera, shell material, echinoid debris, bryozoans, trace of ostracods, coralline algae and mica.

160-188 cm, SAND, pale brown, fine-grained, well-sorted very slightly muddy. Approximately 95% carbonate.

188-190, SAND, Coarse-grained, carbonate-rich. ?storm accumulation. Includes corolline algae fragments. At 190 cm: marked colour change.

190-295 cm, SAND, Dark grey, shelly, containing minor organic material. Very slightly muddy. Fines upwards medium-coarse at base, fine-grained at top. 50% quartz, 50% biogenic carbonate.

295-390 cm, SAND, Dark grey, fine and medium-grained, very slightly muddy. Minor organics. AT 350 cm, 40% quartz, 60% biogenic material (shell fragments, foraminifera, coraline algae etc).

390-398 cm, SAND, Dark grey, very coarse-grained, shelly.

398-445 cm, SAND, Grey, medium to coarse-grained, very shelly, quartzose. At 420 cm, very slightly muddy medium-grained, moderately-sorted, composed of approximately 50% quartz and 50% biogenic carbonate (mainly finely-fragmented shell material with lesser foraminifera, bryozoans, coralline algae and other material.

445-490 cm, SAND, Grey, coarse-very coarse-grained, poorly-sorted, shelly. At 480 cm grey coarse-grained poorly sorted shelly , made up of approximately 20% quartz and 80% biogenic carbonate (60% molluscan debris, 15% coralline algae, 10% foraminifera and 10% bryozoa and others).

490-520 cm, SAND, thin alternating layers of coarse and fine-grained shelly sands. Slightly muddy.

520-545 cm, SAND, Grey very coarse grained very shelly containing a couple of small rounded pebbles.

545-588 cm, SAND, Grey, medium and coarse-grained with shell hash.

588-603 cm, SAND, Grey, very coarse grained, carbonate-rich.

603-640 cm, SAND, Grey, shelly, fine-grained, containing a couple of rounded "beachrock" pebbles up to 5 cm across. At 620 cm biogenic fraction consists of approximately 55% mollusc debris, 15% bryozoa, 20% coralline algae, 5% foraminifera and 5% others (barnacle plates etc).

640-665 cm, Grey very coarse-grained shell hash containing some well-rouned "beachrock" and other pebbles up to 5 cm diameter. Pebbles partly encrusted with coralline algae. 80% carbonate - similar composition to immediately above interval.

665-735 cm, SAND, Dark grey, fine to very fine-grained, partly shelly, quartzone. At 680 and 730 cm approx. 35% of the sand consists of biogenic carbonate. 735-820 cm: very coarse shell hash containing many well-rounded pebbles up to 7 cm in diameter. Pebbles - commonly partly encrusted and bored. Consist of "beachrock" (calcarenite), volcanics and others.

CORE 541 GK (lat.: 27°45'52.7"S, long.: 153°29'59.1"E)
WD = 46 m Recovery = 9.02 m

0-240 cm, SAND, Dark olive grey, slightly muddy, fine (to medium) grained, well-sorted. 20-50% biogenic carbonate (shell material 60%, foraminifera, echinoid debris, coralline algae, ostracods etc.) A few small lithic grains. Traces of large gastropods.

240-c.305 cm, SAND, Dark olive grey, very slightly muddy, medium-coarse grained, poorly sorted, shelly, quartzose. A few large shell fragments. A large pebble at 270 cm.

c.305-c.420 cm, SAND, Dark grey, fine-grained, well-sorted, shelly. Some organic-rich mud.

c.420-c.550 cm, SAND, Dark maroon to black medium-grained well-sorted humate-cemented, composed of quartz. "Sandrock". 0 carbonate.

c.550-902 cm, SAND, Fine to medium-grained well-sorted quartz sand grading downwards into medium-grained well-sorted quartz sand grading into very coarse-grained poorly-sorted quartz sand and gravel at the base. Colour: light grey-brownish grey. 0 carbonate. Considerable garnet and other heavies in thin layers.

CORE 543 GK (lat.: 27°45'51.0"S, long.: 153°29'37.4"E)
WD = 36 m Recovered = 9.20 m

0-900 cm, SAND, uniform, grey, fine-grained (moderately) - well-sorted, slightly shelly. Grains are angular and subangular; typically clear. 85-90% quartz, 1-2% feldspar, 2-3% lithics, 5-10% biogenic carbonate - mainly fragmented shell material, lesser foraminifera, echinoid, bryozoa and other debris. One large bivalve at 642 cm. Couple of small gastrooods at 560 cm. Becomes slightly coarser grained, less well sorted and more shelly towards base.

900-920 cm, SAND, Medium-grained, moderately-sorted, shelly. Approximately 10% of grains ironstained.

CORE 545 GK (lat.: 27°46'00.2"S, long.: 153°28'59.0"E)
WD = 26 m Recovery = 7.77 m

0-40 cm, light brownish grey; grey below.

0-410 cm, SAND, uniform, fine-grained, well-sorted, slightly shelly.

410-420 cm, SAND, as for interval 0-410 cm except fine-meidum grained.

420-777 cm, SAND, uniform, grey, fine-grained, well-sorted, very slightly shelly. Possibly some bioturbation.

HOLE 562 GS (lat.: 27°46'58.5"S, long.: 153°28'17.8"S) (Disturbed samples)
WD = 23 m Recovery = 7.40 m.

Entirely fine-grained, greyish-brown, quartz sands containing approximately 5% biogenic carbonate.

HOLE 564 GS (lat.: 27°46'00.8"S, long.: 153°28'47.4"E) (Disturbed samples).
WD = 24 m Recovery = 9.60 m.

0-400 cm, Grey fine-meidum-grained quartzone sands. Trace of heavy minerals and carbonate.

400-960 cm, Grey, fine-grained, well-sorted quartzose sand. Trace of carbonate.

CORE 566 GK (lat.: 27°46'03.5"5, long.: 153°36'02.6"E)
WD = 64 m Recovery = 5.15 m

0-170 cm, SAND, Olive grey, very slightly muddy, fine-grained, well-sorted (Typical mid-shelf quartz/carbonate sands). 50-60% biogenic carbonate-finely fragmented shell material (fairly commonly ironstained), lesser calcareous algae, foraminifera etc.

170-350 cm, SAND, Olive grey, grey, fine-medium-grained, shelly. Contains a few coarser layers. Coarse to very coarse 260-267 cm.

350-373 cm, SAND, yellowish brown, partly-cemented, medium-coarse grained, poorly-sorted, shelly. Carbonate fraction - made-up of shell material including a few chalky and bored Anadara shells, calcareous algae, bryozoa, echinoid debris etc. A few small rounded pebbles including "beachrock" fragments.

373-515 cm, CLAY, stiff, black, organic-rich. Burrowed in part part. Traces of chalky shell. Below 480 cm becoming slightly mottled (very dark grey and brown) with incipient pisolite formation. Iron-oxide cemented? nodule at 480 cm.

CORE 568 GK (lat.: 27°46'06.7"S, long.: 153°34'36.1"E)
WD = 59 m Recovery = 6.4 m.

0-c.300 cm, SAND, Olive brown-dark greyish brown-olive grey, fine to medium grained, generally well sorted. Grains angular. Very slightly muddy in places. A few larger quartz grains and shell fragments. Biogenic carbonate ✓20-45% - mainly fragmented shell material, foraminifera, echinoid debris and coralline algae.

c.300-c.380 cm, SAND, Coarse grained, poorly sorted with several fragments (pebbles) of calcarenite "beachrock" (commonly encrusted with bryozoans, coralline algae, serpulid tubes etc) and some large bored and abraded shells.

c.380-640 cm, SAND, yellowish-brown to greyish brown fine (to medium) grained, moderately-well sorted, shelly. Contains 10-20% biogenic (shell fragments, bryozoans, coralline algae etc).

CORE 570 GK (lat.: 27°46'03.1"S, long.: 153°33'07.9"E).
WD = 54 m Recovery = 4.4 m.

Similar sequence to 568 GK. At 305-330 cm "beachrock" pebbles, coarse quartz sand and very coarse shell fragments - similar to layer in 568 GK.

CORE 572 GK (lat.: 27°46'01.9"S, long.: 153°31'38.6"E)
WD = 52 m, Recovery = 6.65 m

0-120 cm, SAND, light olive brown, medium to coarse-grained, mainly moderately-sorted, subangular and angular slightly shelly. Grains commonly ironstained. Composed of approximately 80% quartz, 5% lithics (generally rounded and strongly ironstained), and 10-15% biogenic carbonate (shell fragments, minor foraminifera, bryozoa etc).

Grades into:
120-238 cm, SAND, poorly sorted, yellowish brown, medium-coarse grained, shelly, composed of approximately 75% quartz and 20% biogenic carbonate (mainly fragmented shell material, minor foraminifera, bryozoa etc).

238-467 cm, SAND, Olive grey-brown, fine to medium-grained, well-sorted, angular. Approximately 5% of grains strongly ironstained; most grains slightly ironstained. Composed of 90-95% quartz, 5-10% biogenic carbonate (mainly shell material, minor foraminifera, barnacle plates etc), and <5% feldspar and lithics.

Grades into:
467-665 cm, SAND, very slightly muddy (?humate) slightly mottled grey/dark grey, fine-grained (moderately)-well-sorted, quartz. Grains typically clear. No carbonate. 95% quartz, 5% feldspar and lithics, trace of heavy minerals (mainly opaques).

CORE 586 GK (lat.: 27°29'03.3"S, long.: 153°33'05.6"E)
WD = 27 m REcovery = 6.15

Grey, clean, very slightly shelly quartz sands. 0-320 cm fine to medium-grained. 320-400 cm fine-grained, 400-615 cm fine to medium-grained.

HOLE 588 GS (lat.: 27°29'04.3"S, long.: 153°33'58.6"E) (Disturbed samples).

WD = 27 m Recovery = 9.50 m

0-85 cm, Sand, light yellowish grey, medium (-coarse) grained, shelly. Grey at base.

85-950 cm, SAND, uniform grey, clean, fine-grained, well-sorted, slightly shelly. 5-10% biogenic carbonate (mainly finely fragmented shell material).

CORE 636 GK (lat.: 25° 42'31.7"S, long.: 153°16'16.4"E)
WD = 48 m Recovery = 4.0 m

0f-30 cm, SAND, olive grey/olive brown, fine to medium-grained, shelly (35% biogenic carbonate) grading into shell hash 20-30cm.

30-105 cm, SAND, Olive grey, very slightly muddy in lower part, medium-grained, moderately-poorly sorted, shelly. Grains fairly commonly ironstained. Contains 30-35% biogenic carbonate. Some coarse shell material.

Grades into
105-185 cm, SAND, Dark grey, muddy, fine-(medium) - grained, shelly, containing 20-25% carbonate. Contains some whole molluscan shells including Anadara at 180 cm. Some scaphopods, pecten fragments etc at 110 cm.

185-200 cm, MUDDY SAND, Very dark grey, shelly, fine-grained containing chalky and fresh shell material. Organic-rich. Wood fragments.

Grades into:
200-284 cm, MUDDY SAND, very dark grey, very fine-grained, well-sorted, organic-rich, containing some wood fragments. >95% quartz, 1-2% biogenic carbonate (chalky shell fragments).

284-355 cm, SANDY CLAY-CLAYEY SAND, stiff, mottled. Sand fraction consists of fine and very fine-grained quartz. Dark grey 284 - approximately 300 cm; strongly mottled grey and yellowish brown below. Weathered.

355-368 cm, SANDY CLAY-MUDDY SAND, Grey, fine-grained. Iron oxide layer at 370 cm.

368-400 cm, SAND, olive brown, partly cemented, fine to medium-grained, quartz/carbonate. Cemented pebbles and fragmented layer at 395-400 cm. Contains 25-30% biogenic carbonate - mainly shell material.

CORE 639 GK (lat.: 25°42'29.2"S, long.: 153°13'02.2"E)
WD = 48 m REcovery = 1.46 m.

0-68 cm, SAND, Grey, medium-coarse-grained, made-up of quartz and fragmented carbonate. Increasing coarse shell material downwards. Typically medium-grained, moderately sorted, angular and subangular. 10-20% biogenic carbonate made up of fragmented shell material (90%), foraminifera (5-10%), trace of glauconite and other debris. Minor glauconite infilling foram tests.

65-~110 cm, SAND, slightly muddy. Grey and dark grey shelly containing numerous large shells - pectens etc. Some shells articulated. 30-40% shell material.

~110-123 cm, MUD, CLAY AND PEAT, very dark grey, slightly sandy, organic-rich containing a couple of well rouned limestone pebbles.

123-146 cm, WOOD, probably Eucalyptus gummifera (pers. comm. John Wilkes, Forestry School, A.N.U.), hard, red.

CORE 667 GK (lat.: 25°42'30.1"S, long.: 153°09'46.0"E)
WD = 42 m, Recovery = 7.25 m

0-10 cm, SAND, Greyish brown, medium-grained, moderately-well-sorted, shelly. Grains generally angular and subangular. Consists of approximately 80% quartz, 15-20% biogenic carbonate (60% fragmented shell matl., 30% foraminifera, 10% bryozoans, echinoids and other debris).

Grades into:
10-60 cm, SAND, Dark grey-olive grey, very slightly muddy, shelly, fine-to medium-grained.

Grades into:
60-135 cm, SAND, Dark grey, slightly muddy, fine-grained containing approximately 40% biogenic carbonate. At 130 cm, muddy.

135-185 cm, MUDDY SAND, Dark grey-dark olive grey, shelly. Fine-grained. Contains about 20% biogenic carbonate including some large shell fragments. Some peat/black organic-rich clay between 183-185 cm.

185-335 cm, SAND, uniform, reltively clean, light grey to light yellowish grey, fine to medium-grined, very slightly calcareous (<5%), well-sorted, quartzone. Very slightly muddy in their upper part. Grains typically angular and subangular. 2-3% of grains significantly ironstained. Couple of small "beachrock" fragments present. Fragment of wood at 330 cm.

335-370 cm, SAND, similar to above interval except slightly mottled. Light yellowish grey. Fine to medium grained, well sorted quartz sand. No carbonate. Contains 5% feldspar and 1-2% lithics. Grains commonly slightly ironstained.

Grades into:
370-725 cm, SAND, uniform grey, fine to medium grained, well-sorted. No carbonate. Grains typically clear. Leached. Small wood fragment at 495 cm.

HOLE 669 GS (lat.: 25°42'30.8"S, long.: 153°06'53.7"E) (Disturbed samples)
WD = 29 m Recovery = 9.50 m.

0-180 cm, SAND, Greyish brown, slightly shelly, fine to medium-grained, moderately to well-sorted. Occasional larger shell fragment. Sand consits of approximately 90% quartz, 1-2% feldspar, 1-2% lithics and 5-10% biogenic carbonate (mainly fragmented shell material, minor foraminifera and others).

180-200 cm, CHARCOAL AND WOOD, Black.

200-950 cm, SAND, Light grey fine to medium-grained, quartz. Moderately-well sorted. Minor coarser quartz and lithics towards base. No carbonate.

CORE 672 GK (Lat.: 25°42'27.2"S, long.: 153°05'57.1"E)
WD = 20 m, Recovery = 5.15 m

0-255 cm, SAND, Dark grey, fine-grained, well-sorted, very slightly muddy, shelly consisting of 75-85% quartz and 10-20% biogenic carbonate (finely fragmented shell material, foraminifera, pteropods, echinoid debris etc). Couple of larger shell fragments between 215 and 230 cm. Limestone pebble at 255 cm.

255-515 cm, SAND, Dark reddish brown, humate-cemented. Humate material partially or completely coating grains. Sand is fine to medium-grained, moderately well sorted and composed of approximately 95% quartz, <5% lithics and 1-2% feldspar. No carbonate. Grains typically angular or subangular. "Sandrock".

HOLE 674 GS (lat.: 25°37'29.1"S, long.: 153°06'07.4"E) (Disturbed samples)
WD = 21 m Recovery = 8.50 m
Approximate stratigraphy only.

0-50 cm, SAND, shelly, marine. Brownish grey/grey.

50-260 cm, SAND, Chocolate brown, humate-cemented. (sandrock). Ranges into

260-850 cm, SAND, Grey, leached. Fine to medium-coarse-grained.

CORE 675 KH (lat.: 25°37'29.6"S, long.: 153°78'12.4"E)
WD = 30 m Recovery = 0.30 m.

0-15 cm, SAND, Light yellowish brown, medium-grained slightly shelly.

15-30 cm, SAND, Greyish brown, very shelly, medium to coarse-grained. Large shell fragments are common. A few large (up to 5 cm diameter) rounded pebbles present. These are mainly dark grey well-cemented quartzone calcarenites similar to the pebble in 672 GK.

CORE 676 KH (lat.: 25°37'30.2"S, long.: 153°09'01.7"E)
WD = 36 m Recovery = 1.25 m

0-20 cm, SAND, Light yellowish-brown, medium-grained containing some fragmented shell material.

Grades into:
20-60 cm, SAND, grey (fine to) medium-grained, very slightly muddy, shelly.

60-70 cm, SAND, Grey, fine to medium-grained, slightly shelly. Very slightly muddy. Couple of small rounded pebbles (mainly limestone) at 60-70 cm and in core catches. Thin fragments of "beachrock" at 125 cm.

CORE 700 KH (lat.: 25°37'31.4"S, long.: 153°10'43.1"E)
WD = 42 m Recovery = 1.75 m

0-90 cm, SAND, Light yellowish brown, medium-grained, shelly. Increasingly shelly downwards.

Grades into:
90-175 cm, SAND, Medium-grained very shelly and shell hash. Light yellowish brown. Approximately 50% carbonate-mainly shell hash and whole bivalves. Couple of "beachrock" fragments. Slightly less shell hash in the interval 150-175 cm.

CORE 701 KH (lat.: 25°37'34.6"S, long.: 153°13'32.5"E)
WD = 46 m Recovery = 0.10 m

SAND, Olive grey, slightly muddy, fine to very fine-grained. Composed of quartz and biogenic carbonate..

CORE 703 KH (lat.: 25°37'31.6"S, long.: 153°16'13.3"E)
WD - 47 m Recovery = 2.10 m

0-95 cm, SAND, Light brownish grey, fine to medium-grained, (slightly) shelly. Shell material is finely fragmented and increasing downwards. One rounded pebble at about 25 cm.

95-160 cm, SAND, As above but contining 50% coarse shell hash including some large bivalve shells and scaphopods. Slightly greyer at base.

Grading into:
160-210 cm, SAND, Light olive grey, fine-grained containing about 10% fragmented shell material.

CORE 705 KH (lat. 25°32'33.9"S, long.: 153°11'13.3"E)
WD = 40 m No recovery.

CORE 706 KH (lat.: 25°32'34.8"S, long.: 153°11'14.2"E)
WD = 150 m Recovery = 2.30 m

0-150 cm, SAND, Olive grey, fine-medium-grained composed mainly of quartz and finely fragmented shell material. Biogenic carbonate makes up about 15% of the sand. Shells become larger towards base. Botryoidal quartz pebble at 15-20 cm.

150-230 cm, SAND, Dark grey, fine-grained containing similar shells to above interval. Whole shells etc including pectens in interval 200-215 cm.

CORE 708 KH (lat.: 25°32'32.5", long.: 153°12'39.6"E)
WD = 45 m Recovery = 2.10 m

0-76 cm, SAND, Light olive brown, shelly, fine to medium-grained. Shell material (mainly finely fragmented) makes up about 15% of the sand fraction. Couple of fine-grained shell hash lenses. Shell material increases slightly downwards.

76-110 cm, SAND, simiir to above interval but containing approximately 50% coarse-grained shell hash including large bivalve shells & scaphopods. Marked colour change at 110 cm.

110-158 cm, SAND, Grey, fine to very fine-grained slightly muddy, containing minor (<10%) fine-grained carbonate (mainly shell material; some foraminifera). Couple of irregular pebbles of carbonate-cemented fine-grained quartzone sand - 'beachrock"?.

158-165 cm, SAND, grey, fine-very fine grained, slightly muddy, containing minor comminuted carbonate inc. forams.

165-210 cm, SAND, similar to 158-165 cm except mottled grey and olive yellow. Increase in carbonate to 10% including a couple of scaphopods. Large carbonate cemented pebble at 180 cm.

HOLE 719 GS (lat.: 25°32'31.9"S, long.: 153°10'00.9"E) (Disturbed samples).
WD = 30 m Recovery = 9.30 m

0-40 cm, SAND, Light yellowish brown, medium-grained, moerately-well sorted, slightly shelly. Grains generally angular or subangular and commonly ironstained. Composed of (average): 85% quartz, 2-5% lithics and 10% carbonate (mainly fragmented shell material, minor (10% foraminifera, traces of coralline algae etc. including a few large bivalve fragments and gastropod shells).

40-180 cm, SAND, medium grey. Similar to the above interval except less ironstaining. Approximately 10% biogenic carbonate. At about 180 cm some wood fragments coming in, possibly from an interval above due to sorting.

At approx. 200cm, SAND, Dark reddish brown, humate-cemented ("sandrock"). Fine-medium grained well sorted with angular and subangular grains. Grains typically stained with organics. 0 carbonate. some small fragments of wood.

√250-√600 cm: at √250 cm, SAND, Brownish grey partly stained, fine to medium-grained, well-sorted. Made up of 95% quartz, 2-3% feldspar and 1-2% lithics. At 400-600 cm: light yellowish grey medium-grained moderately well-sorted quartz sands. Grains typically clear and angular or subangular.

600-c.800 cm, SAND, yellowish brown, iron-oxide stained, medium and coarse-grained, quartzose.

c.800-930 cm, SAND, light yellowish brown-yellowish grey, partly iron-oxide stained, very shelly. Medium and coarse grained. Made up to approximately 68% quartz, 2% feldspar, 5% lithics (generally strongly ironstained) and 20-25% biogenic carbonate - partly chalky and abraded; mainly fragmented shell material, forams and bryozoans. Traces of calcareous algae. Fragments of well-cemented calcarenite common. Calcarenite ("beachrock") at base.

HOLE 721 GS (lat.: 25°32'26.1"S, long.: 153°08'28.1"E) (Disturbed samples).
WD = 24 m Recovery = 5.60 m

0-c.100 cm, SAND, light brownish grey, fine to medium-grained, well-sorted, very slightly shelly. Approximately 20% of grains significantly ironstained. Composed of 90% quartz, 2-3% feldspar, 1-2% lithics and approximately 5% biogenic carbonate.

c.100-560 cm, SAND, Brown, fine-grained, well-sorted, lightly humate-cemented sandrock. Grains coated and stained with organic compounds. No carbonate.

HOLE 723 GS (lat. 25°27'30.7"S, long.: 153°11'29.4"E) (Disturbed samples)
WD = 28 m, Recovery = 9.50 m

0-c.200 cm, SAND, Olive brown, medium-grained, moderately-sorted, slightly shelly. Grains are typically angular and subangular and are commonly ironstained. Sand made-up of approximately 90% quartz, 2-3% feldspar, 2-3% lithics and 5% biogenic carbonate (mainly fragmented shell material and small whole bivalves; trace of forams).

c.200-950 cm, SAND, Light olive brown 200-400 cm, then olive yellow. Fine to medium or medium-grained, moderately-well sorted. Grains commonly ironstained and generally angular and subangular. Composed of approximately 90-95% quartz, 1-3% feldspar and 2-5% lithics. No carbonate.

HOLE 725 GS (lat.: 25°24'57.8"S, long.: 153°12'45.5"E) (Disturbed samples).
WD = 29 m Recovery = 9.50 m.
Similar to 723 GS

0-c.60 cm, SAND, Yellowish grey, fine to medium-grained moderately-well sorted, slightly shelly containing a few small lithic pebbles. Composed of 85% quartz, 1-2% feldspar, 5% lithics and 5-10% biogenic carbonate. 10% of grains significantly ironstained.

c.60-950 cm, SAND, yellowish grey passing into medium brown at base, fine-grained, moderately well-sorted, 0 carbonate. Grains are typically ironstained; strongly ironstained at the base. A few 'beachrock' fragments towards tthe base. Coarse and very coarse shelly material near base (800-950 cm). Coralline algae present.

HOLE 727 GS (lat.: 25°27'29.3"5, long.: 153°17'14.3"E) (Disturbed samples).
WD = 48 m Recovery = 5.60 m

0-c.200 cm: Mixed sample. SAND, light yellowish brown, medium-grained with abundant gravel-size shell fragments. Some whole single valves.

c.200-400 cm: Mixed sample. SAND, Olive fine to medium-grained.

400- cm: Mixed sample. SAND, Light brownish grey, fine and medium-grained containing rudaceous-sized shell material and coralline algal fragments. A number of "beachrock" pebbles recovered.

CORE 729 GK (lat.: 25°27'31.7"S long.: 153°14'00.2"E).
WD = 49 m Recovery = 5.20 m.

0-315 cm, SAND, uniform very dark grey-very dark olive grey, very slightly muddy, shelly, fine and very fine-grained. Consists of approximately 50% biogenic carbonate (mainly finely fragmented; very occasional large bivalve shell), and 50% quartz.

315-335 cm, SAND, light yellowish brown, shelly, fine to medium-grained, very slightly muddy. Composed of approximately 50% quartz and 50% biogenic carbonate. Slightly oxidised.

335-355 cm, SAND, mid-grey, slightly shelly containing approximately 15% finely fragmented biogenic carbonate.

355-375 cm, layer of calcarenite ("beachrock") pebbles up to 5 cm diameter. A few bivalve fragments.

375-475 cm, SAND, Grey, very slightly muddy, fine to very fine-grained, shelly. Shell material ~30%. "Beachrock" pebbles at 398 and 442 cm. Couple of large ANADARA? fragments present.

475-480 cm, SHELL HASH.

480-475cm, SAND, grey, slightly muddy, similar to 375-475 cm. Large abraded and bored "Anadara" shell at 510 cm. Considerable shell hash between 495 and 510 cm.

CORE 731 GK (lat.: 25°24'58.6"S, long.: 153°16'58.4"E).
WD = 50 m Recovery = 7.05 m.

0-480 cm, SAND, Dark olive grey - light brownish grey, muddy - slightly muddy, shelly, fine or medium-grained grading into coarse to very coarse shelly sand towards base.

480-525 cm, SAND, sand fraction finer and blacker than above. At base mixed with mud probably coming from layer below. Large shells and "beachrock" pebbles between 500 and 520 cm. Admixed coarsecarbonate debris including bryozoans. Piece of recrystallised coral from the some depth as the bryozoans.

525-543 cm, Black intercalated mud and shelly pebbly sand.

543-607 cm, MUD, black with a little sand.

607-640 cm, MUD, very dark grey, containing thin shells. Pebbly.

640-705 cm, MUDDY SAND, dark grey, fine-grained with an occasional shell fragment.

CORE 755 GK (lat.: 25°19'53.9"S, long.: 153°17'43.6"E)
WD = 45 m Recovery = 6.95 m

0-130 cm, SAND, Medium-dark grey, medium (-coarse) -grained shelly, containing approximately 15% biogenic carbonate - 85% fragmented shell material, 5% bryozoans, 5% foraminifera and 5% others.

Increasing mud downwards.
130-250 cm, SAND, Grey, fine-grained, shelly.

Grades into
250-280 cm, SAND, very dark grey in upper part, greyish brown in lower part, humate-rich, fine (-medium)- grained, well-sorted. No carbonate. Grains typically angular and subangular. Composed of quartz.

280-295 cm, SAND, very dark grey, fine-grained with increasing organics downwards.

295-340 cm, SANDY CLAY, black, very organic-rich, containing pieces of wood.

340-380 cm, CLAYEY SAND, slightly mottled (light olive grey and grey). Contains a couple of roots.

380-510 cm, CLAYEY SAND, increasingly darker grey, fine to very fine-grained, containing 35-40% carbonate (mainly finely fragmented shell material).

Grades into:
510-695 cm, SAND, dark olive grey, fine-grained moderately-sorted, shelly, consisting of 55-60% quartz and 40-45% biogenic carbonate. Large abraded and bleached Anadara fragments, couple of rounded pebbles and a piece of coral between 600 and 635 cm. Large (4cm across) piece of coral at the base.

CORE 757 GK (lat.: 25°17'30.5"S, long.: 153°17'29.5"E)
WD = 32 m Recovery = 2.15 m

0-60 cm, SAND, Grey-dark grey, medium-grained, well-sorted, slightly muddy and shelly. At 20 cm consists of 90% quartz, 1-2% feldspar, 2-3% lithics and 5% biogenic carbonate.

60-140 cm, SAND, Dark grey, (fine-) medium-grained, moderately well-sorted, slightly muddy. Contains approximately 15% carbonate (mainly fragmented shell material). Couple of whole bivalves and gastropods towards the base.

140-215 cm, SAND, very dark reddish brown-black, organically (humate)-cemented - "sandrock". Grains typically coated with humate. No carbonate. Composed of quartz with minor feldspar and lithics. At 160 cm the quartz is medium grained, moderately-well sorted; at 210 cm the quartz is fine-medium grained, well-sorted.

CORE 759 GK (lat.: 25°17'26.9"S, long.: 153°22'24.2"E).
WD = 45 m Recovery = 7.20 m

0-410 cm, SAND, Dark olive grey, fine (-very fine-grained) generally well-sorted (minor coarser shell material) very slightly muddy, shelly. Composed of approximately 70-85% quartz, 2-3% feldspar, 5% lithics and 10-25% biogenic carbonate (mainly fragmented shell material, minor foram and echinoid debris, some fecal pellets, a few scaphopods.

410-433 cm, SAND, fine as above, but containing slightly more shell material.

433-563 cm, SAND, Olive grey, fine-grained, well-sorted, very slightly muddy. Grains typically clear and angular. Contains approx. 5% biogenic carbonate.

563-575 cm, SAND, very coarse grained containing about 20% coarse shell hash.

575-680 cm, SAND, uniform grey, fine to very fine-grained, well-sorted, slightly shelly composed of approximately 85-90% quartz 1-2% feldspar, 1-2% lithics and 5-10% biogenic carbonate (finely-fragmented shell material, foraminifera 25%, others 10%). At 680 cm increasing shell material.

680-700 cm, SAND, Grey, slightly muddy, shelly, fine-grained containing a few irregular coarse-grained "beachrock" pebbles, a large extensively bored "Anadara" valve and some wood fragments.

700-720 cm, SAND, Black-very dark brown, humate-cemented, fine-grained ("sandrock"). Contains approximately 5% biogenic carbonate mainly - finely fragmented shell material and a couple of small gastropods.

HOLE 769 GS (lat.: 25°07'26.8"S, long.: 153°21'34.9"E) (Disturbed samples)
WD = 27 m Penetration = 9.50 m
SAND, fine-grained, well-sorted containing very minor carbonate. Colour ranges from buff grey to olive grey. Basically beach/dune-type material.

HOLE 771 GS (lat.: 25°07'33.1"S, long.: 153°24'03.5"E) (Disturbed samples).
WD = 25 m Penetration = 9.50 m

0-200 cm, SAND, light yellowish brown, coarse-grained.

200-400 cm, SAND, grey, medium-grained.

400-600 cm, SAND, light grey, fine-grained containing some shells.

600-950 cm SAND, Grey-right brownish grey, fine-grained.

CORE 795 GK (Lat.: 25°07'30.0"S, long.: 153°25'35.0"E)
WD = 40 m Recovery = 7.40 m

0-105 cm, SAND, Pale brown mixture of medium-grained quartz and coarse-grained shell sands. Approximately 25-30% carbonate.

105-140 cm, SAND, Grey, fine to coarse grained quartz and coarse-very coarse grained carbonate. Poorly sorted. Consists of 35% quartz and 65% biogenic carbonate (mainly fragmented shell material, a few small "beachrock" fragments, minor echinoid, foram and other debris).

140-182 cm, SAND, Olive grey, fine-grained, well-sorted, very slightly muddy shelly. Occasional larger shell fragment. Consists of approx 75% quartz, 15-20% biogenic carbonate. Rounded calcarenite pebble (3 cm long) at 180 cm. A little ironstaining on some of the grains.

182-187 cm, SAND, Olive grey with 30% coarse shell hash. Several irregular "beachrock" pebbles. Large bivalve fragments.

187-400 cm, SAND, Olive, fine-very fine-grained, well-sorted. Very slightly muddy in places. At 210 cm contains 15% finely fragmented partly bleached shell material. A few small cemented fragments. Below 210 cm (sampled at 280, 360 and 390 cm) 0-1-2% carbonate-mainly chalky shell fragments. 1-2% opaques.

400-740 cm, SAND, Light grey-white at base, fine to medium-grained partly-cemented quartz/carbonate sands. Slightly muddy (white carbonate mud). Typically 40-55% carbonate in the framework. By 700 cm virtually a pure calcarenite limestone. Bleached. Partial hard in situ cementation. At 730 cm white well-cemented calcarenite. Contains various fragments of shell, some recognisable foraminifera, bryozoa etc.

CORE 797 GK (lat.: 25°07'30.1, long.: 153°26'27.3"E).
WD = 38 m Recovery = 4.55 m

0-55 cm, SAND, Brownish yellow, coarse to very coarse-grained, poorly-sorted, very shelly. Biogenic carbonate is commonly ironstained. Composed of 55% quartz, 5% lithics and 40% biogenic carbonate (shell framents, small gastropods etc (70%), foraminifera (5%), bryozoans (5%). Some small fragments of cemented material.

55-255 cm, SAND, Brownish yellow. Similar to above.

255-455 cm, SAND, Brownish yellow 255-405 cm, light brownish grey 405-455 cm. Medium to very coarse-grained shelly containing 15-20% biogenic carbonate. Grains commonly ironstained.

CORE 799 GK (lat. 25°02'32.2"S, long. 153°28'19.4"E)
WD = 44 m Recovery = 6.20 m

0-80 cm, SAND, Brownish yellow,, medium-coarse grained, poorly-sorted, shelly. Minor encrusted "beachrock" fragments. Grains, particularly carbonate (20-50%), commonly ironstained.

80-275 cm, SAND, Olive, very fine-fine-grained, well-sorted slightly muddy containing 5-10% biogenic carbonate and traces of biotite and lithics.

275-620 cm, SAND, Olive yellow, partly-cemented (patches & layers), medium to very coarse-grained, quartz/carbonate. Grains commonly ironstained. Contains 50-65% biogenic carbonate - chalky in places. Very slightly muddy. Thin clay band at 355 cm.

CORE 801 GK (lat.: 25°02'32.7"S, long.: 153°26'33.8"E)
WD = 43 m Recovery = 3.42 m.
Similar sequence to 799 GK.

0-45 cm, SAND, Brownish grey-olive brown, medium-coarse grained, moderately-poorly sorted, very shelly; combined with coralline algal nodules and pieces of coralline algal-encrusted "beachrock". Grades into

45-60 cm, SAND, Fine-grained, well-sorted, quartz/carbonate.

60-~150 cm, SAND, olive brown, fine-grained, well-sorted, slightly muddy. 15-25% biogenic carbonate-mainly finely-fragmented shell material, foraminifera, bryozoa, coralline algae etc. A few larger shell fragments. Pebbly layer at the base - pebbles mainly fine-grained quartzite.

~150-220 cm, SAND, Olive, very fine-grained, well-sorted containing 5-10% biogenic carbonate. Burrowed throughout except for 210-220 cm. Black organics infilling the disturbed burrows. Large quartzite pebble at 185 cm.

220-342 cm, SAND, olive, partly-cemented, fine to very fine-grained, moderately-well sorted. Grains very commonly ironstained. Composed of 70-75% quartz, 20-25% biogenic carbonate. Very slightly muddy. ?vadose cementation. Root cast remanants? - rhizomorphs?

HOLE 803 GS (lat.: 25°02'29.8"S, long.: 153°23'26.4"E) (Disturbed samples)
WD = 32 m Penetration = 9.50 m

Few details. Mainly fine and very fine-grained sands.
0-110 cm: Mixed fine-quartz and coarse-carbonate sand.

HOLE 805 GS (lat.: 25°02'35.8"S Long.: 153°25'16.9"E) (Disturbed samples).
WD = 36 m. Penetration = 9.50 m.

0-20 cm, SHELL HASH, Light yellowish brown, very coarse-grained containing coralline algal fragments and numerous small "beachrock" pebbles.

20-25 cm, Fragments of "beachrock" (cemented sand). Possibly partly dispersed in material above.

25-200 cm, SAND, Olive grey, fine-grained, slightly shelly. 5-10% finely-fragmented carbonate. Some grains, partic. carbonate, ironstained. A few granule-size cemented fragments.

200-950 cm, SAND, fairly similar to 25-200 cm. Olive grey, fine-grained, well sorted containing 15-20% finely fragmented carbonate. Some cemented layers which have been broken-up in the drilling. Typical "beachrock" material. Similar to the basal part of 801 GK.

HOLE 807 GS (lat.: 25°05'03.2"S, long.:153°25'16.9"E) (Disturbed samples).
WD = 24 m Penetrations = 9.50 m.

0-100 cm, SAND, light brownish grey, coarse and medium-grained, shelly. Mainly poorly sorted. Grains typically angular and subangular and ironstained. Composed of 60% quartz, 1-2% feldspar, 1-2% lithics and 35% biogenic carbonate.

100-c.130 cm, SAND, light grey-grey, coarse-very coarse-grained, poorly-sorted, shelly. A few grains ironstained. 50% quartz, 40-45% biogenic carbonate, and 5% others. (mainly feldspar and lithics).

c.130-400 cm, SAND, light grey, fine-grained, well-sorted containing 2-5% biogenic carbonate (mainly finely fragmented shell material).

400-800 cm, SAND, Brown-dark chocolate brown, humate-cemented ("sandrock"). Fine-grained, well-sorted. 0-tr of carbonate. Virtually pure quartz sand cemented with organics.

800-950 cm, SAND, brown-greyish brown. Significant decrease in humate (organic material) over above interval. Fine-medium-grained. Minor coarse quartz material. 90% quartz, o-tr biogenic carbonate, 10% others (feldspar, lithics etc).

CORE 809 GK (lat. 25°12'29.5"S, long. 153°18'58.6"E)
WD = 31 m Recovery = 9.60 m

0-172 cm, SAND, uniform grey and dark grey, slightly muddy, shelly. Fine-grained quartz, fine-medium-grained carbonate. Moderately sorted. At 20 cm, 100 cm and 160 cm, 30%, 10% and 15% carbonate respectively.

172-180 cm, GRAVEL, Dark grey-black. At 175 cm, well-rounded fine gravel (av. grain size 4.5 mm). Gravel made-up of quartz, lithics, well-rounded fragments of shell etc. Possibly transgressive horizon.

180-192 cm, SAND, light brownish grey, fine to medium-grained quartz, medium-coarse grained commonly ironstained carbonate (25-30%). Carbonate - shell material (50%) coralline algae (30%), foraminiferal (5%), bryozoans (5%), echinoid debris (5%) and others (5%).

192-235 cm, SAND, light brownish grey, fine to medium-grained, very fine-grained towards base. Very shelly. 45% biogenic carbonate at 210 cm - shell material (70%) foraminifera (10%), echinoid debris (5%), bryozoa (5%), coralline algae (5%) and others (5%).

235-253 cm, SAND, light brownish grey medium to coarse-grained moderately to poorly-sorted, very shelly. Grains, particularly carbonate, fairly commonly ironstained. At 245 cm, 35-40% carbonate made-up of 35% coralline algae, 50% shell material, 5% foraminifera, 5% bryozoans and 5% others.

253-263 cm, SAND, light grey, fine-grained, carbonate-rich. 70% carbonate - mainly finely fragmented shell material (partly chalky).

263-840 cm, SAND, dark grey, fine (to very fine) - grained, well-sorted, shelly. 15-40% carbonate. Very coarse-grained sand layer between 785 and 790 cm.

840-907 cm, SAND, light brownish-grey, coarse-grained, moderately-poorly-sorted, shelly. Carbonate grains are commonly ironstained.

907-960 cm, SAND, brownish grey, fine-grained, shelly. 20-25% carbonate.

CORE 811 GK (lat. 25°12'31.9"S, long. 153°21'00.7"E)
WD = 34 m Recovery = 4.80 m

0-312 cm, SAND, Grey, very slightly muddy, fine-grained containing 10-15% fine to medium-grained carbonate.

312-313 cm, MUD, dark grey.

313-325 cm, SAND, grey, muddy very shelly, medium (to coarse-grained) containing 30-35% coarse-grained shell material. Some small bivalves. Organic inclusions.

325-420 cm, SAND, Dark greyish brown, fine-grained, (medium to) well-sorted. Grains slightly stained with organics (humate). At 330 cm, 45% quartz, 2-3% feldspar, 1-2% lithics and trace of carbonate. At 360 cm, 90% quartz, 5% feldspar, 5% lithics and 0 carbonate. Resembles sandrock.

420-480 cm, SAND, very dark greyish brown, fine-grained, well-sorted. 0 carbonate. 95% quartz, 1-2% feldspar, 2-3% lithics.

CORE 813 GK (lat.25°12'32.3"S, long. 153°23'29.8"E)
WD = 37 m Recovery = 2.20 m

0-~100 cm, SAND, grey, fine-grained.
~100-220 cm, SAND, slightly muddy, shelly.

CORE 815 GK (lat. 25°12'35.2"S long. 153°25'32.3"E)
WD = 35 m Recovery = 1.67 m

SAND, Olive grey, fine to medium-grained.

APPENDIX 2

RESULTS OF GRAINSIZE ANALYSES

APPENDIX 2

RESULTS OF GRAINSIZE ANALYSES OF THE SAND FRACTION OF SELECTED CORE MATERIAL*

CORE	DEPTH(cm)	MEAN GRAINSIZE (Ø)	SORTING (Ø)	SKEWNESS	KURTOSIS
169	300	1.78	0.53	0.16	0.19
	470	1.85	0.71	0.46	0.68
	600	1.57	0.69	-0.02	0.68
	640	2.52	0.67	-1.25	4.88
146	185	1.73	0.51	0.05	2.79
167	170	2.33	0.66	-1.32	4.13
	210	2.73	0.51	-0.74	4.88
174	200	0.99	0.74	0.38	0.58
	330	1.58	0.62	0.15	0.44
	350	1.78	0.48	0.28	1.97
	580	2.16	0.45	-0.23	2.77
204	120	2.66	0.56	-0.92	5.26
	240	2.63	0.55	-0.54	3.58
210	0-200	1.92	0.46	-0.08	3.31
	200-400	1.94	0.44	-0.12	3.52
	400-600	1.85	0.44	-0.13	5.23
	600-750	1.97	0.34	-0.42	7.79
228	0-40	1.99	0.45	-0.13	7.14
	40-110	1.34	0.67	-0.33	0.72
	110-180	1.52	0.61	-0.35	1.03
	200-400	1.87	0.50	-1.00	5.58
	400-600	2.01	0.45	-0.22	3.18
	600-750	1.89	0.49	-0.54	5.65
273	0-200	2.93	0.57	-1.52	6.63
	200-340	2.92	0.58	-1.35	4.98
	340-520	2.81	0.79	-2.20	6.18
	520-780	2.57	0.87	-1.04	1.40
	780-950	2.24	0.96	-0.86	0.93
282	0-100	2.57	0.60	-2.12	11.34
	250	2.58	0.56	-2.81	14.38
	450	2.67	0.71	-2.19	7.93
	550	2.65	0.78	-1.69	4.94
310	550	2.76	0.76	-1.99	6.44
	750	2.73	0.63	-1.37	6.43
	980	2.85	0.66	-2.26	9.21

* Analyses made using the settling tube method and the grainaize analysis program of Mayo (1972).

CORE	DEPTH (cm)	MEAN GRAINSIZE (Ø)	SORTING (Ø)	SKEWNESS	KURTOSIS
311	330	1.90	0.57	-0.37	3.98
	410	2.23	0.63	-0.36	2.78
	420	1.88	0.60	-0.79	3.23
	500	2.72	0.77	-1.72	5.59
	750	2.73	0.71	-1.29	3.33
	860	2.53	0.66	-1.39	4.72
355	850	2.21	0.63	-2.19	7.49
	1030	2.65	0.68	-2.14	8.34
350	730	2.11	0.79	-0.53	1.27
	920	2.25	0.81	-1.24	2.30
466	10	2.72	0.69	-1.75	5.10
	50	2.68	0.82	-2.24	6.17
	100	2.58	0.86	-2.12	5.58
	150	2.71	0.81	-1.93	4.30
	200	2.07	1.20	-0.74	-0.55
	250	2.57	0.80	-2.07	6.09
	300	2.61	0.76	-1.52	3.27
	350	2.70	0.83	-2.53	8.04
	450	2.64	0.84	-1.89	5.33
	650	2.55	0.72	-1.45	3.19
	730	2.67	0.75	-1.79	4.85
489	5	2.71	0.79	-2.59	8.58
	40	2.58	0.66	-1.92	4.92
	110	2.61	0.82	-2.30	6.82
	140	2.33	0.87	-1.08	1.11
	155	2.35	1.00	-1.36	1.64
411	150	1.91	0.68	-0.44	1.49
	190	2.47	0.64	-1.49	4.43
412	280	2.48	0.62	-1.15	4.26
	370	2.73	0.95	-2.27	5.91
535	200	2.88	1.02	-1.95	4.18
	250	2.30	0.87	-1.08	2.70
	300	2.09	0.68	-0.25	1.72
	520	2.38	0.62	-1.13	4.14
541	450	1.84	0.53	0.11	1.81
	620	2.19	0.44	0.57	2.10
	810	1.52	0.43	0.69	3.91
543	100	2.55	0.55	-0.41	1.96
	160	2.50	0.54	-0.92	5.07
	220	2.66	0.56	-0.88	4.43
	520	2.30	0.52	-0.16	3.98
	820	2.44	0.62	-0.83	2.94
	905	1.45	0.90	0.43	-0.56
	915	1.89	0.74	0.19	0.12

CORE	DEPTH (cm)	MEAN GRAINSIZE (ø)	SORTING (ø)	SKEWNESS	KURTOSIS
572	520	2.65	0.56	-1.08	5.67
	560	2.50	0.60	-0.25	2.14
	620	2.24	0.62	0.54	0.26
	660	2.82	0.60	-0.81	2.52
588	0-85	1.62	0.64	0.44	0.44
	85-200	2.14	0.43	-0.69	4.38
	200-400	2.27	0.38	-2.45	19.75
	400-600	2.37	0.39	-1.96	18.05
	600-800	2.39	0.38	-1.43	13.82
	800-950	2.47	0.32	0.29	7.47
667	200	2.04	0.52	-0.03	0.56
	300	1.99	0.52	0.00	4.02
	350	1.91	0.47	-0.21	5.95
	400	1.82	0.49	-0.08	3.19
	500	1.72	0.57	-1.01	3.19
	600	1.91	0.47	-0.09	5.21
	700	1.73	0.52	0.05	2.23
669	200-400	1.76	0.59	-0.58	3.40
	400-600	1.52	0.61	-0.09	1.21
	600-800	2.26	0.80	-0.46	0.57
	800-950	1.94	0.89	-0.37	0.19
672	280	2.28	0.60	-1.07	4.10
	500	2.00	0.73	-0.58	2.83
719	200	1.89	0.61	-0.83	3.15
	250	2.00	0.57	-1.04	3.36
	400-600	1.70	0.60	-0.49	2.37
	600-800	2.00	0.87	-0.43	-0.09
	800-930	1.90	0.91	-0.19	-0.25
723	0-200	1.63	0.60	-0.37	2.57
	200-350	1.90	0.65	-0.35	4.40
	350-400	1.76	0.60	-0.43	3.13
	400-600	1.85	0.57	-0.18	2.21
	600-800	1.78	0.65	0.03	2.37
	800-950	1.91	0.57	-0.77	2.92
795	280	3.21	0.56	-2.58	11.75
	360	3.06	0.47	-1.68	11.17
	390	3.15	0.51	-2.04	9.73
799	75	2.81	0.88	-1.56	2.44
	100	2.88	0.55	-0.94	3.83
	110	3.02	0.57	-2.29	11.67
	130	3.10	0.53	-2.48	12.59
	260	2.91	0.51	-1.58	8.76
801	220	2.99	0.71	-2.74	9.87

CORE	DEPTH (cm)	MEAN GRAINSIZE (Ø)	SORTING (Ø)	SKEWNESS	KURTOSIS
807	130-200	2.60	0.43	-1.67	11.81
	200-400	2.68	0.41	-2.00	13.99
	400-600	2.54	0.47	-0.61	5.73
	600-800	2.20	0.53	-0.59	3.52
	800-950	2.37	0.75	-1.02	1.29
811	330	2.71	0.62	-0.79	3.00
	360	2.55	0.69	-0.83	2.12
	450	2.70	0.53	-0.51	3.03