RECENT TEMPERATE CARBONATE DEPOSITS
ON THE CONTINENTAL SHELF
NORTH AND WEST OF SCOTLAND:
DISTRIBUTION, SEDIMENTOLOGY AND RESERVES

Volume 2 : Figures, Tables & Appendices

A thesis submitted for the
degree of
Doctor of Philosophy

by
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Glasgow

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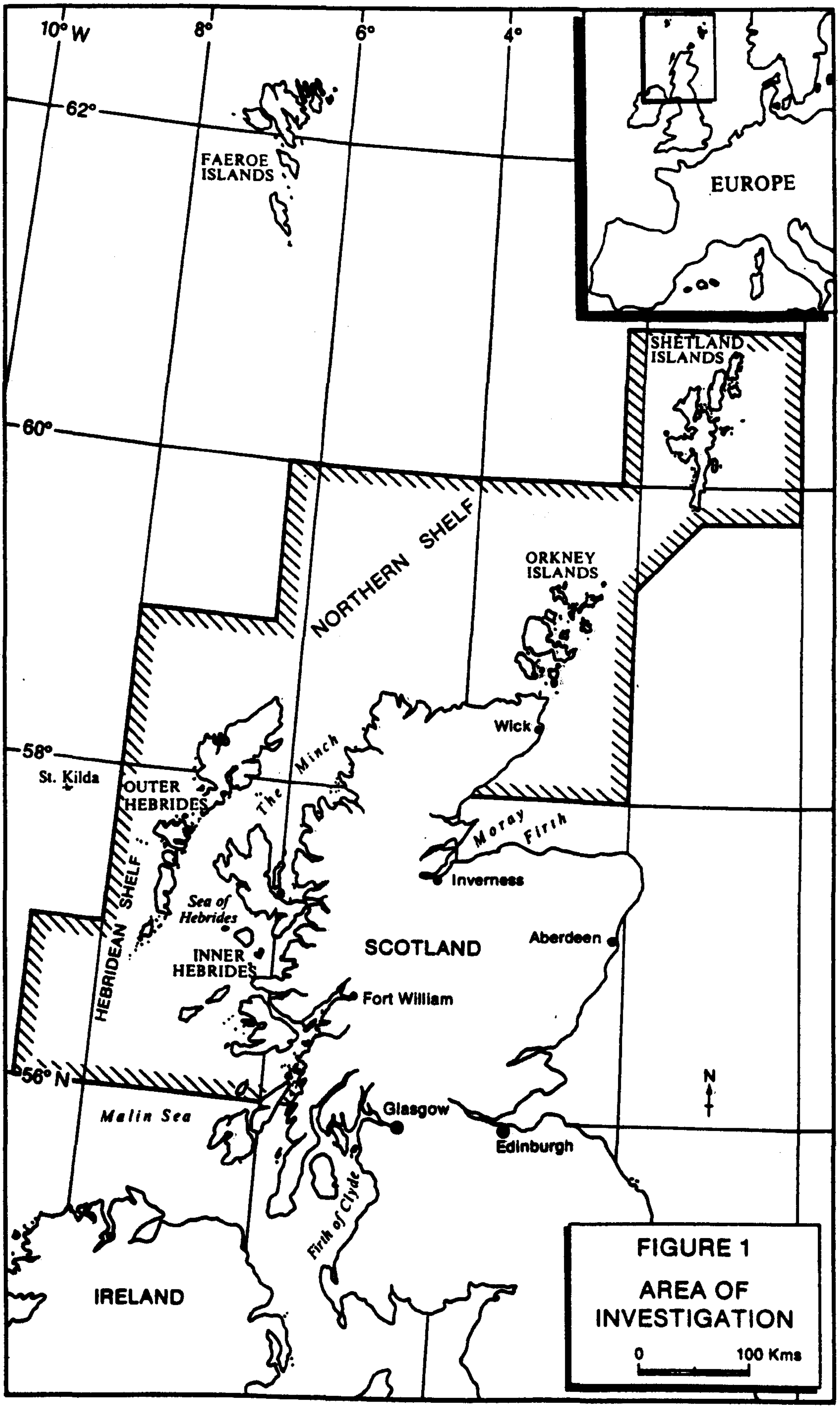


FIGURE 1

AREA OF INVESTIGATION

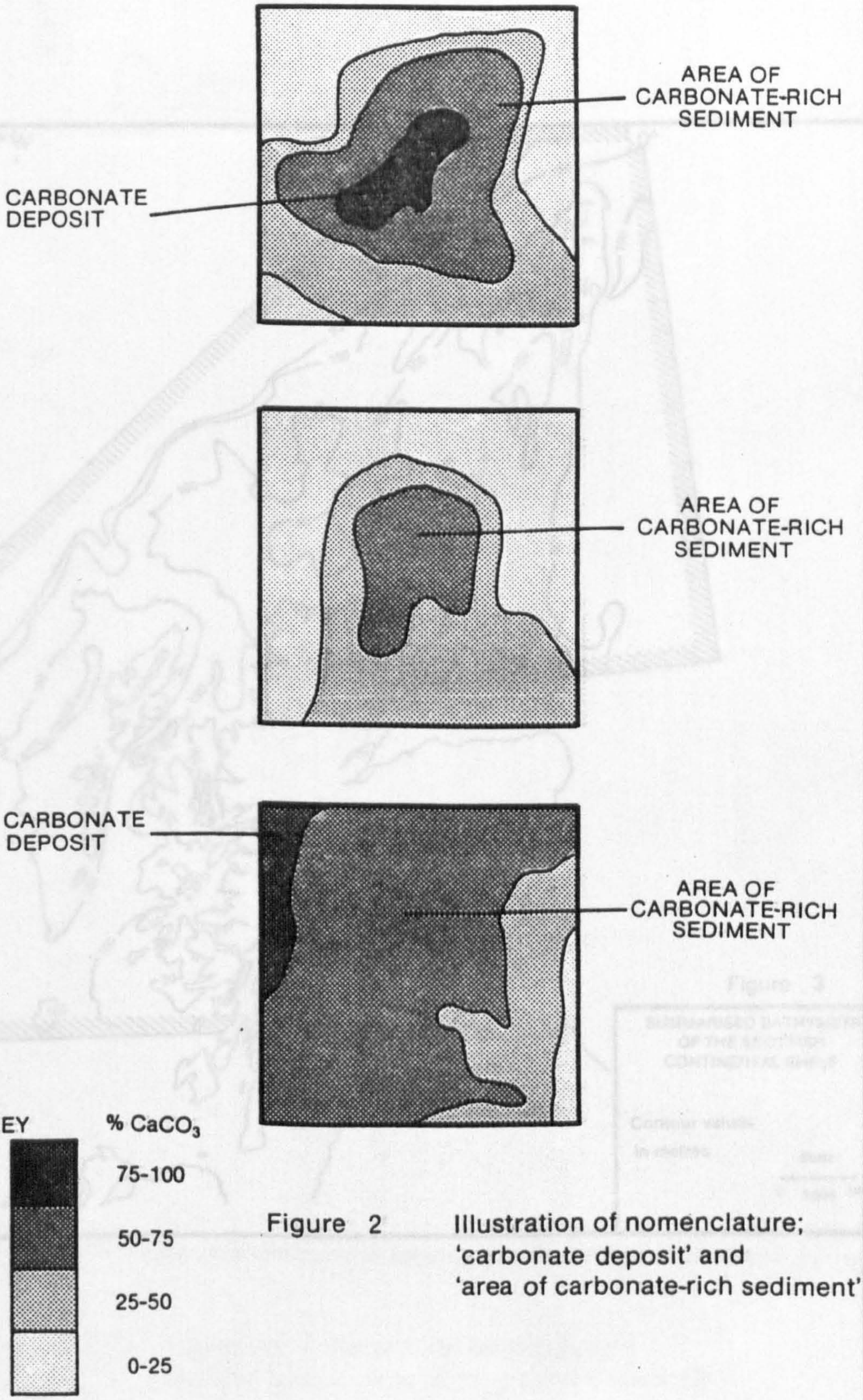


Figure 2 Illustration of nomenclature; 'carbonate deposit' and 'area of carbonate-rich sediment'

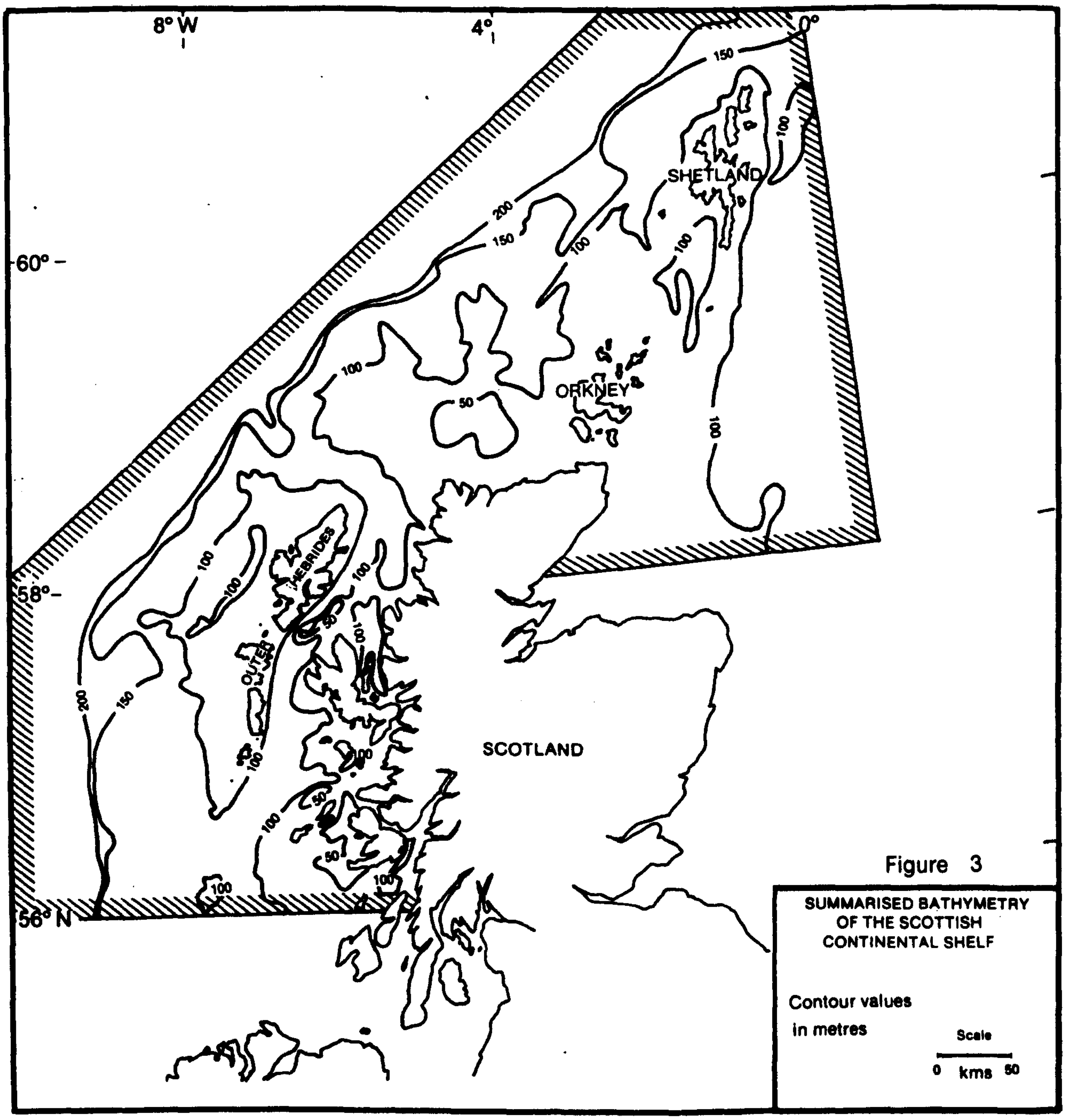
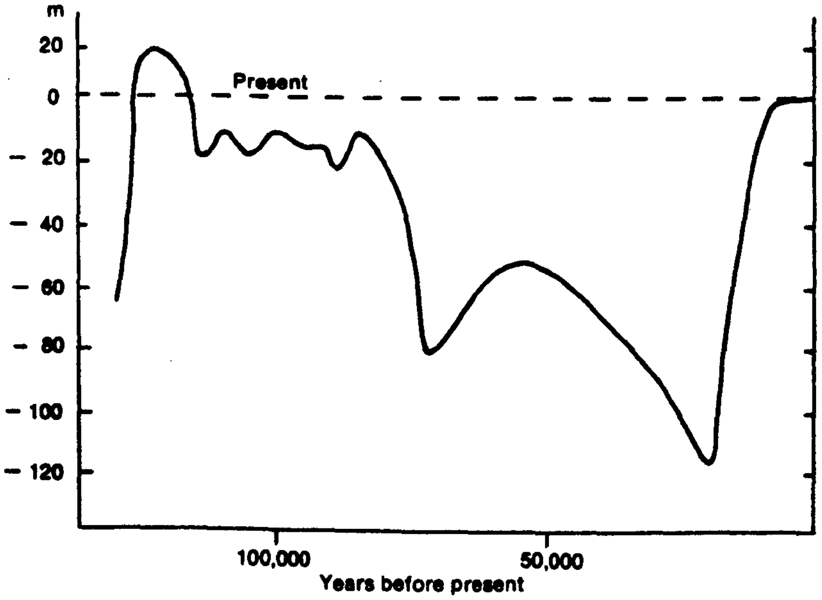


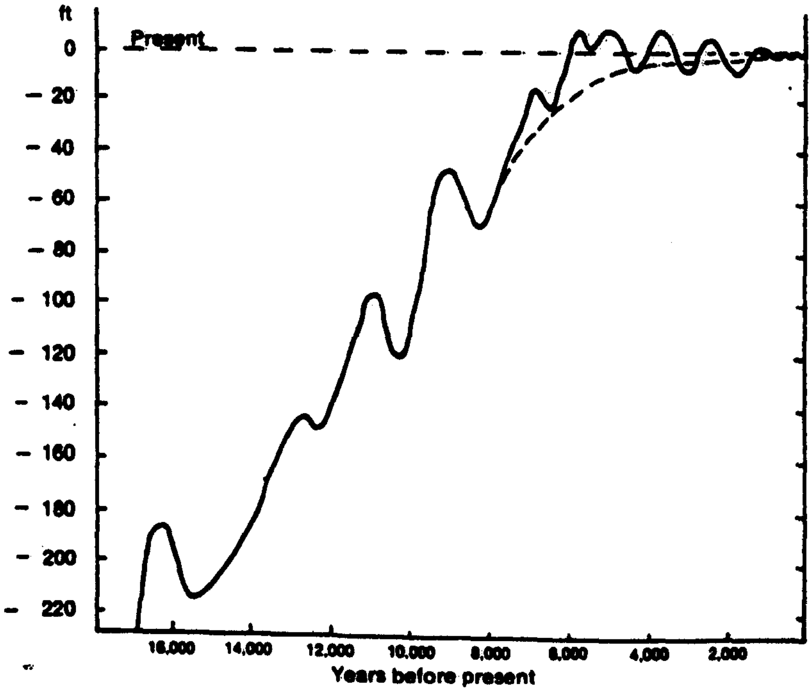
Figure 3

SUMMARISED BATHYMETRY OF THE SCOTTISH CONTINENTAL SHELF

Contour values in metres



(a) Sea level curve calculated from oxygen isotope data



(b) Eustatic changes of sea level based on R.W. Fairbridge. The broken line shows the alternative interpretation of other workers.

Figure 4 Quaternary-Recent sea level changes
(a) after Anderton et. al. 1979 (b) after Sissons, 1967.

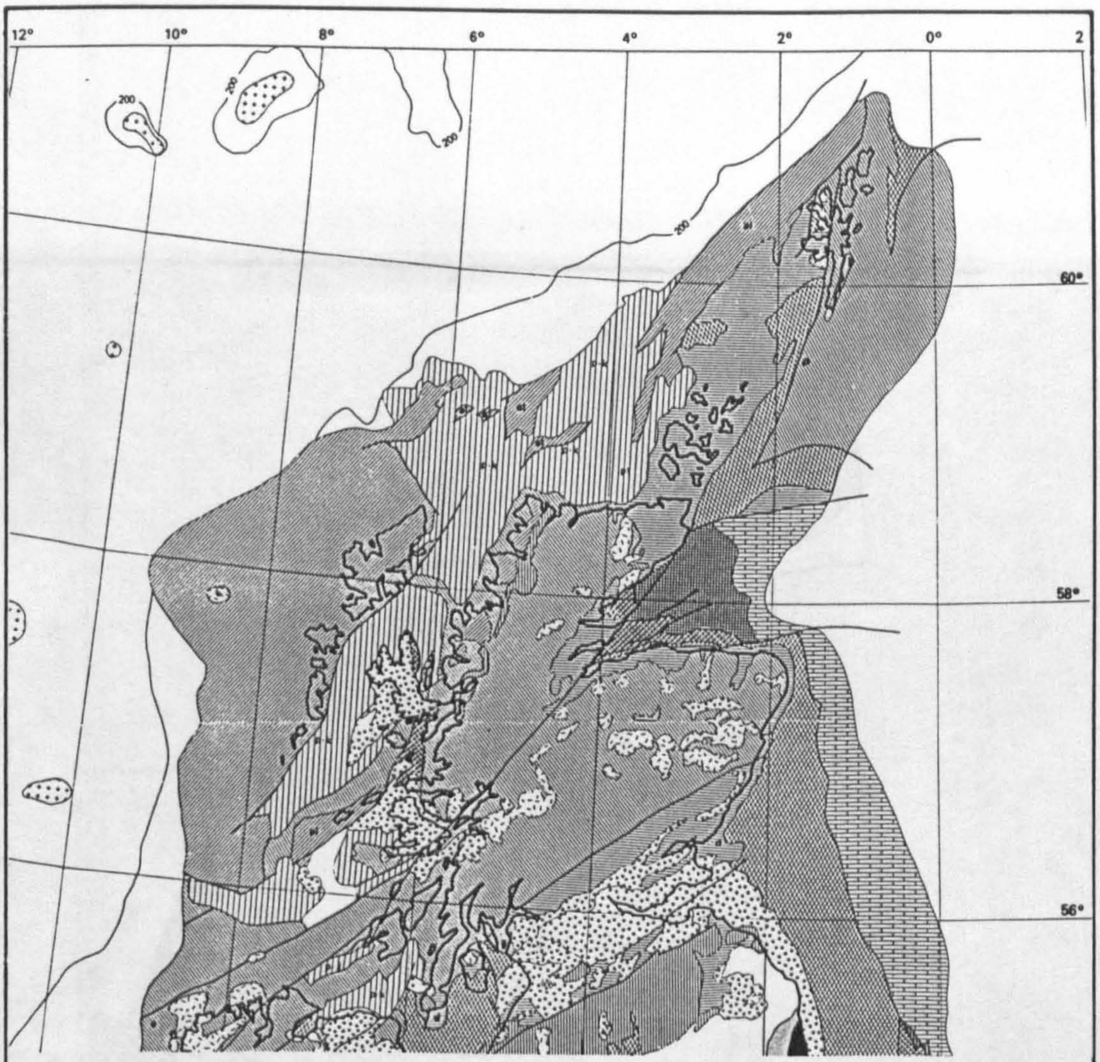
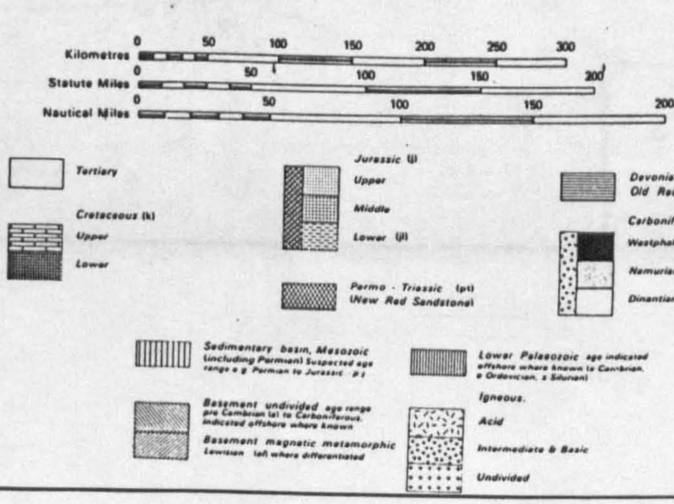


Figure 5

SUB-PLEISTOCENE GEOLOGY OF SCOTLAND AND THE ADJACENT CONTINENTAL SHELF

from Rhys and Ardus 1981



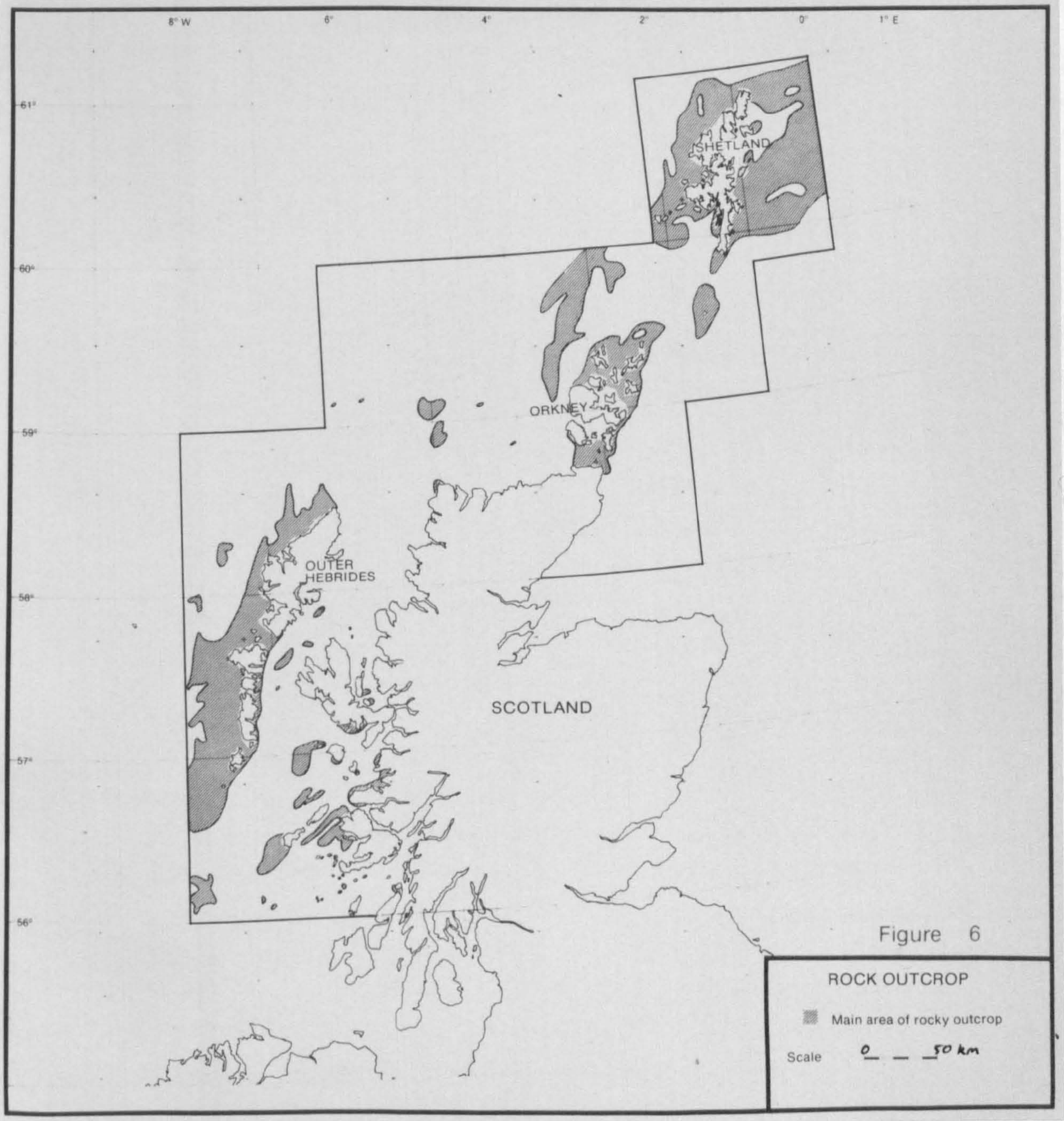

8° W
6°
4°
2°
0°
1° E
61°
60°
59°
58°
57°
56°
SHETLAND
ORKNEY
OUTER HEBRIDES
SCOTLAND
ROCK OUTCROP
▨ Main area of rocky outcrop
Scale 0 — 50 km

Figure 6

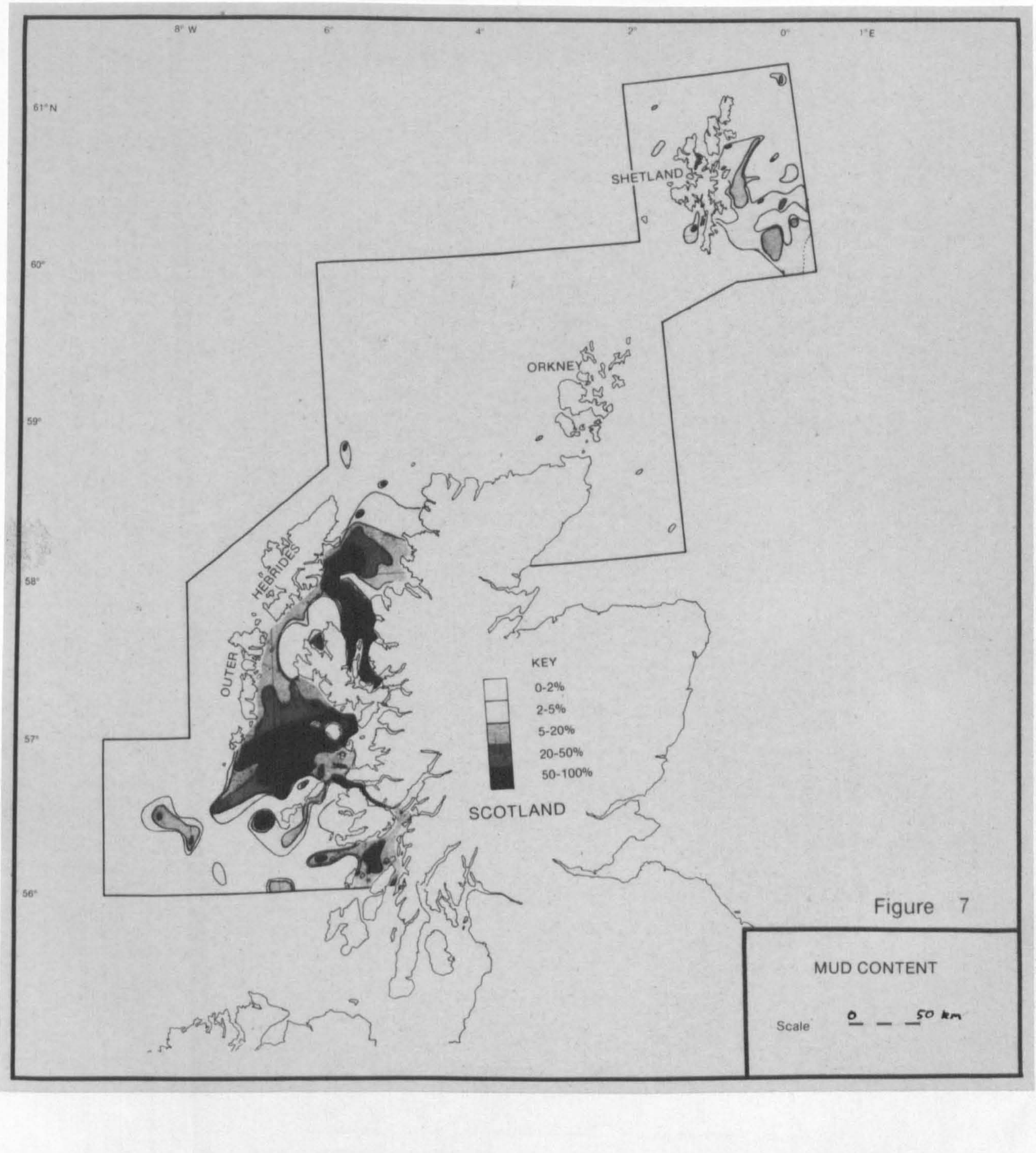


Figure 7

MUD CONTENT

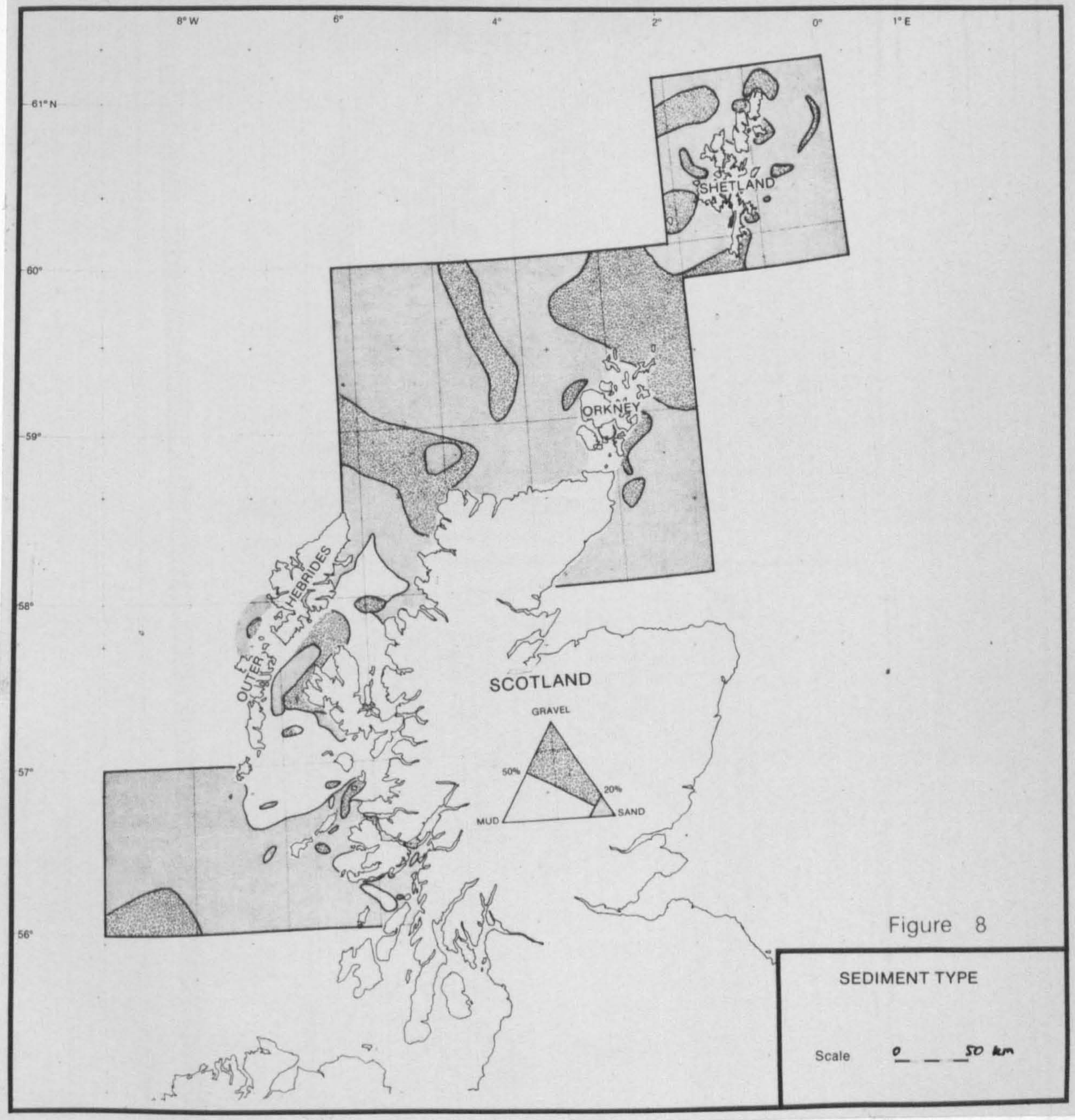
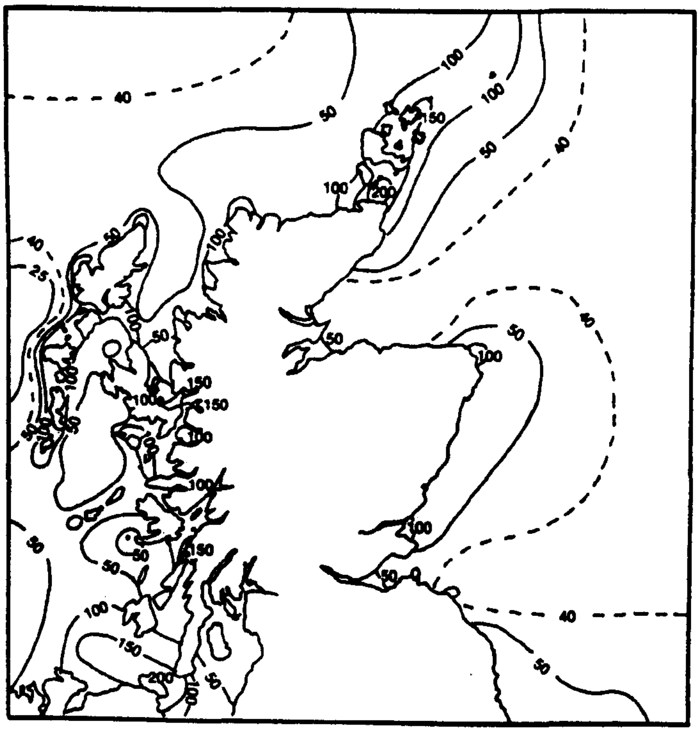


Figure 8

SEDIMENT TYPE



(a) TIDAL CURRENT STRENGTH (cm/sec)

(b) TIDAL RANGE (m)

Figure 9 Tides
after Lee and Ramster 1981

0 kms 100

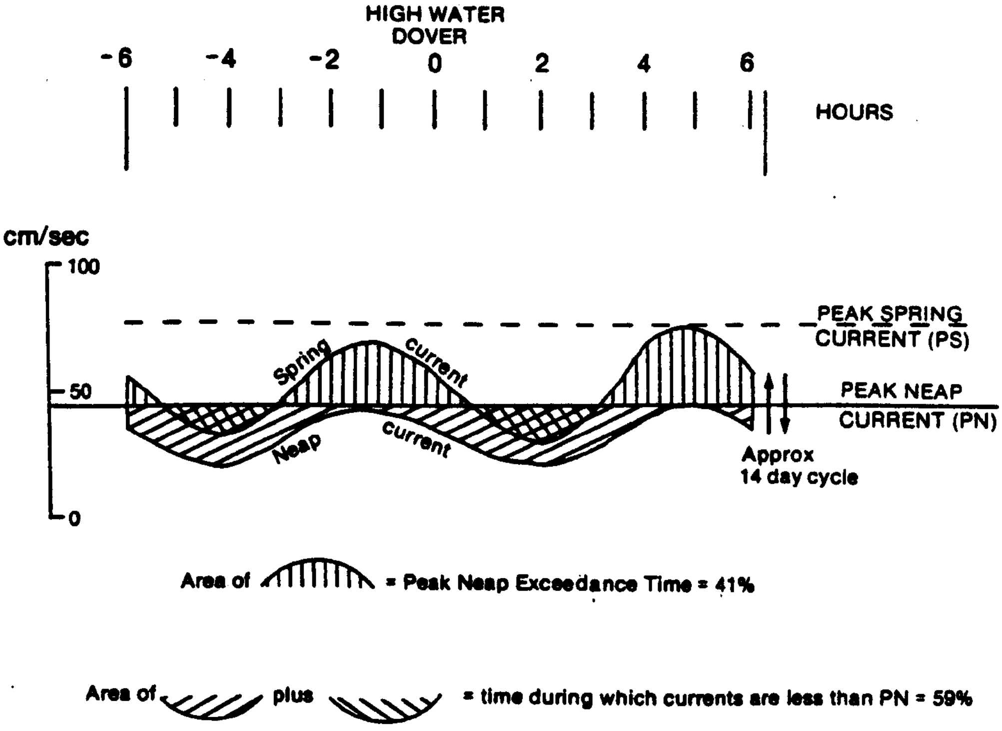


Figure 10 **Example of tidal current diagram showing variation of diurnal pattern over a neap - spring cycle and showing relationship of PNET.**

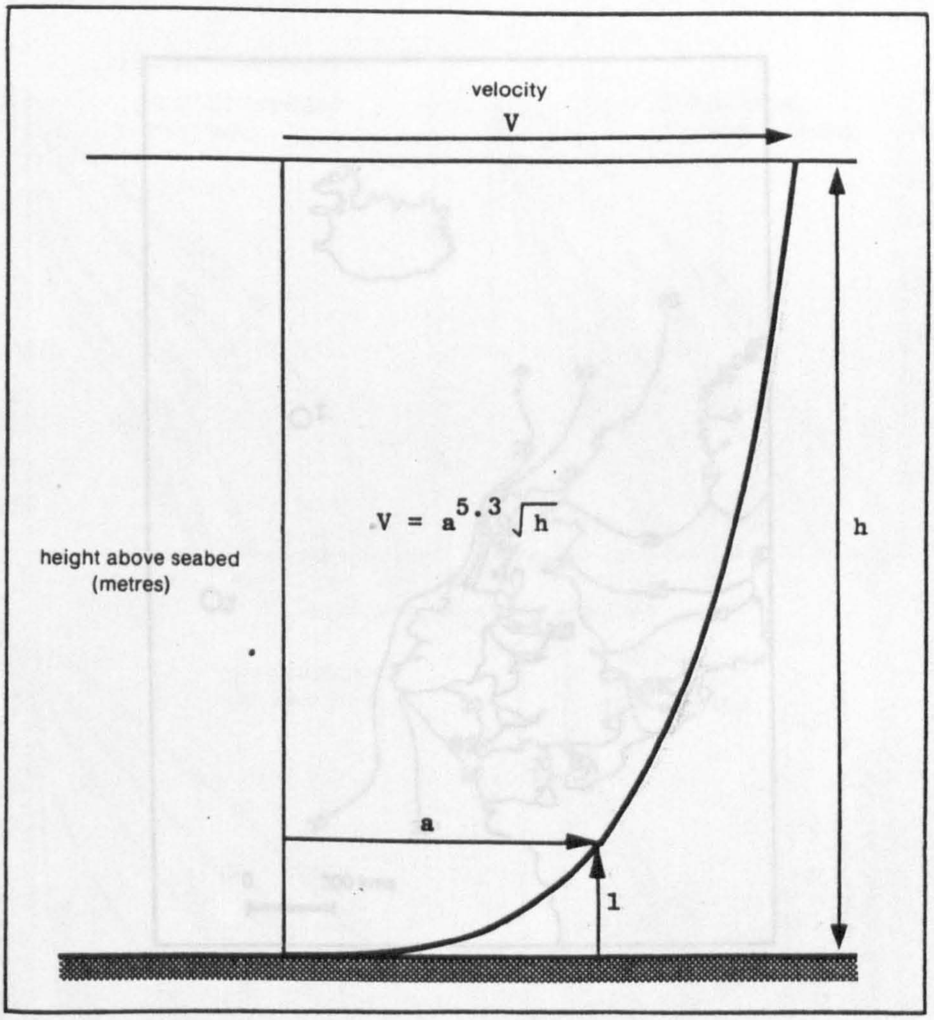


Figure 11 Parabolic current profile and the van Veen formula, after van Veen (1938)

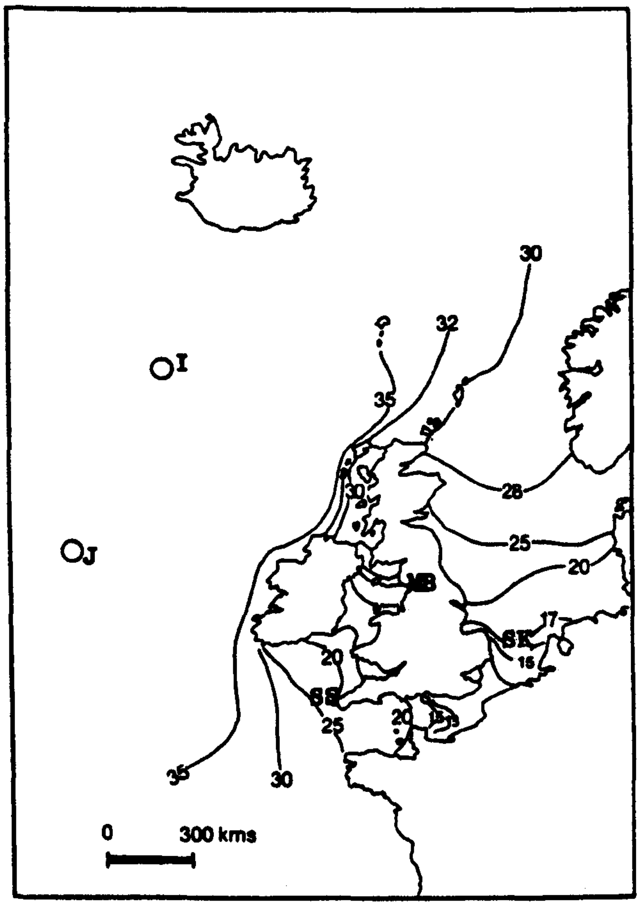


Figure 12 Extreme wave heights (for fully developed storms lasting 12 hours) in waters around the British Isles. Estimated values of crest to trough heights, in metres, of the highest waves likely to occur once in 50 years.

Letters represent wave recording stations used for Draper's (1967) bottom-current graphs (Fig.13): I, J- O.W.S. India, Juliett. SS - Sevenstones, MB - Morecambe Bay, SK - Smith's Knoll (after Draper, 1967)

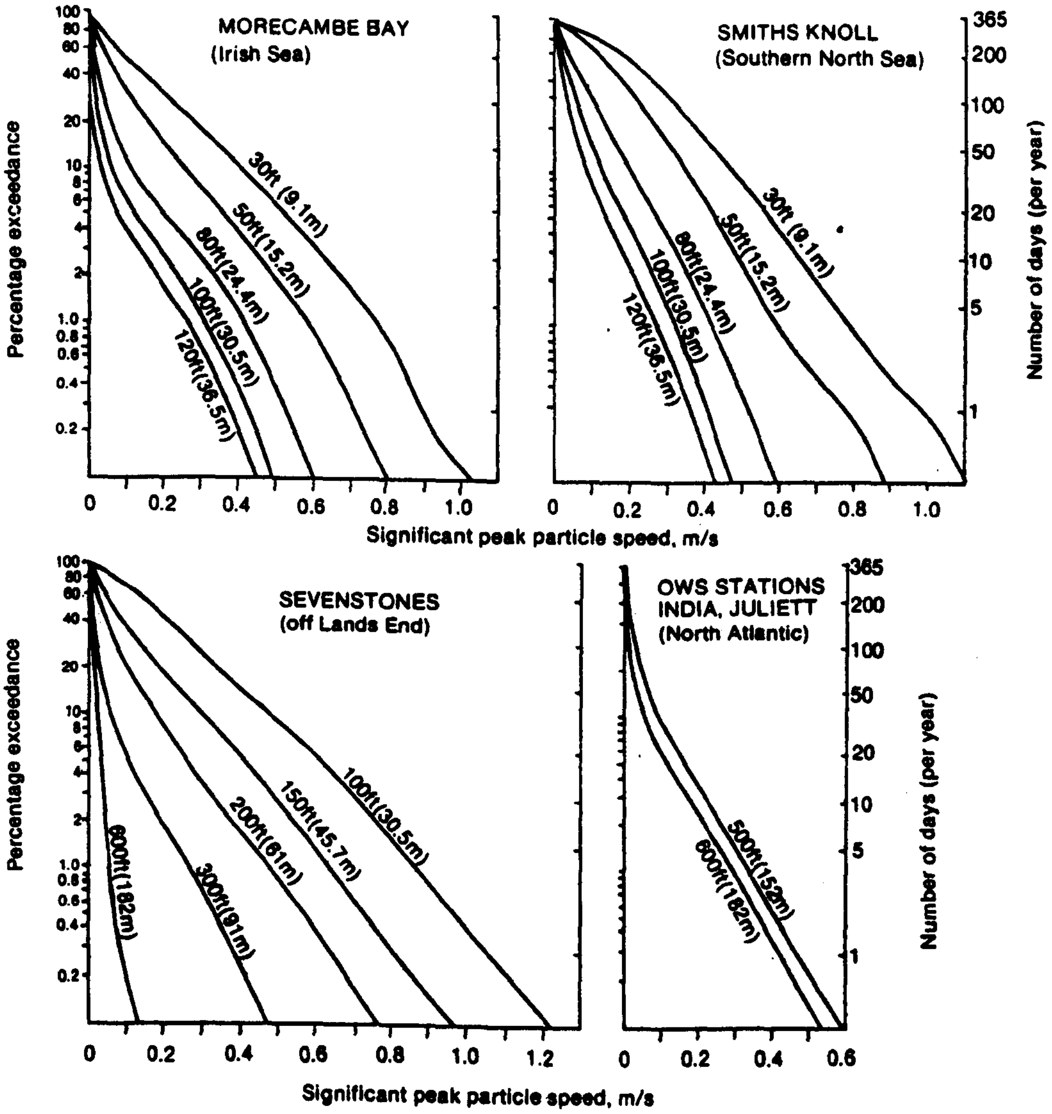


Figure 13 **Wave activity at the sea bed around the British Isles. The percentage of the time during which water particle speeds exceed any given value at certain depths. (The significant peak particle speed is the maximum speed which will be attained during the passage of each wave having a height equal to the significant height at the time). (after Draper 1967, 1980.)**

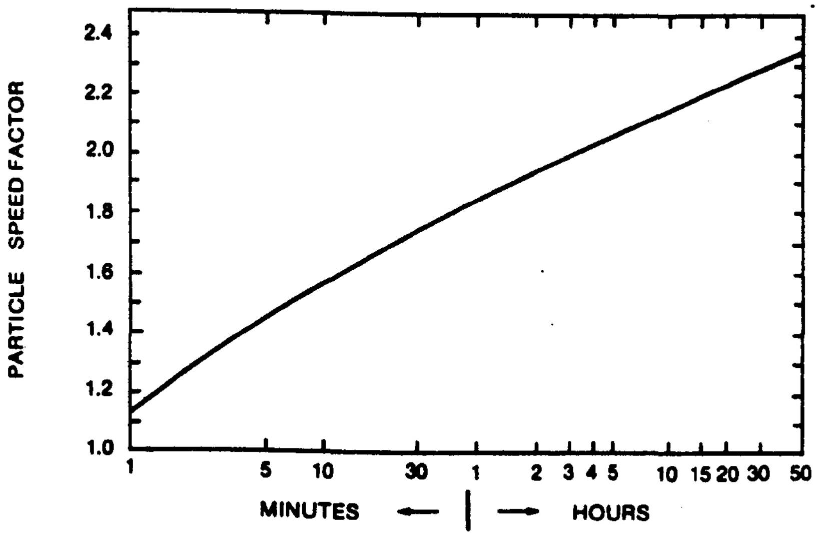


Figure 14 Particle speed factor. The ratio of the most probable value of maximum particle speed to the significant peak particle speed, as a function of time. To obtain the probable maximum value of particle speed in any particular situation, the value of significant peak speed obtained from Fig.13 must be multiplied by the relevant particle speed factor. (after Draper, 1967)

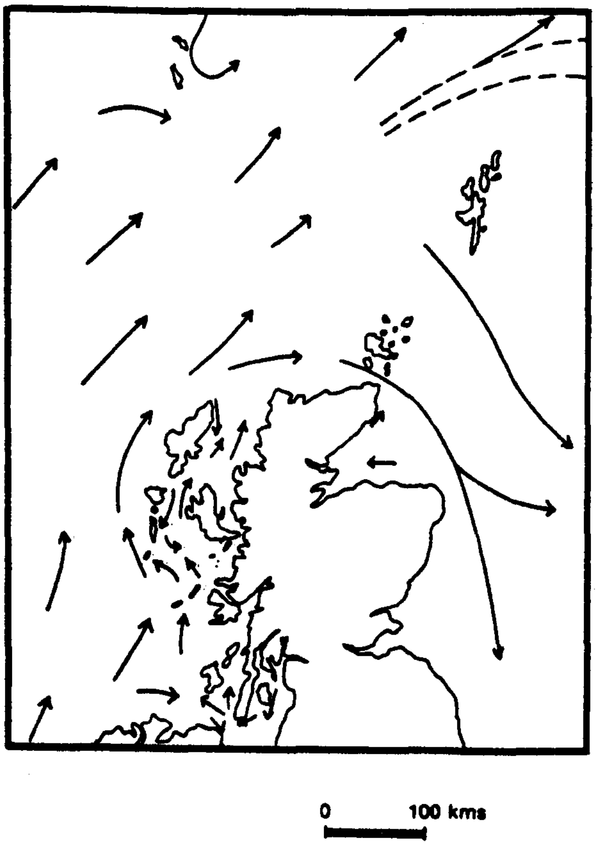


Figure 15 Net surface water movements (after Lee and Ramster 1981)

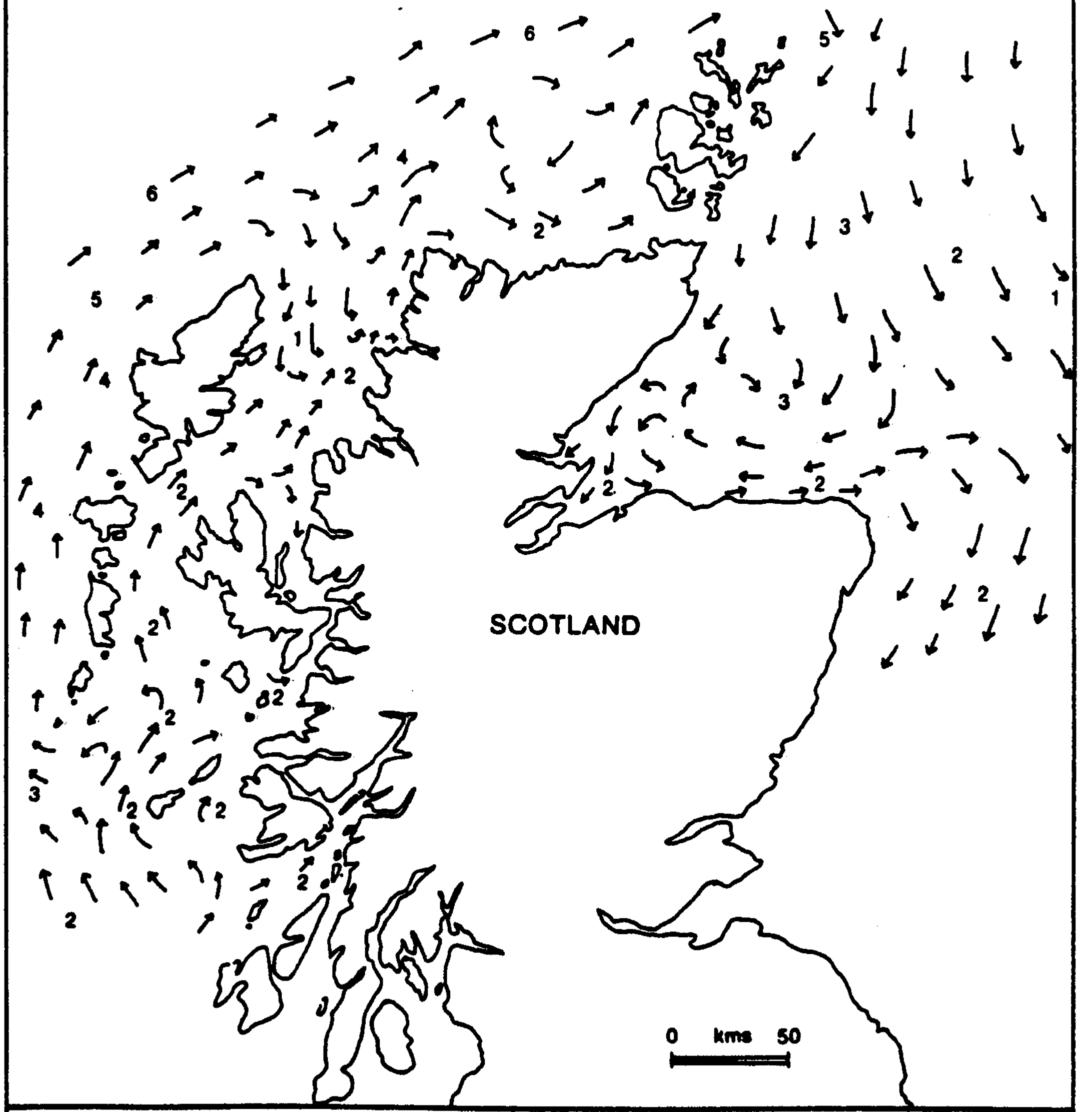


Figure 16 Estimated net water movements near the bottom. The figures indicate very approximate drift speeds in kilometers per day. (from Craig 1959)

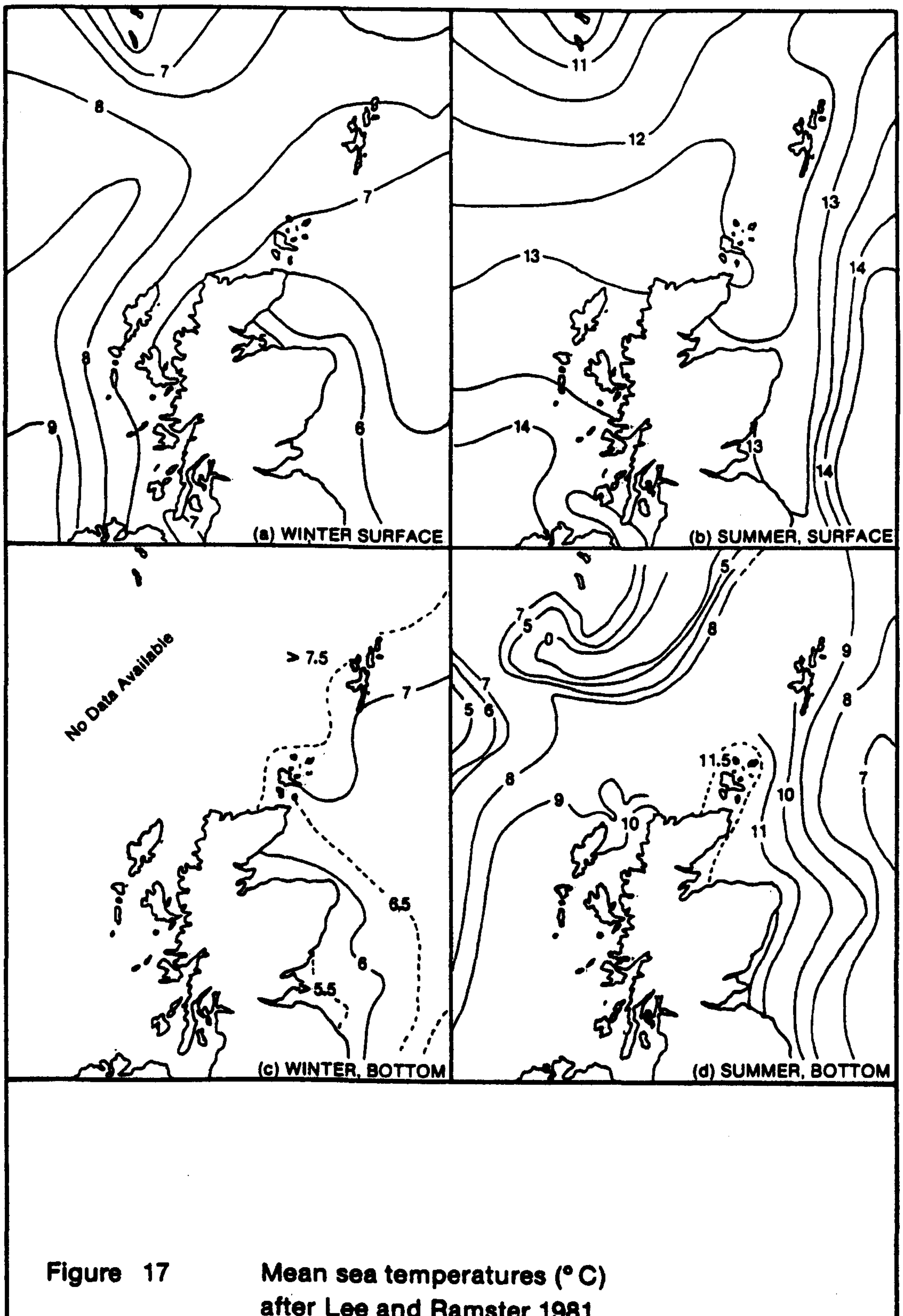
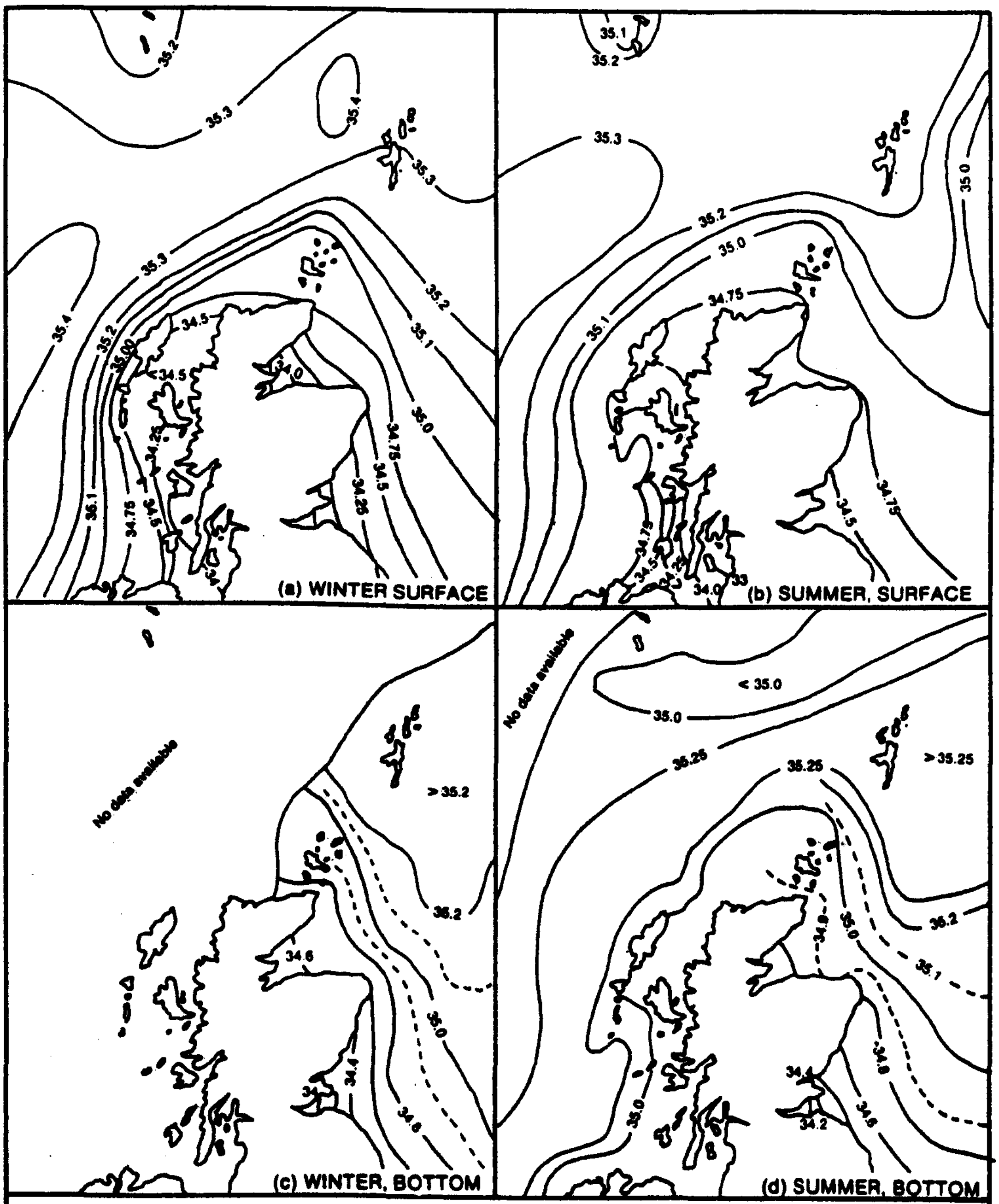


Figure 17 Mean sea temperatures (° C) after Lee and Ramster 1981



(a) WINTER SURFACE

(b) SUMMER, SURFACE

(c) WINTER, BOTTOM

(d) SUMMER, BOTTOM

Figure 18 Mean sea salinities (‰), after Lee and Ramster 1981

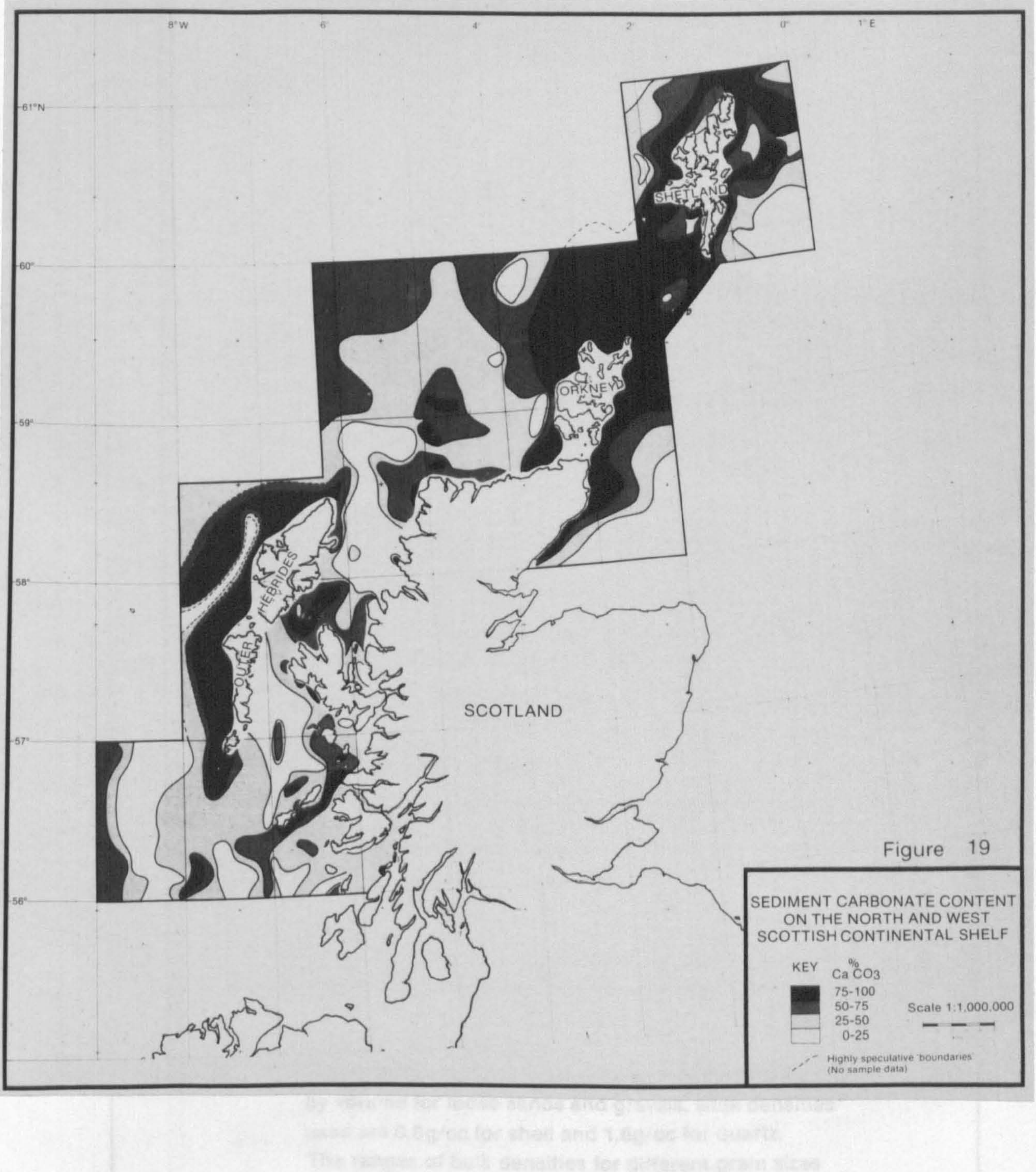
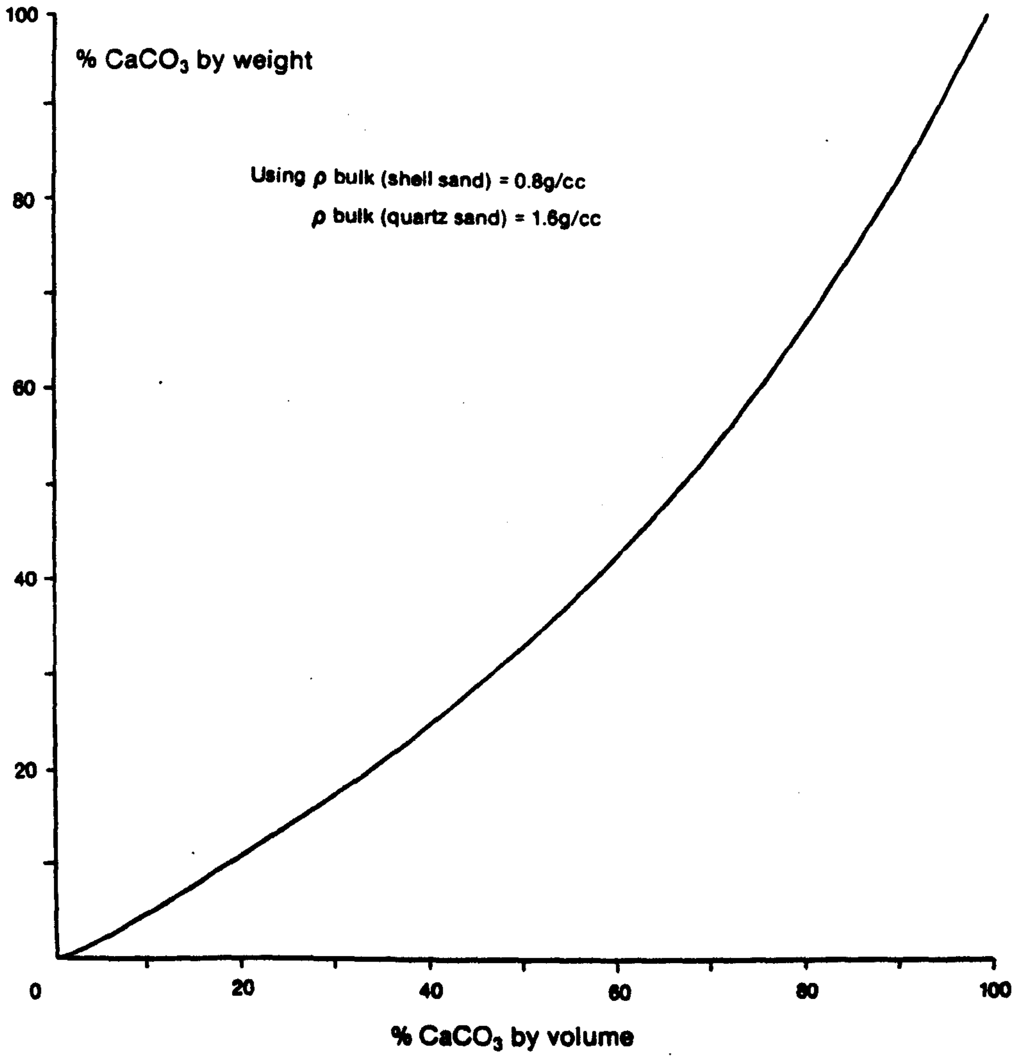


Figure 19

SEDIMENT CARBONATE CONTENT ON THE NORTH AND WEST SCOTTISH CONTINENTAL SHELF



Experimentaly determined bulk densities (ρ bulk)

GRAIN SIZE (mm)	ρ BULK (SHELL)	ρ BULK (QUARTZ)
0.5-1.0	1.0	1.6
1.0-2.0	0.8	1.6
2.0-4.0	0.7	1.5

Figure 20 Conversion graph for % Ca CO$_3$ by weight to % Ca CO$_3$ by volume for loose sands and gravels. Bulk densities used are 0.8g/cc for shell and 1.6g/cc for quartz. The ranges of bulk densities for different grain sizes are also shown.

Figure 21 Typical Inner Hebridean carbonate, rich in bivalve and barnacle debris. Rubha Nan Clach deposit (see Fig. 32a).

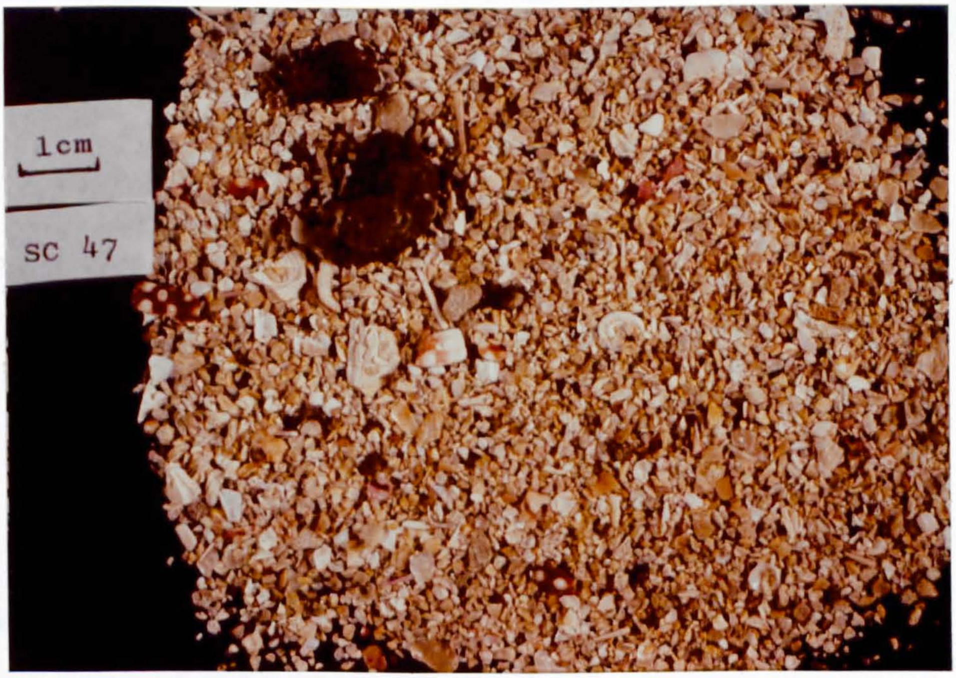


Figure 22 Typical West Hebridean Platform carbonate (see Fig.44), containing bivalve, barnacle, echinoid, gastropod, serpulid and bryozoan debris.

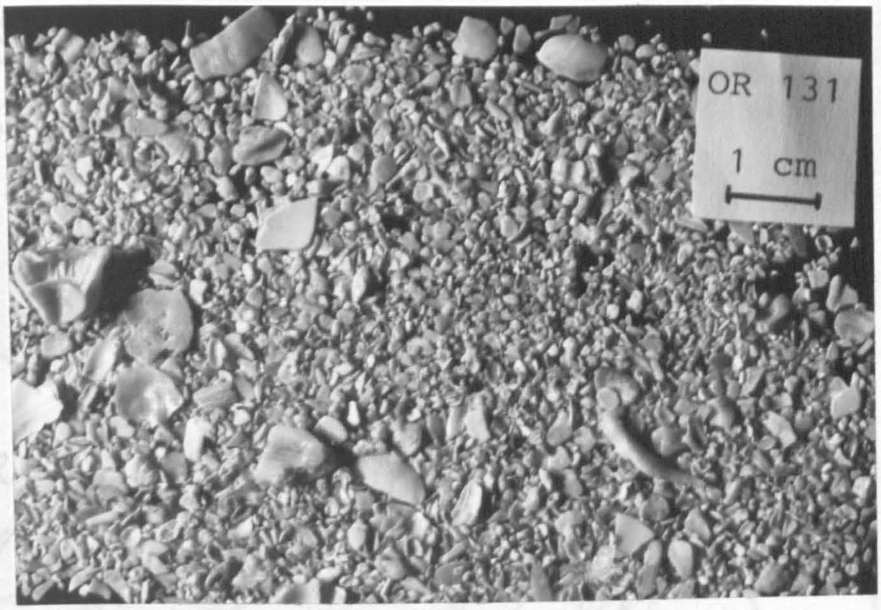


Figure 23 Typical Orkney sandbank carbonate containing well rounded, polished debris, mainly bivalve, barnacle and serpulid. North Ronaldsay north bank, North Orkney deposit (see Fig. 52a).

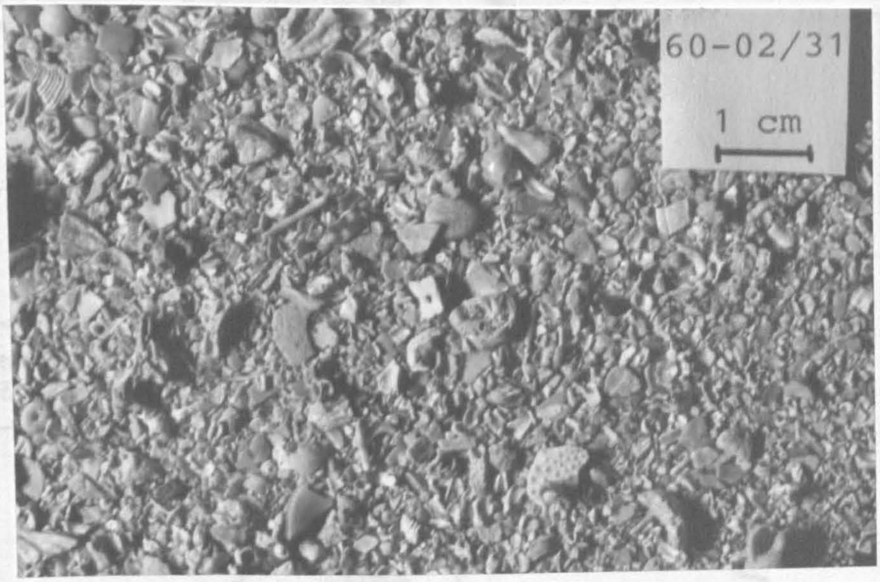
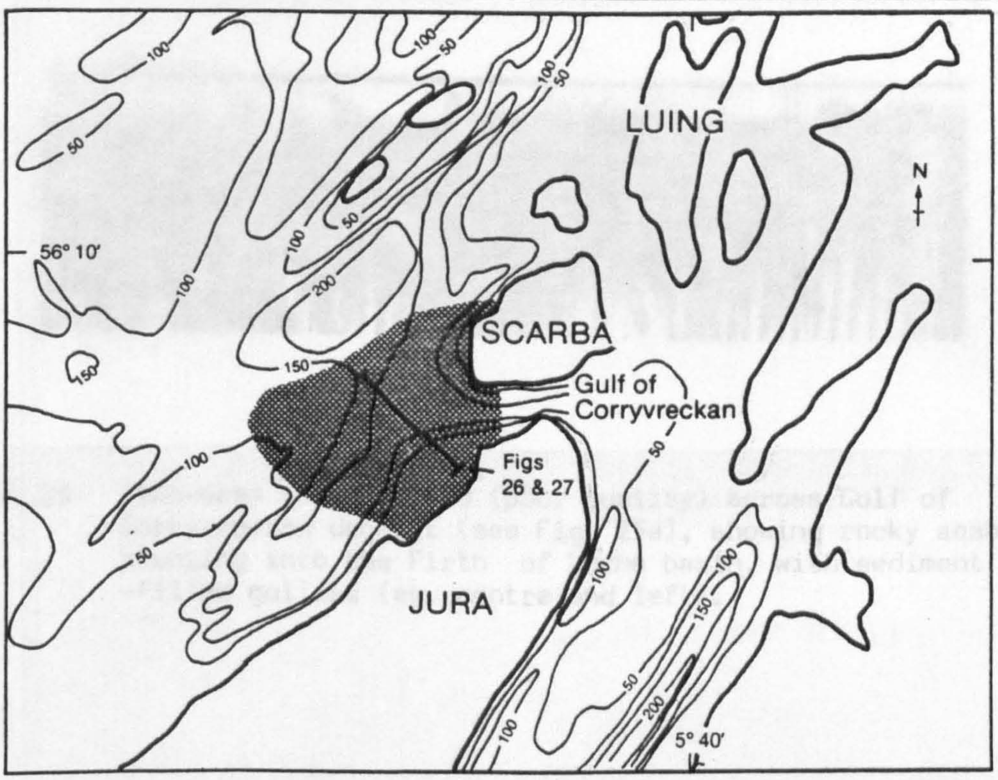
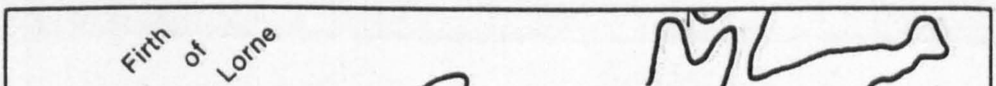


Figure 24 Typical West Shetland carbonate (see Fig. 83a), rich in bivalve, barnacle, and serpulid debris along with echinoid and bryozoan material.



(a) LOCATION AND BATHYMETRY
Contour values in metres below mean sea level.

▨ Area of Carbonate deposit ($>75\%$ $CaCO_3$)



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH
↔ Predominant tidal current direction

Figure 25 Gulf of Corryvreckan Deposit
Location and Physical Conditions

Scale 1:250,000
0 kms 5

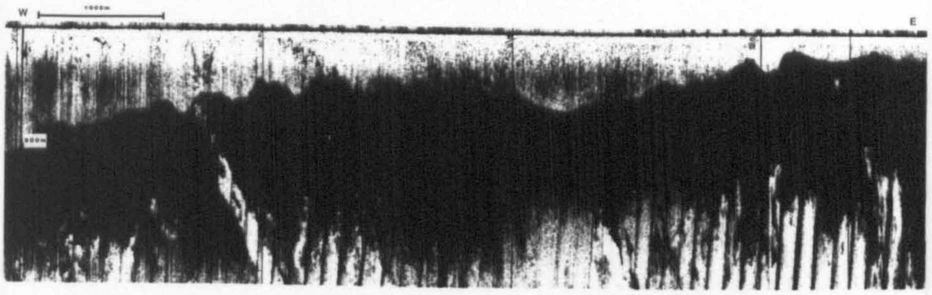


Figure 26 Side-scan sonar record (poor quality) across Gulf of Corryvreckan deposit (see Fig. 25a), showing rocky seabed plunging into the Firth of Lorne basin, with sediment-filled gullies (eg. centre and left).

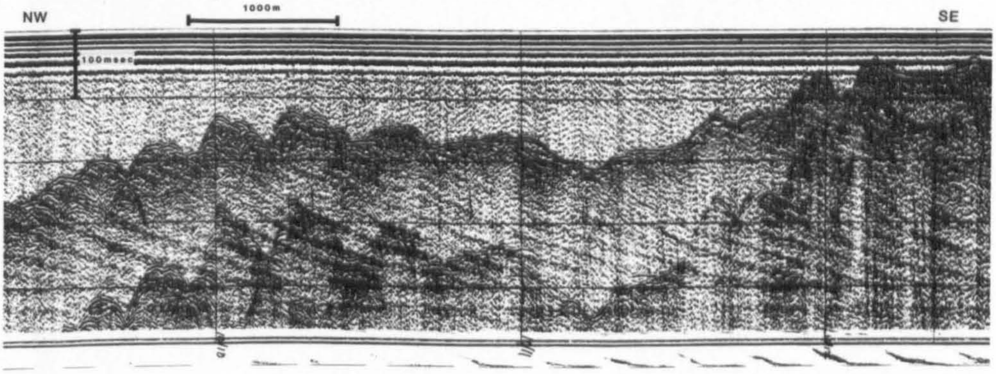


Figure 27 Sparker line across Gulf of Corryvreckan deposit (see Fig. 25a), showing rockhead generally very close to the seabed so that sediment cover must be very thin.

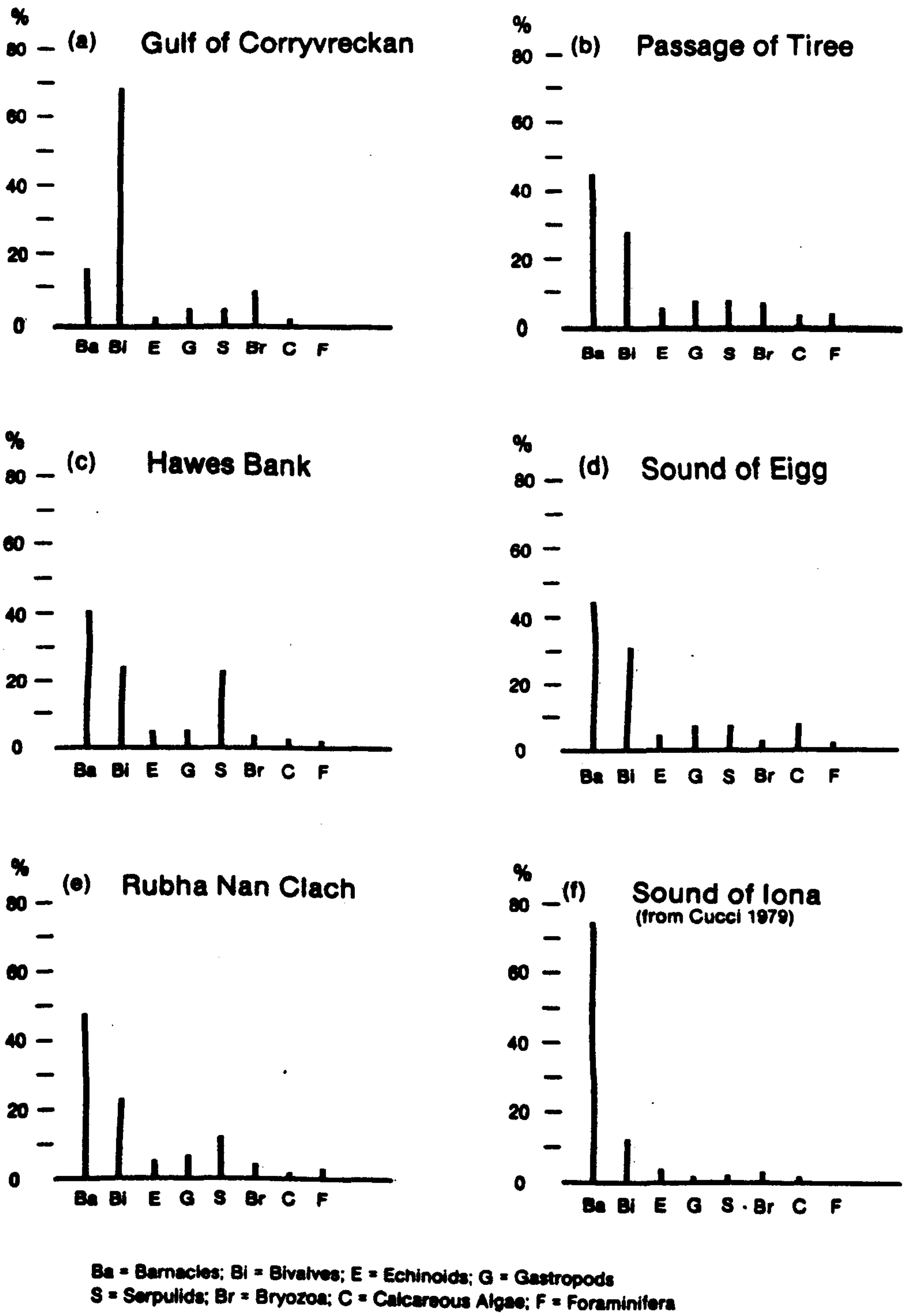
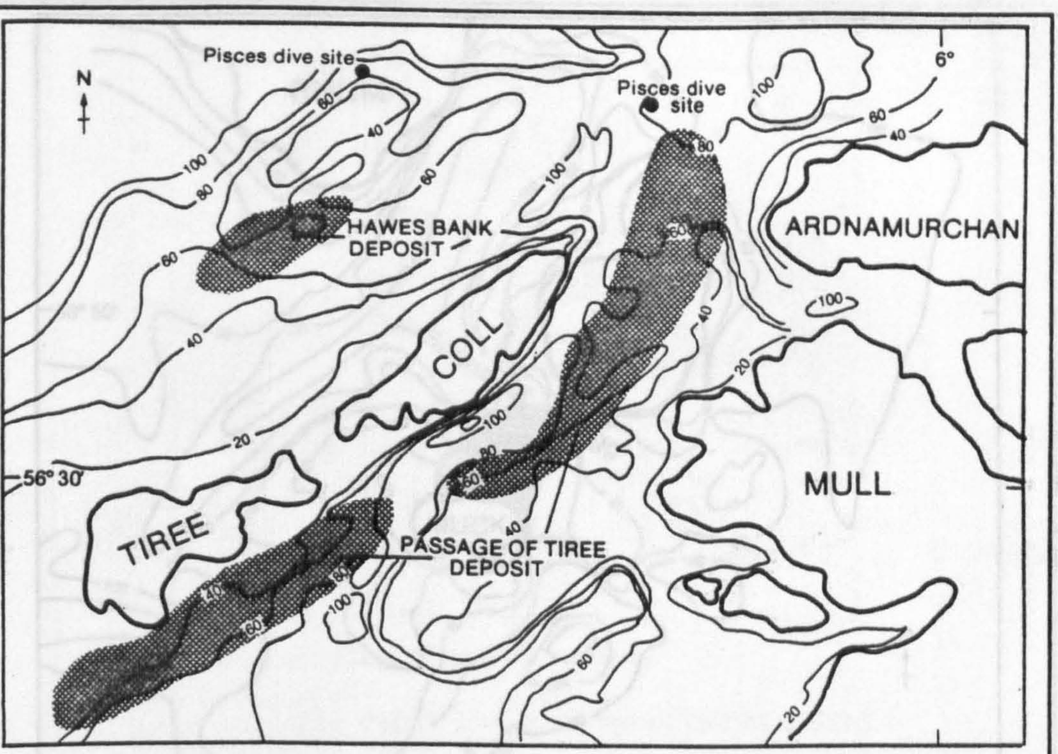
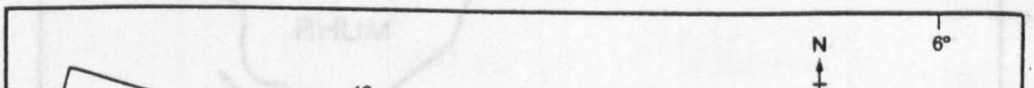


Figure 28 Biogenic composition of Inner Hebridean carbonates



(a) LOCATION AND BATHYMETRY
Contour values in metres below mean sea level.

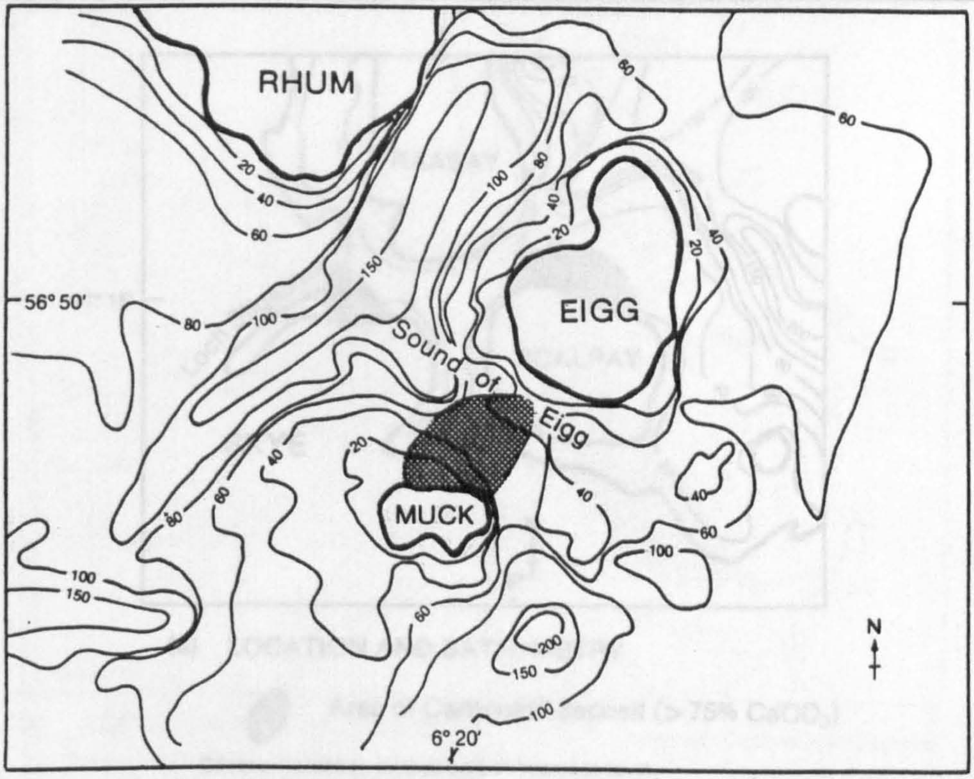
▨ Area of Carbonate deposit ($>75\%$ $CaCO_3$)



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH
↔ Predominant tidal current direction

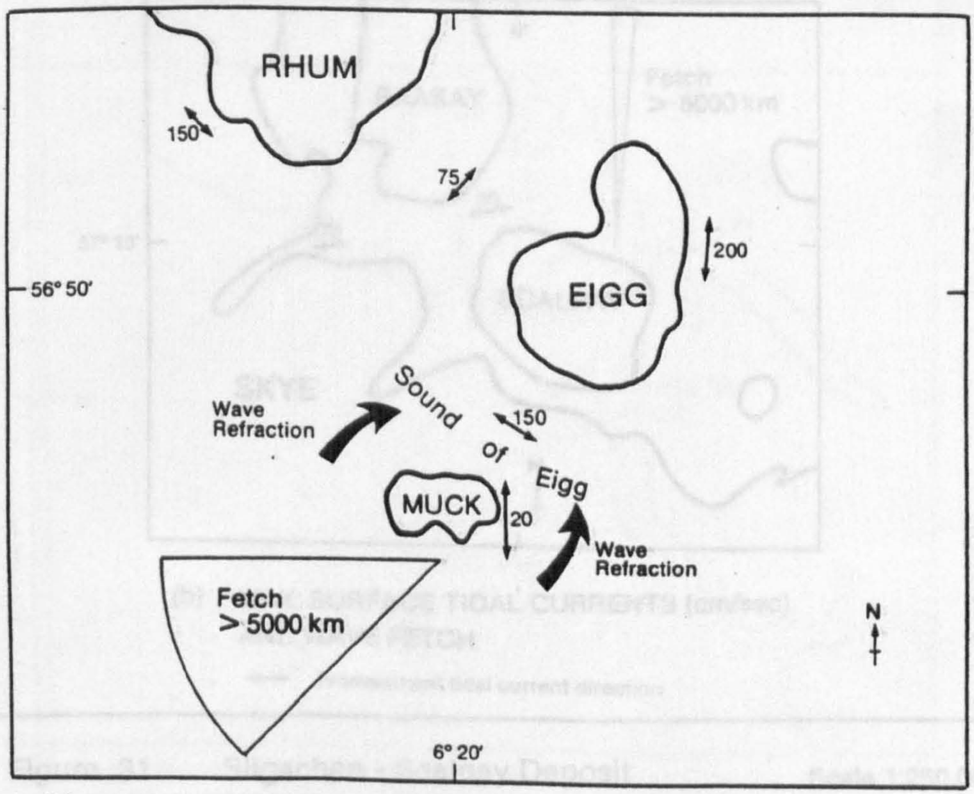
Figure 29 Passage of Tiree and Hawes Bank Deposits Location and Physical Conditions

Scale 1:500,000
0 kms 10



(a) LOCATION AND BATHYMETRY
Contour values in metres below mean sea level.

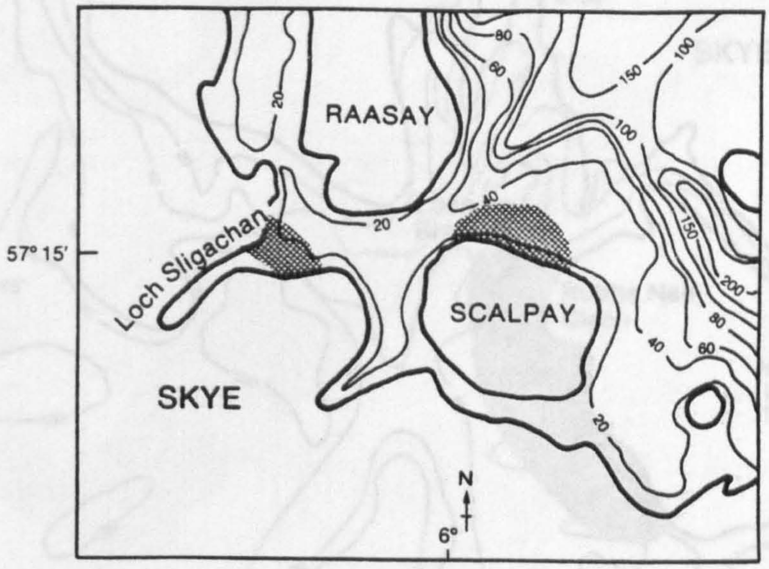
● Area of Carbonate deposit ($>75\%$ $CaCO_3$)



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH
↔ Predominant tidal current direction

Figure 30 Sound of Eigg Deposit
Location and Physical Conditions

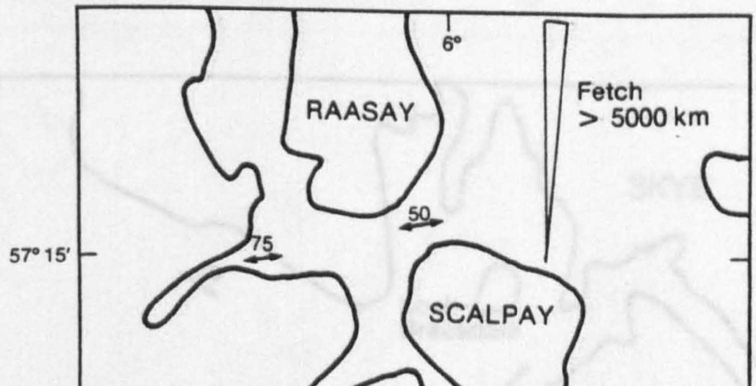
Scale 1:250,000
0 kms 5



(a) LOCATION AND BATHYMETRY

▨ Area of Carbonate deposit ($> 75\%$ $CaCO_3$)

Contour values in metres below mean sea level.



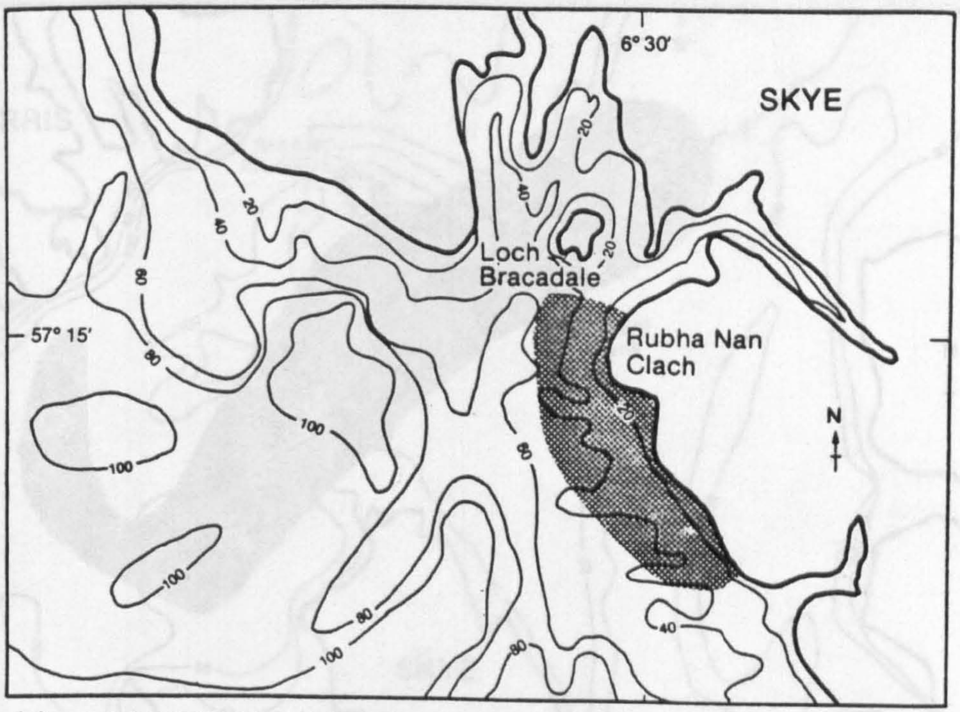
(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH

↔ Predominant tidal current direction

Figure 31 Sligachan - Scalpay Deposit Location and Physical Conditions

Scale 1:250,000

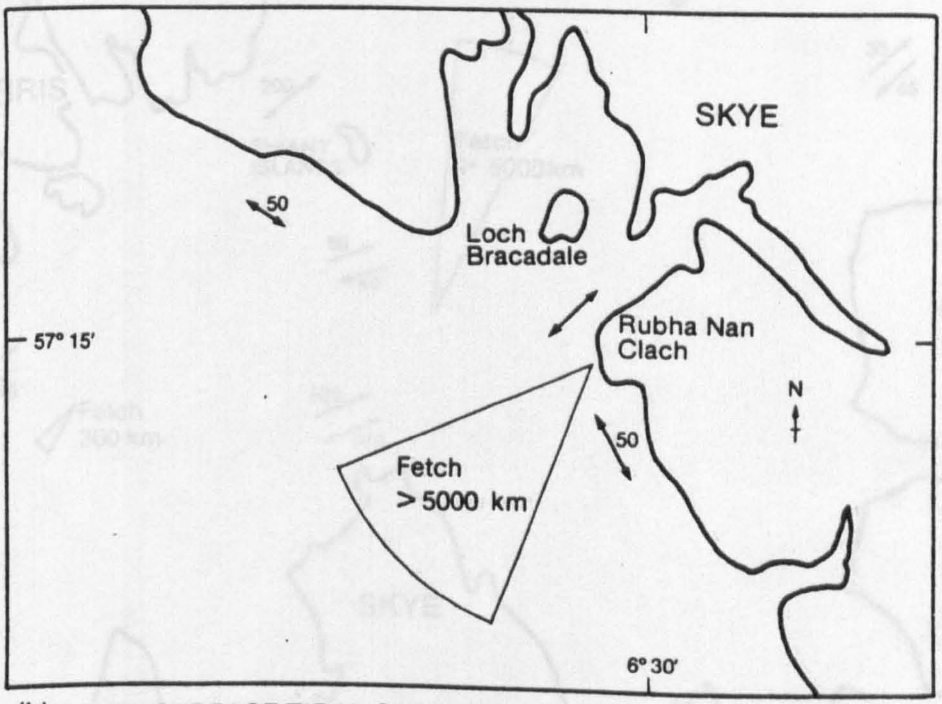
0 kms 5



(a) LOCATION AND BATHYMETRY

Contour values in metres below mean sea level.

▨ Area of Carbonate deposit ($>75\%\ CaCO_3$)



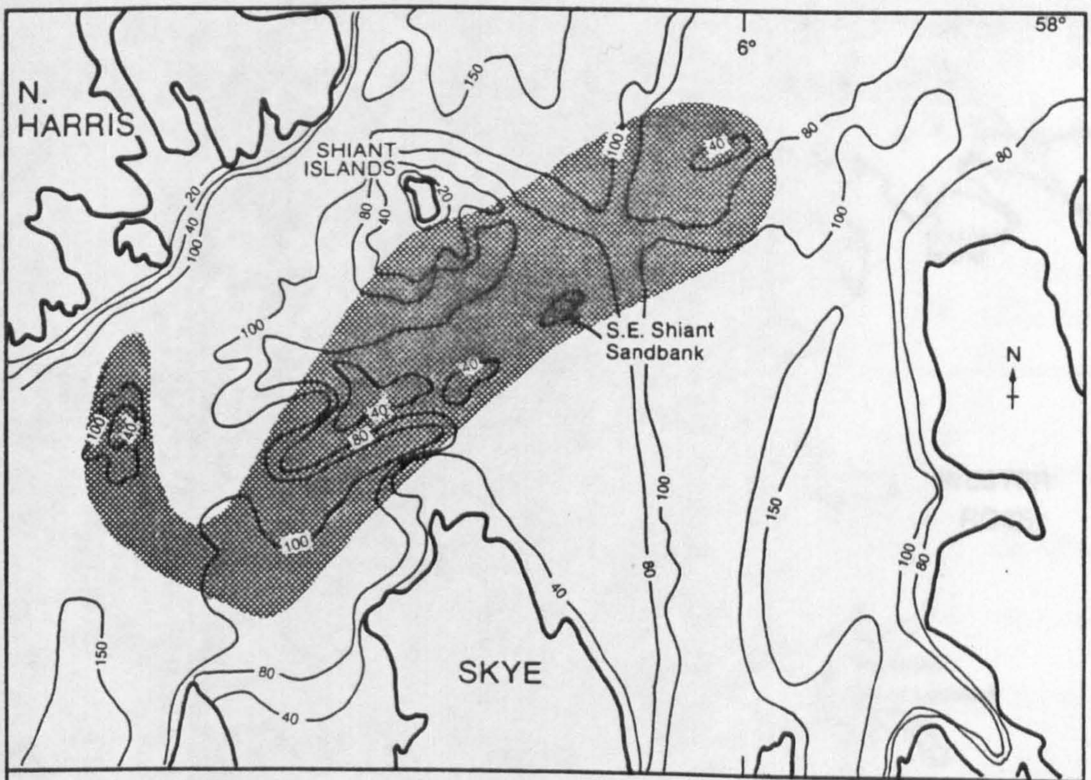
(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH

↔ Predominant tidal current direction

Figure 32 Rubha Nan Clach Deposit Location and Physical Conditions

Scale 1:250,000

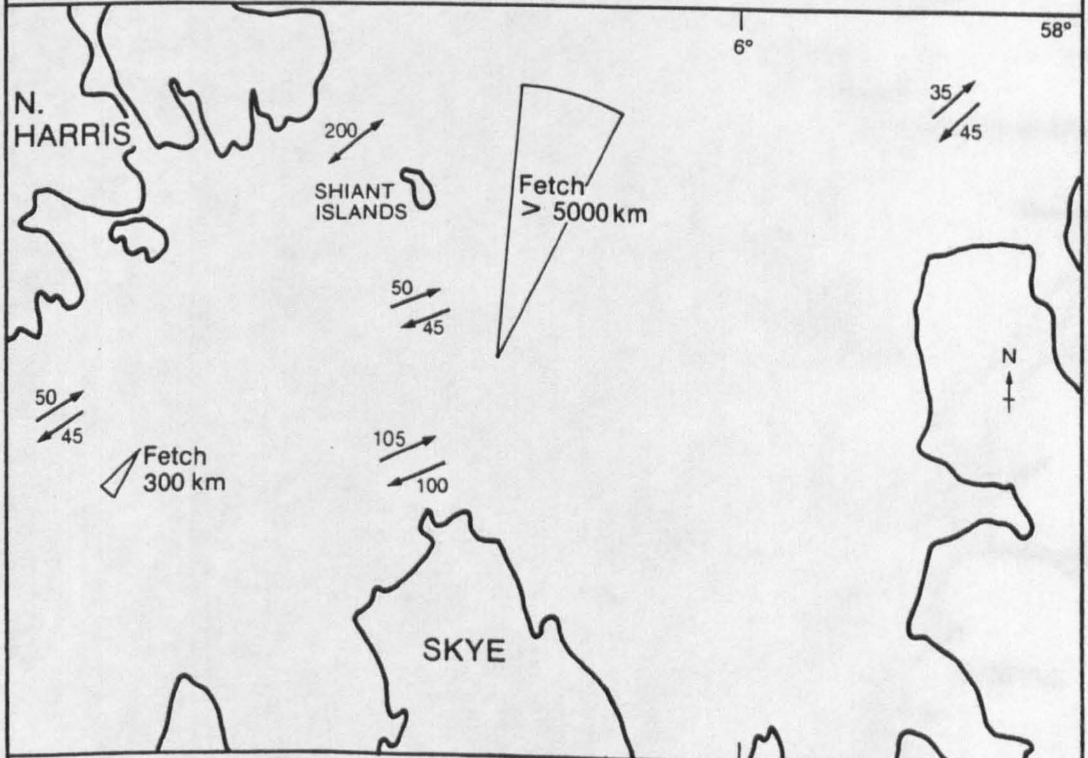
0 kms 5



(a) LOCATION AND BATHYMETRY

Contour values in metres below mean sea level.

▨ Area of Carbonate deposit ($>75\%$ $CaCO_3$)



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH

↔ Predominant tidal current direction

Figure 33 Shiant Deposit

Location and Physical Conditions

Scale 1:500,000

0 kms 10

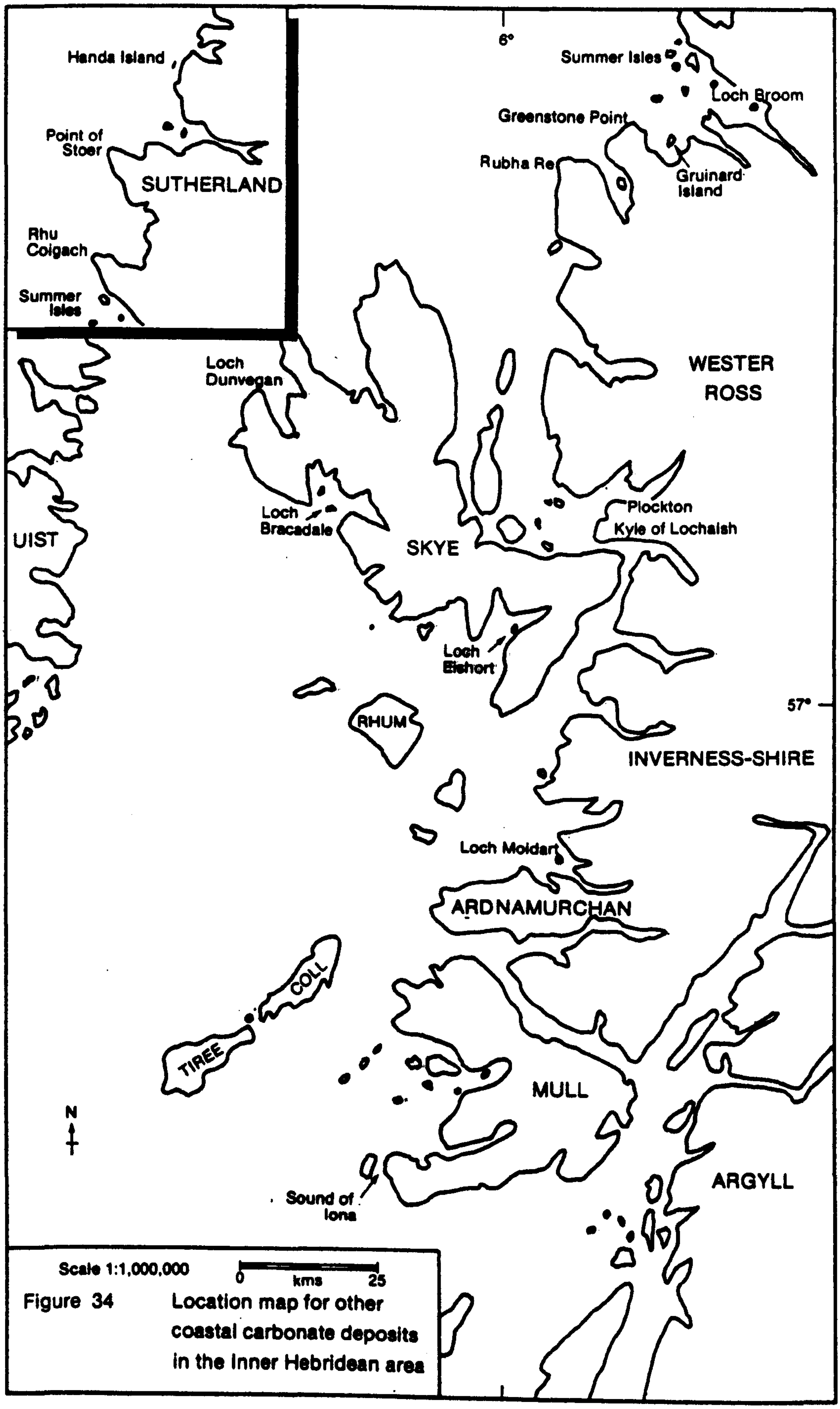


Figure 34 Location map for other coastal carbonate deposits in the Inner Hebridean area

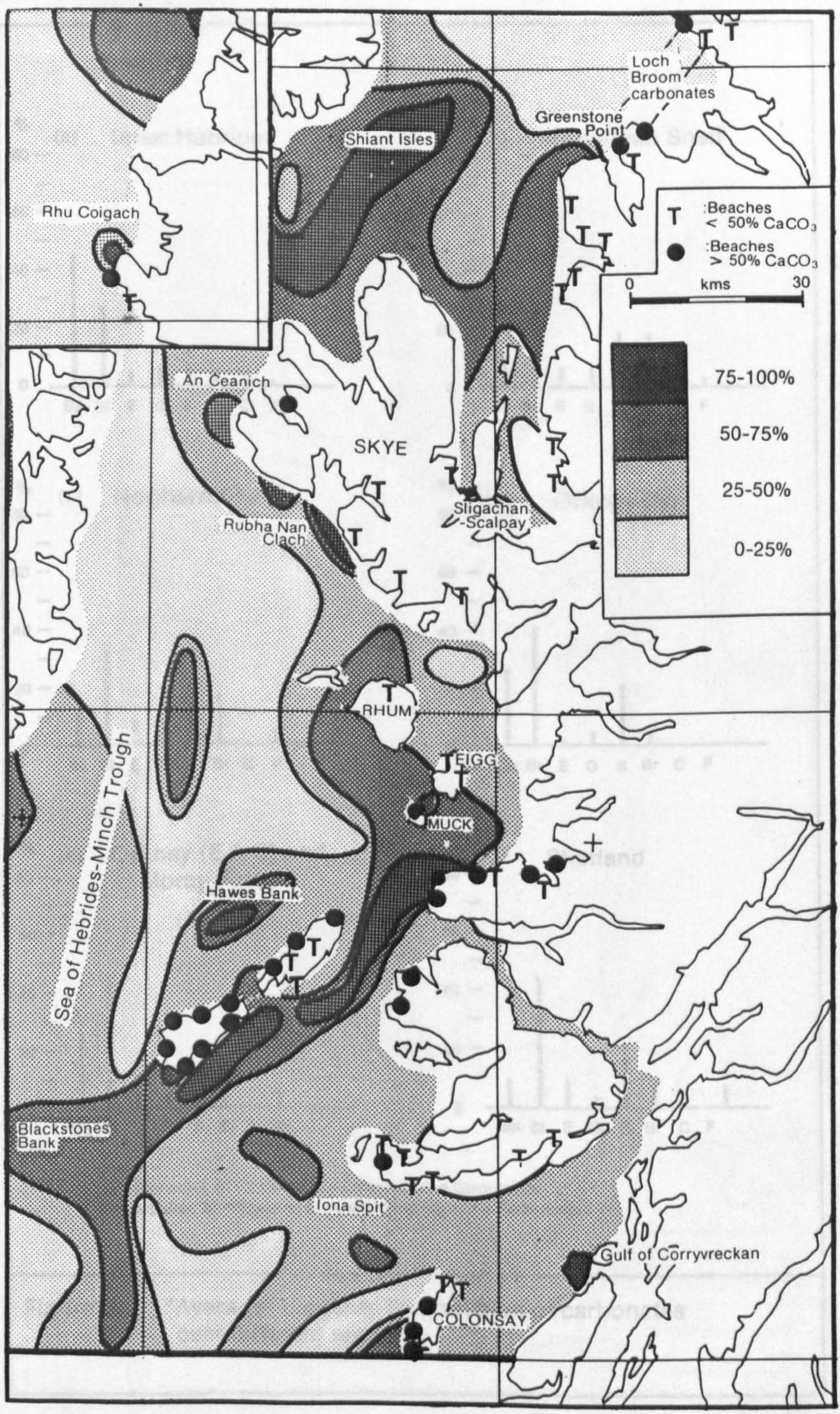


Figure 35 Carbonate content of Inner Hebridean Sediments including beaches (See Table 1 for beach references)

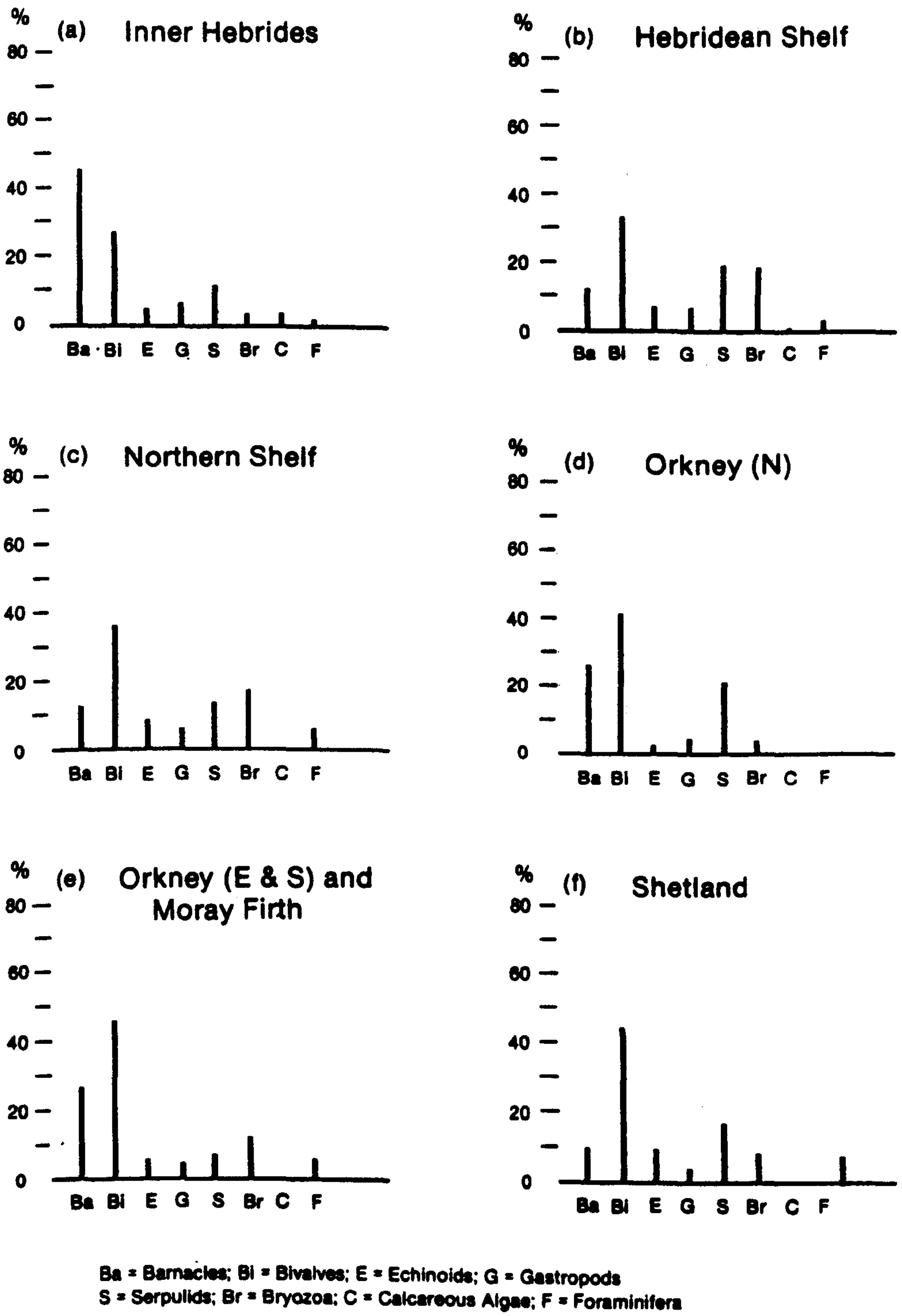


Figure 36 "Average" biogenic composition of carbonates over different regions

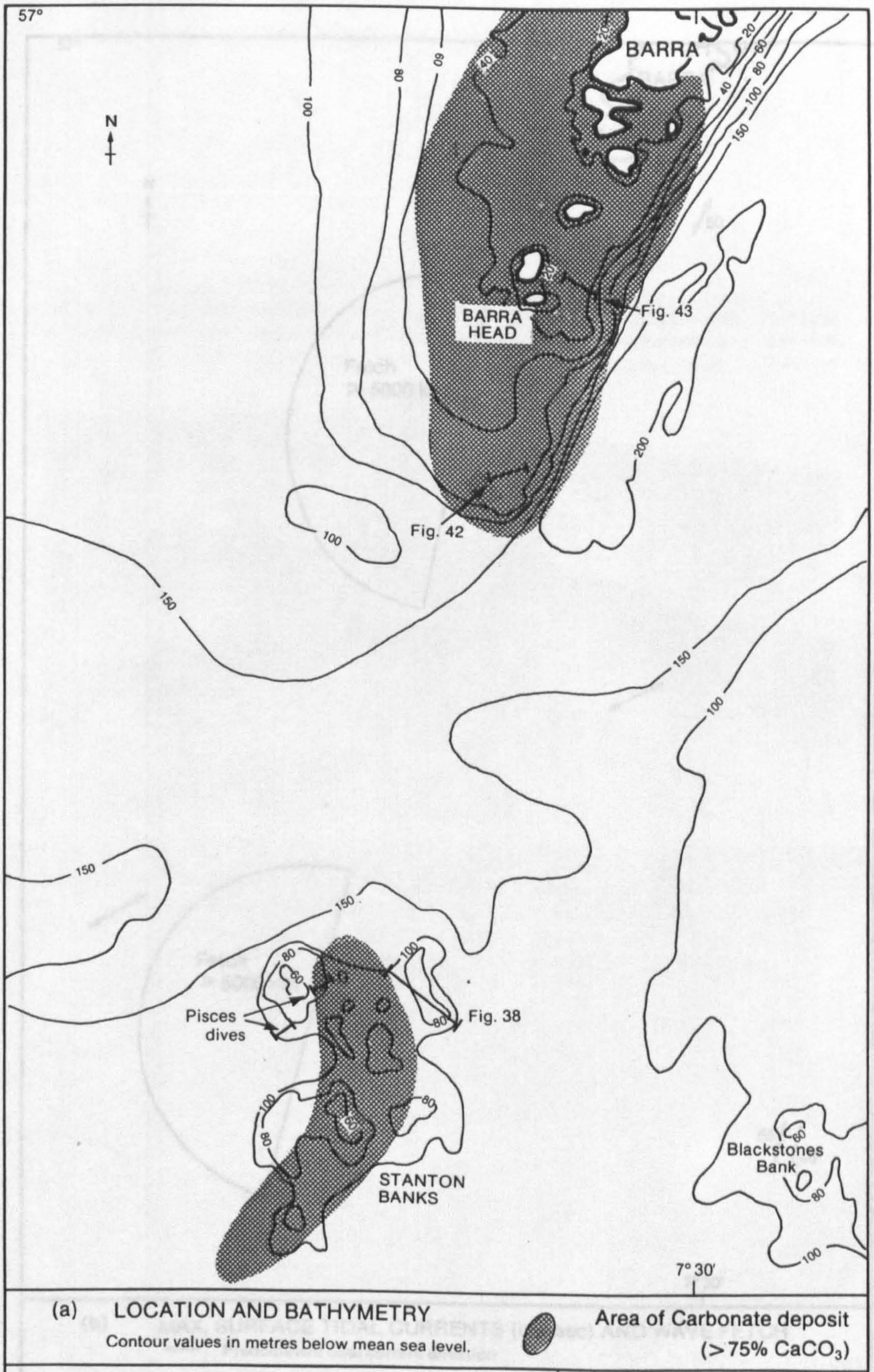


Figure 37a Stanton Banks and Barra Head Deposits

Scale 1:500,000

0 kms 10

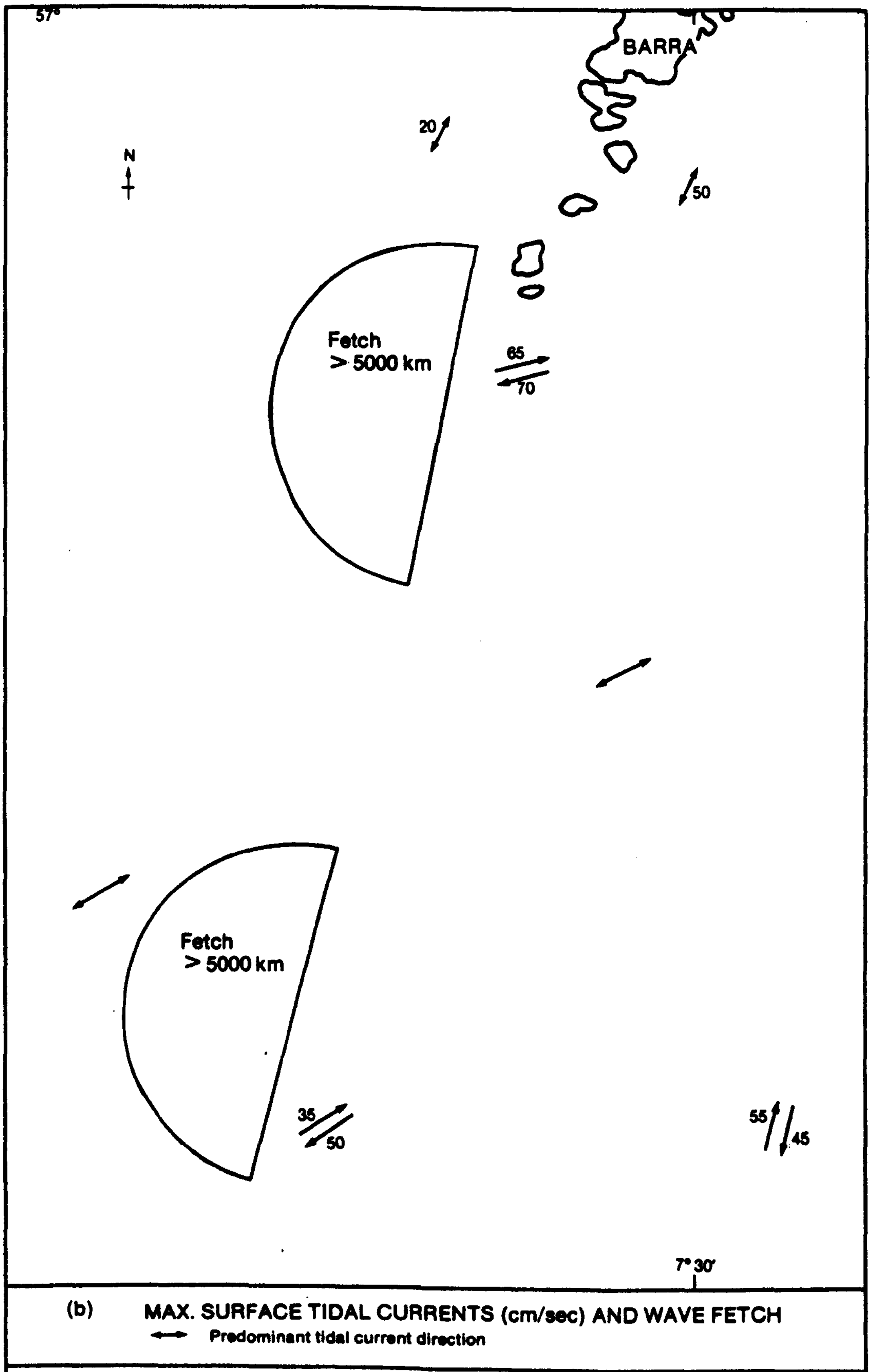


Figure 37b Stanton Banks and Barra Head Deposits

Scale 1:500,000
0 kms 10

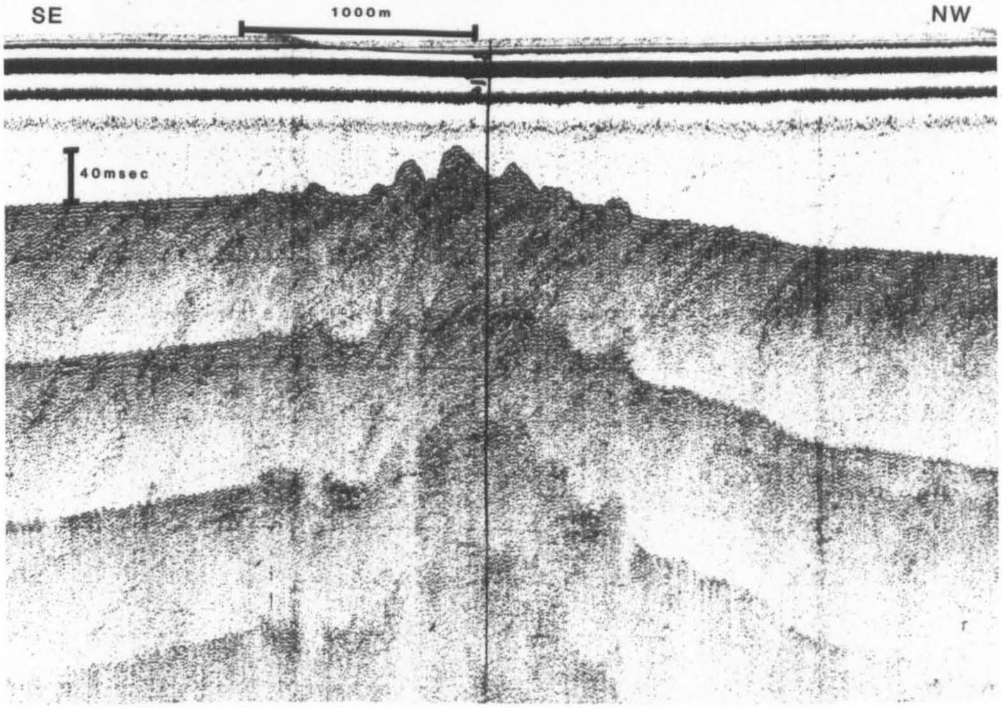


Figure 38 Sparker line across Stanton Banks (see Fig. 37a) showing rockhead emerging from superficial sediment cover. The carbonates form a veneer over the shoal and down its flanks, but are too thin to resolve.

Figure 39 Underwater photograph taken from Pisces on Stanton Banks (see Fig.37a) showing boulder-strewn seabed, typically encrusted with carbonate secreting organisms and heavily populated by ophiuroids. Pure carbonate can be seen filling the crevices between the rocks. Field of view approx. 1m.

Figure 40 Underwater photograph taken from Pisces on Stanton Banks (see Fig. 37a) showing starved wave-generated carbonate megaripple with a wavelength of about 1m. Depth 77m

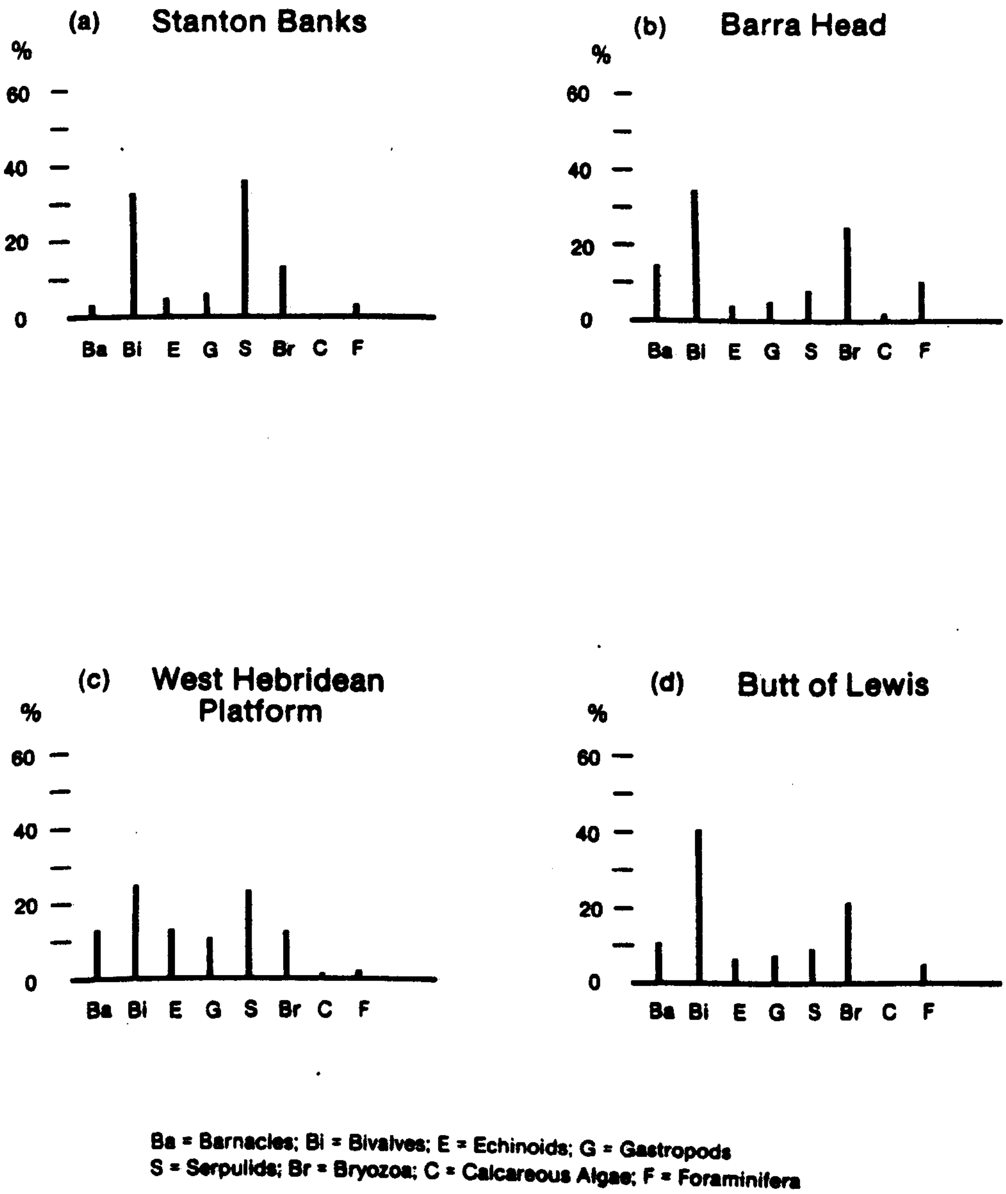


Figure 41 Biogenic composition of Hebridean Shelf carbonates

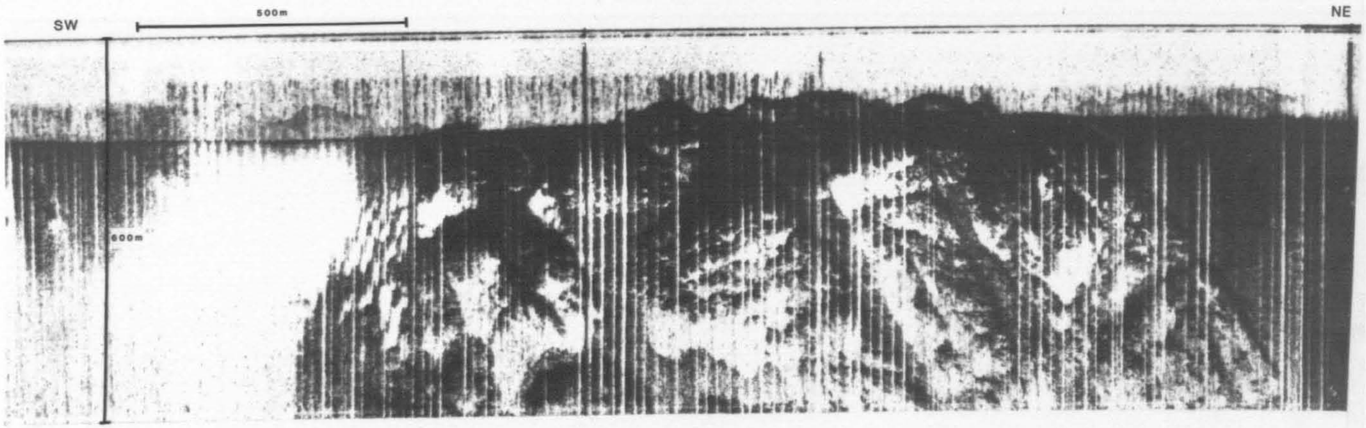


Figure 42 Side-scan sonar record across the southern part of the Barra Head deposit (see Fig. 37a), showing extensive rocky areas surrounded by large patches of carbonate sediment.

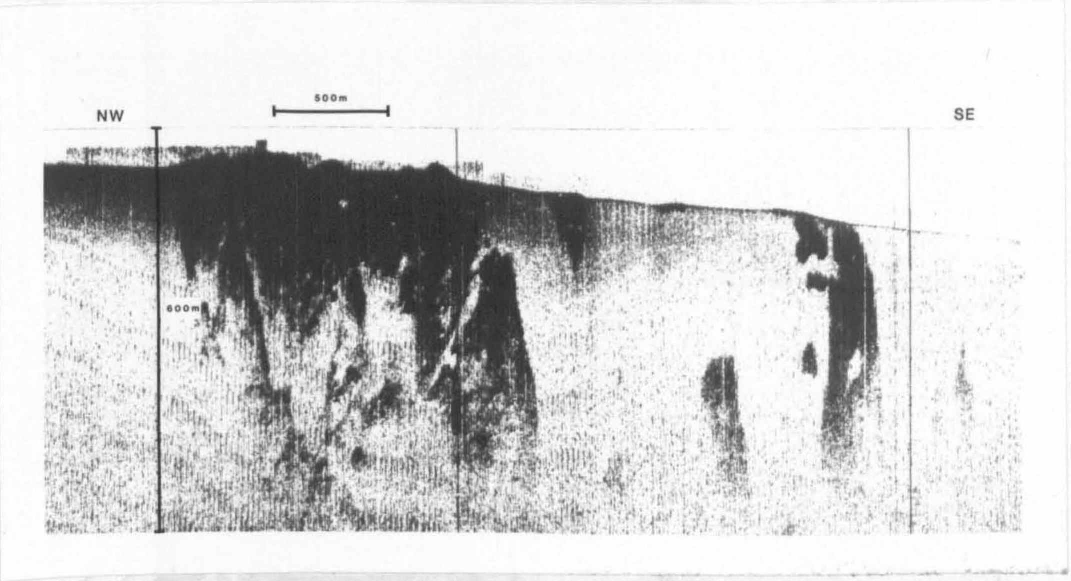
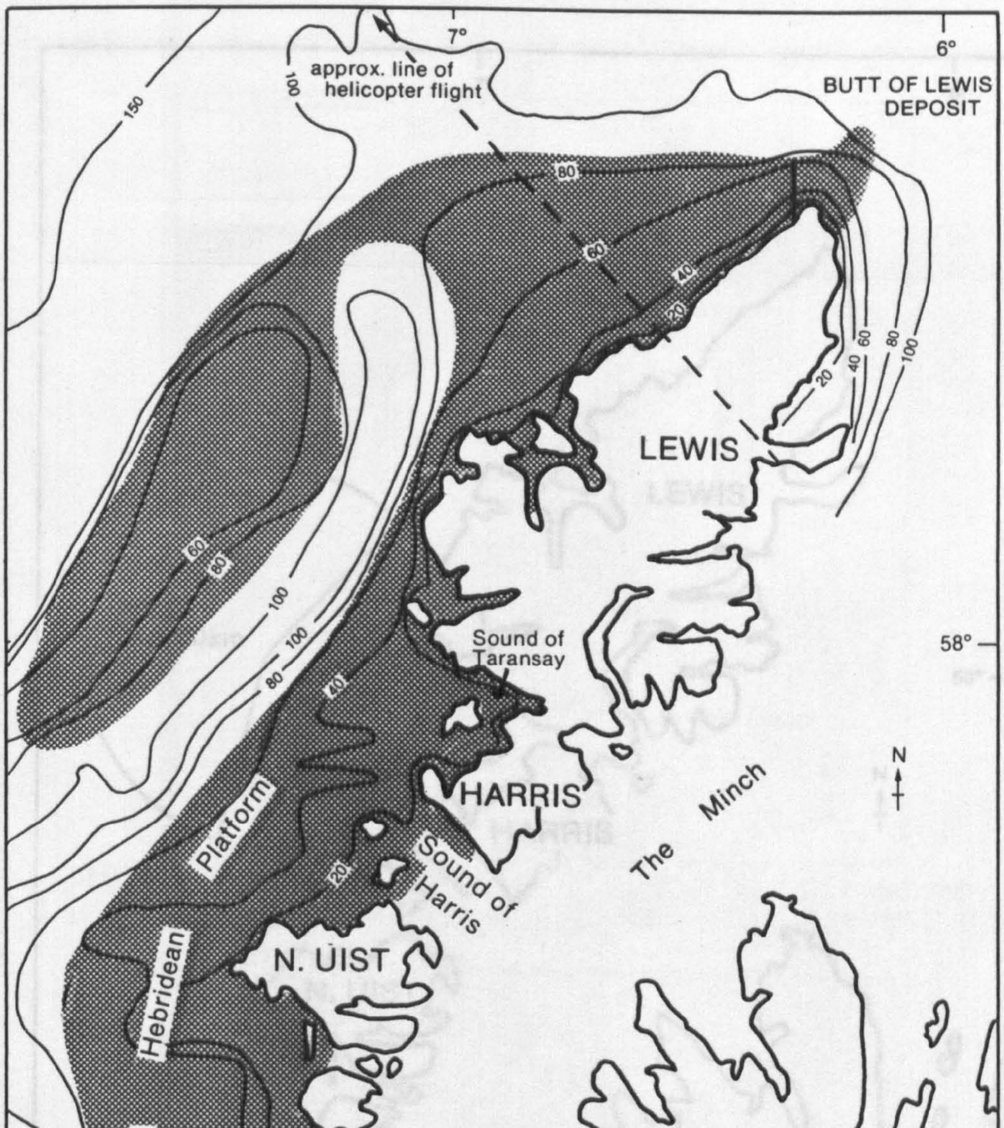


Figure 43 Side-scan sonar record across the eastern flank of the Barra Head deposit (see Fig 37a) showing sediment cover becoming more continuous as seabed drops off into the Minch basin. Carbonates become progressively more terrigenous down-slope from west to east.



(a) LOCATION AND BATHYMETRY
Contour values in metres below mean sea level.

▨ Area of Carbonate deposit (>75% $CaCO_3$)
(Speculative - not surveyed in detail)

Figure 44a West Hebridean Platform Deposit

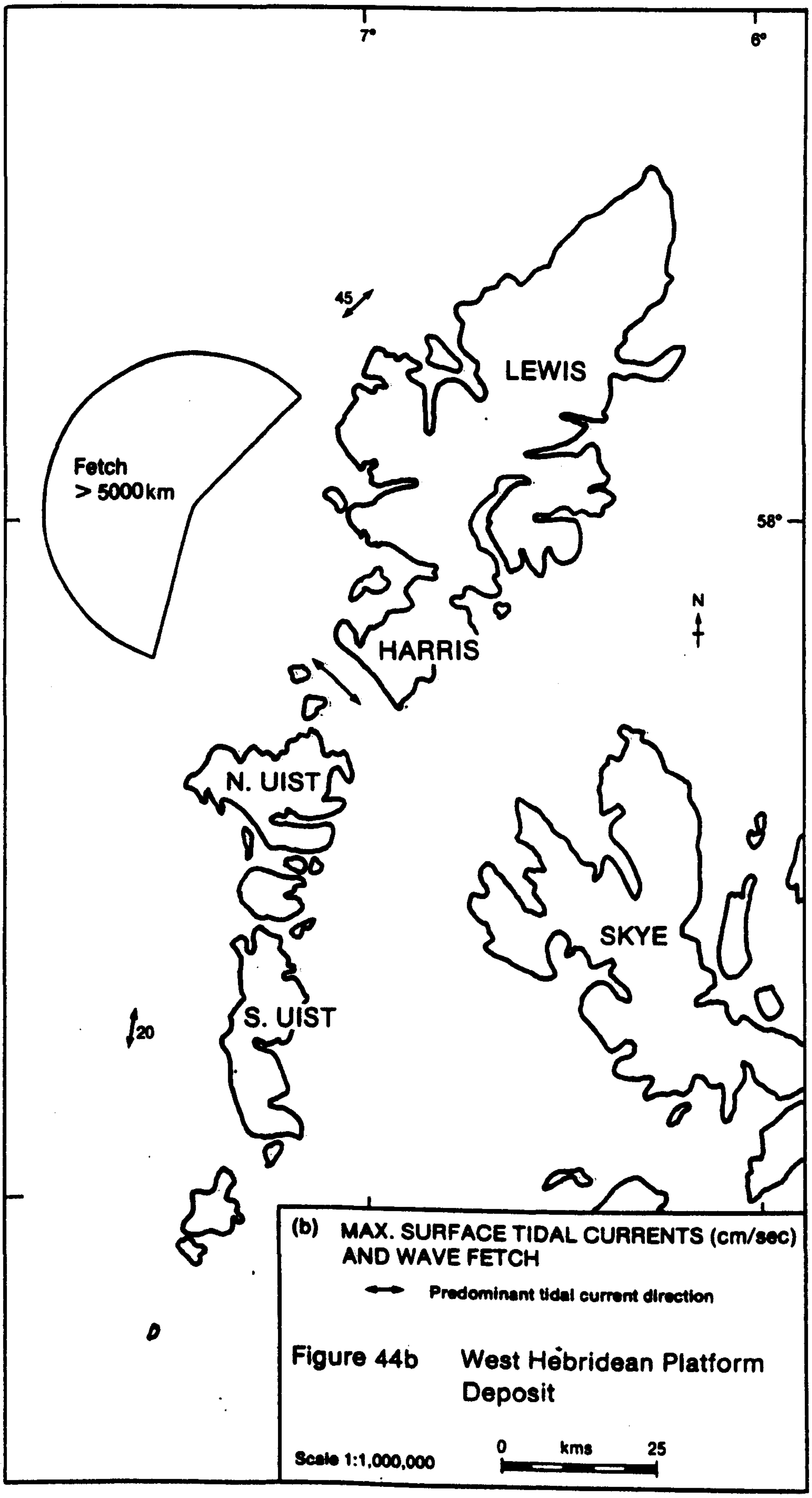
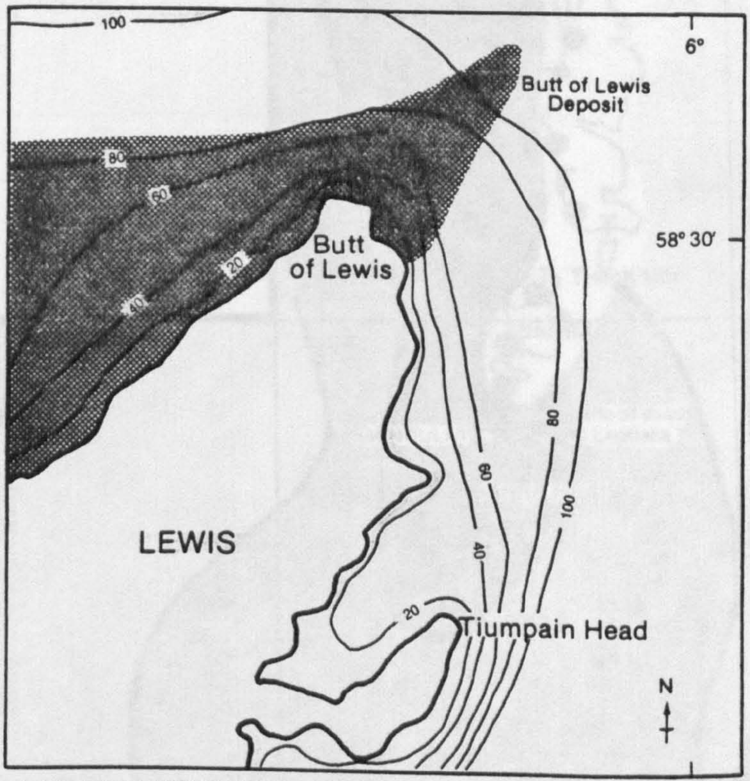


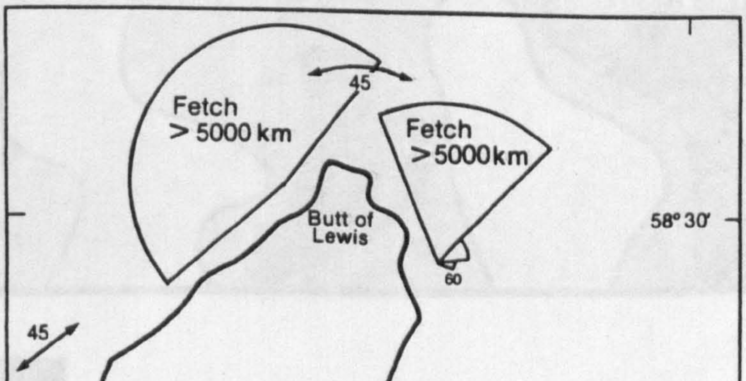
Figure 44b West Hebridean Platform Deposit



(a) LOCATION AND BATHYMETRY

Contour values in metres below mean sea level.

▨ Area of Carbonate deposit ($>75\%$ $CaCO_3$)



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH

↔ Predominant tidal current direction

Figure 45 Butt of Lewis Deposit
Location and Physical Conditions

Scale 1:500,000
0 kms 10

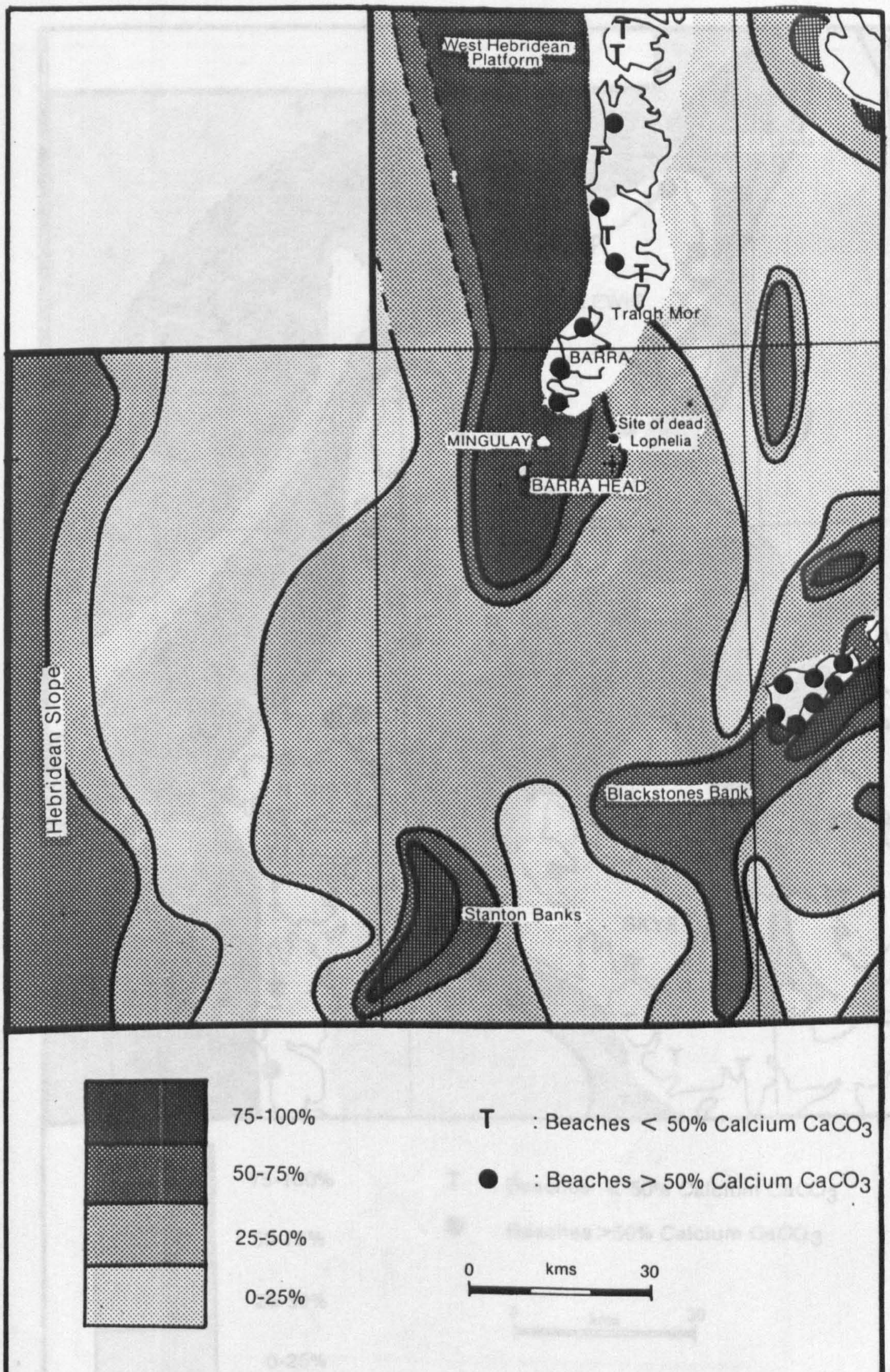


Figure 46 Carbonate content of southern West Hebridean Shelf sediments, including beaches (See Table 1 for beach references)

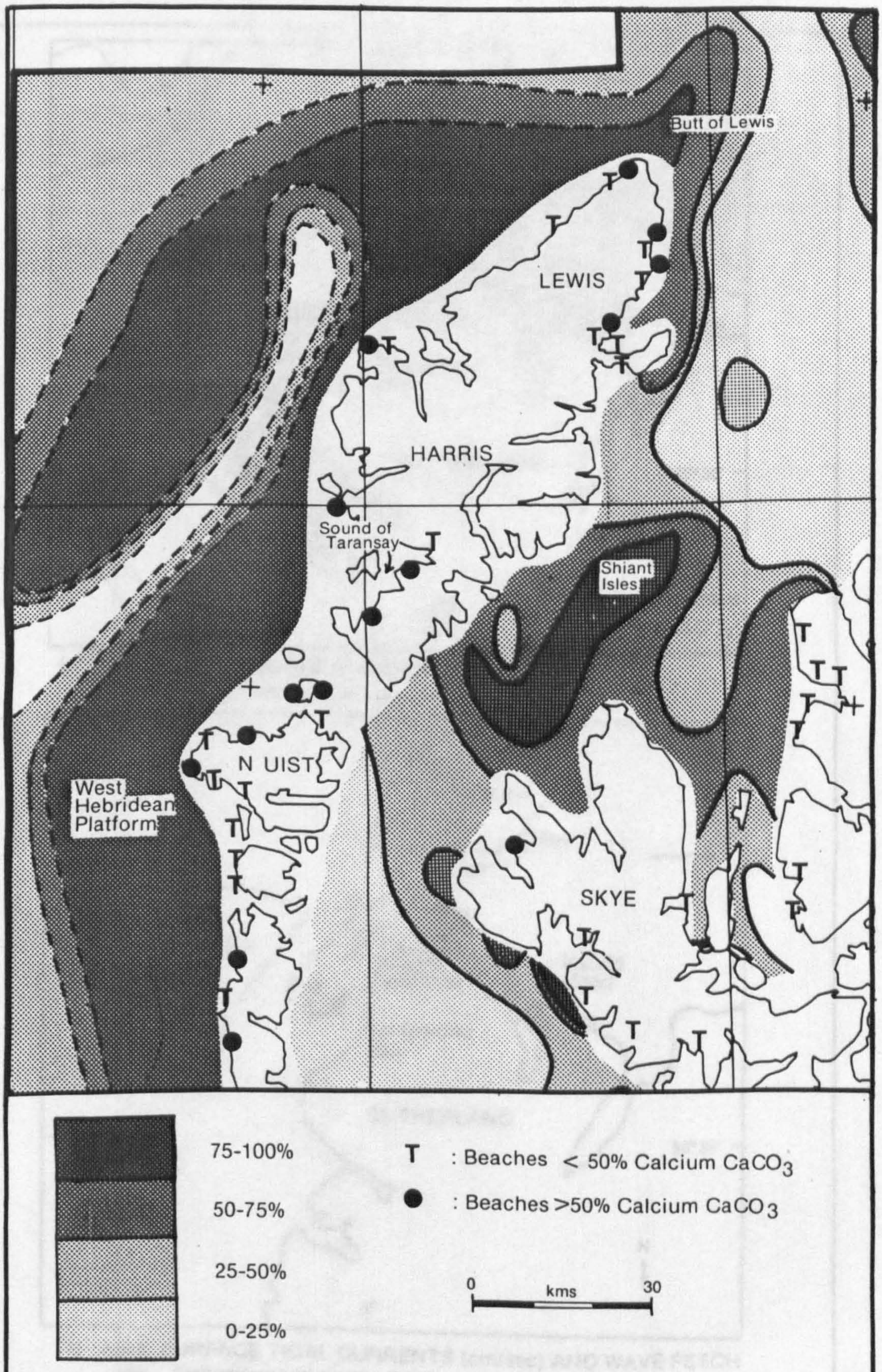
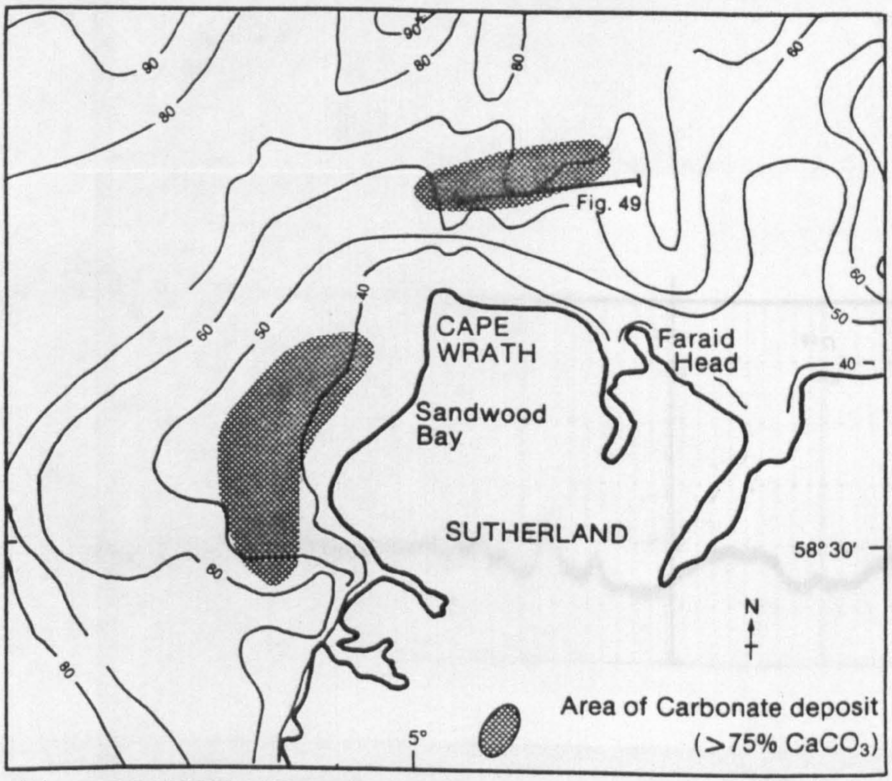
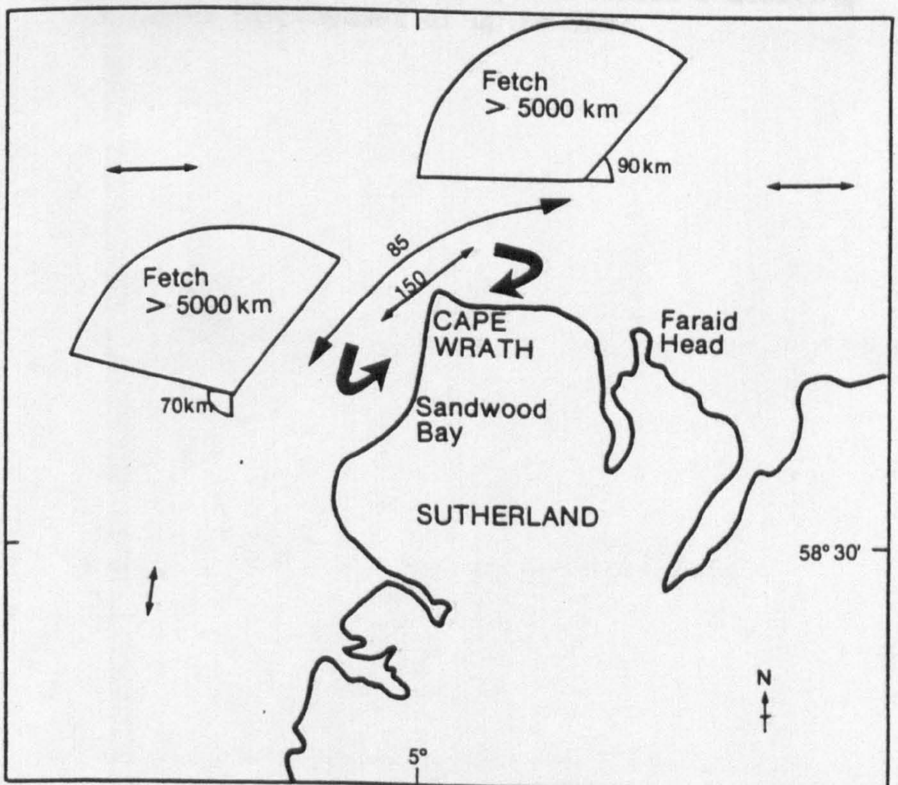


Figure 47 Carbonate content of northern West Hebridean Shelf sediments, including beaches (See Table 1 for beach references)



(a) LOCATION AND BATHYMETRY
Contour values in metres below mean sea level.



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH
↔ Predominant tidal current direction

Figure 48 Cape Wrath Deposit
Location and Physical Conditions

Scale 1:500,000
0 kms 10

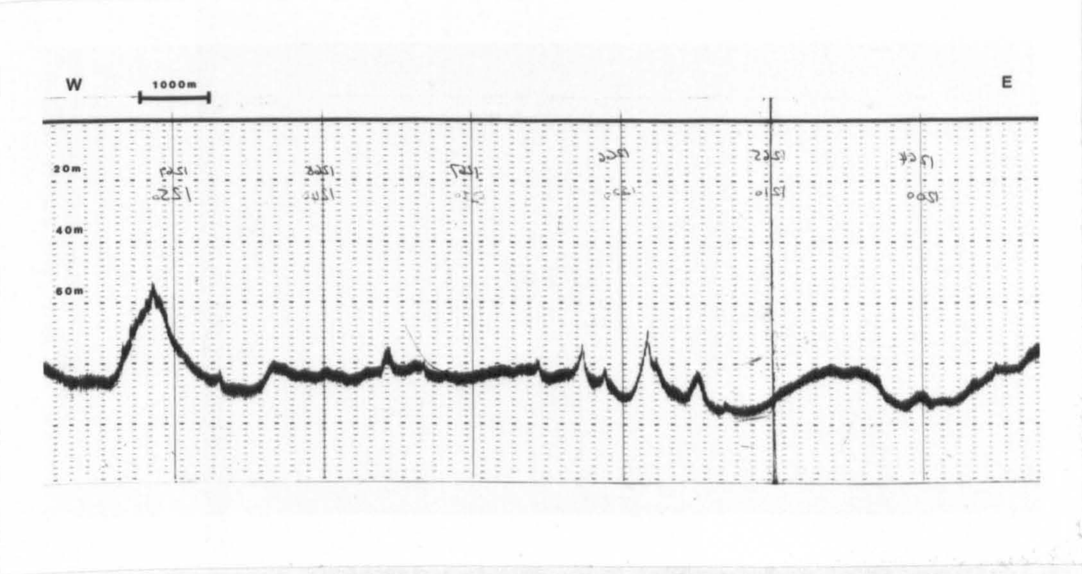


Figure 49 Echosounder profile across Cape Wrath deposit showing sandbanks and large sandwaves indicating sediment thicknesses of up to 30m.

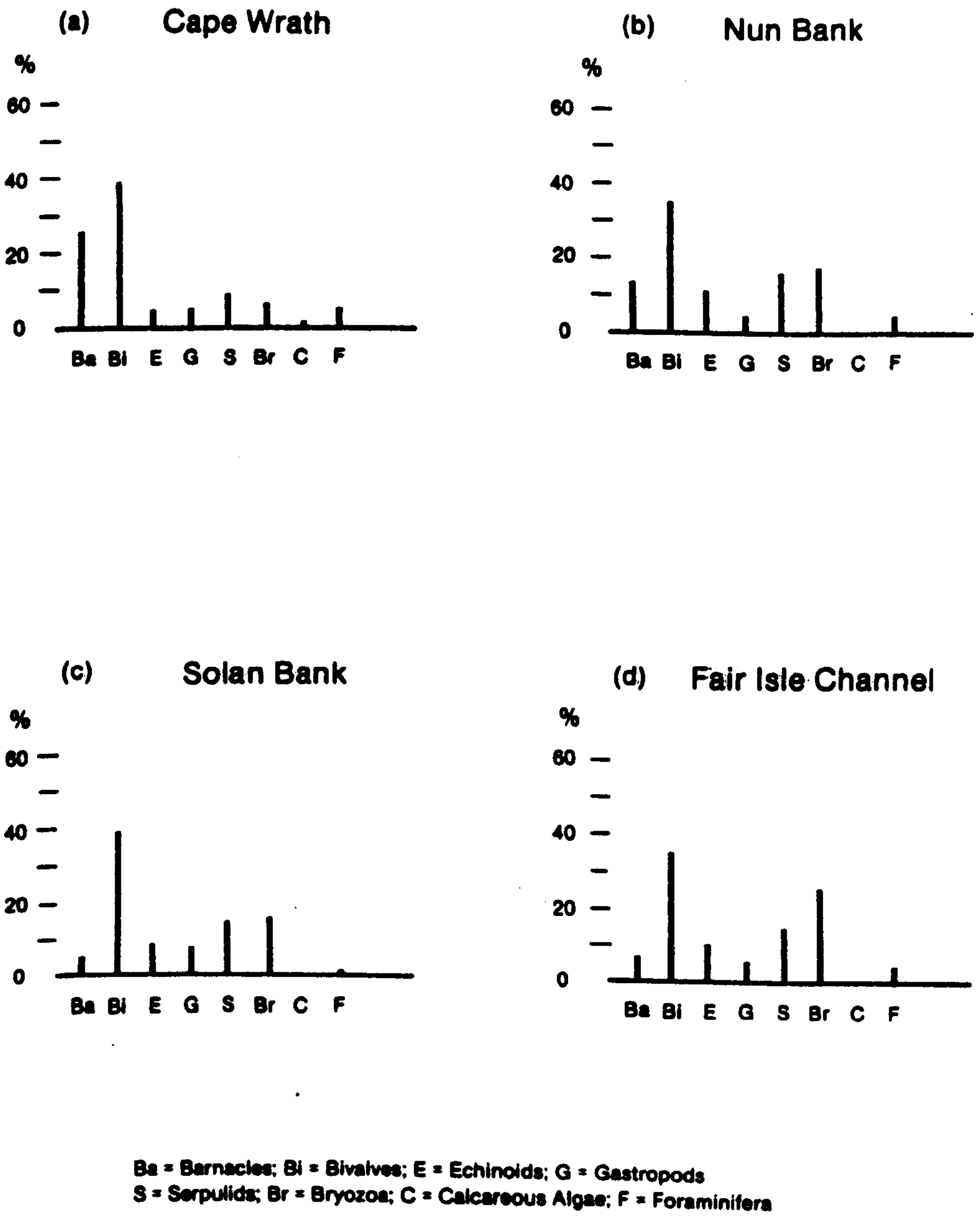
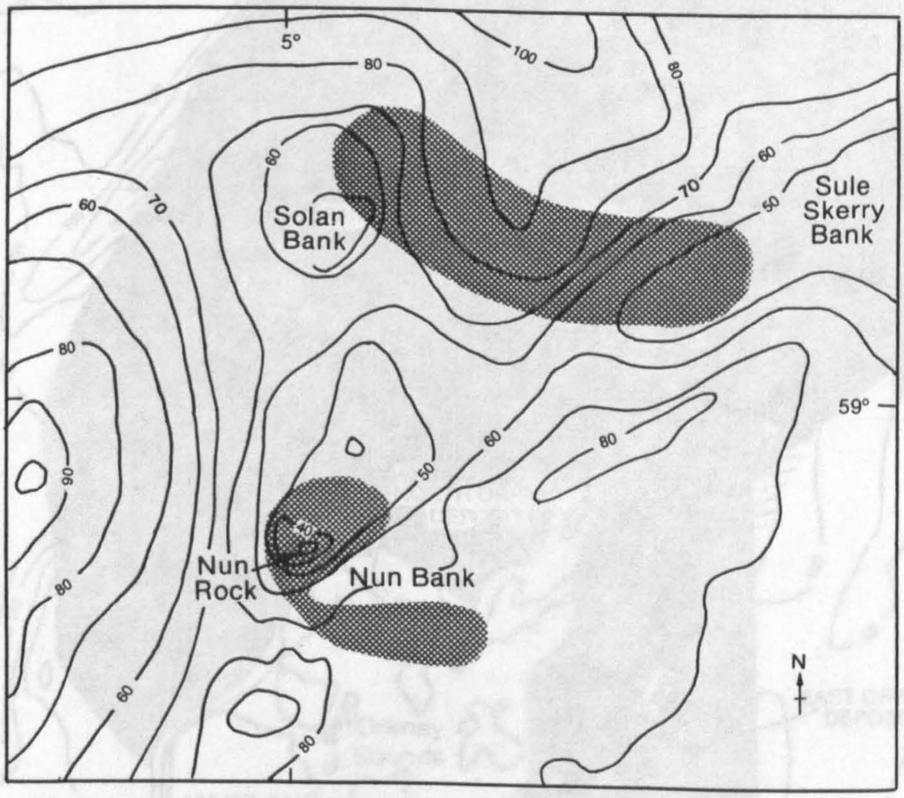


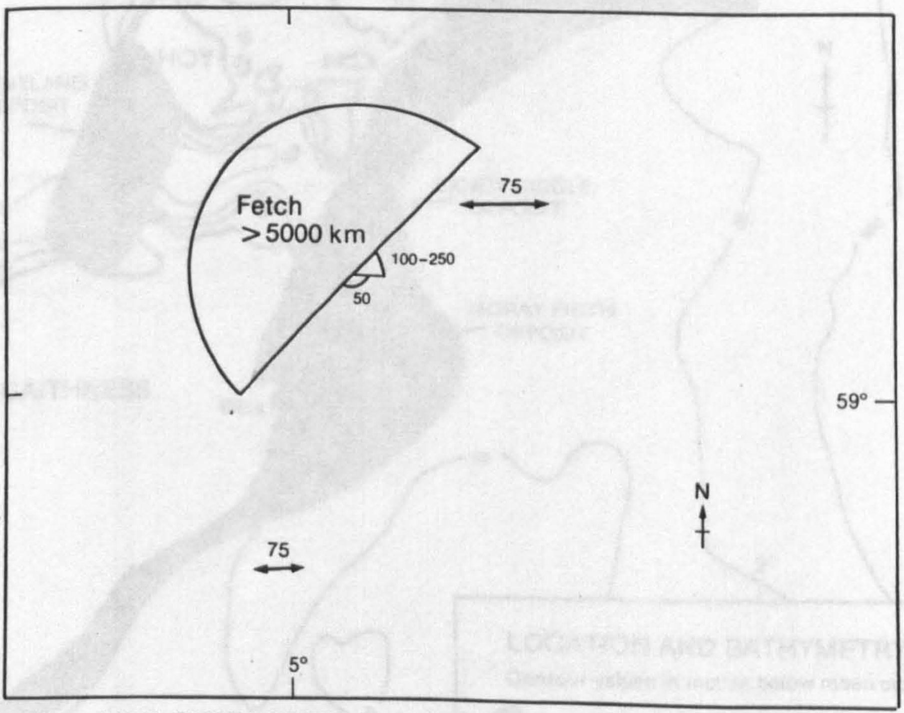
Figure 50 Biogenic composition of Northern Shelf carbonates



(a) LOCATION AND BATHYMETRY

Contour values in metres below mean sea level.

▨ Area of Carbonate deposit ($>75\%$ $CaCO_3$)



(b) MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH

↔ Predominant tidal current direction

Figure 51 Nun Bank and Solan Bank Deposits
Location and Physical Conditions

Scale 1:500,000

0 kms 10

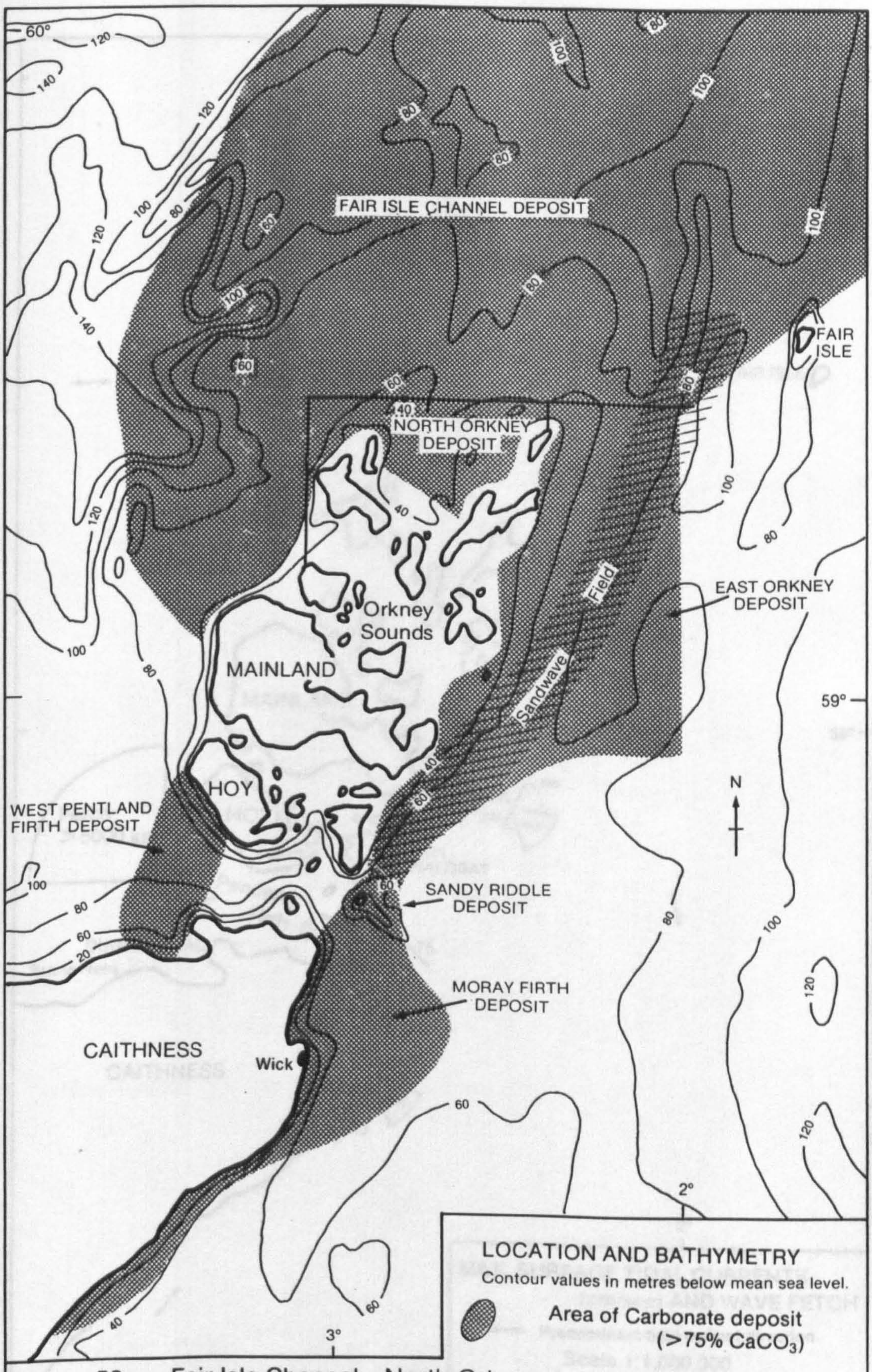


Figure 52a Fair Isle Channel – North Orkney
East Orkney – West Pentland Firth
Sandy Riddle – Moray Firth Deposits

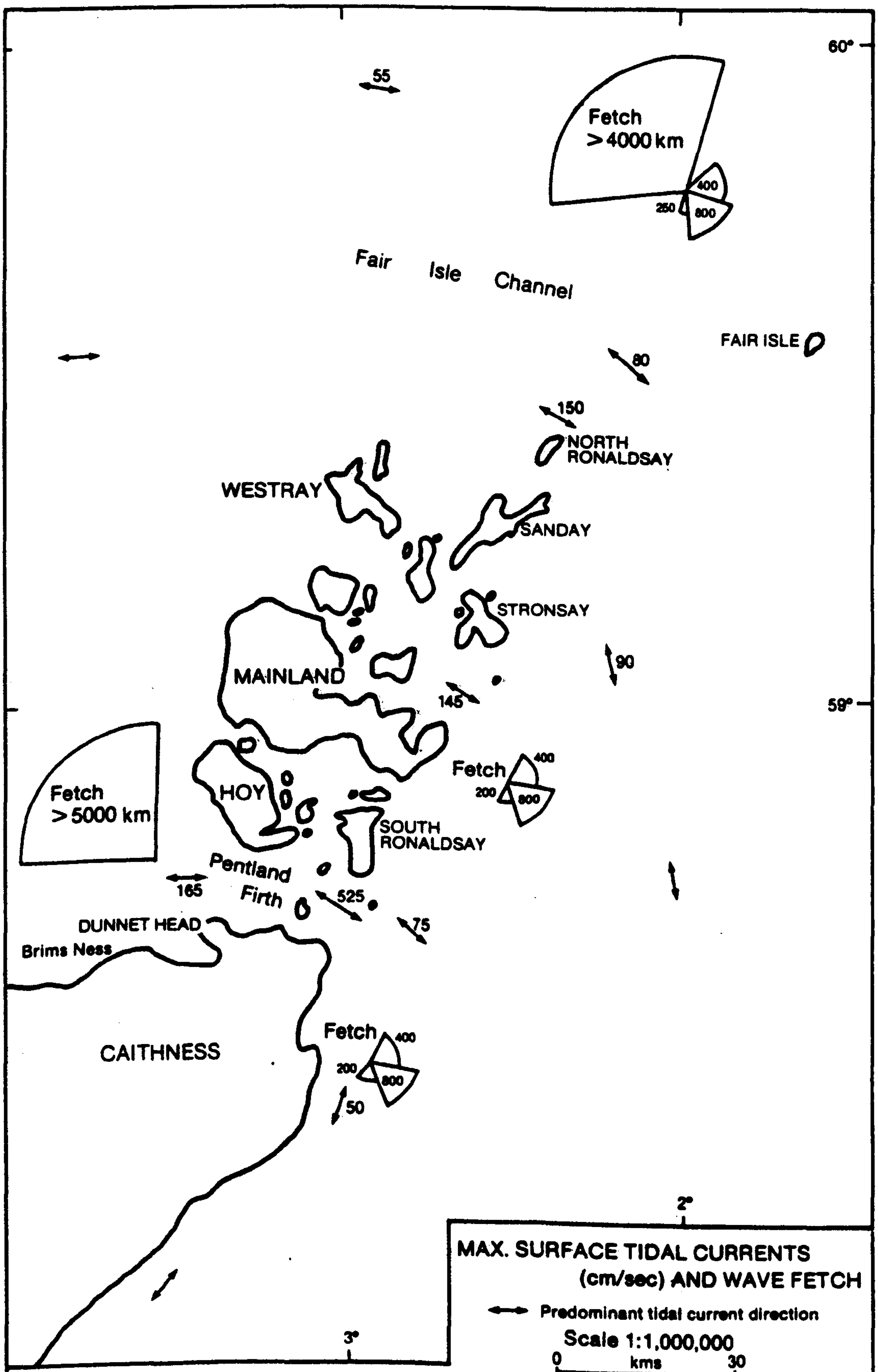


Figure 52b Fair Isle Channel-Orkney-Moray Firth Deposits

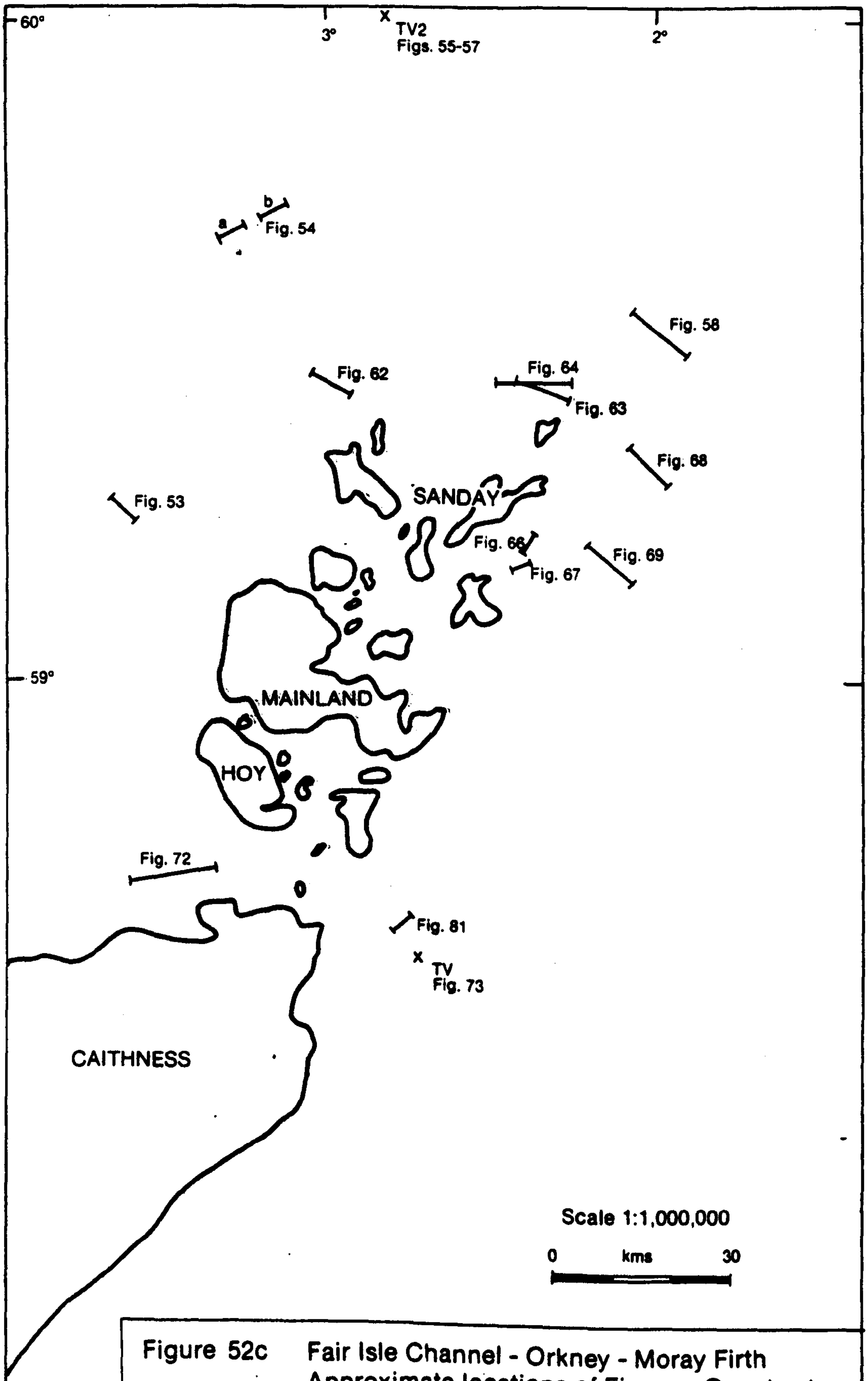


Figure 52c Fair Isle Channel - Orkney - Moray Firth Approximate locations of Figures: Geophysics and T.V. stations

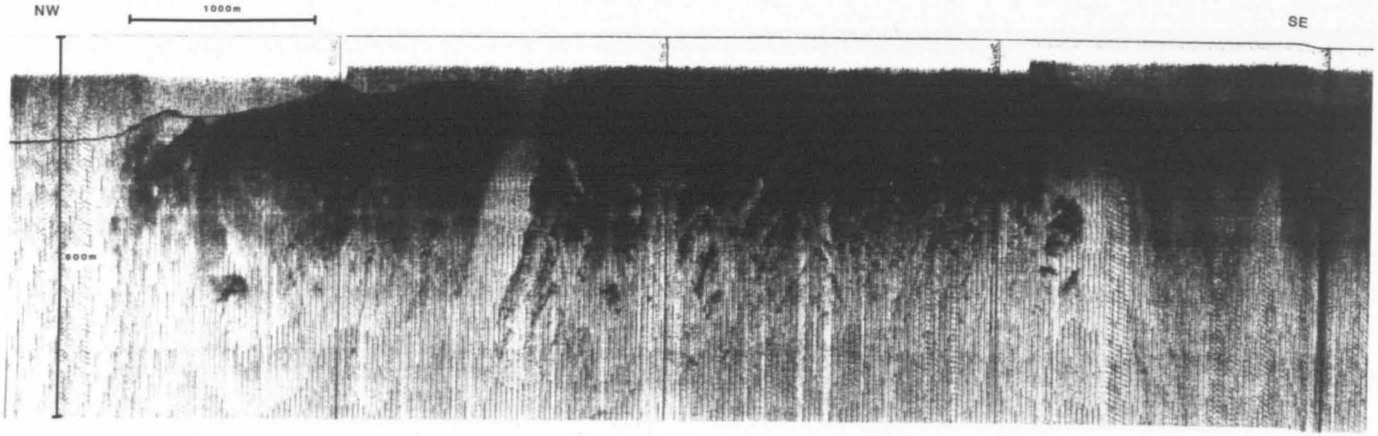


Figure 53 Side-scan sonar record across the rocky ridge at the south-western limits of the Fair Isle Channel deposit. The feature, scored with gullies containing carbonate, separates the more terrigenous sediments on the Northern Shelf in the west (L.H. side) from the carbonates lying on the platform in the Fair Isle Channel (R.H. side). See Figs. 52a & 52c).

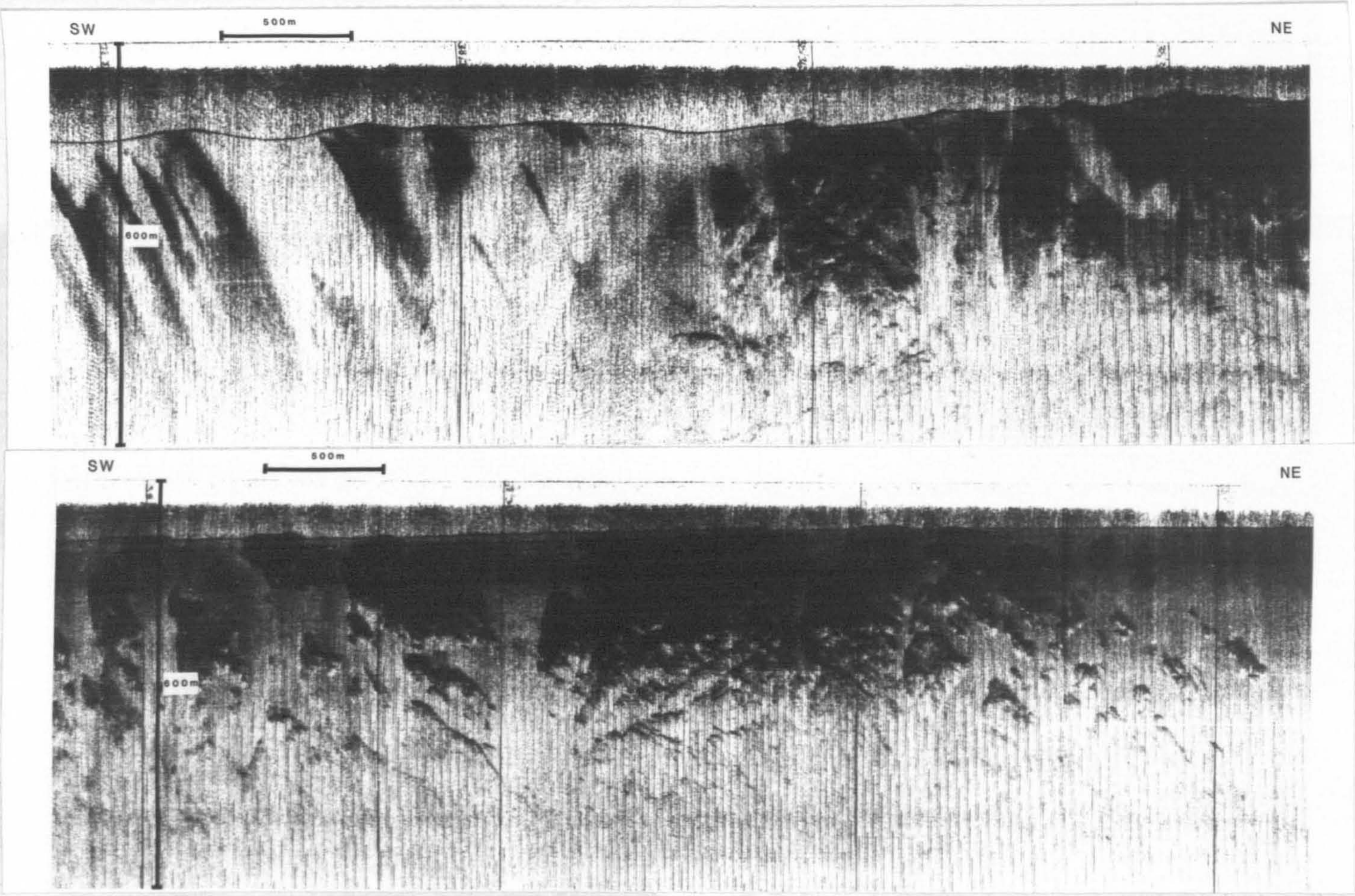


Figure 54 Side scan sonar record across the rocky ridge at the western limit of the Fair Isle Channel deposit. The ridge, with gullies and hollows filled with carbonate sediment, emerges from the more terrigenous sediments of the Northern Shelf (top left). NB. The two sections are part of the same line but there is a gap between them (see Figs 52c & 52a).

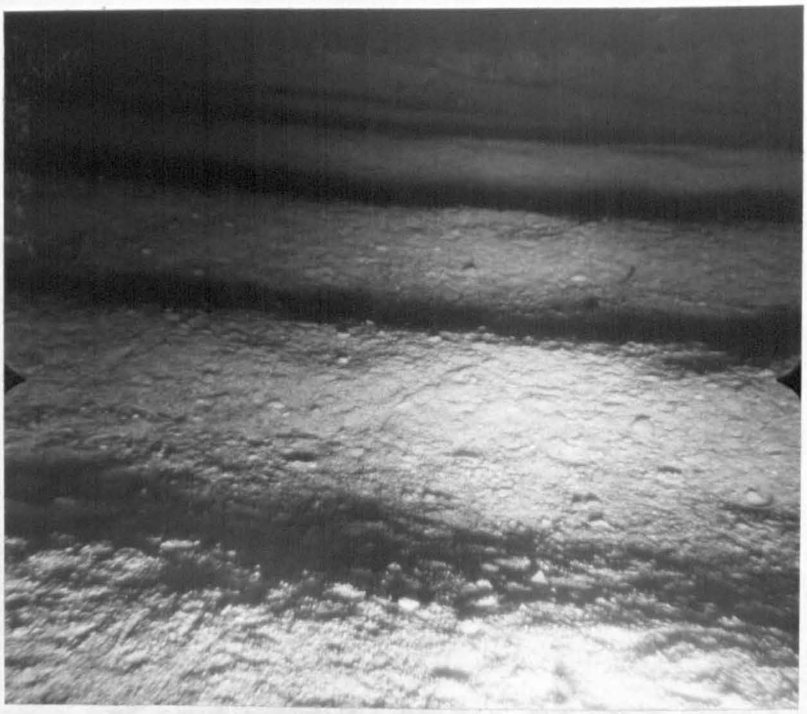


Figure 55 Underwater photograph of wave-generated gravelly carbonate megaripples in a water depth of 80m, Fair Isle Channel (see Fig.52c - station TV2). Wavelengths are 1-2m and heights 10-20cm. See pp. 191 - 198 & Appendix 3 & 4). July 1977.

Figure 56 Underwater photograph of carbonate megaripples in the Fair Isle Channel, a/a. Note that heavily encrusted boulders project out of the gravel, suggesting that they are not covered for substantial periods.

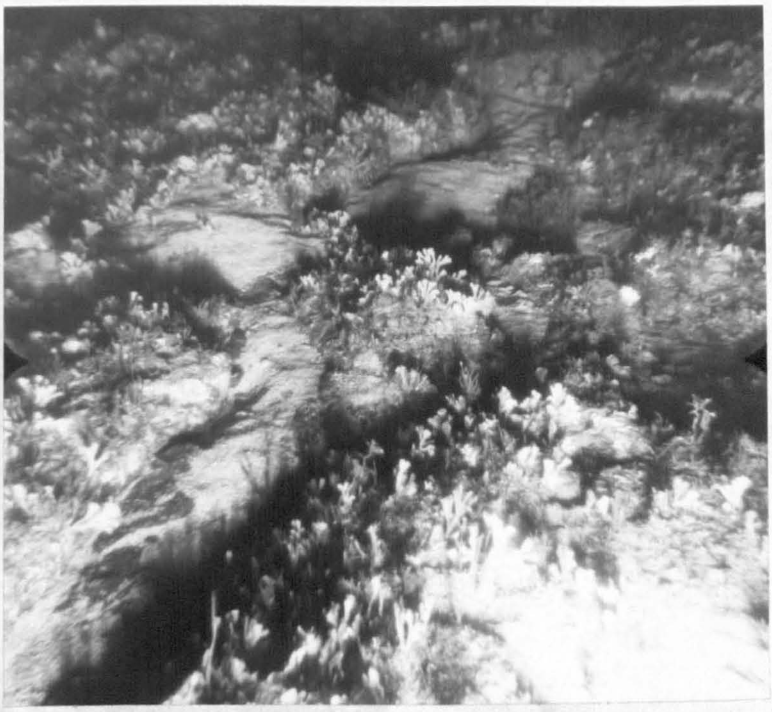


Figure 57 Underwater photograph of the seabed in the Fair Isle Channel near the megaripple field (see Fig.52c - station TV2, and Figs 55 & 56). The ground is rocky and heavily colonised but there is a transitory 'sprinkling' of fine - medium carbonate sand. Water depth 80m. See also pp. 191–198 & Appendix 3, Table 47. Field of view approx. 1m.

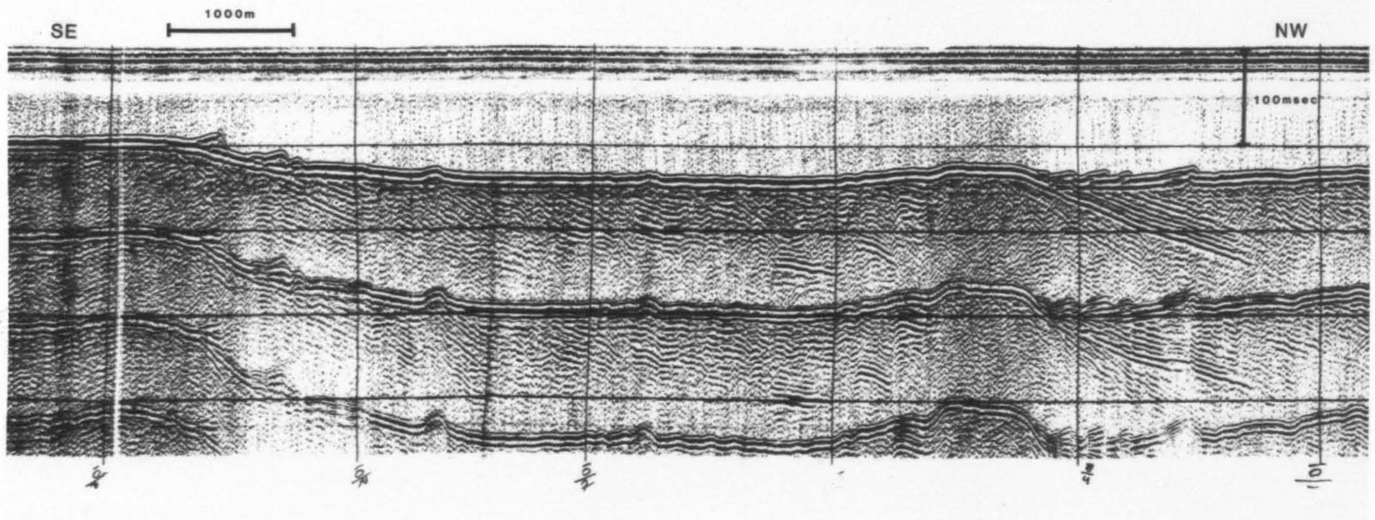


Figure 58 Sparker line across the Fair Isle Sandwave Field (see Figs. 52a & 52c) showing the development of carbonate sandwaves on the eastern flank of the Fair Isle Channel platform.

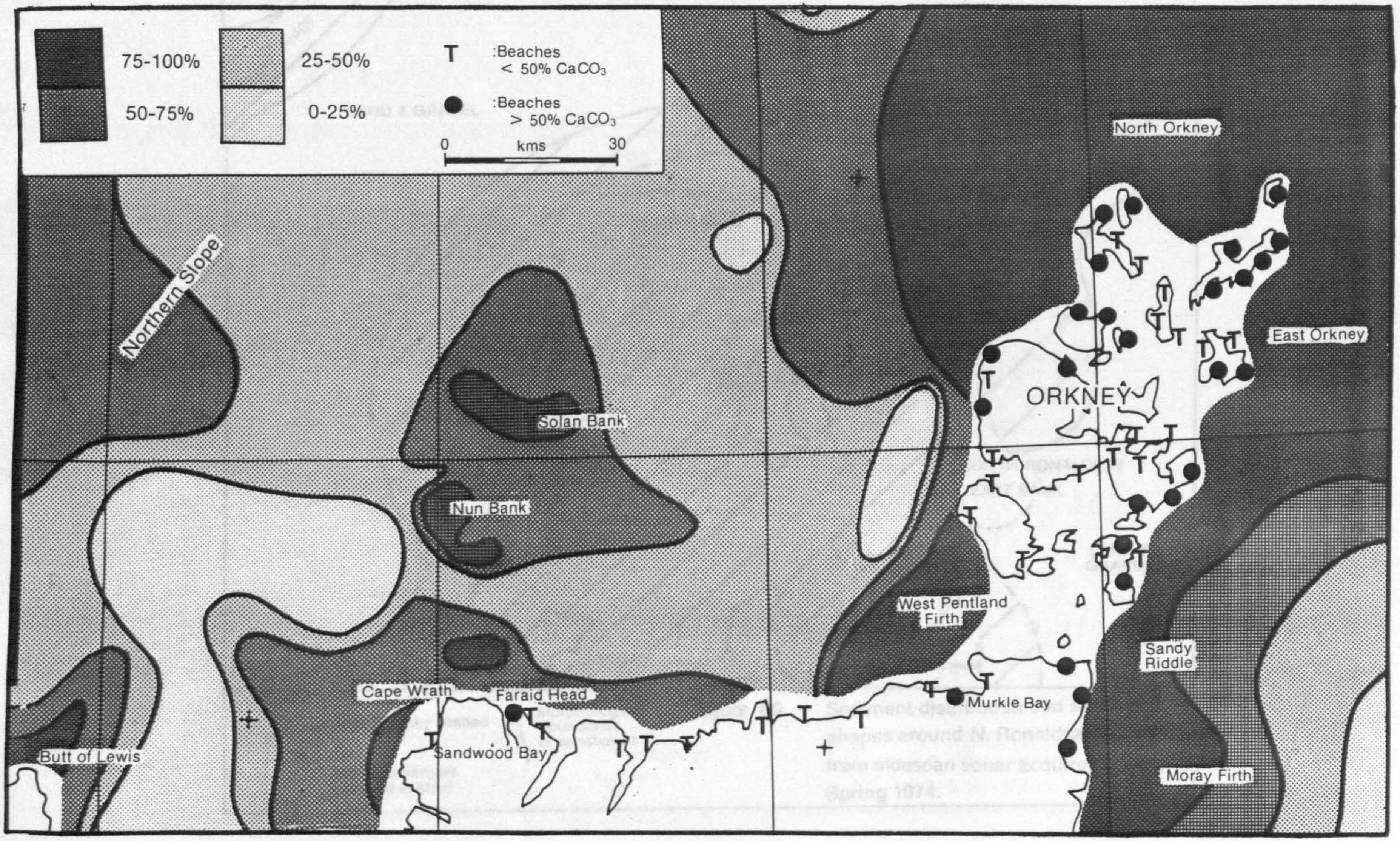


Figure 59 Carbonate content of Northern Shelf and Orkney sediments, including beaches (See Table 1 for beach references)

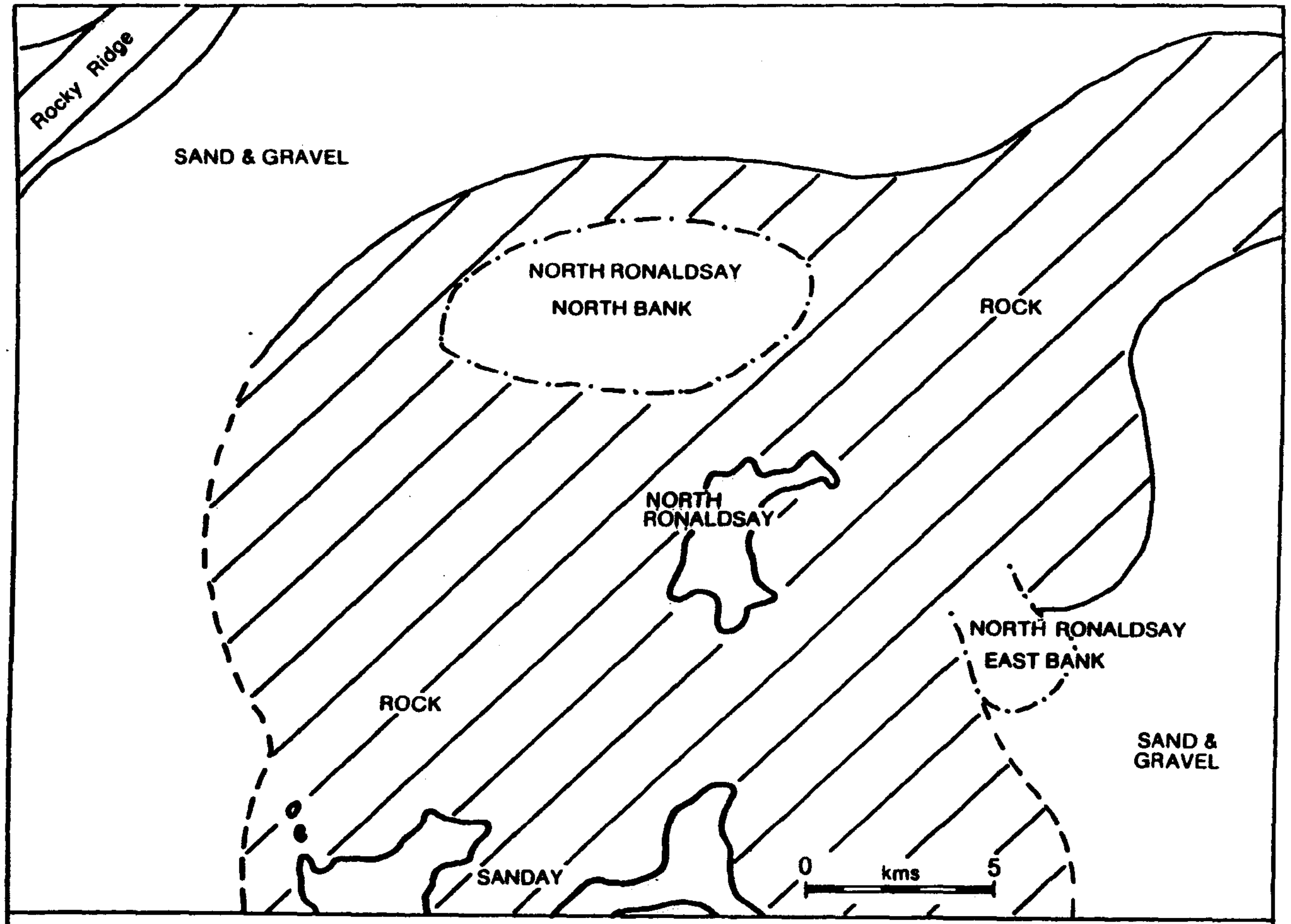


Figure 60 Sediment distribution and sandbank shapes around N. Ronaldsay mapped from sidescan sonar acquired during Spring 1974.

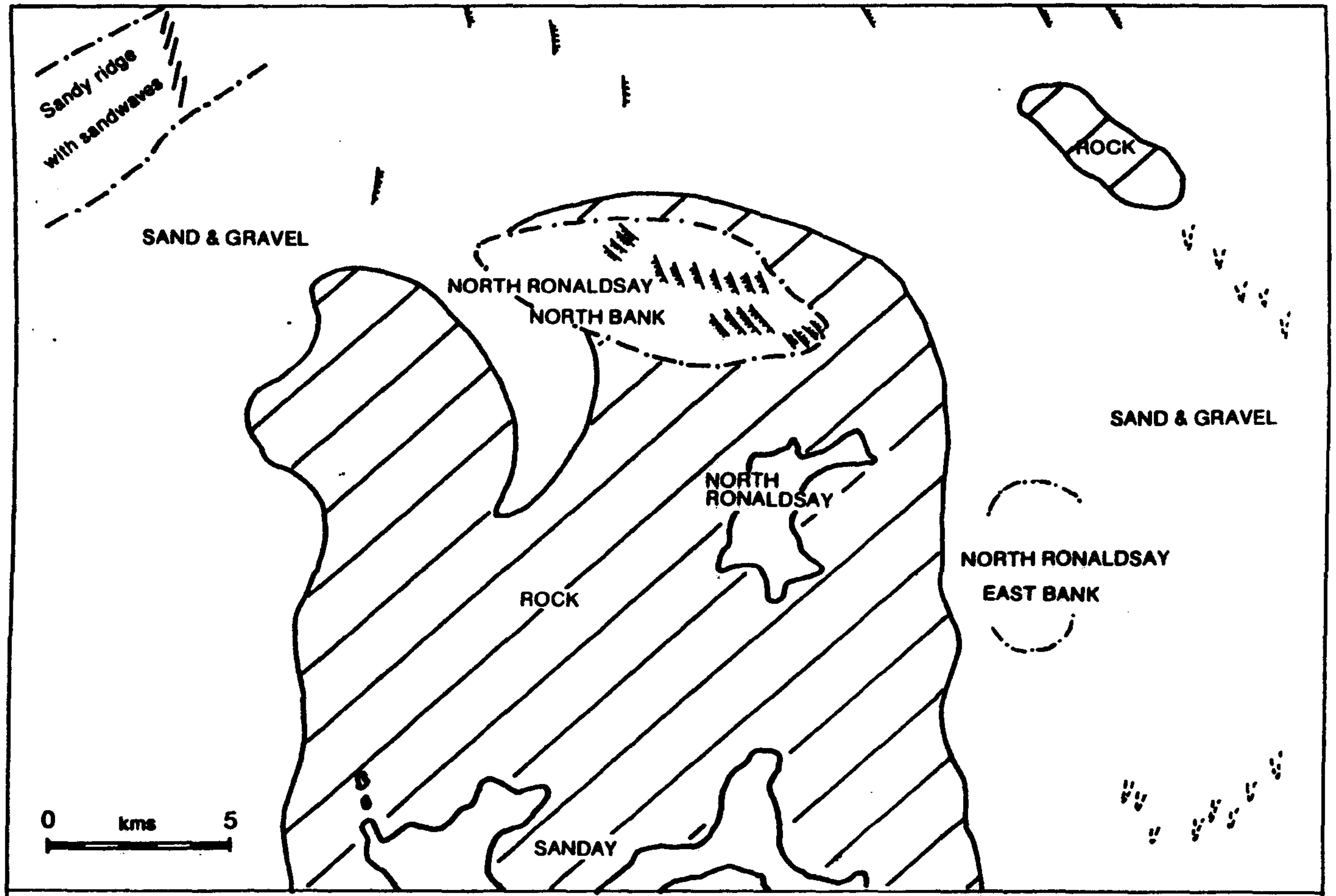


Figure 61 Sediment distribution, sandbank shapes and bedforms around N.Ronaldsay, mapped from sidescan sonar acquired during July 1977.

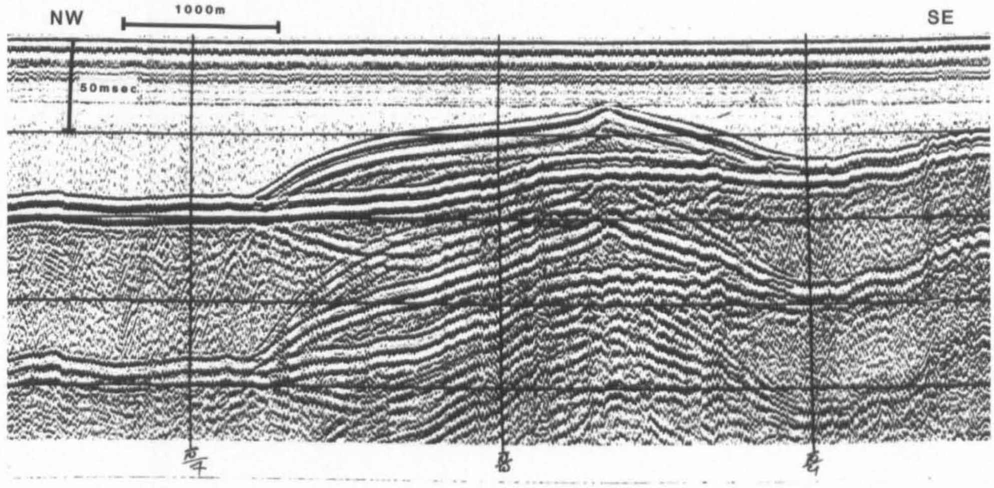


Figure 62 Sparker line through bank of superficial sediment lying on the north-west side of the ridge running north-east from Papa Westray, North Orkney deposit (Fig. 52c,). Although its surface is covered with carbonate sediment, its smooth nature (with no sandwaves) suggests that it is either mainly moraine or a degraded sandbank.

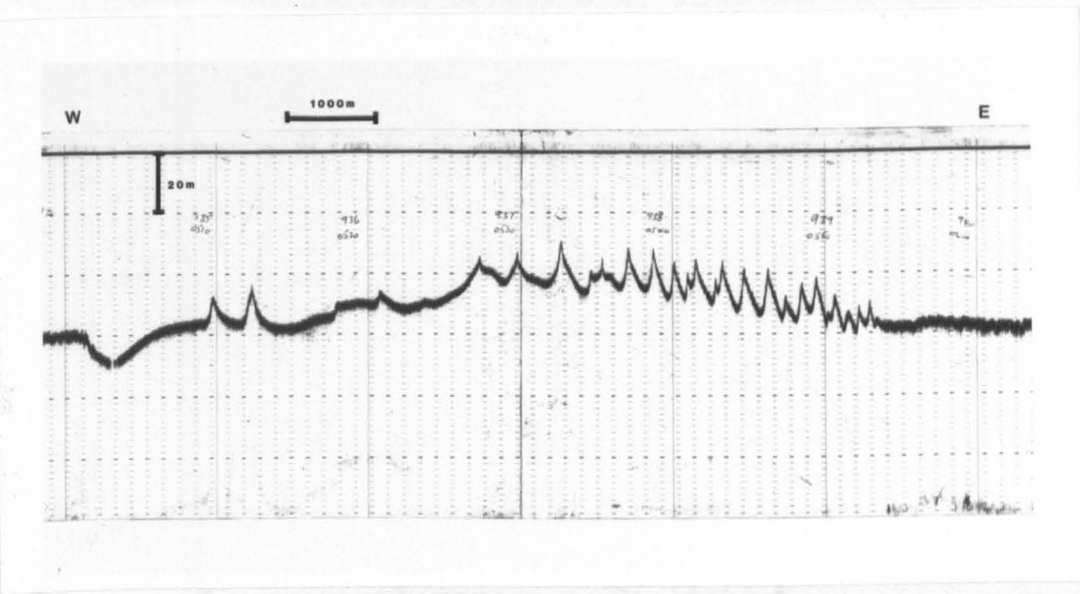


Figure 63 Echosounder profile across North Ronaldsay north bank North Orkney deposit (Figs. 52a & 52c) with carbonate sandwaves up to 15m high, and steep sides facing west. (July 1977). See also Figs. 60 & 61.

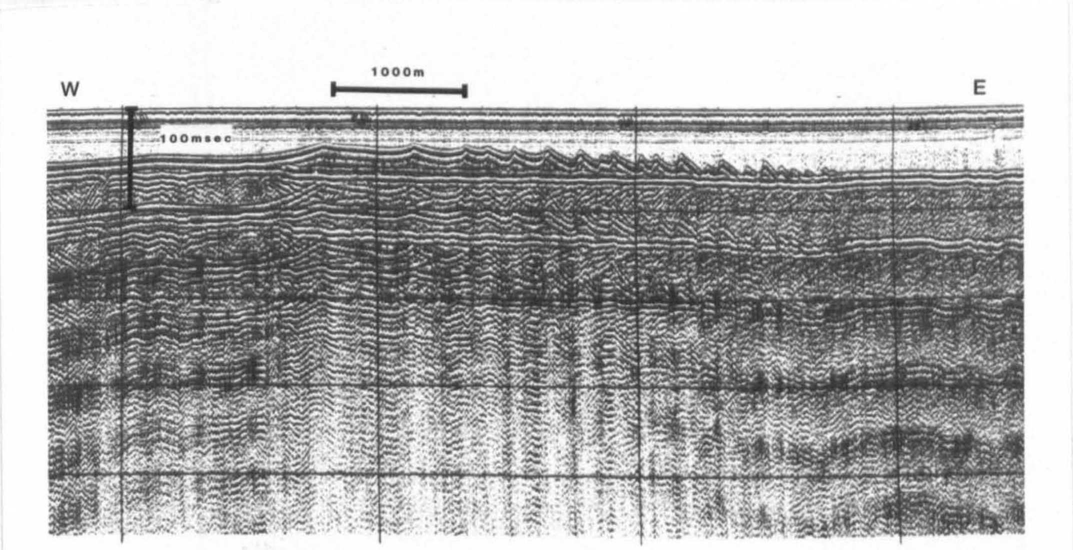
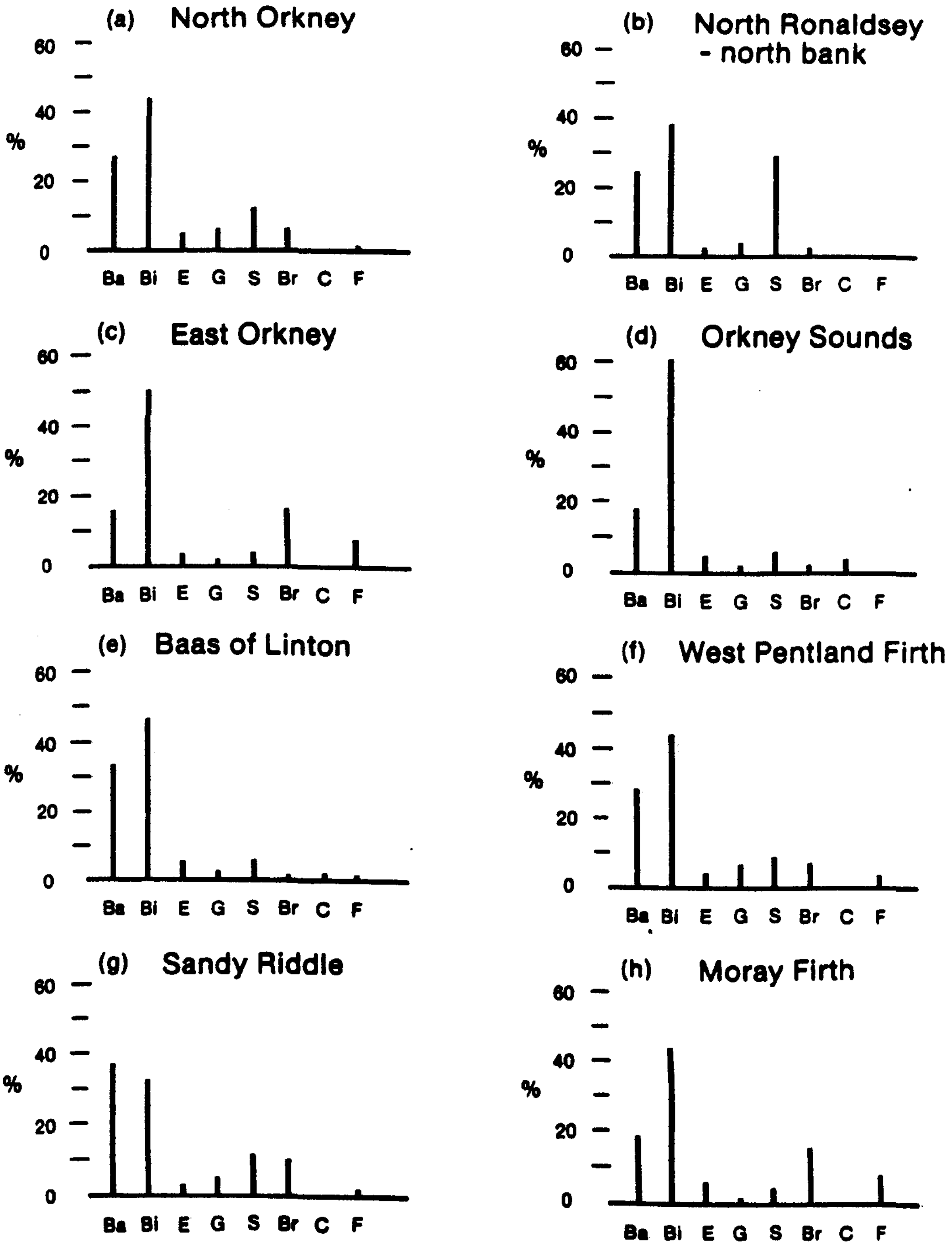


Figure 64 Sparker line through North Ronaldsay north bank, North Orkney deposit (Figs. 52a & 52c) showing the sandwaves to be up to 7m high and thickness of superficial sediment to be at least 20m (Spring 1974). See also Figs. 60 & 61.



Ba = Barnacles; Bi = Bivalves; E = Echinoids; G = Gastropods
S = Serpulids; Br = Bryozoa; C = Calcareous Algae; F = Foraminifera

Figure 65 Biogenic composition of Orkney and Moray Firth carbonates

Figure 66 Side-scan sonar record along the edge of the inner platform,East Orkney Deposit (see Figs. 52a &52c). Large gullies in the rocky seabed contain carbonate sediment spilling out eastwards down the flank of the platform. See Appendix 7 fig. 4.

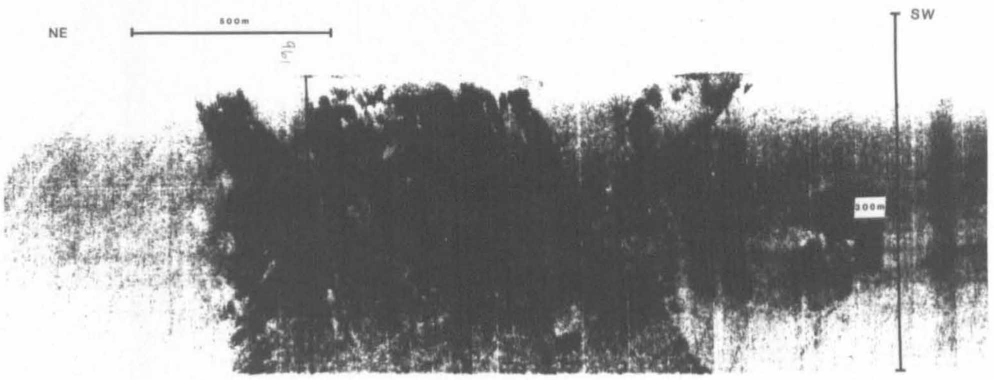


Figure 67 Side scan sonar record along the edge of the inner platform, East Orkney Deposit (see Figs. 52a & 52c). Large gullies in the rocky seabed contain carbonate sediment spilling out eastwards down the flank of the platform. See Appendix 7, fig 4.

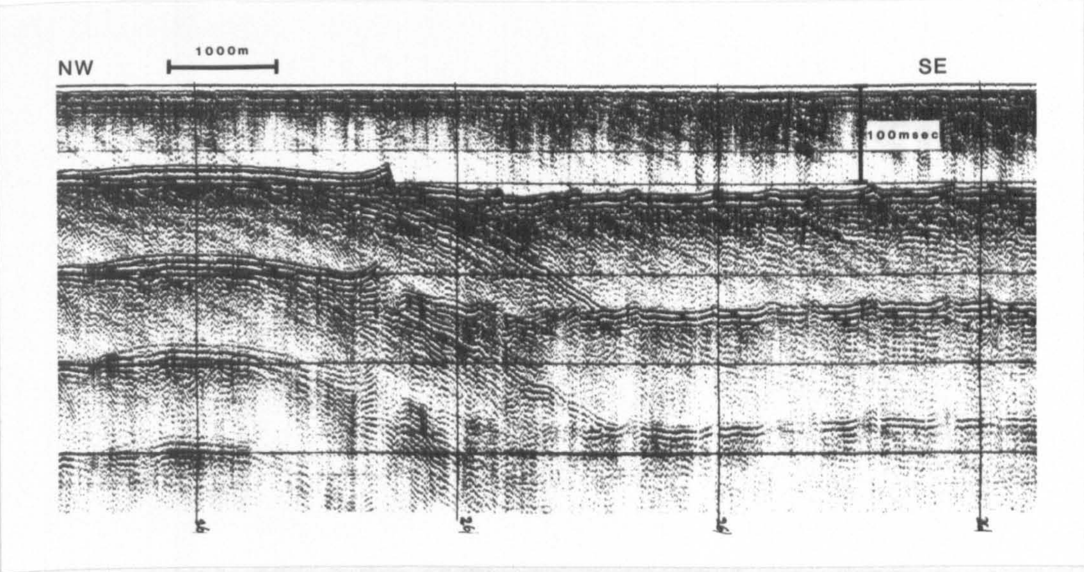


Figure 68 Sparker line through the East Orkney Sandwave Field on the platform flank, East Orkney deposit (see Figs. 52a & 52c). Large carbonate sandwaves are developed on the slope particularly where major bedrock reflector are subcropping. See Appendix 7, fig. 4.

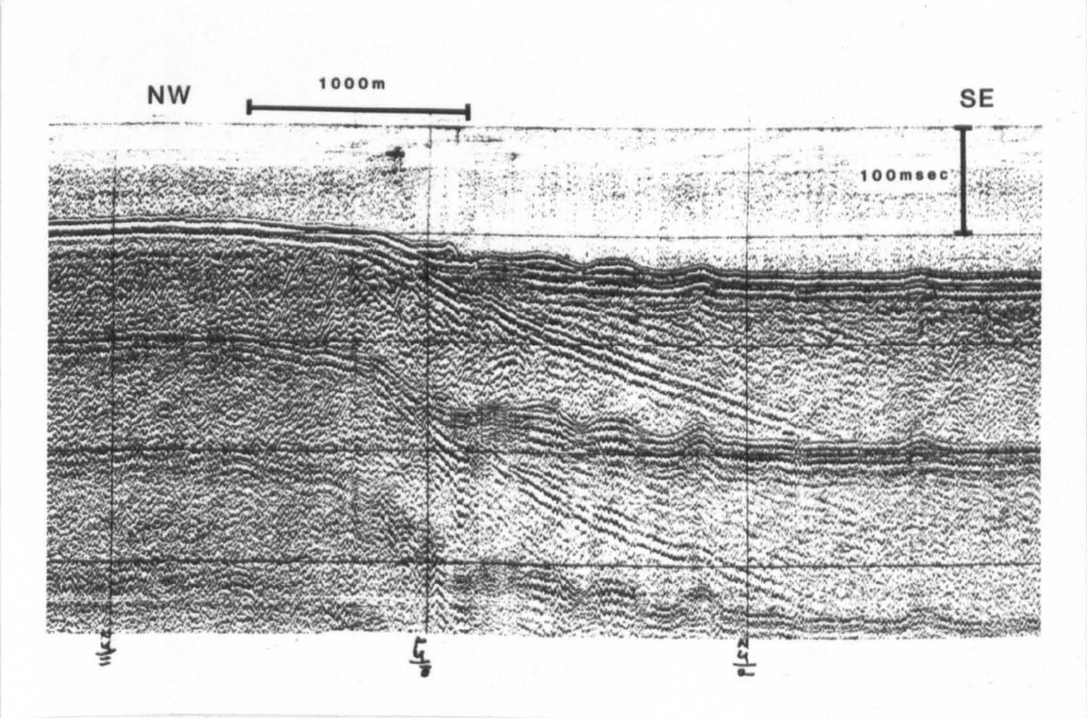


Figure 69 Sparker line through the East Orkney Sandwave Field on the platform flank, East Orkney deposit (see Figs. 52a &52c). Carbonate sandwaves are developed on the slope but the deeper ones appear to be degraded, possibly after winter storms (line shot in Spring 1974). See Appendix 7, fig.4.

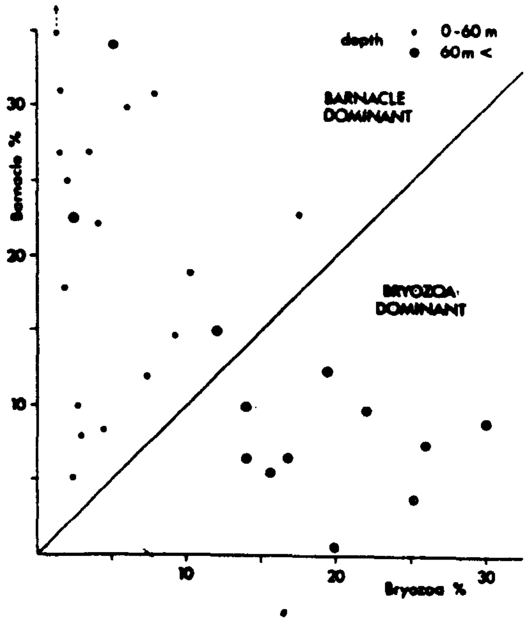


Figure 70 Plot of barnacle versus bryozoan content for carbonates around Orkney

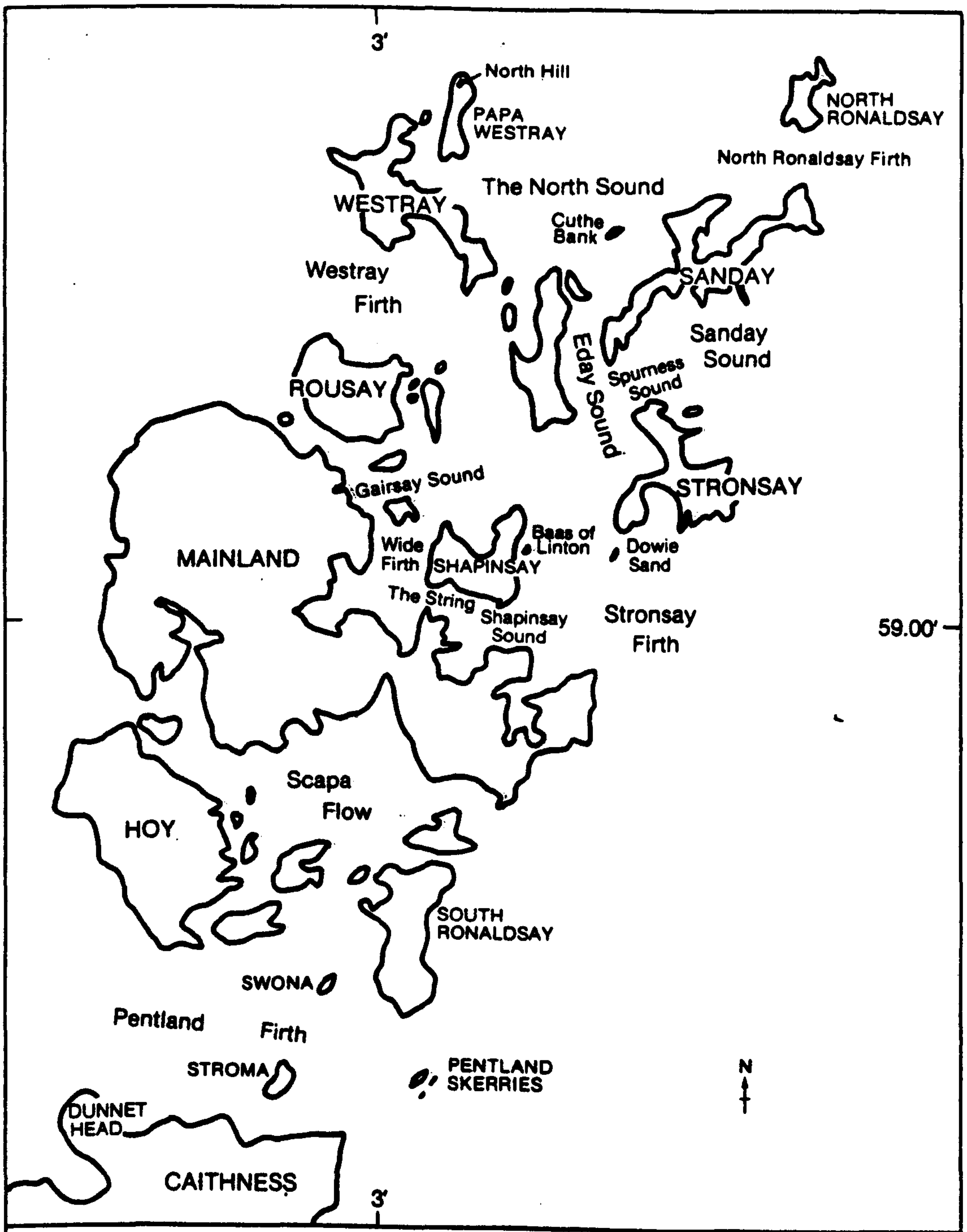


Figure 71 Orkney Sounds Location map

Scale 1:500,000

0 kms 20

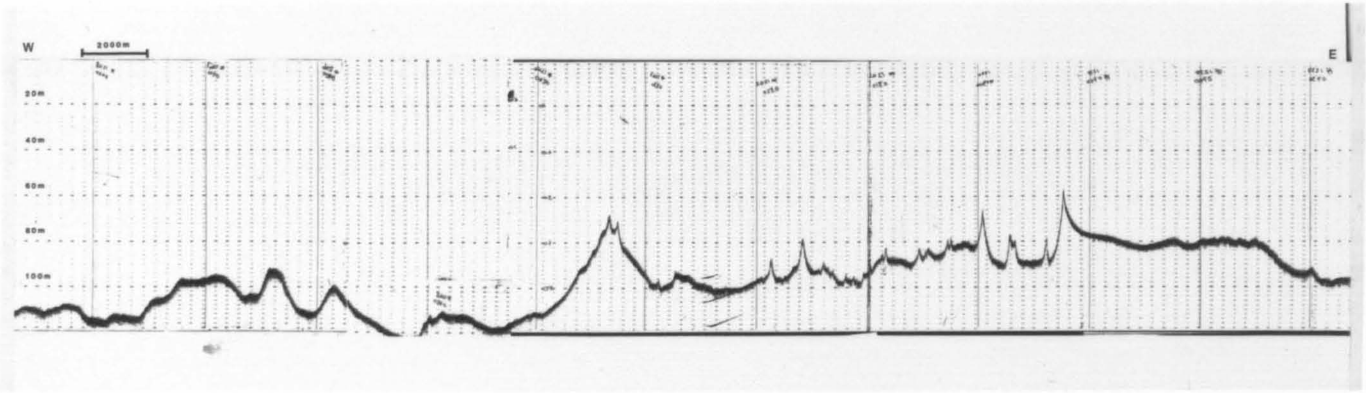


Figure 72 Echosounder profile across the West Pentland Firth deposit (see Figs. 52a &52b). Large sandbanks and sandwaves are developed at the western end of the rocky tidally-scoured channel. The bedforms have sharp profiles and are strongly asymmetrical in the east but towards the west they become symmetrical and then more rounded and degraded in appearance. This probably represents the transition from east-going storm-wave dominated transport in the west to local west-going tidally dominated transport in the east.

Figure 73 Underwater photograph on the seabed to the south-west of Sandy Riddle(see Fig. 52c).Although there is a 'sprinkling' of fine-medium carbonate sand between them, the boulders are extremely heavily encrusted with barnacles and serpulids and there is clearly no build-up of sediment. Note also the preponderance of grazing echinoids. Picture taken at 'slack' tide, water depth approx. 70m. Field of view approx. 1m.

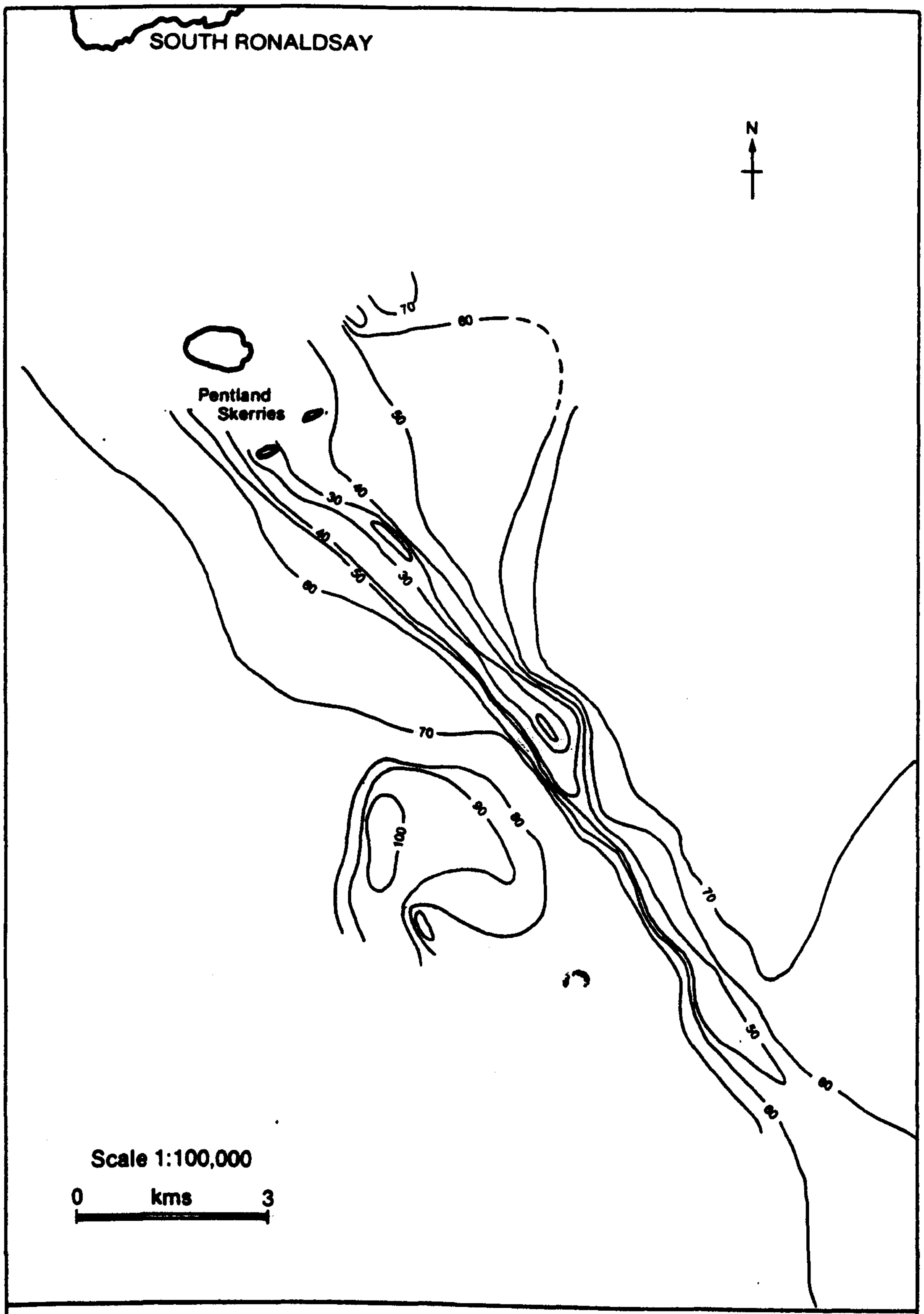


Figure 74 Bathymetry of Sandy Riddle based on survey from RRS John Murray July 1977

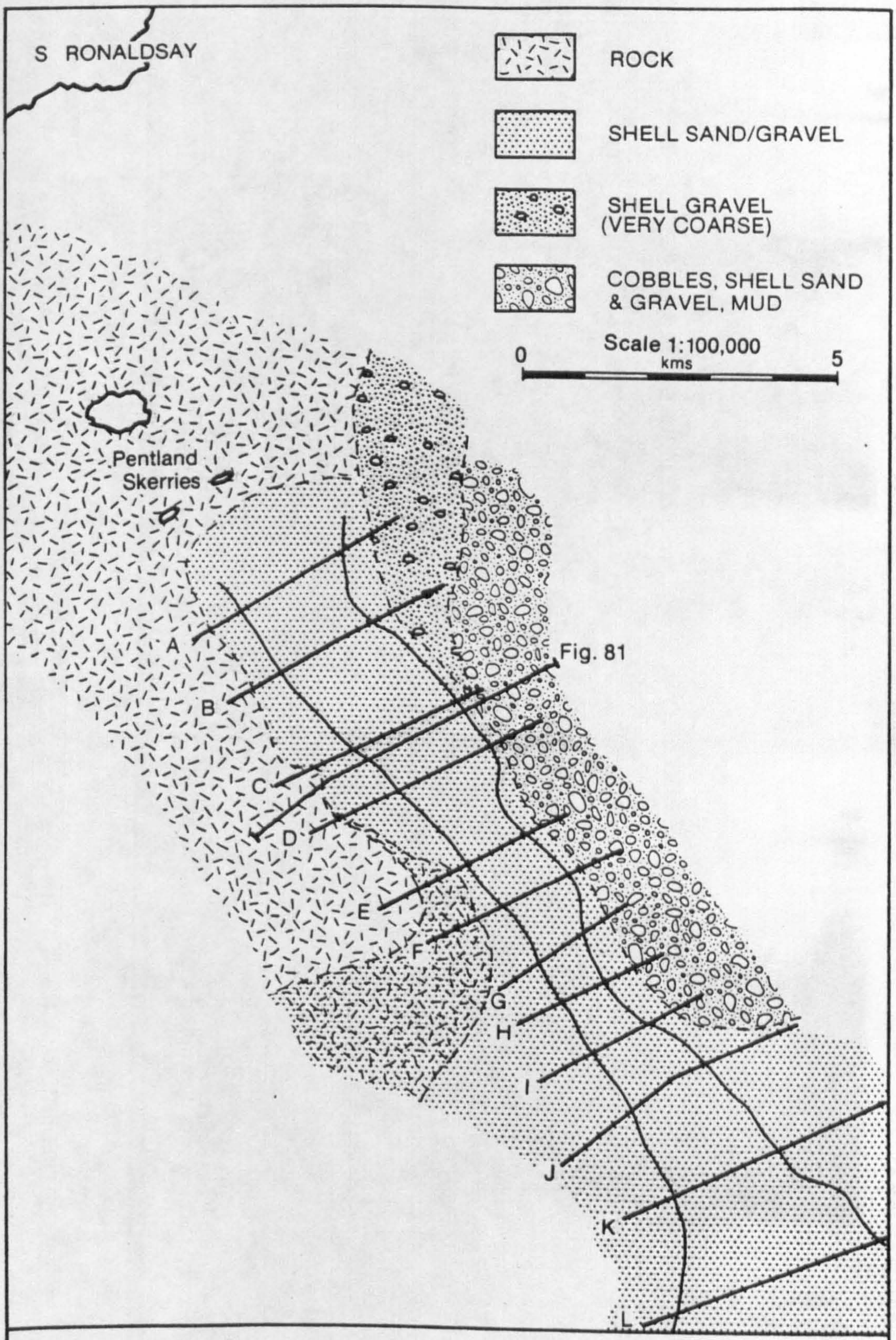


Figure 75 Sediment distribution around Sandy Riddle.
Also showing lines of sections for Fig 79

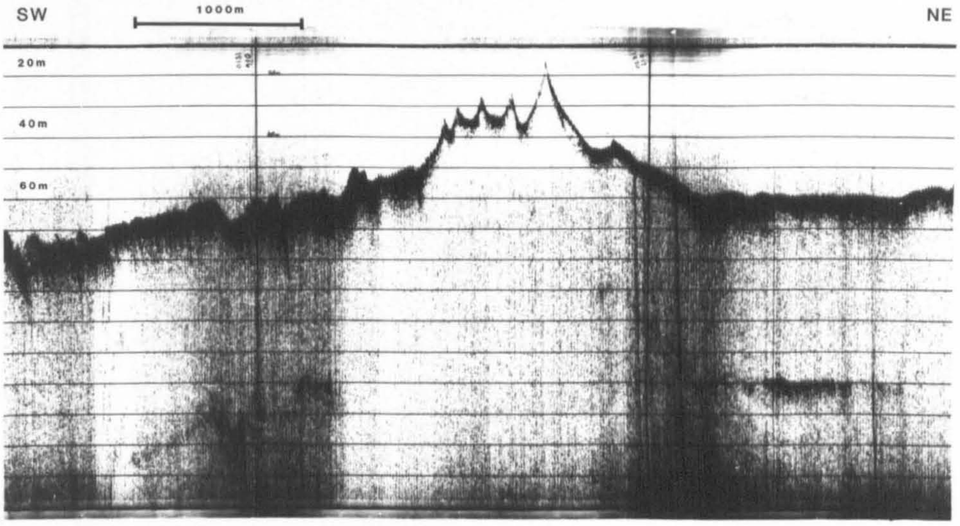


Figure 76 Pinger profile across the carbonate sandbank, Sandy Riddle. Line A (see Fig 75). Sandwaves 10 m high have steep sides facing east.

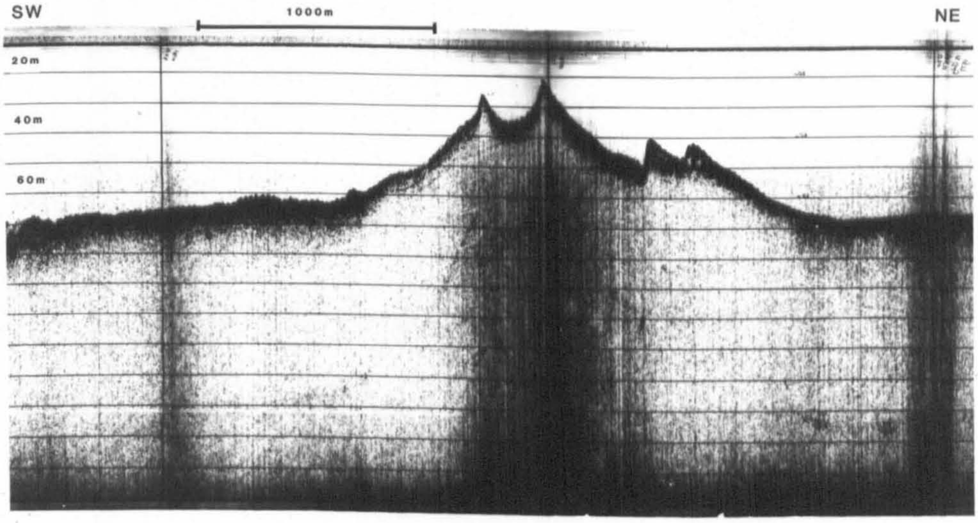


Figure 77 Pinger profile across the carbonate sandbank, Sandy Riddle. Line B (see Fig. 75). Sandwaves are 10m high and have steep sides facing west.

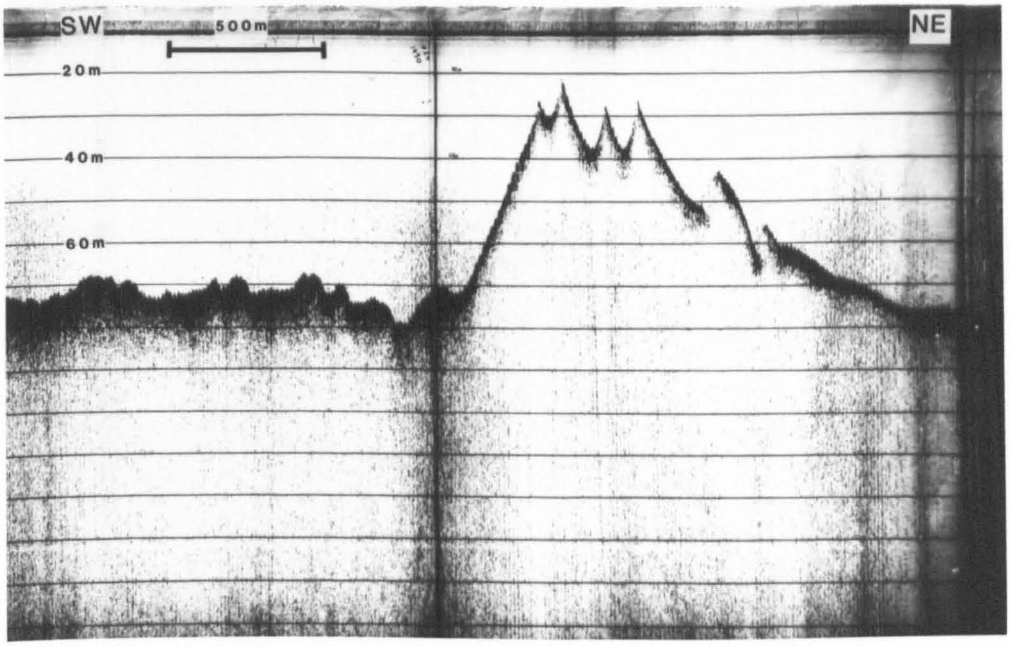


Figure 78 Pinger profile across the carbonate sandbank, Sandy Riddle. Line C (see Fig. 75). Sandwaves are 10m high and have steep sides facing west.

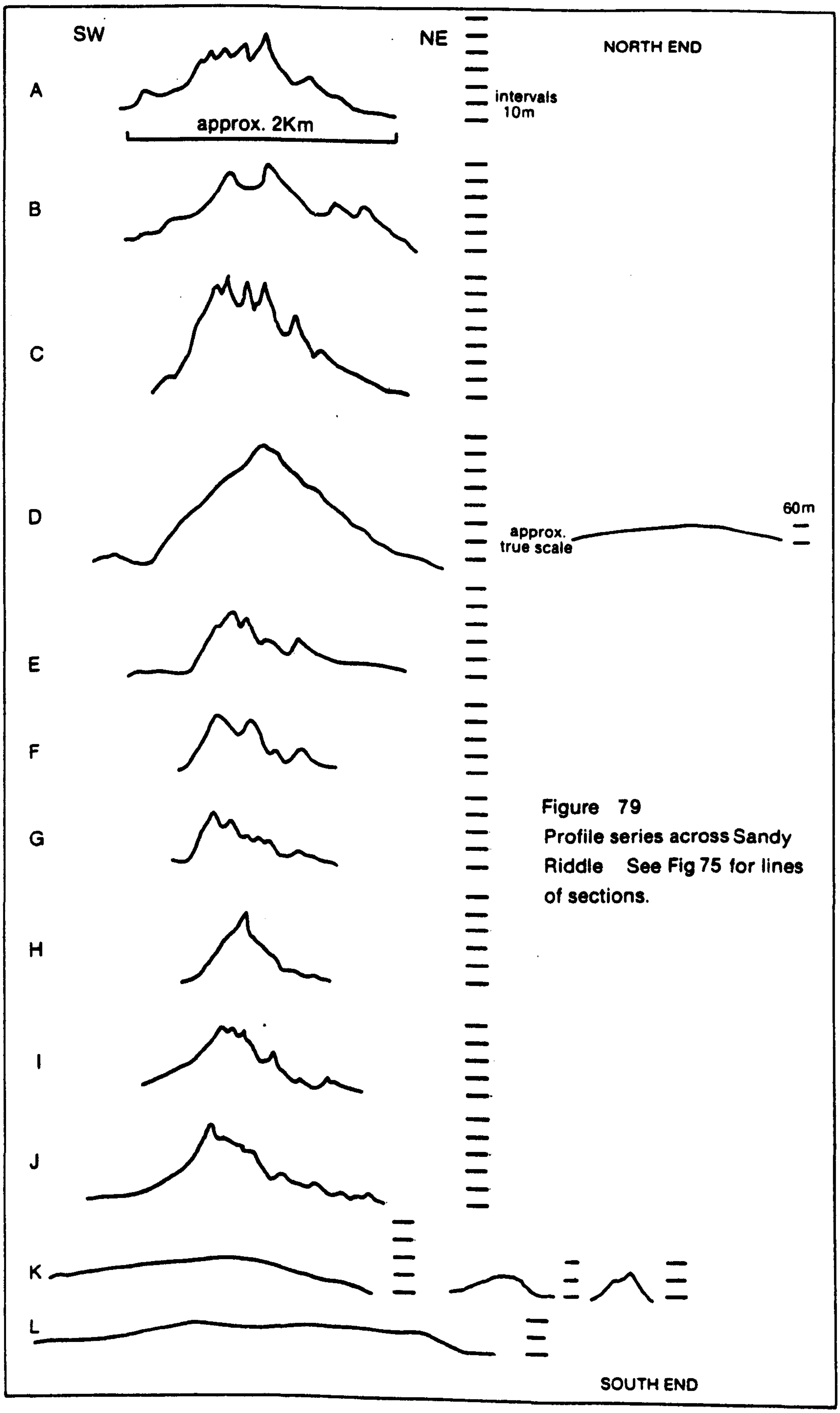


Figure 79
Profile series across Sandy Riddle See Fig 75 for lines of sections.

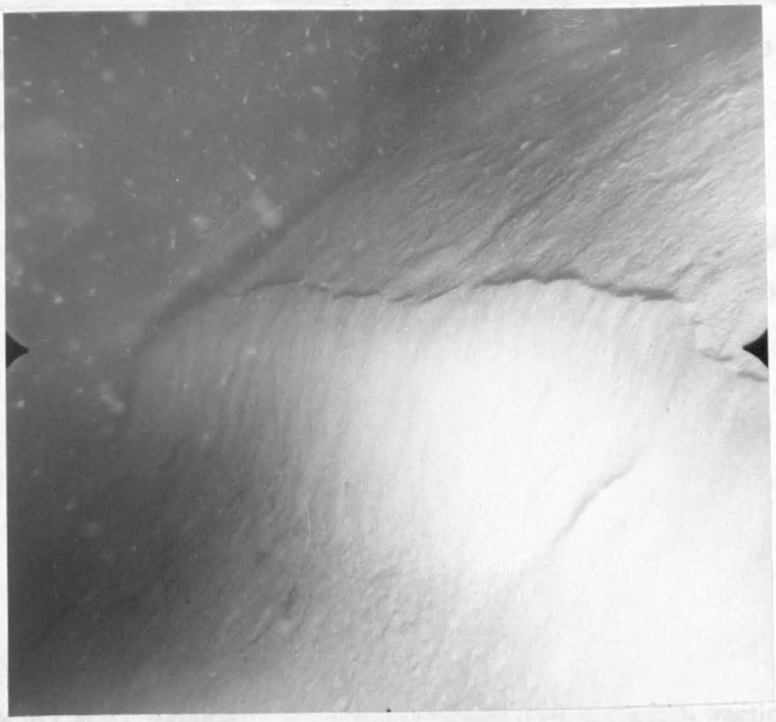


Figure 80 Underwater photograph of a carbonate megaripple on the south-west flank of the sandbank, Sandy Riddle. The feature has a relief of 30-50cm. Note the reworked lip on its crest(picture taken just after 'slack' tide. Water depth approx. 50m.

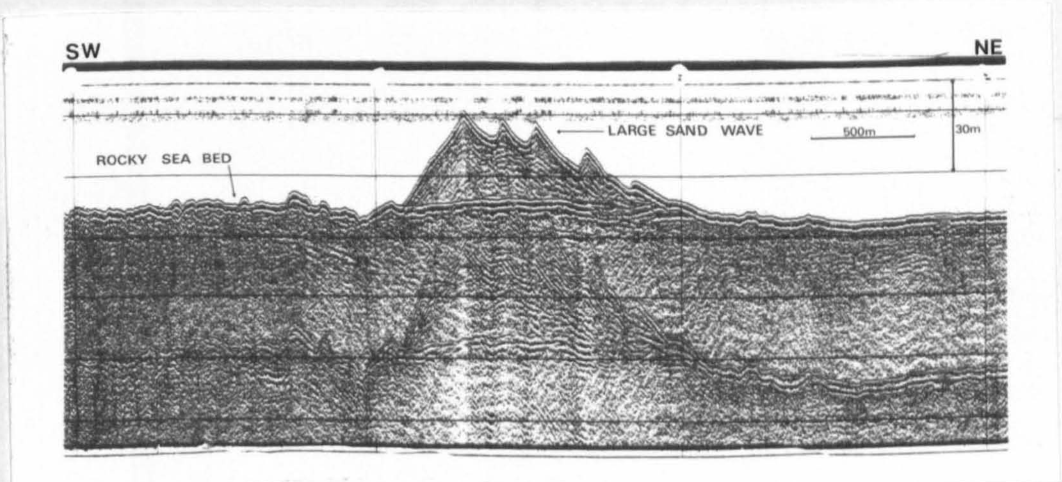
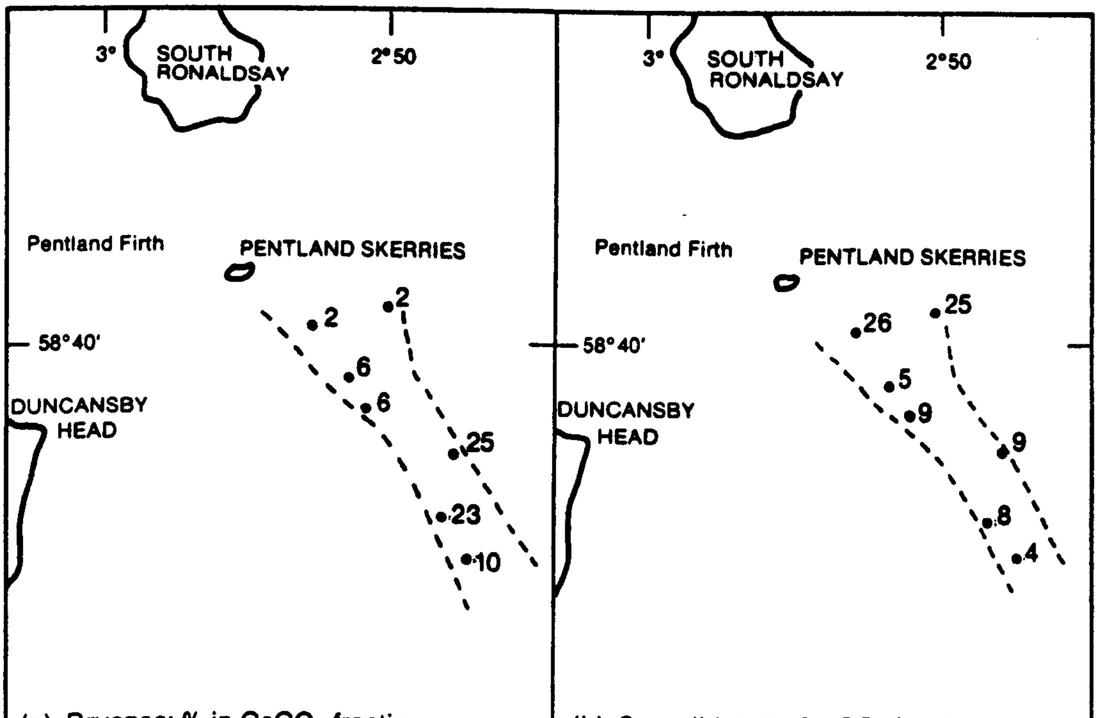
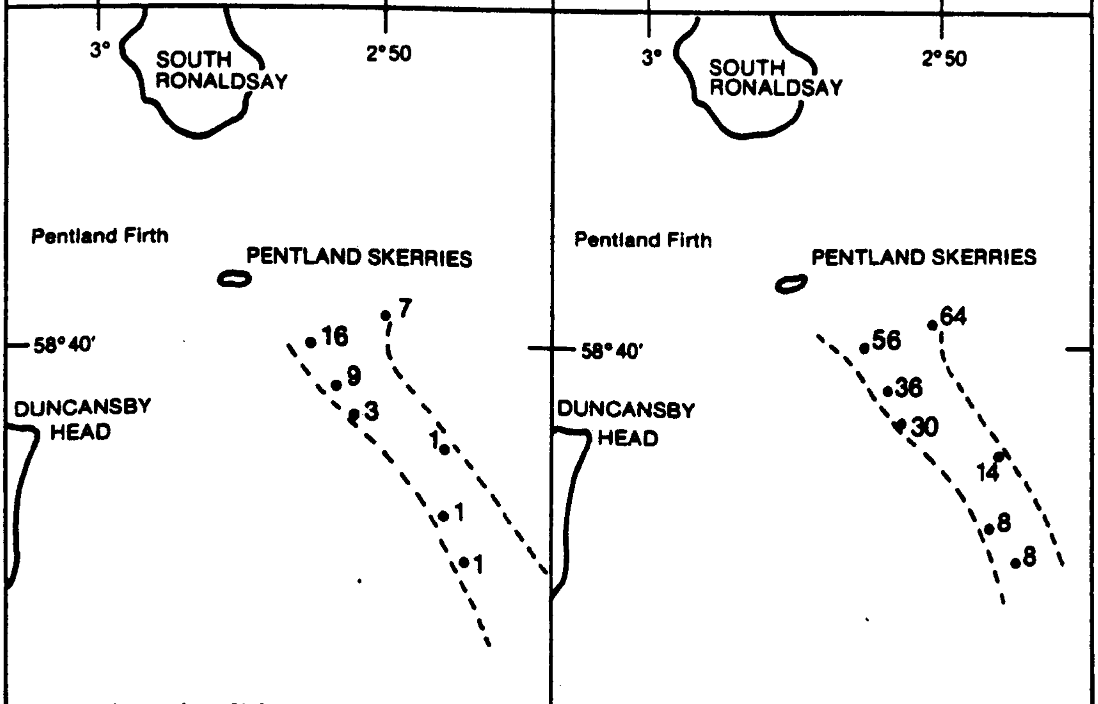


Figure 81 Sparker line through the carbonate sandbank, Sandy Riddle, showing that the feature consists entirely of superficial sediment approx. 30m thick at this location (see Fig 52c & Fig. 75).



(a) Bryozoa; % in $CaCO_3$ fraction

(b) Serpulid; % in $Ca\ CO_3$ fraction



(c) Lithic grains; % in sample

(d) Gravel; % in sample

Figure 82 Petrographic variation along the length of the carbonate sandbank Sandy Riddle

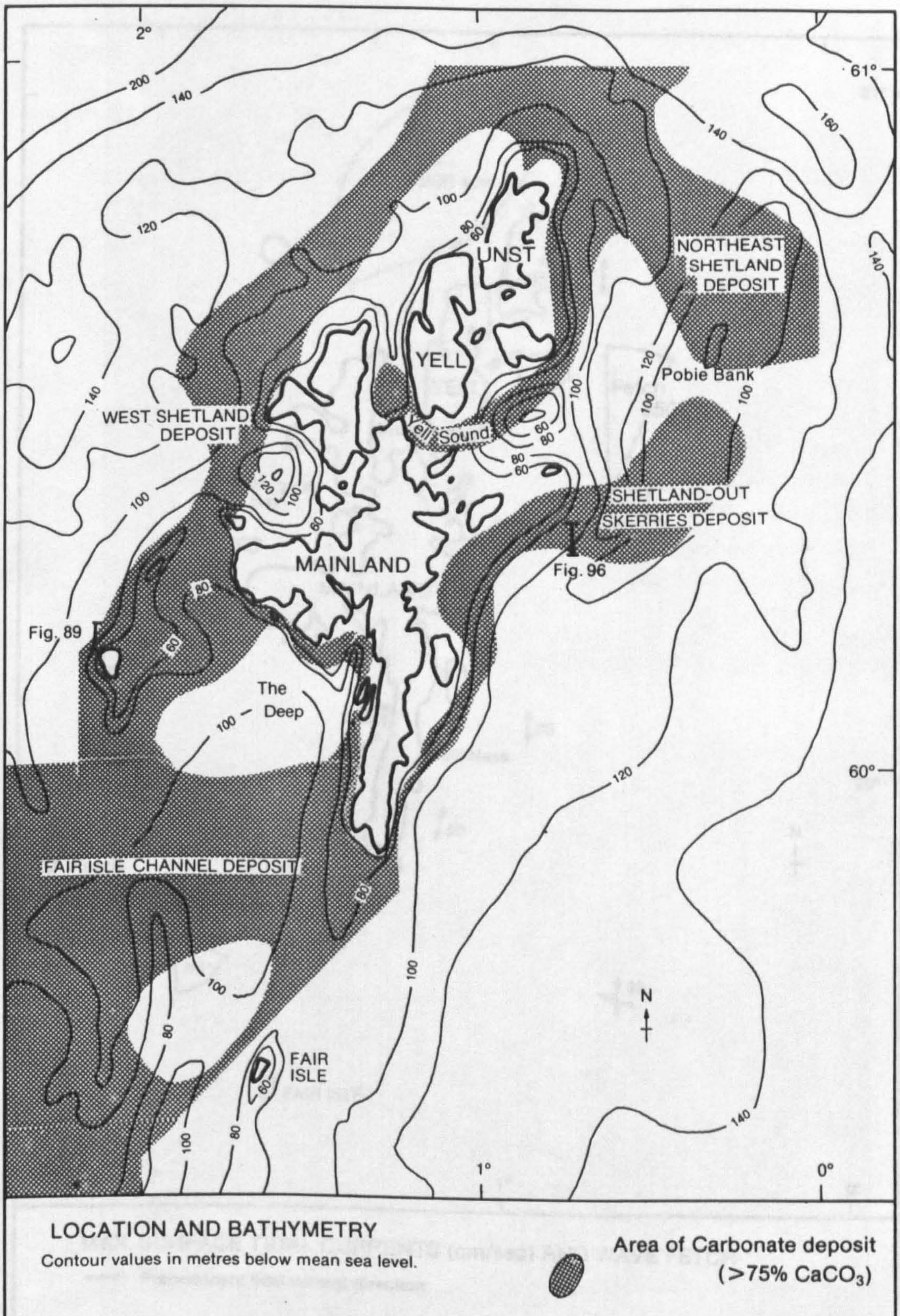
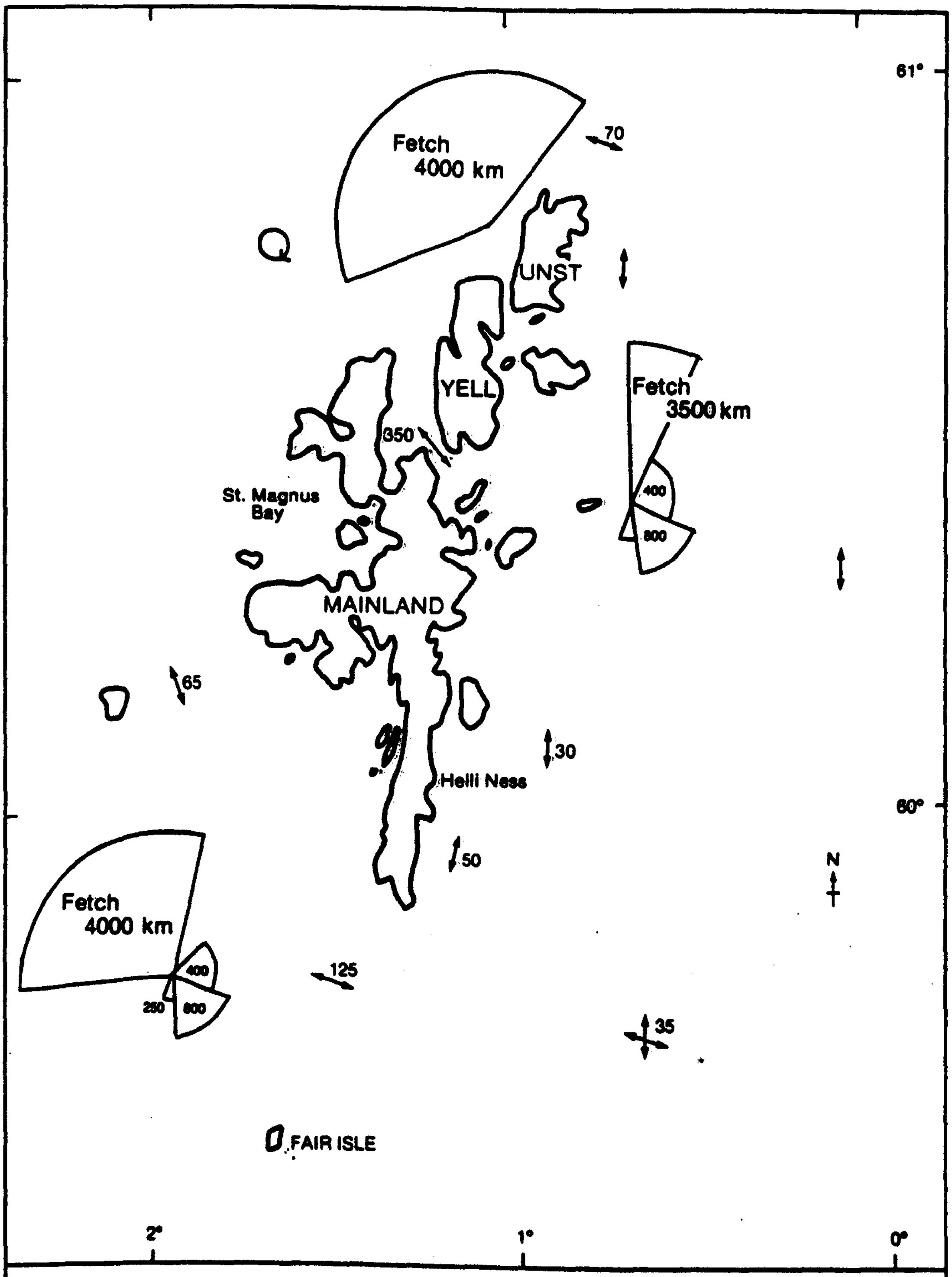


Figure 83 West Shetland Northeast Shetland
Shetland-Out Skerries
Yell Sound Deposits

Scale 1:1,000,000
0 kms 25



MAX. SURFACE TIDAL CURRENTS (cm/sec) AND WAVE FETCH

⟷ Predominant tidal current direction

Figure 84 West Shetland – Northeast Shetland
Shetland-Out Skerries
Yell Sound Deposits

Scale 1:1,000,000
0 kms 30

Figure 85 Consub photograph taken in St Magnus Bay, West Shetland deposit (see Fig. 84). Water depth 108m. Rocks are extensively encrusted by serpulids and other calcareous organisms. Also heavily populated by echinoids and crustacea.
Field of view approx. 50cm.

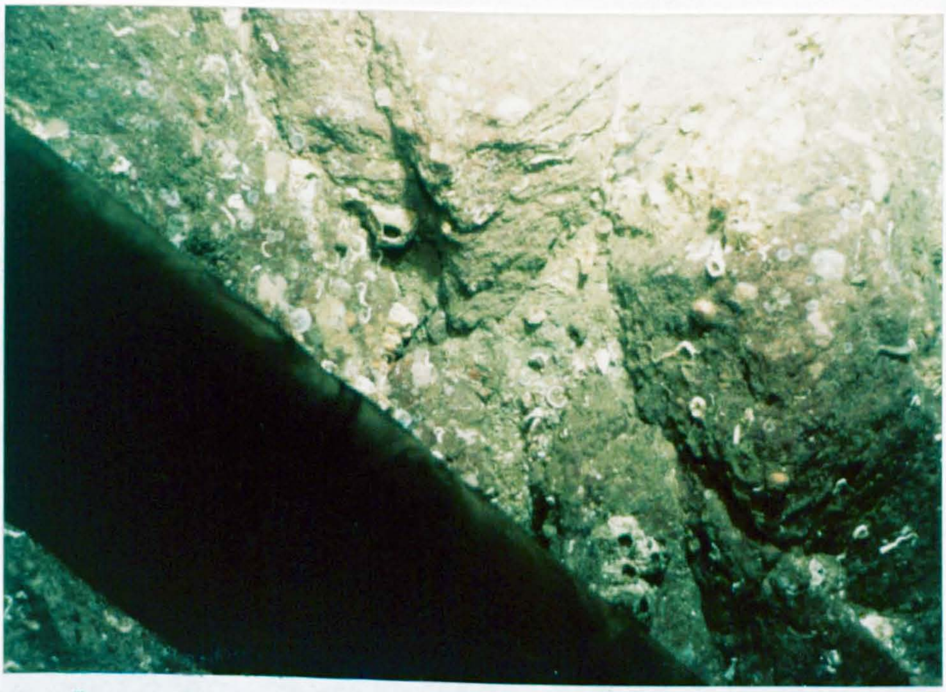


Figure 86 Consub photograph taken in St Magnus Bay, West Shetland deposit (see Fig. 84). Water depth 108m. Besides serpulid encrustations, barnacles are fairly common.
Field of view approx. 30 cm.

Figure 87 Consub photograph taken in St. Magnus Bay, West Shetland deposit (see Fig. 84). Water depth 100m. Encrusted with serpulids and heavily populated by echinoids, ophiuroids and asteroids. Field of view approx. 70cm.

Figure 88 Consub photograph of large accumulation of shell gravel, in St Magnus Bay at 100m. Debris is very discoloured and may be relict from times of lower sealevel. Probably comprises mainly Modiolus and Glycymeris.
Field of view approx. 70 cm (foreground).

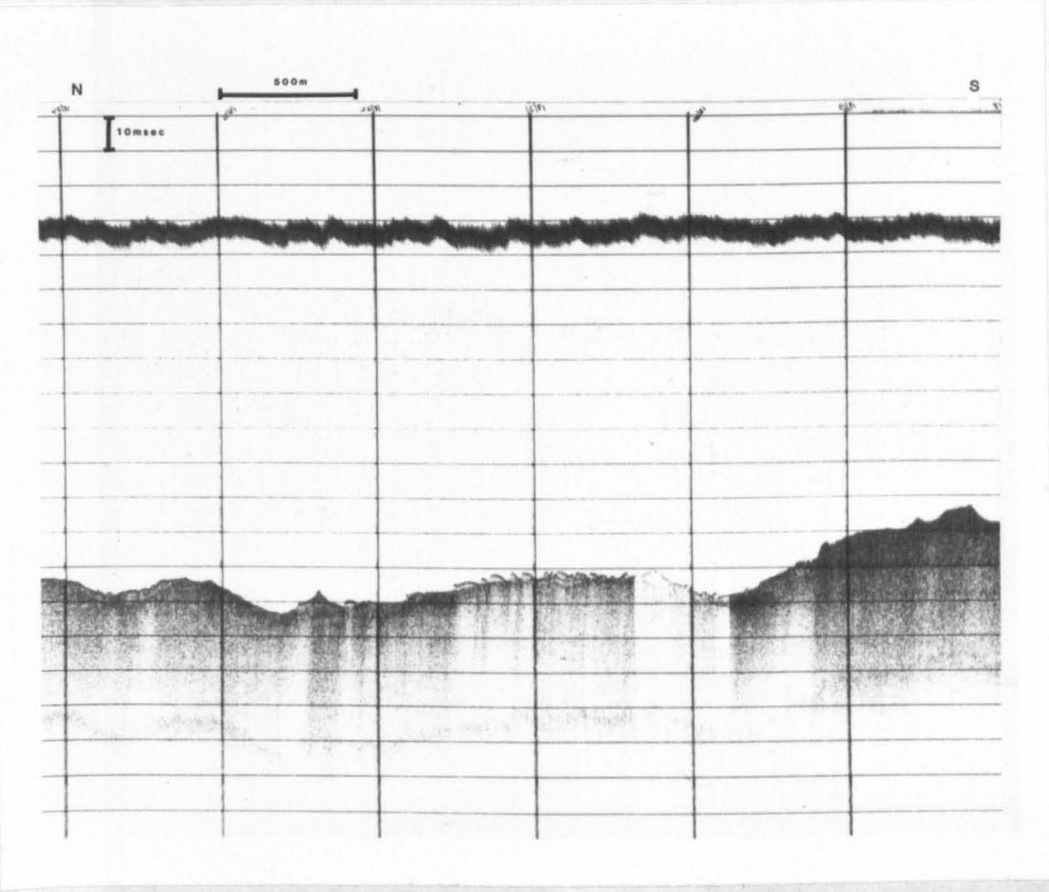


Figure 89 Boomer line through the West Shetland deposit north of Foula (see Fig. 83). The sandwaves (presumably of carbonate) are 2.5m high and face in a northerly direction.

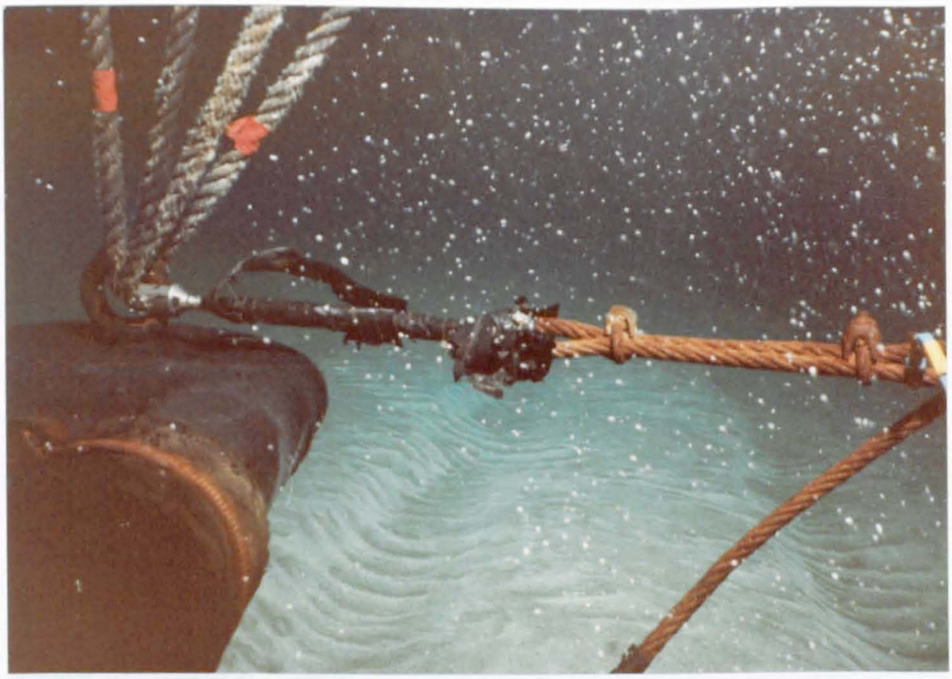


Figure 90 Consub photograph of asymmetrical (? tidal-current generated) carbonate megaripples east of Foula, West Shetland deposit (see Figs 83 & 84). Heights approx. 30cm and wavelengths 1m. Note small-scale ripples in troughs at right-angles to the megaripples. Water depth 38m.

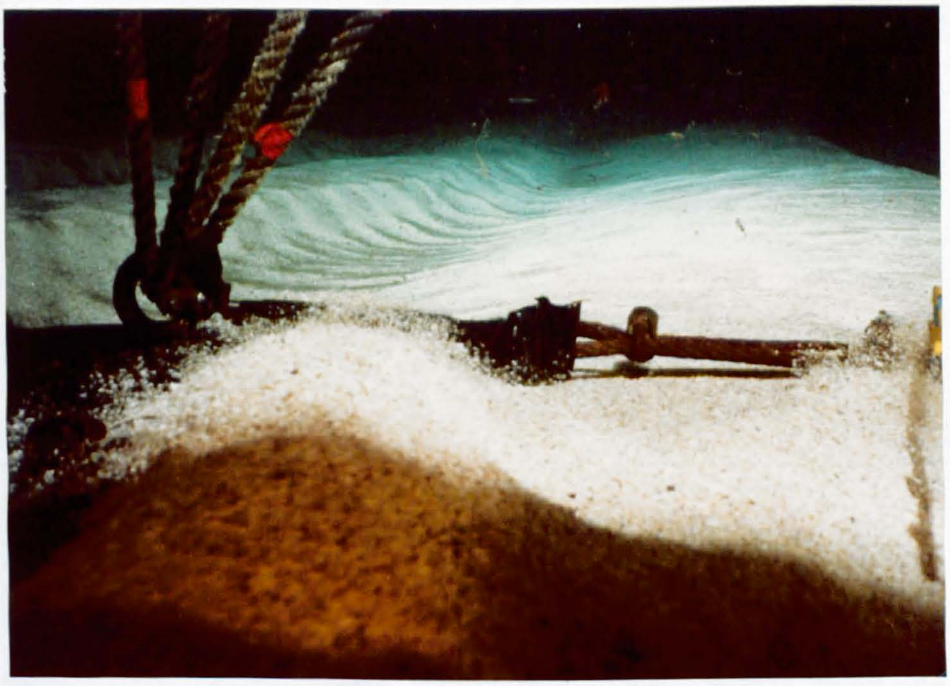


Figure 91 Consub photograph of carbonate megaripples east of Foula. See above.

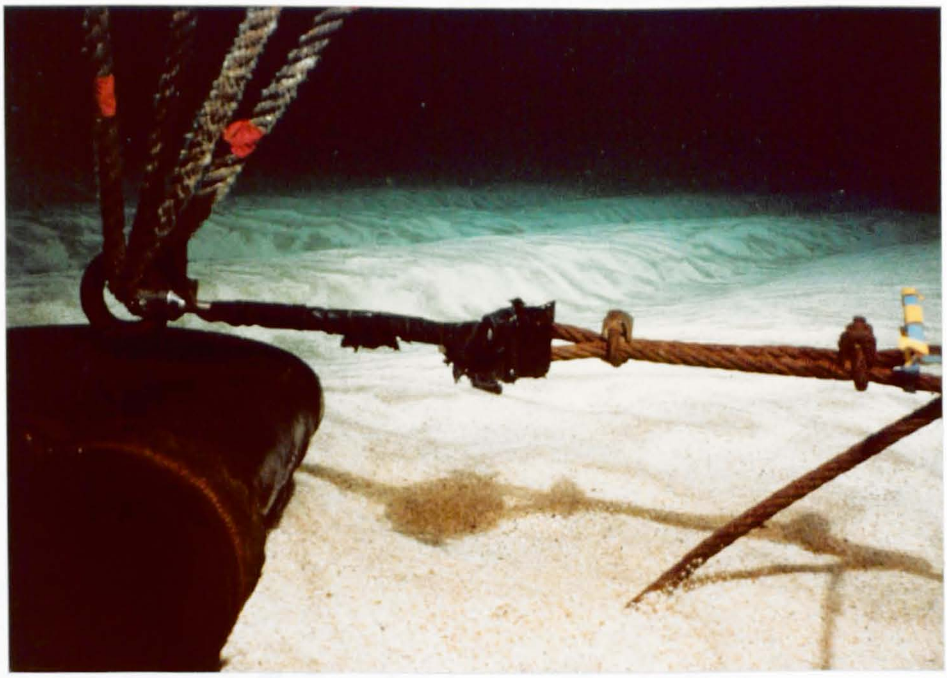


Figure 92 Consub photograph of carbonate megaripples east of Foula. See Fig. 90 for description.

Figure 93 Consub photograph of carbonate sediment in the vicinity of the megaripple field east of Foula, West Shetland deposit (see Figs 83 & 84). Water depth 38m.

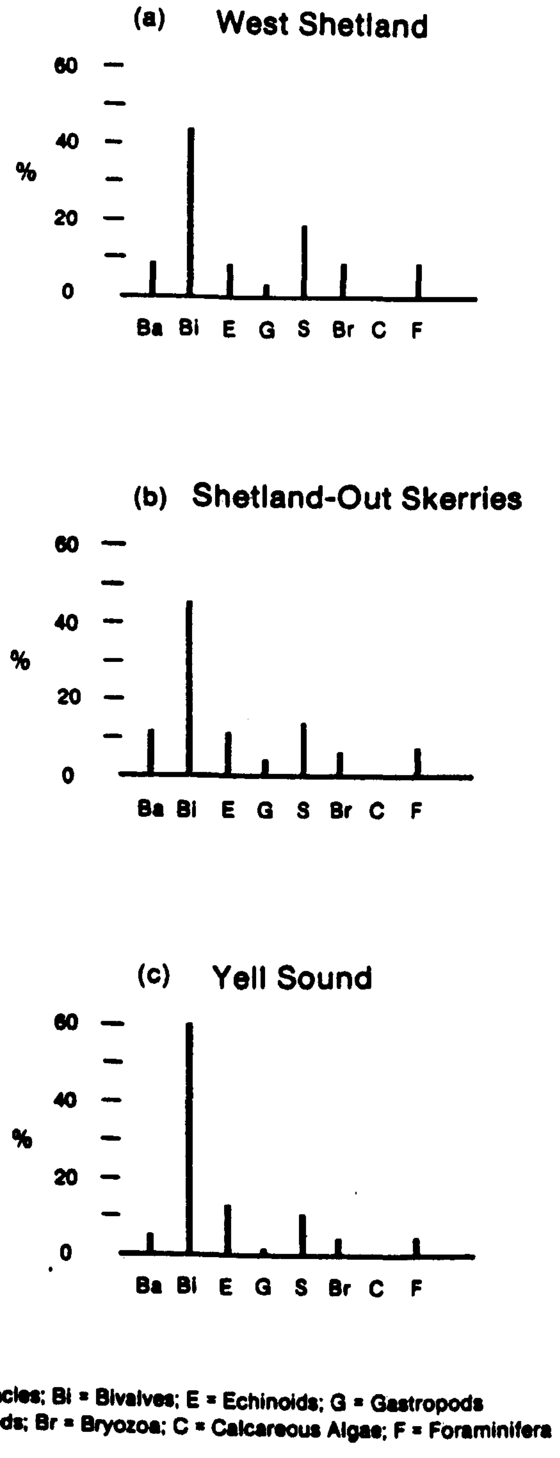


Figure 94 Biogenic composition of Shetland carbonates

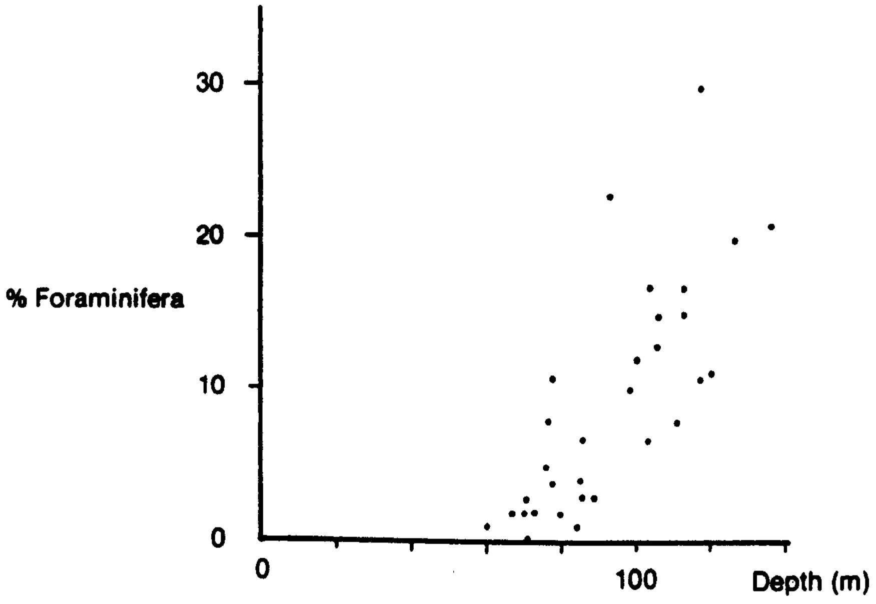


Figure 95 Variation diagram for carbonate foraminiferal content v. water depth West Shetland

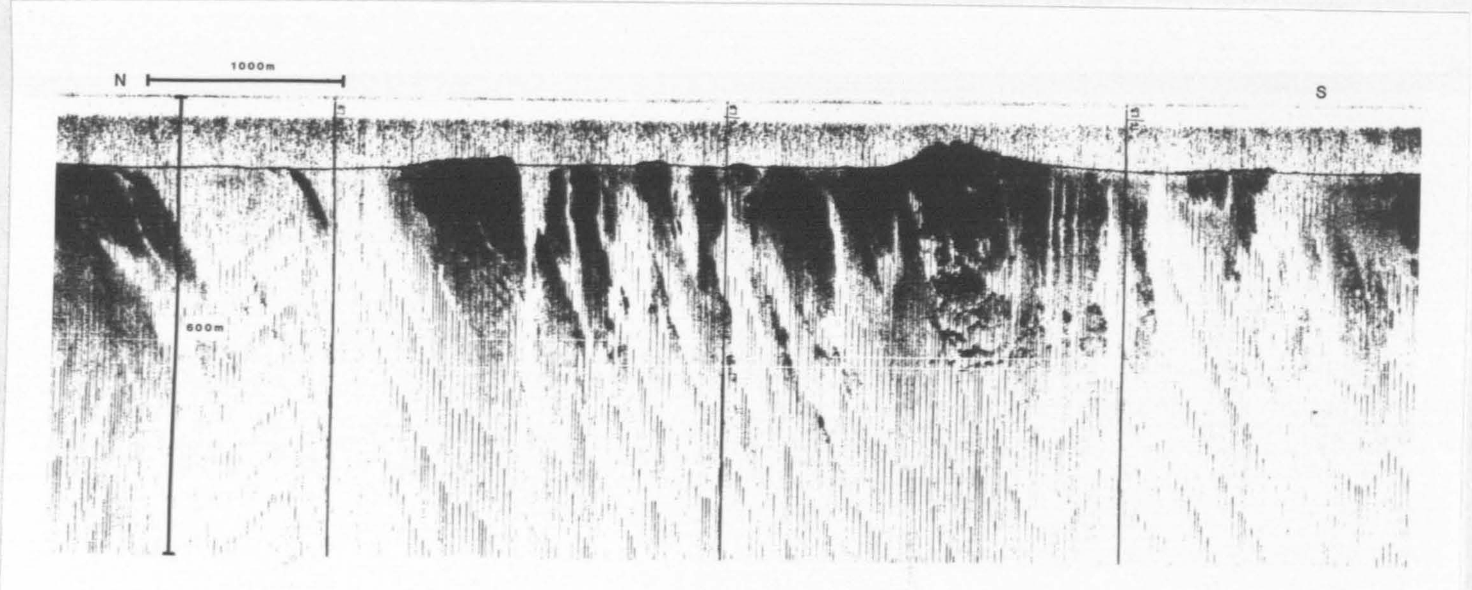


Figure 96 Side-scan sonar record across Shetland - Out skerries deposit, east of Whalsey, showing linear sand/gravel patches developed between rock outcrops.

Figure 97 Consub photograph of the seabed west of Helli Ness, Shetland - Out Skerries deposit (see Figs 83 & 84). The carbonate gravel is spread thinly over a cobbly base. Numerous whole valves are also visible. Note the fragment of the branching coral Lophelia (top right). Water depth 96m.

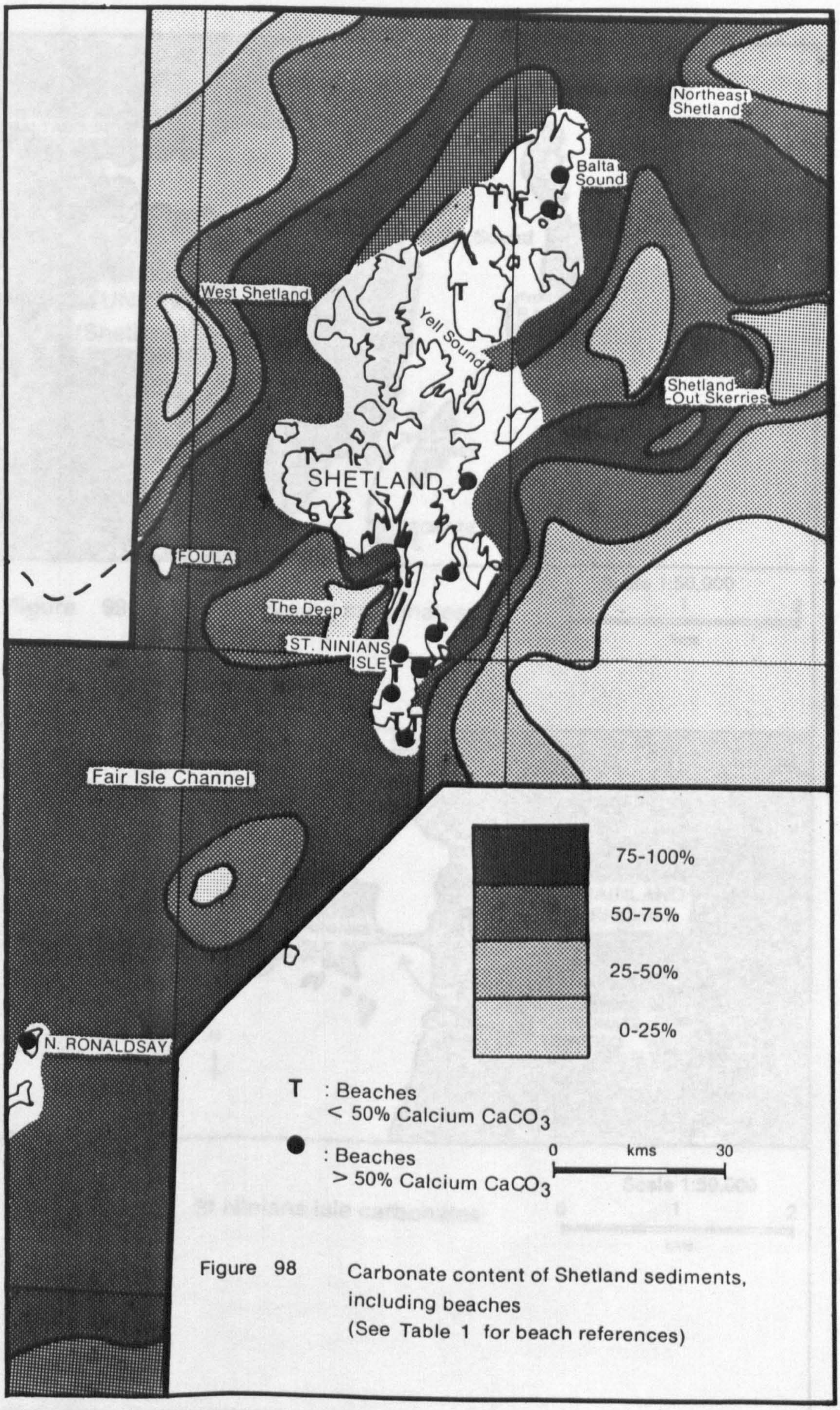


Figure 98 Carbonate content of Shetland sediments, including beaches (See Table 1 for beach references)

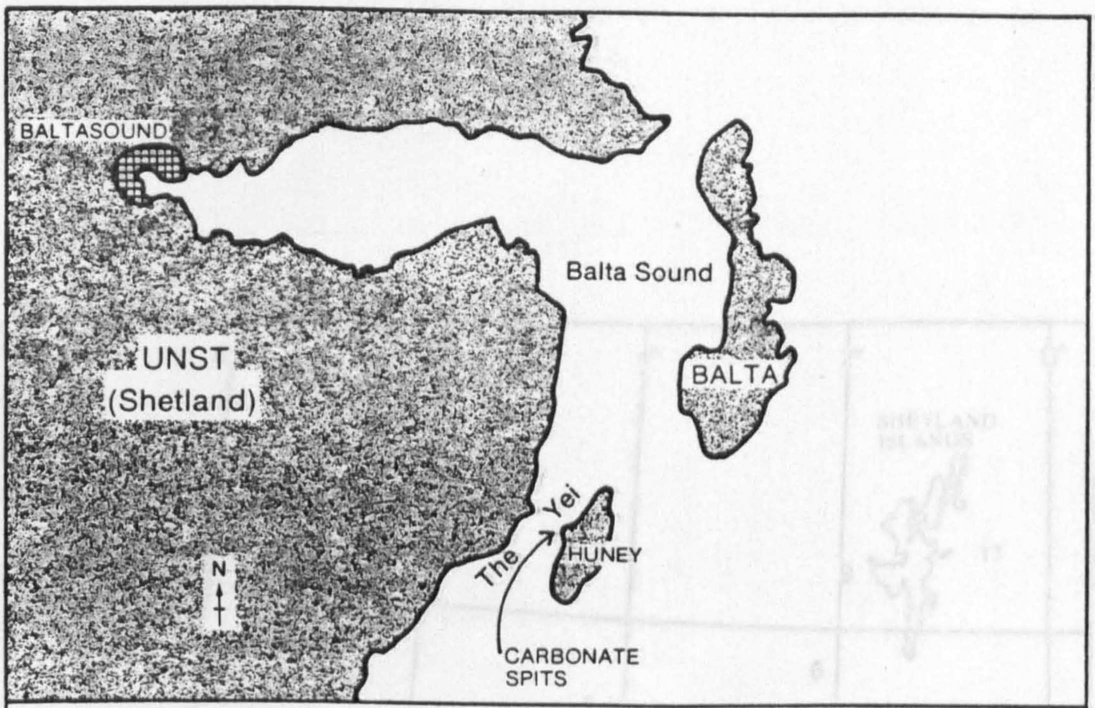


Figure 99 Balta Sound carbonates

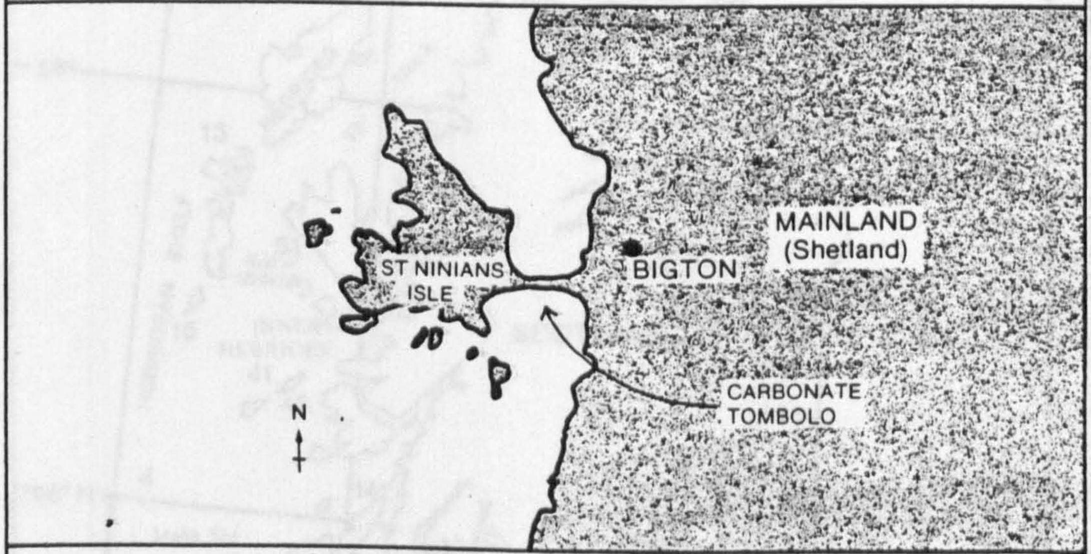


Figure 100 St Ninians Isle carbonates

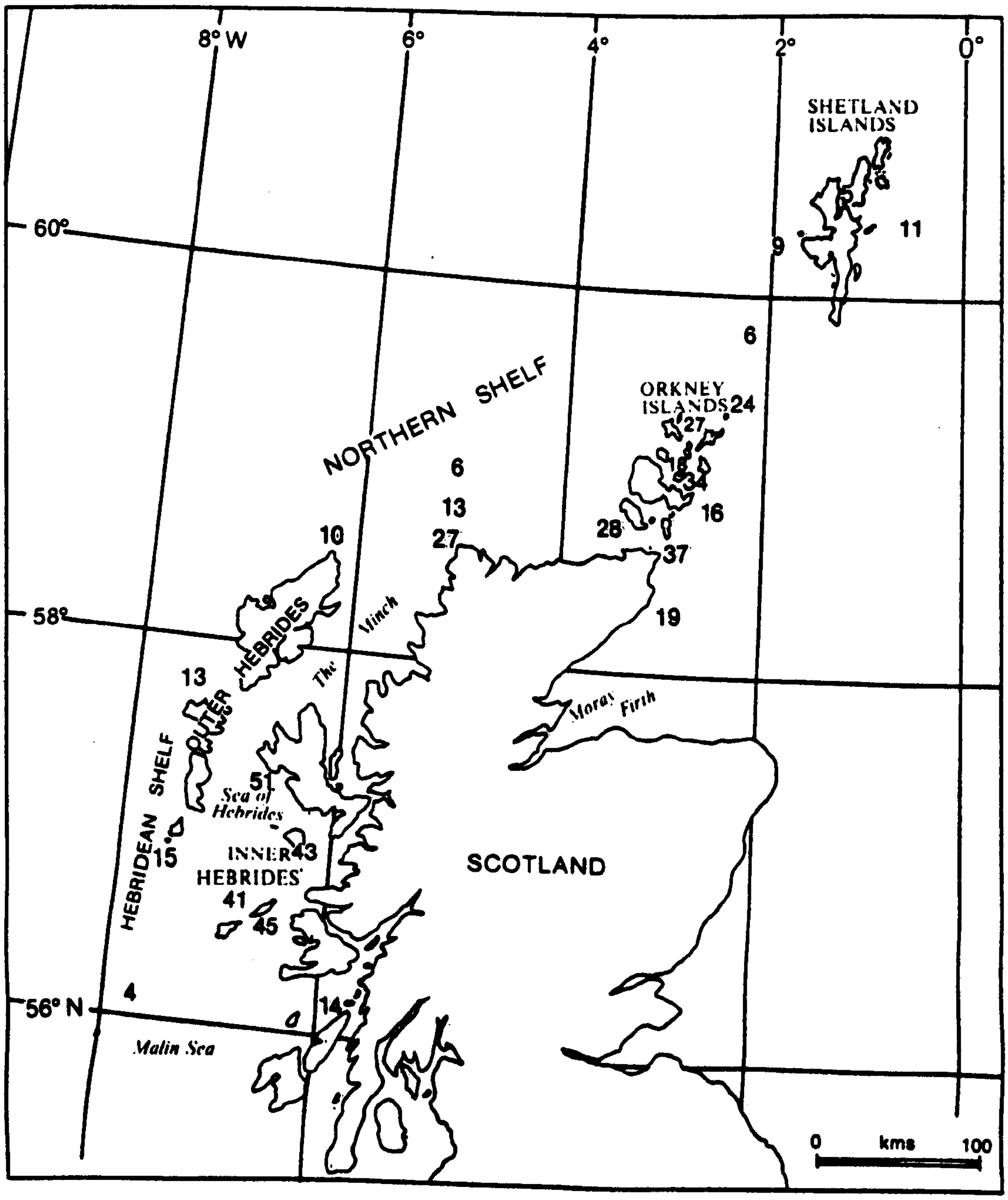


Figure 101 Variation in average barnacle content between carbonate deposits on the SCS. Values represent % in identifiable carbonate fraction

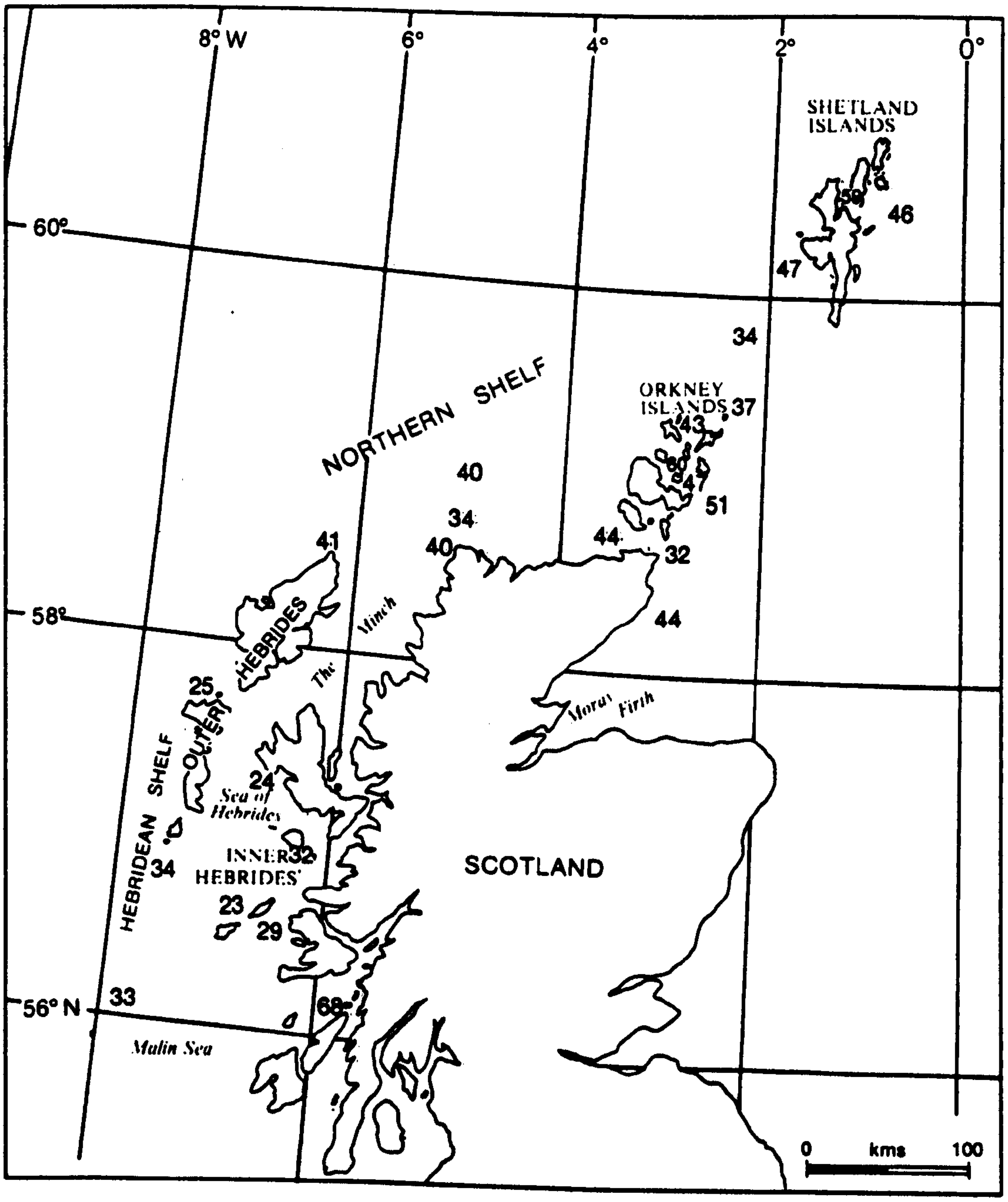


Figure 102 Variation in average bivalve content between carbonate deposits on the SCS. Values represent % in identifiable carbonate fraction

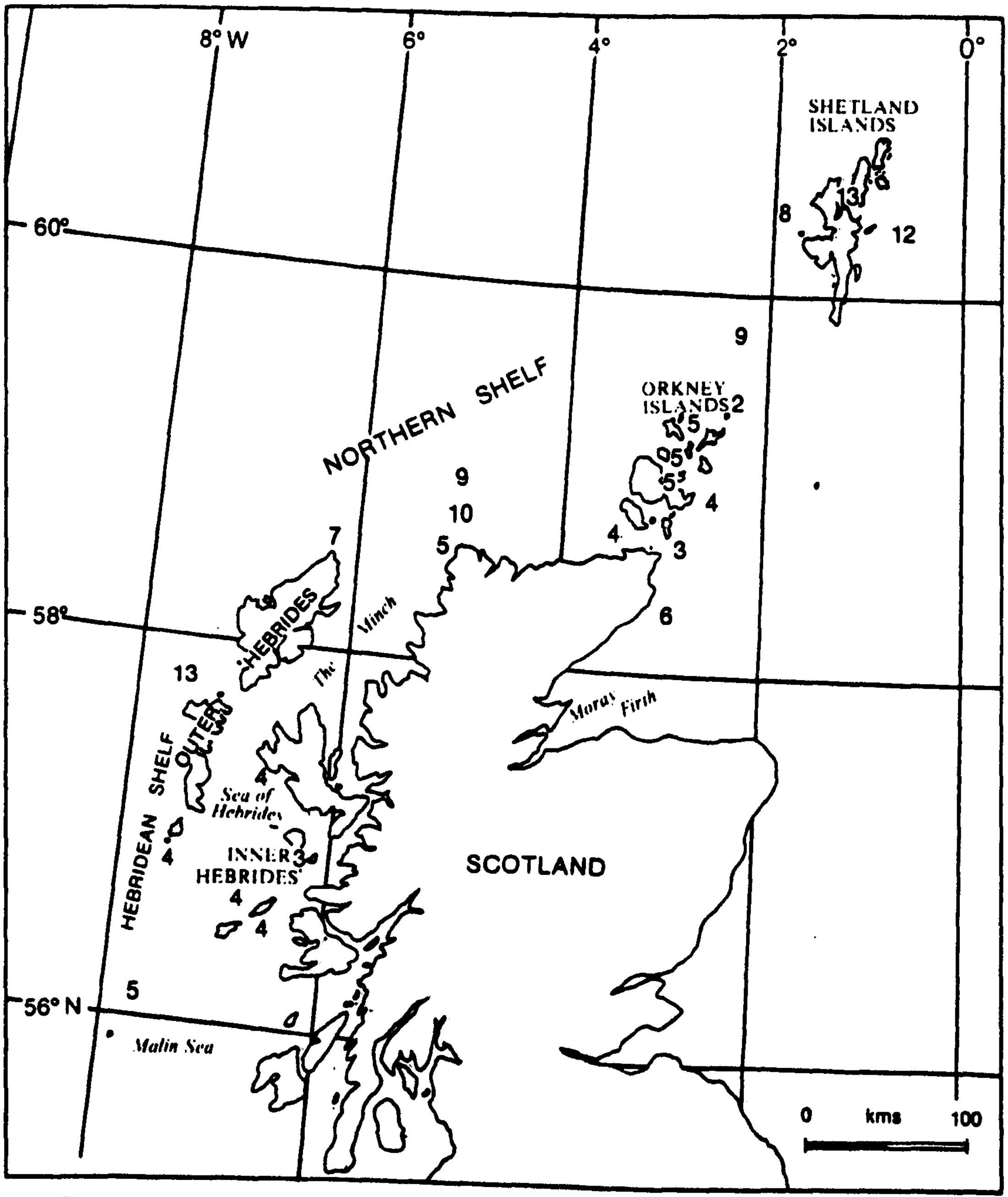


Figure 103 Variation in average echinoid content between carbonate deposits on the SCS. Values represent % in identifiable carbonate fraction

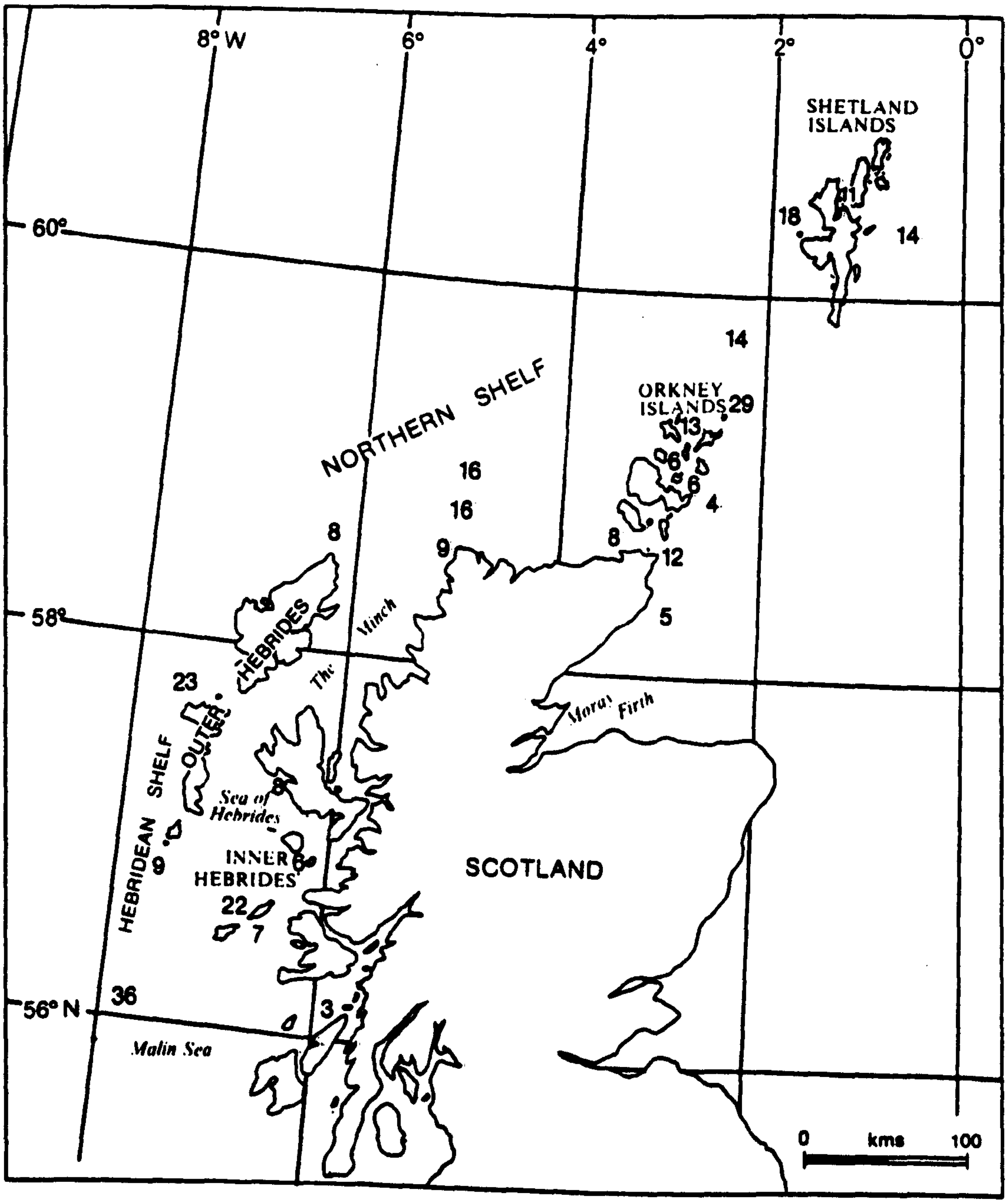


Figure 104 Variation in average serpulid content between carbonate deposits on the SCS. Values represent % in identifiable carbonate fraction

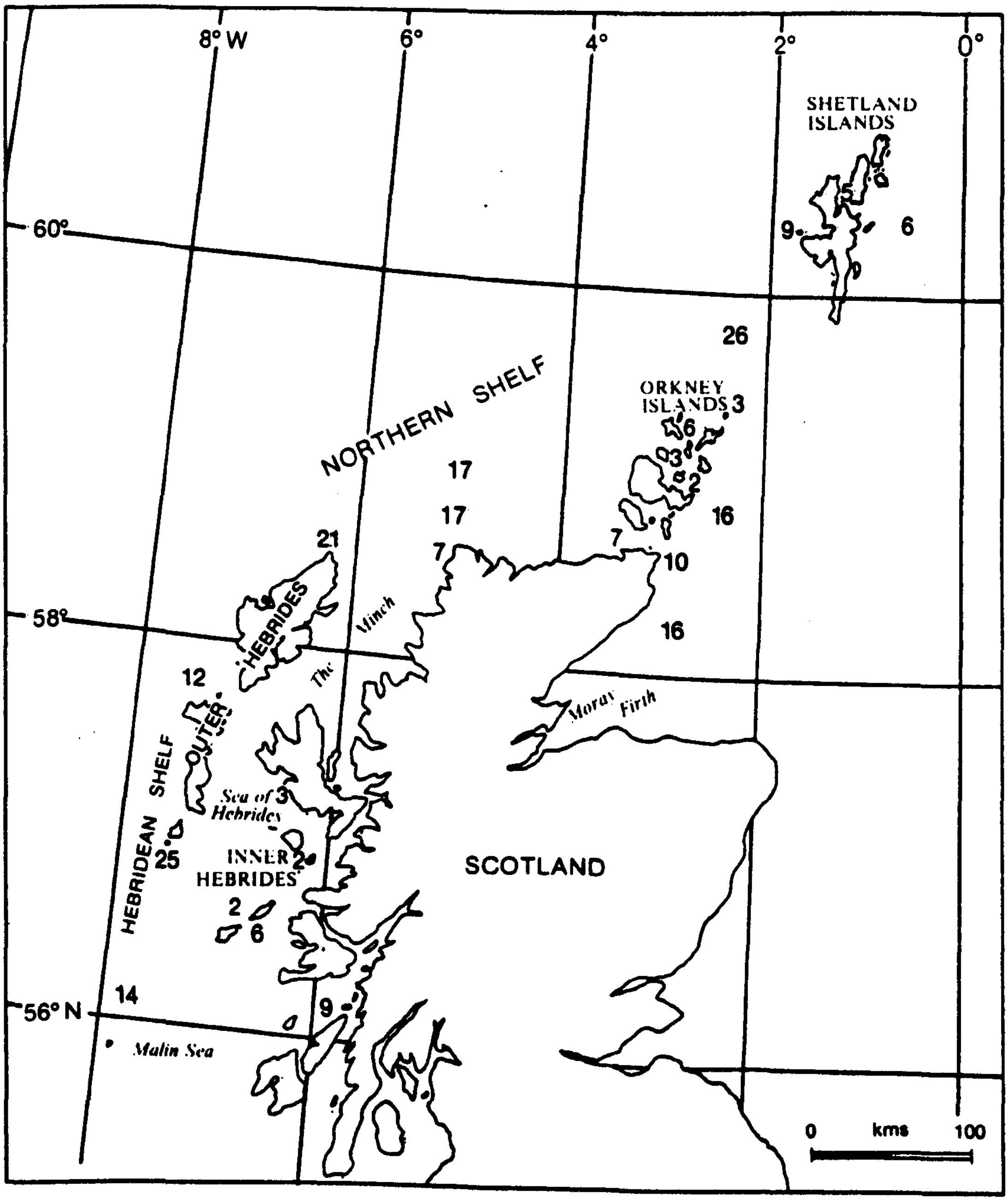


Figure 105 Variation in average bryozoan content between carbonate deposits on the SCS. Values represent % in identifiable carbonate fraction

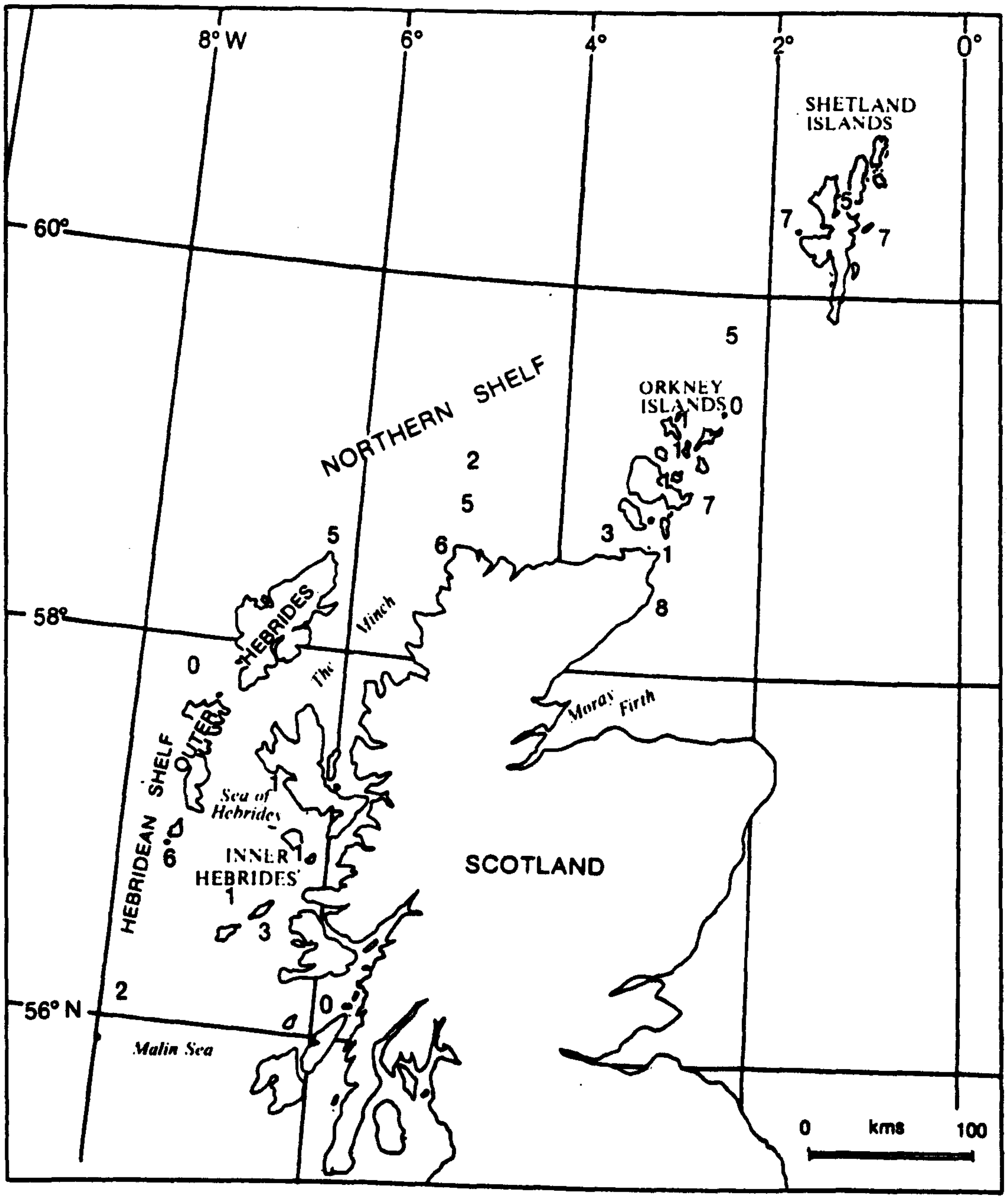


Figure 106 Variation in average foraminiferal content between carbonate deposits on the SCS. Values represent % in identifiable carbonate fraction

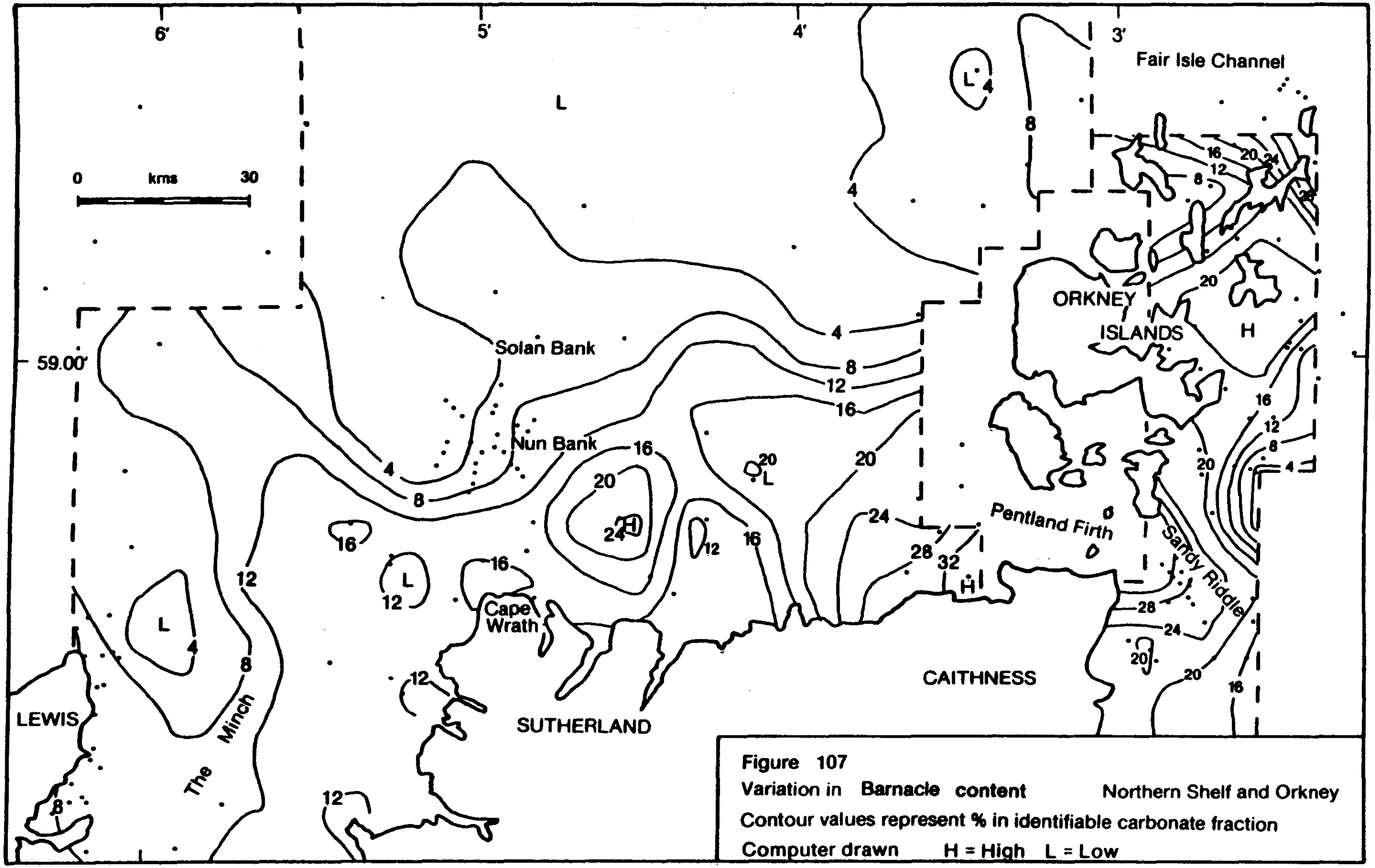


Figure 107
Variation in **Barnacle content** Northern Shelf and Orkney
Contour values represent % in identifiable carbonate fraction
Computer drawn H = High L = Low

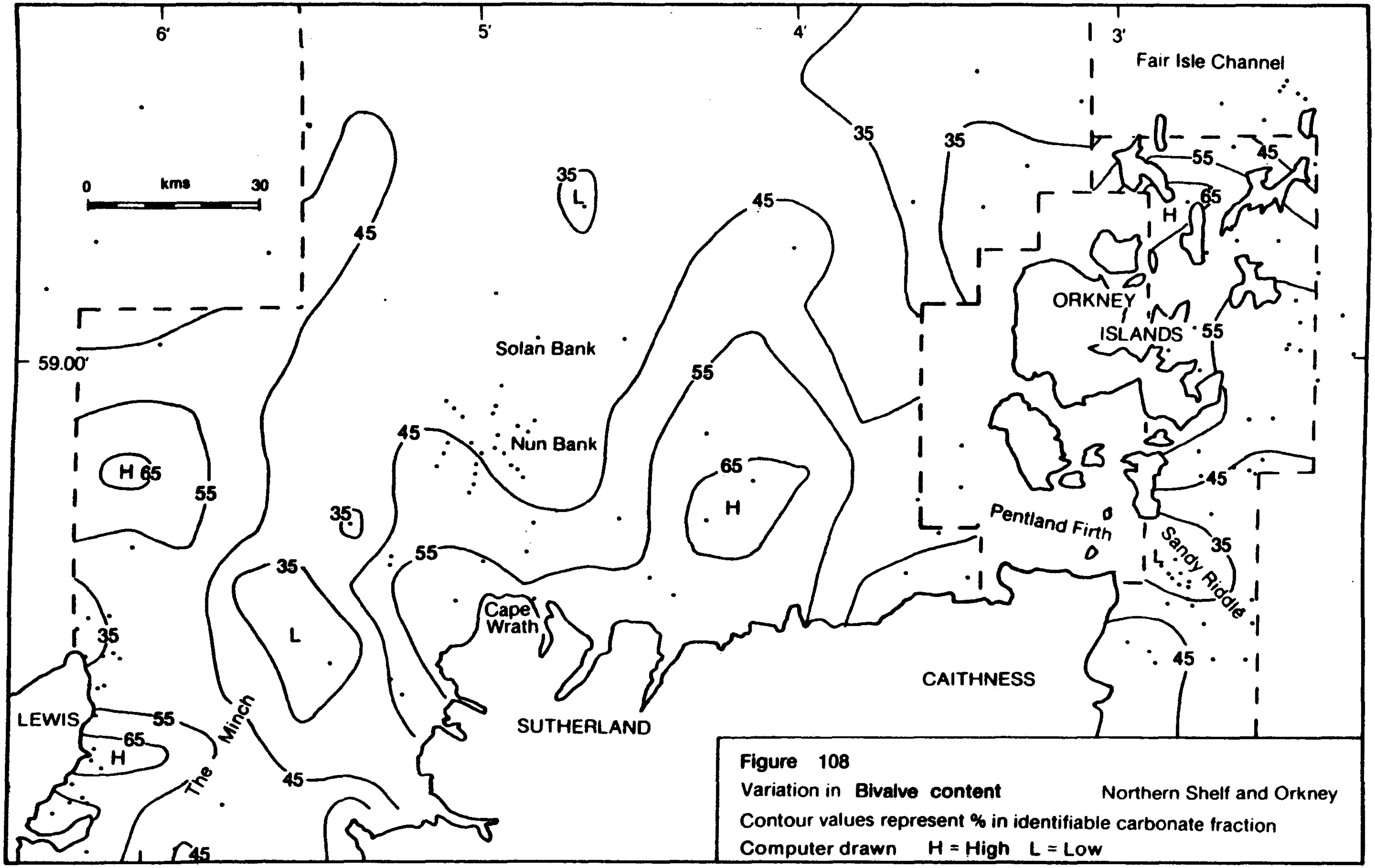


Figure 108
Variation in **Bivalve content** Northern Shelf and Orkney
Contour values represent % in identifiable carbonate fraction
Computer drawn H = High L = Low

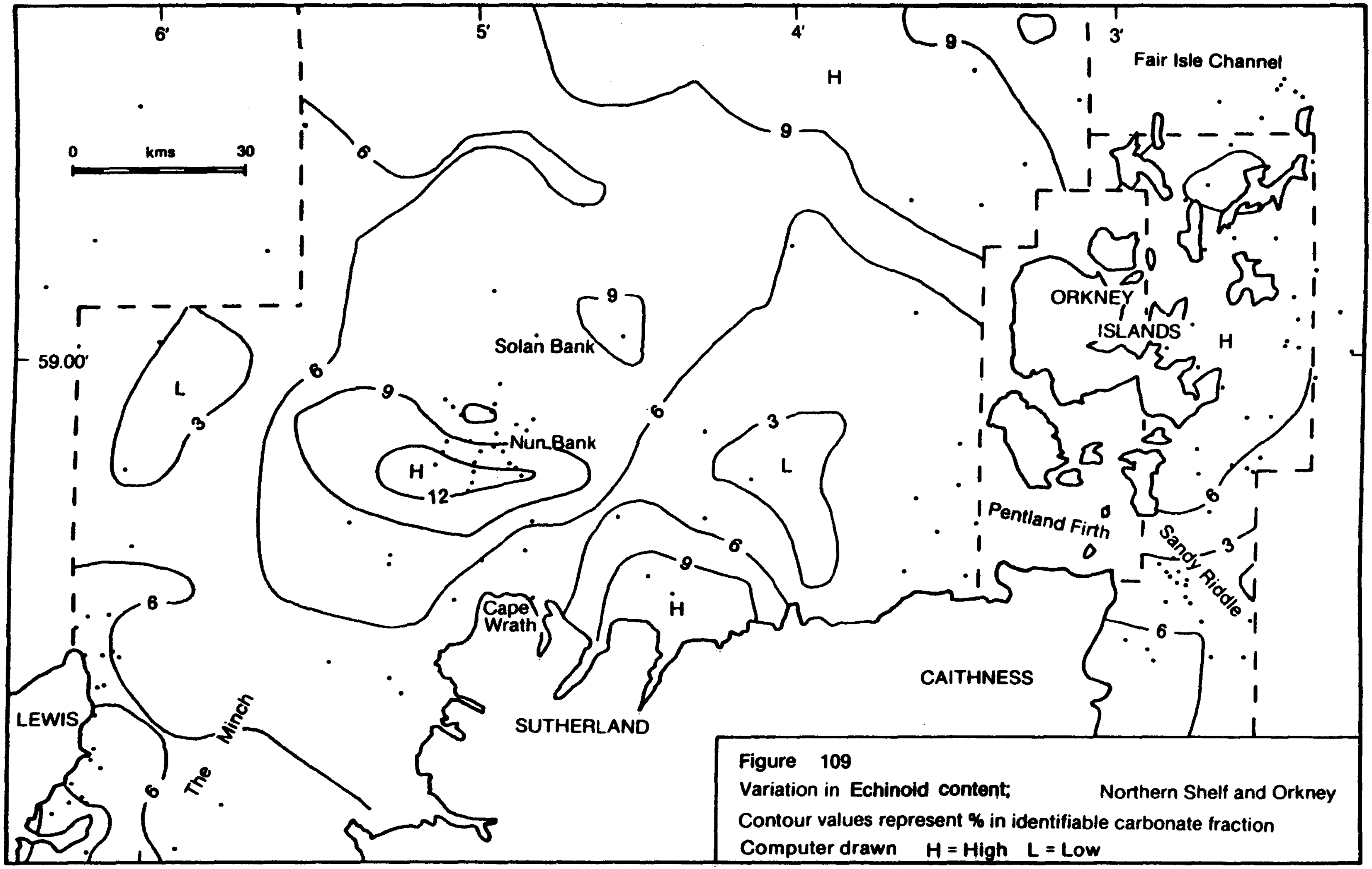


Figure 109
Variation in Echinoid content; Northern Shelf and Orkney
Contour values represent % in identifiable carbonate fraction
Computer drawn H = High L = Low

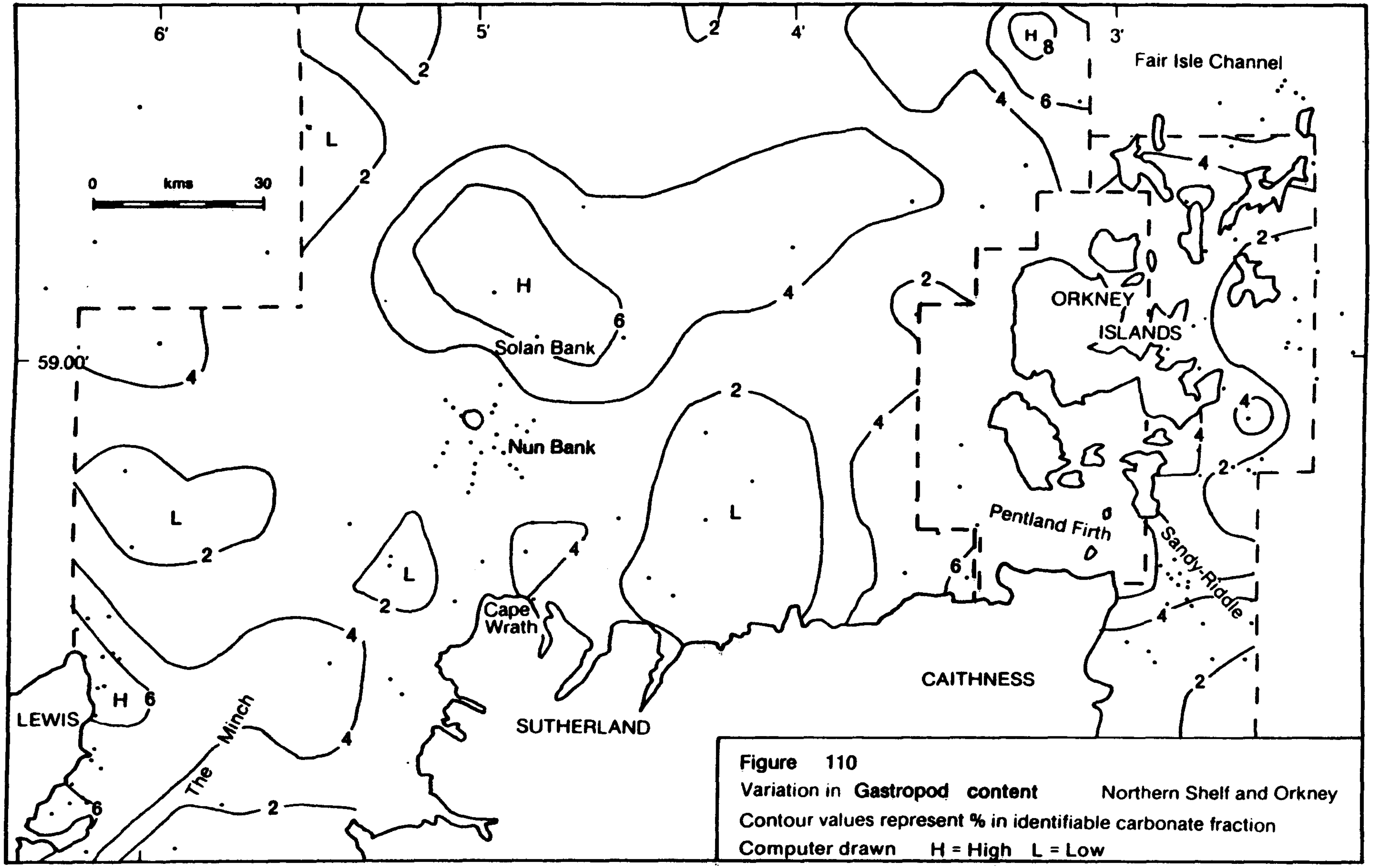


Figure 110

Variation in **Gastropod content** Northern Shelf and Orkney

Contour values represent % in identifiable carbonate fraction

Computer drawn H = High L = Low

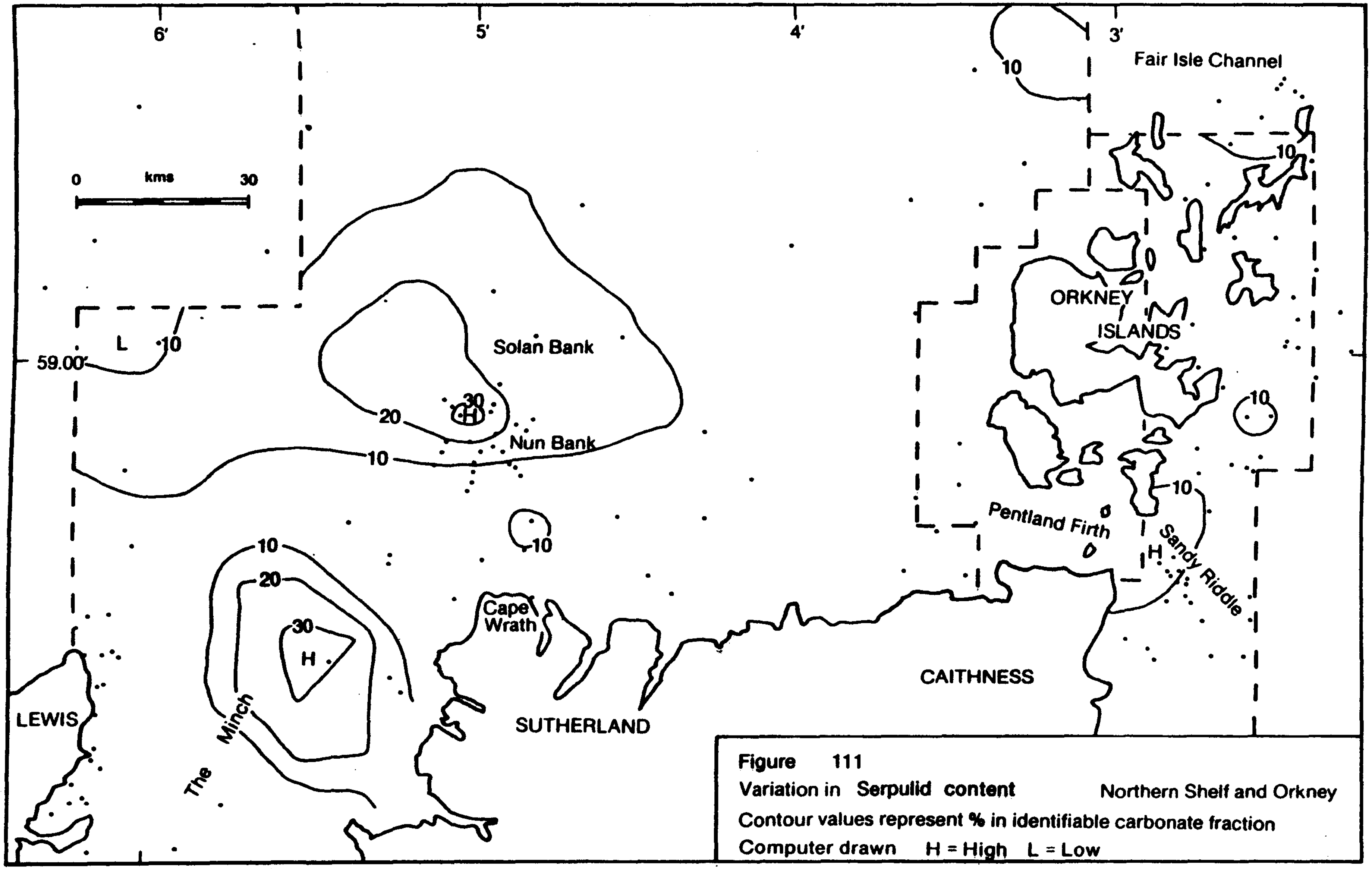


Figure 111
Variation in **Serpulid content** Northern Shelf and Orkney
Contour values represent % in identifiable carbonate fraction
Computer drawn H = High L = Low

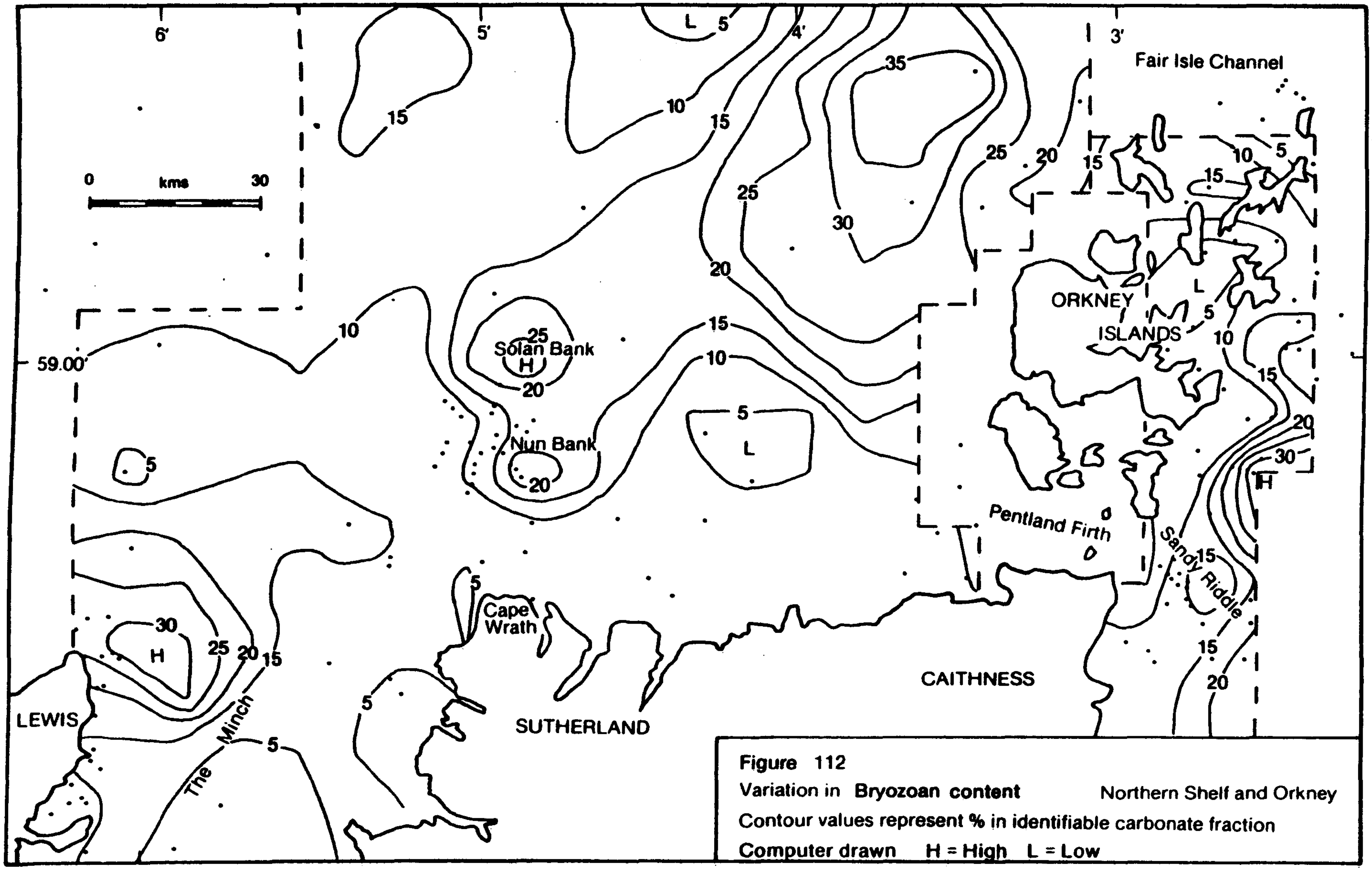


Figure 112

Variation in **Bryozoan content** Northern Shelf and Orkney

Contour values represent % in identifiable carbonate fraction

Computer drawn H = High L = Low

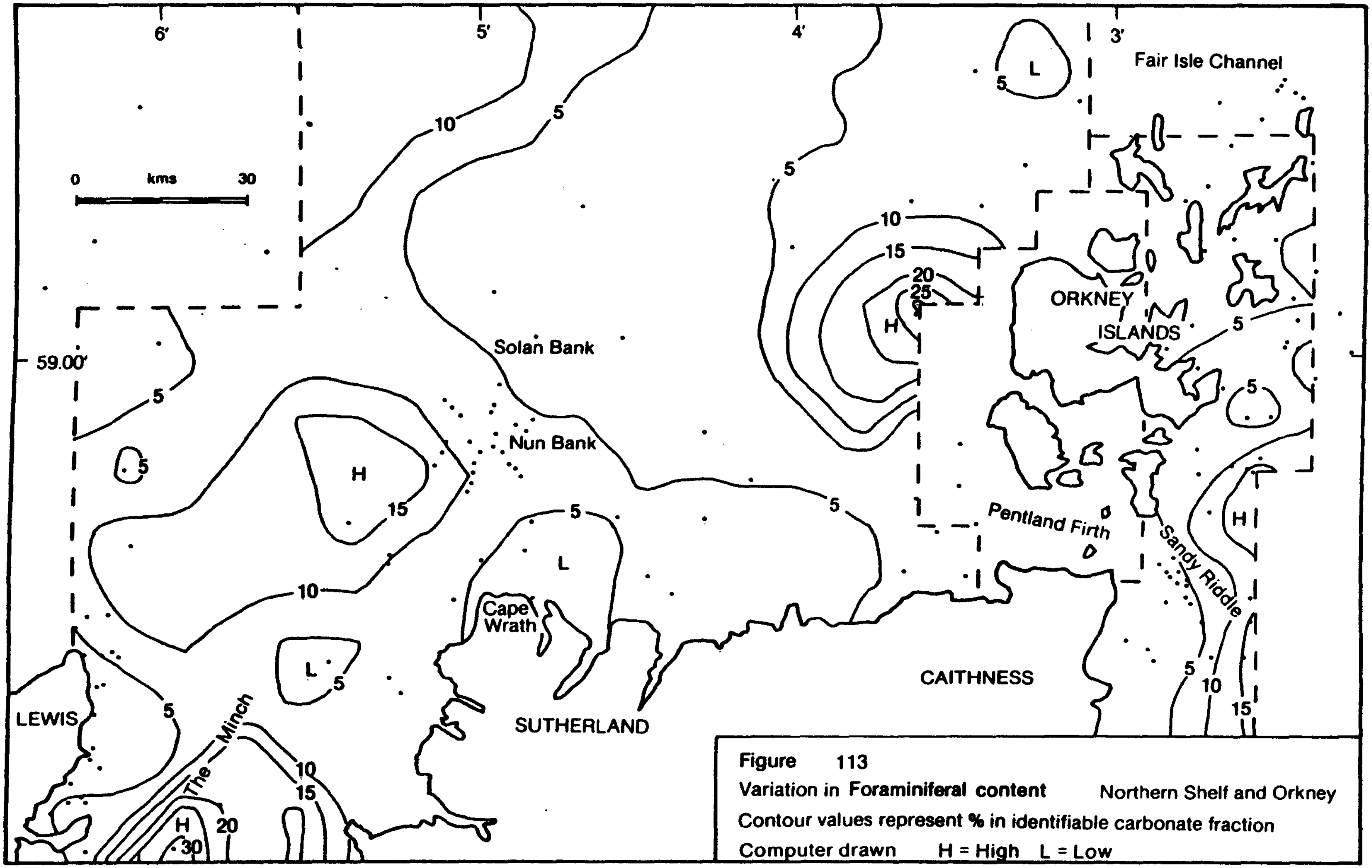


Figure 113
Variation in **Foraminiferal content** Northern Shelf and Orkney
Contour values represent % in identifiable carbonate fraction
Computer drawn H = High L = Low

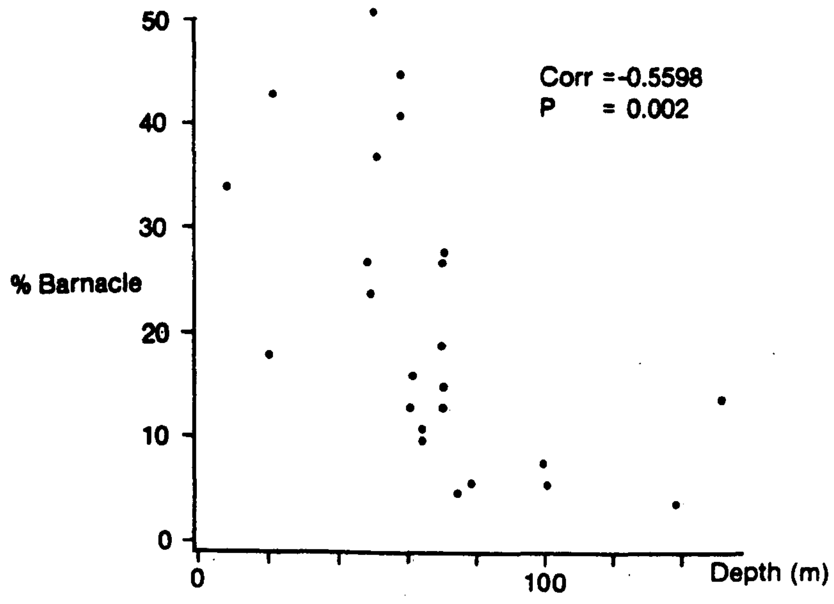


Figure 114 Variation diagram for carbonate barnacle content v. water depth

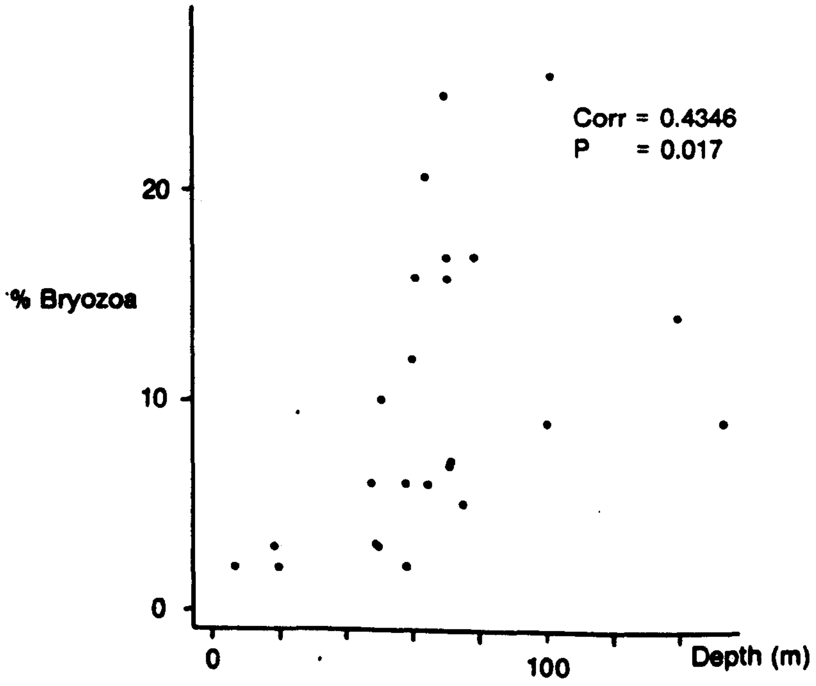


Figure 115 Variation diagram for carbonate bryozoan v. water depth

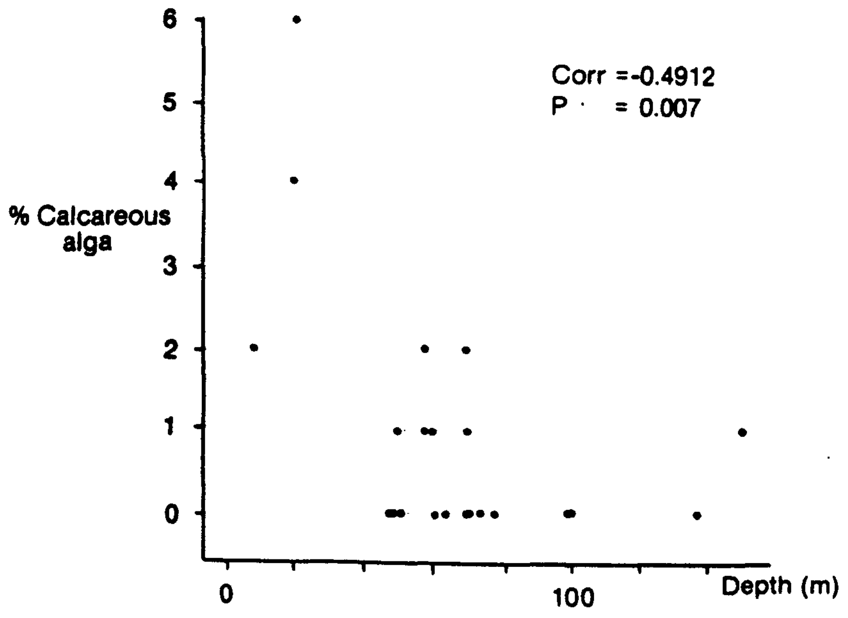


Figure 116 Variation diagram for carbonate calcareous alga content v. water depth

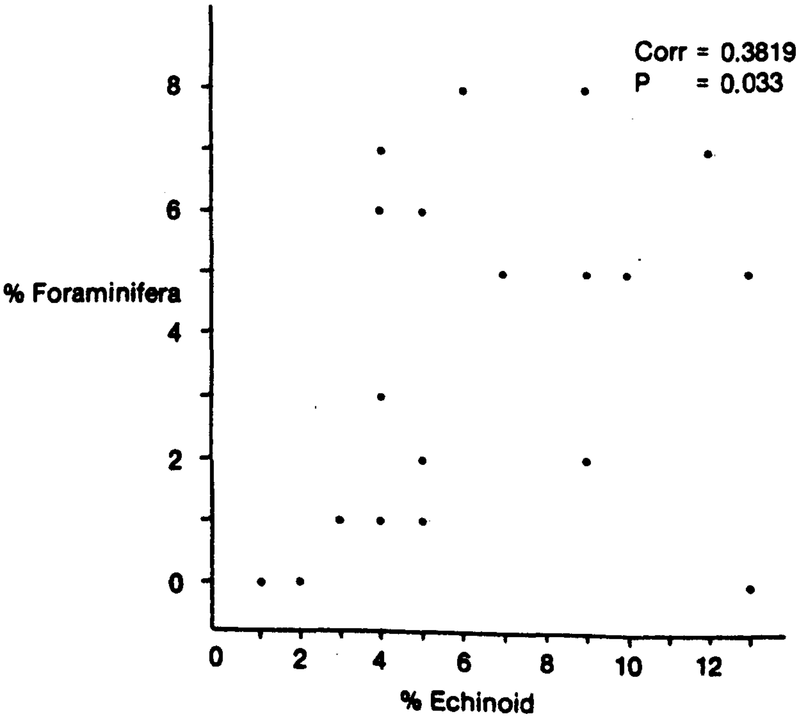


Figure 117 Variation diagram for carbonate foraminiferal content v. echinoid content

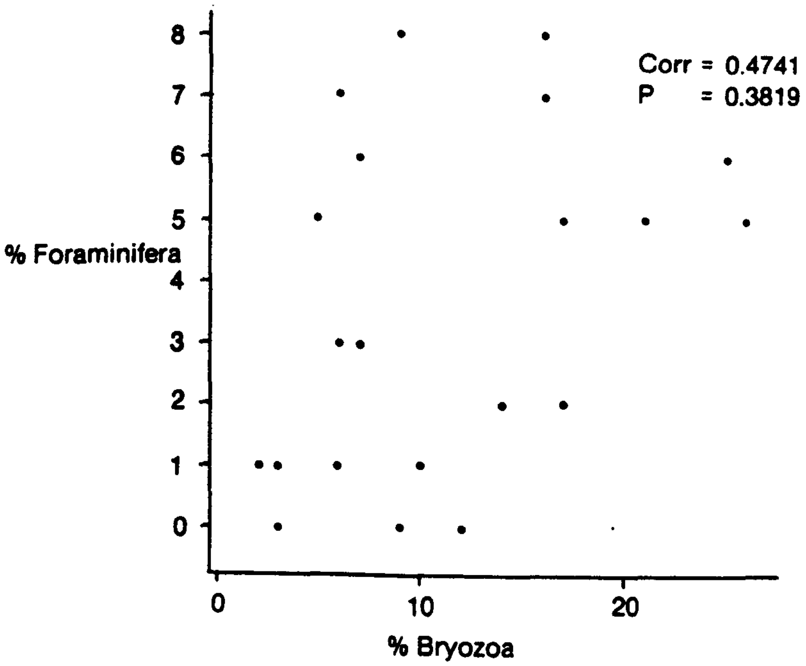


Figure 118 Variation diagram for carbonate foraminiferal content v. bryozoan content

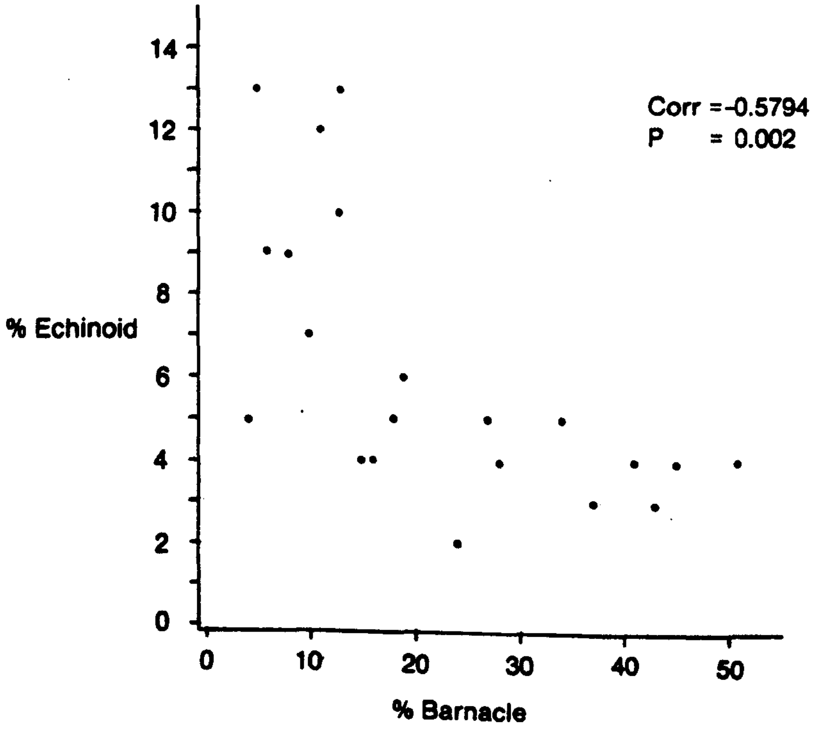


Figure 119 Variation diagram for carbonate echinoid content v. barnacle content

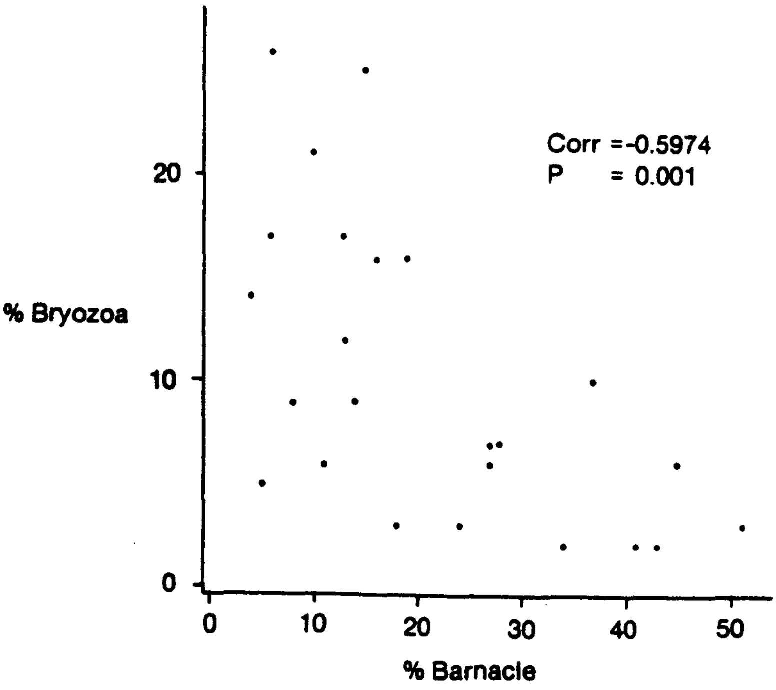


Figure 120 Variation diagram for carbonate bryozoan content v. barnacle content

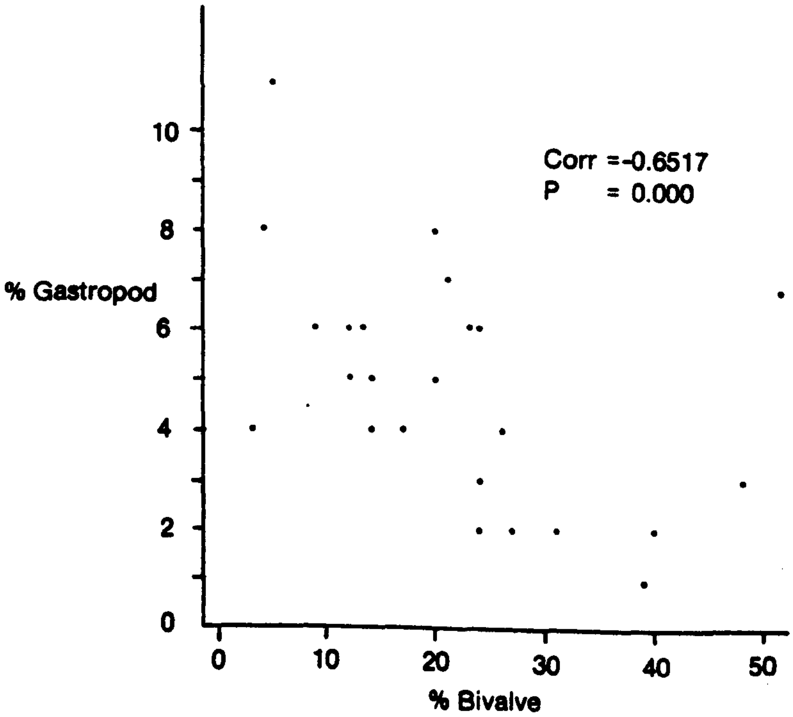


Figure 121 Variation diagram for carbonate gastropod content v. bivalve content

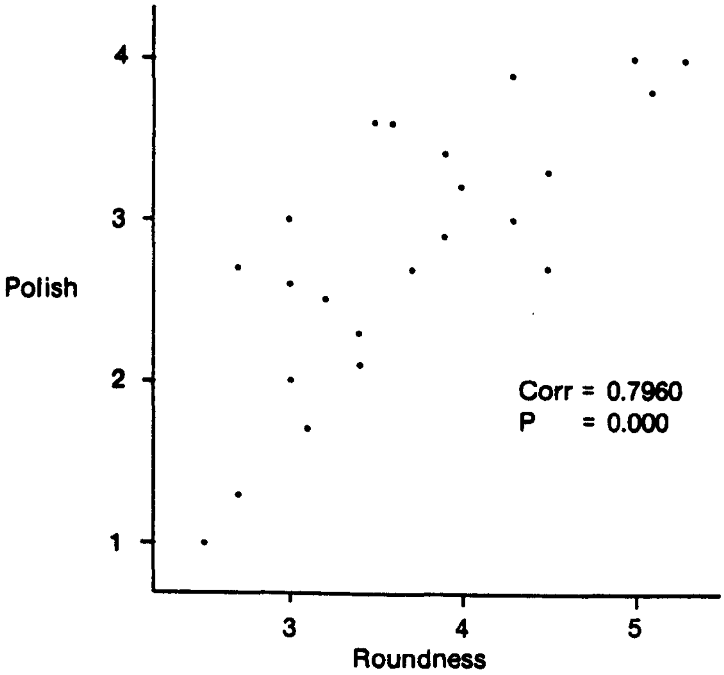


Figure 122 Variation diagram for carbonate polish v. roundness

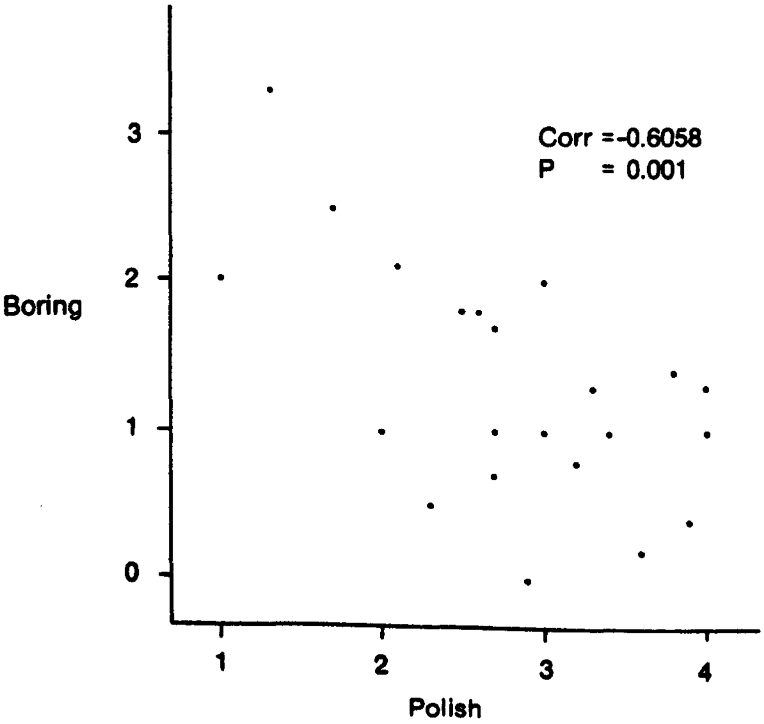


Figure 123 Variation diagram for carbonate degree of boring v. polish

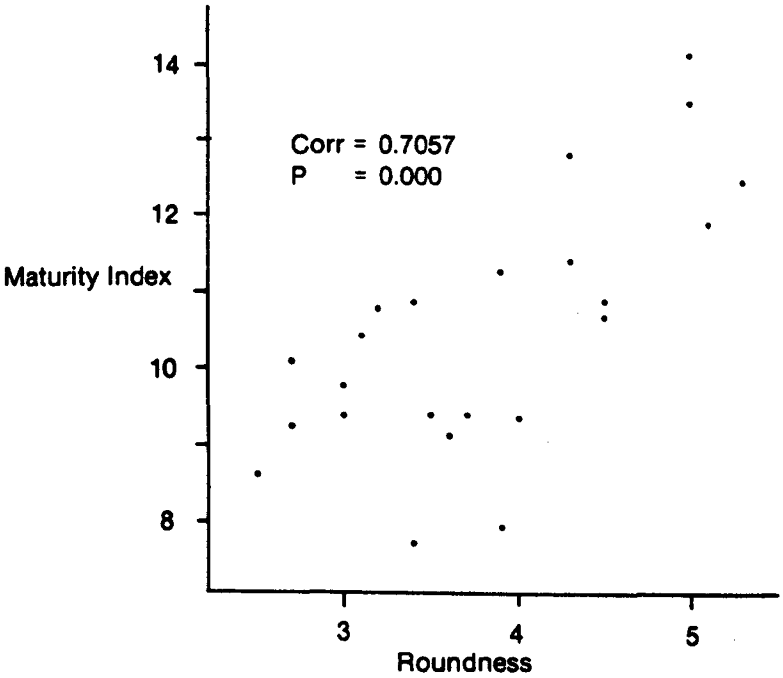


Figure 124 Variation diagram for carbonate Maturity Index v. roundness

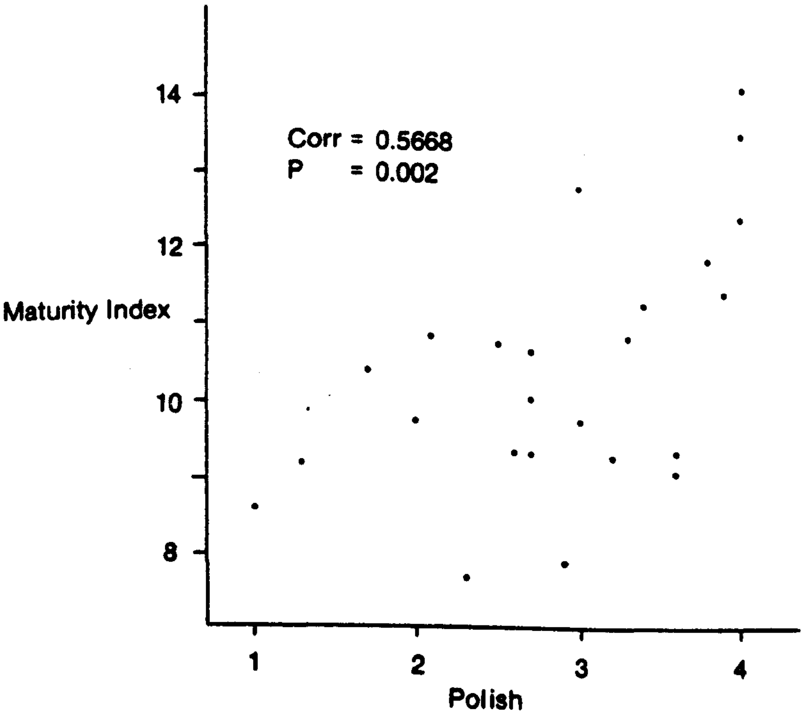


Figure 125 Variation diagram for carbonate Maturity Index v. polish

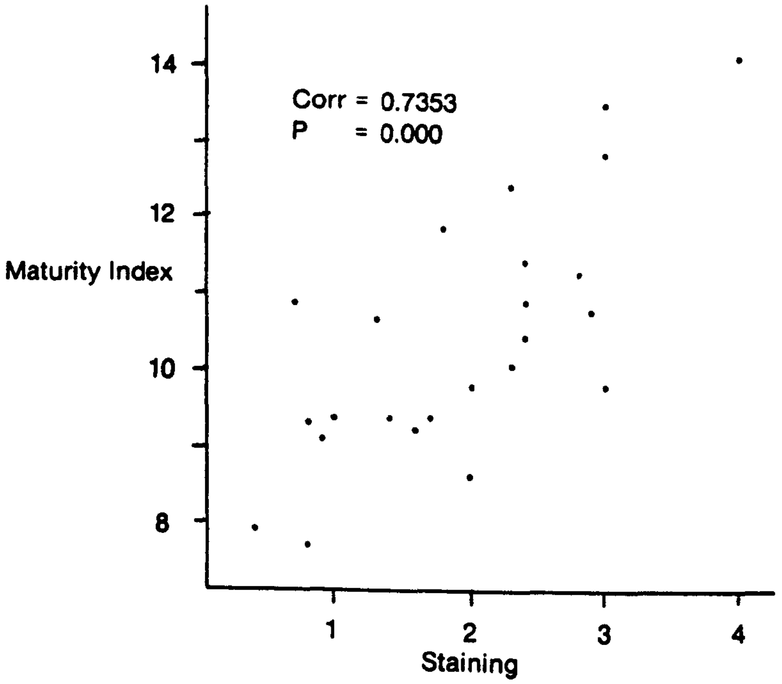


Figure 126 Variation diagram for carbonate Maturity Index v. staining

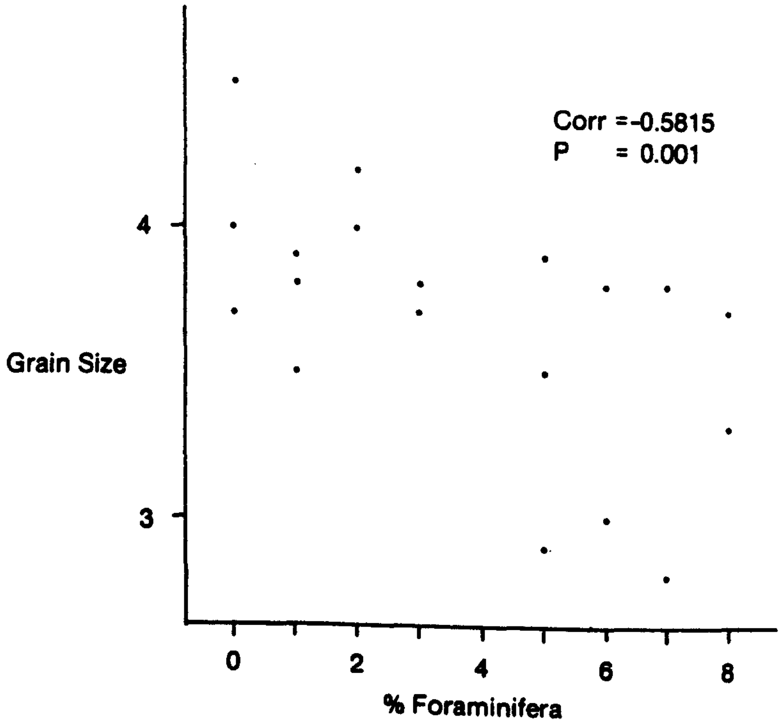


Figure 127 Variation diagram for carbonate grain size v. foraminiferal content

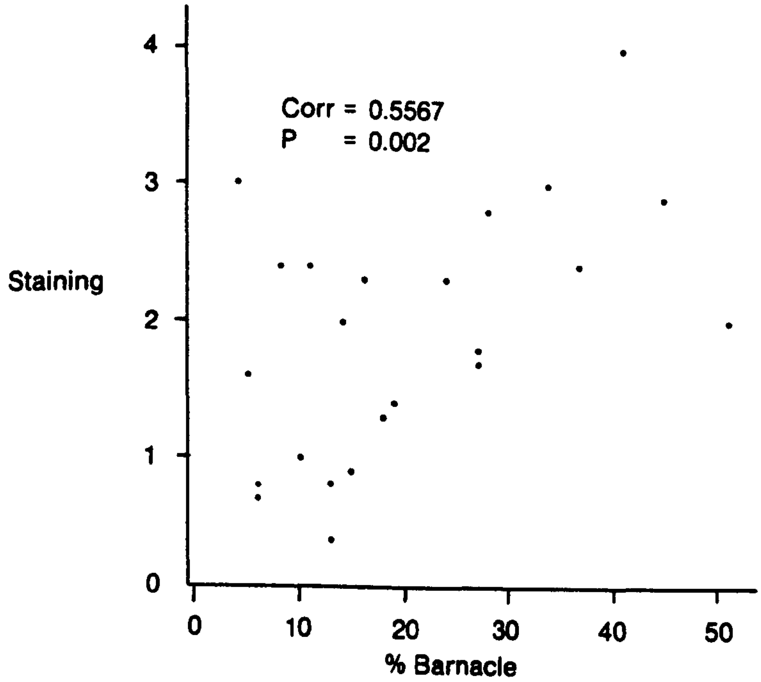


Figure 128 Variation diagram for carbonate staining v. barnacle content

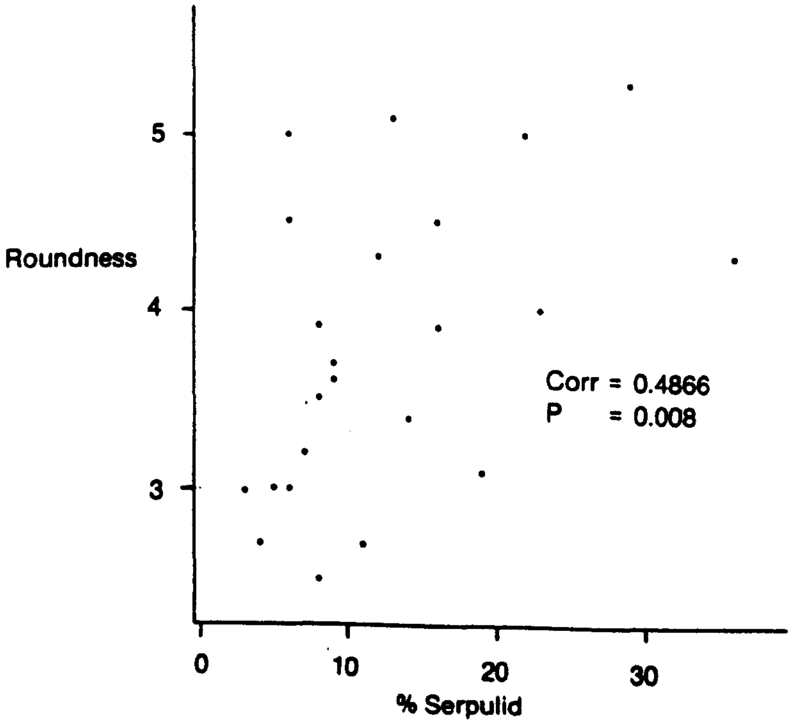


Figure 129 Variation diagram for carbonate roundness v. serpulid content

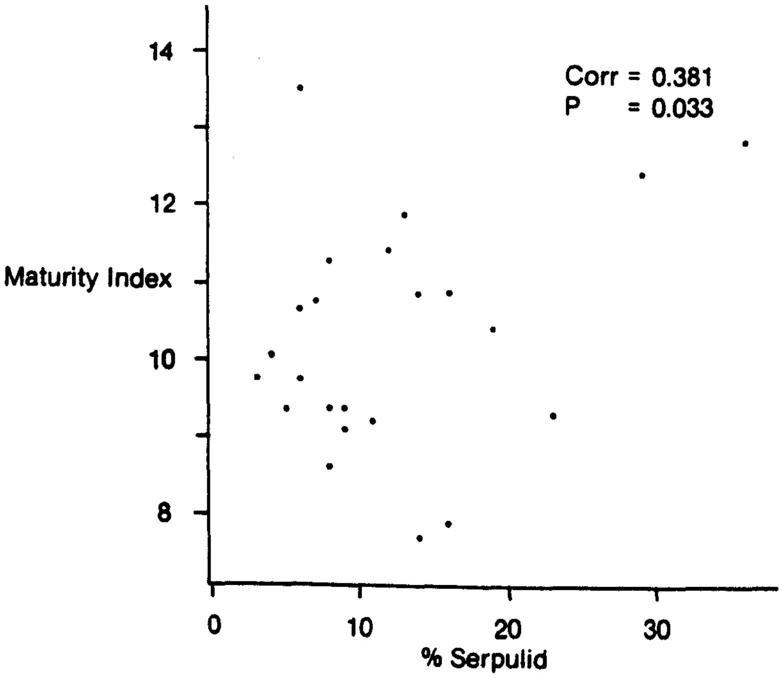


Figure 130 Variation diagram for carbonate Maturity Index v. serpulid content

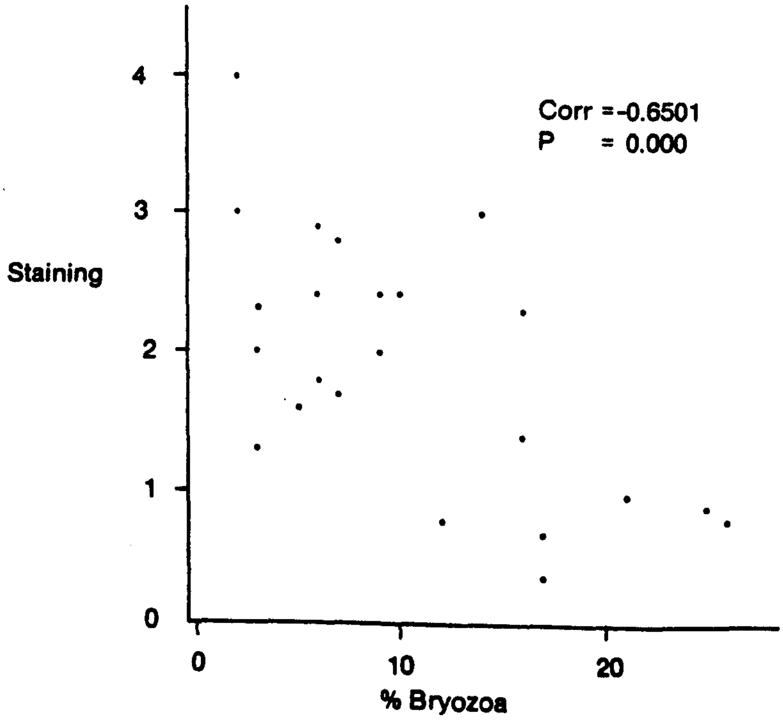


Figure 131 Variation diagram for carbonate staining v. bryozoan content

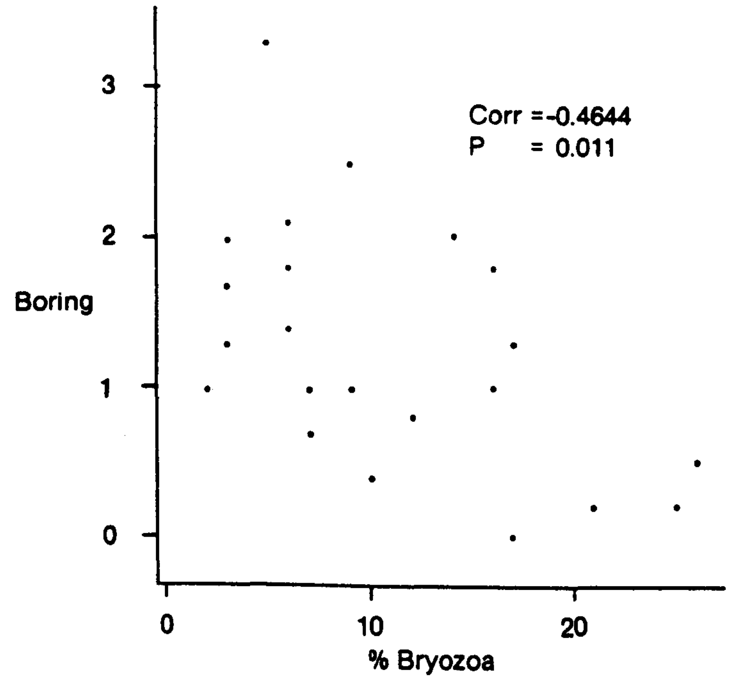


Figure 132 Variation diagram for carbonate degree of boring v. bryozoan content

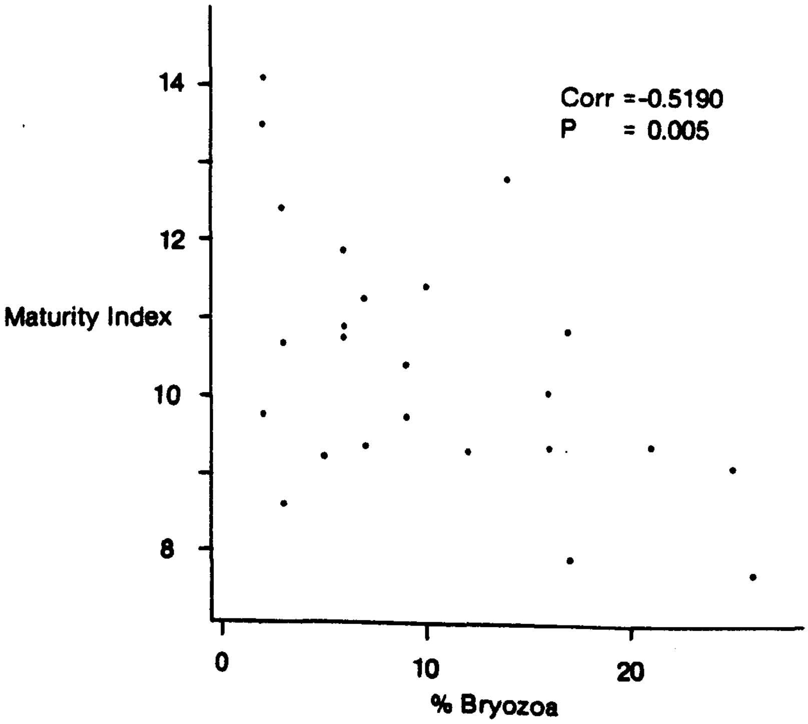


Figure 133 Variation diagram for carbonate Maturity Index v. bryozoan content

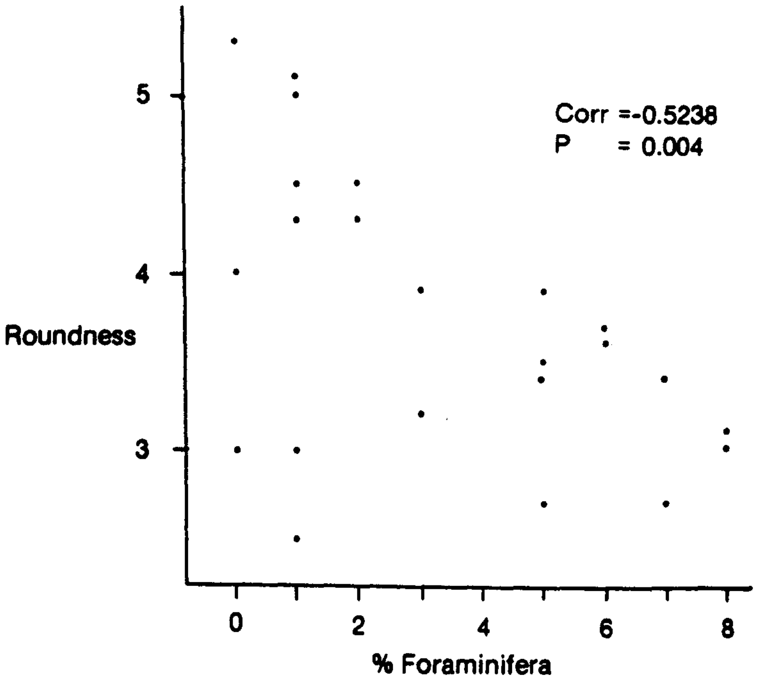


Figure 134 Variation diagram for carbonate roundness v. foraminiferal content

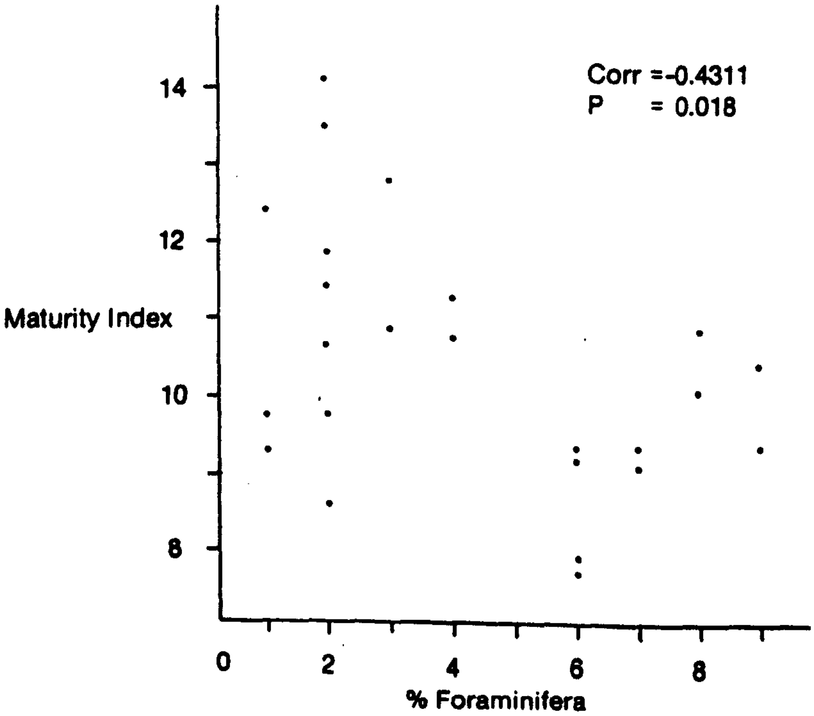


Figure 135 Variation diagram for carbonate Maturity Index v. foraminiferal content

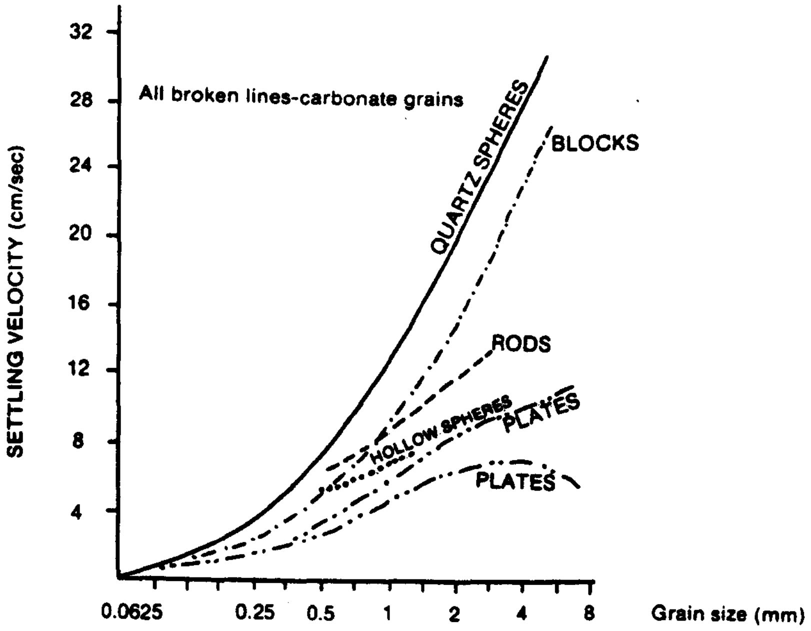


Figure 136 Settling curves for carbonate fragments compared with spherical quartz grains (after Maiklem 1968, and Blatt et al. 1980.)

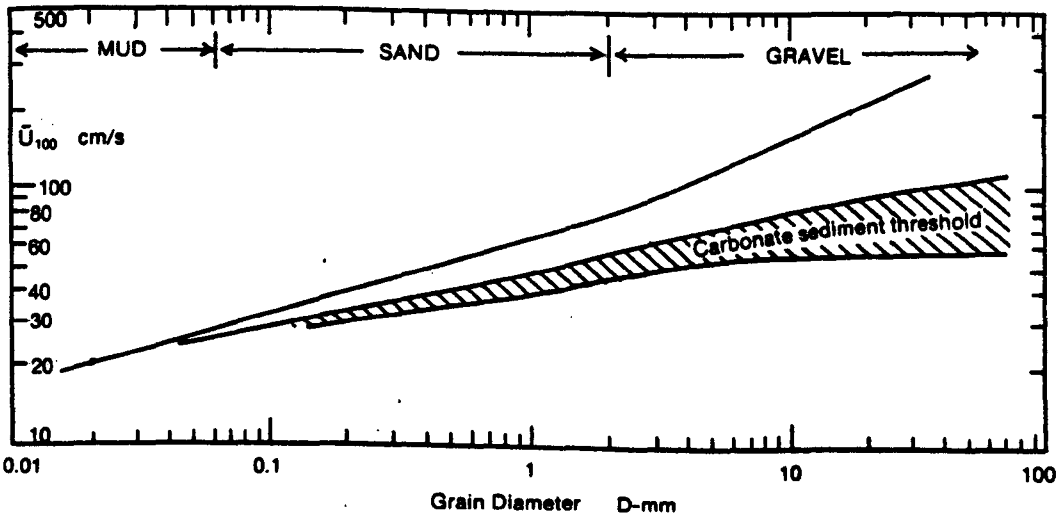


Figure 137 Sundborg's (1956) threshold curve for quartz grain diameter versus flow velocity (100cm above bed) at 20°C, modified from Miller et al. (1977) for shelly (platey) carbonate.

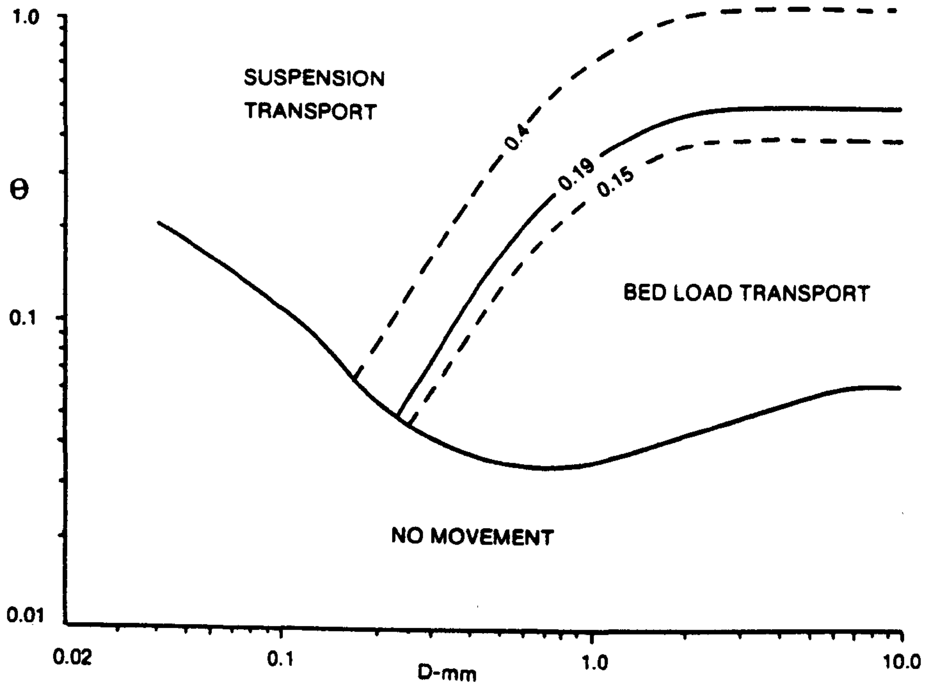


Figure 138 Dimensionless shear stress (Θ) versus grain diameter (D, in mm) showing critical suspension curves for constants, 0.4, 0.19, 0.15 (from McCave, 1971a.)

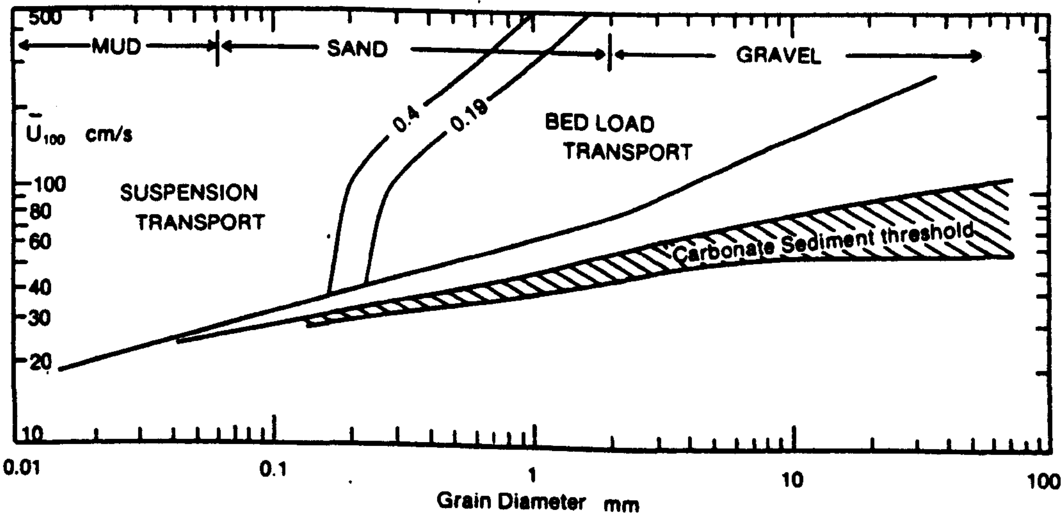


Figure 139 McCave's (1971a) critical suspension curves superimposed on Sundborgs' (1956) threshold curve (20°C) modified for shelly (platey) carbonates (see Figure 137)

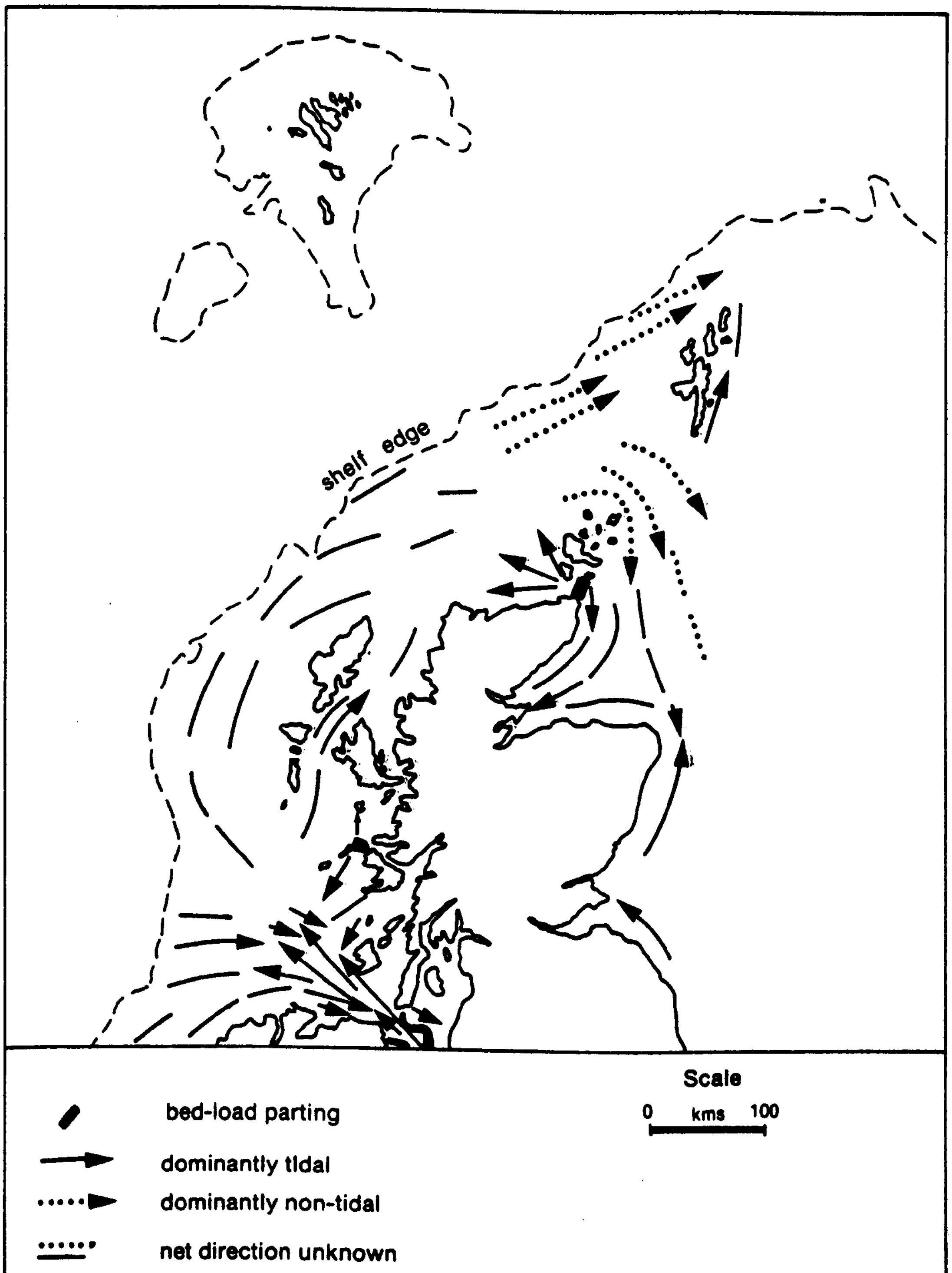
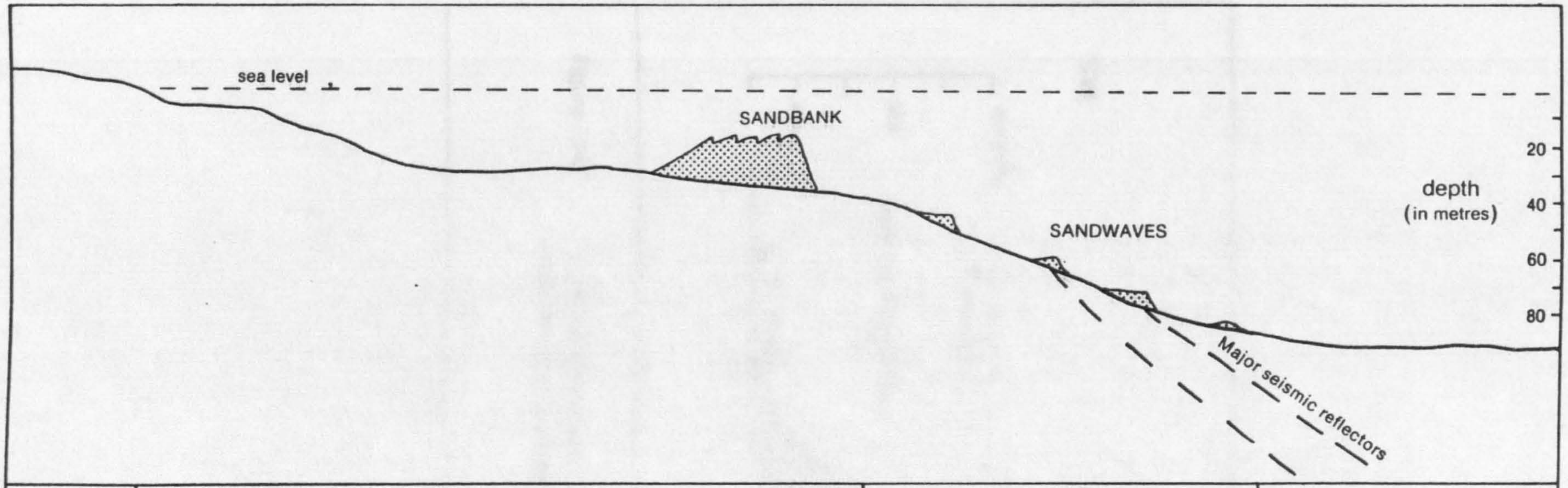


Figure 140 Interpreted net transport on the SCS (from Lee and Ramster 1981 and Johnson et al.1982)



ORKNEY	EAST ORKNEY PLATFORM	ORKNEY-FAIR ISLE SANDWAVE FIELD	NORTH SEA BASIN
LAND	Rock, coarse carbonate sands and gravels	Thick carbonate sands and gravels	Fine carbonate sands becoming terrigenous and muddy.
	Suspended - and bed load transport	Suspended transport decreasing Bedload transport increasing. Transport rate decreasing.	Much slower transport rates

Figure 141 Diagrammatic illustration of carbonate transport. East Orkney

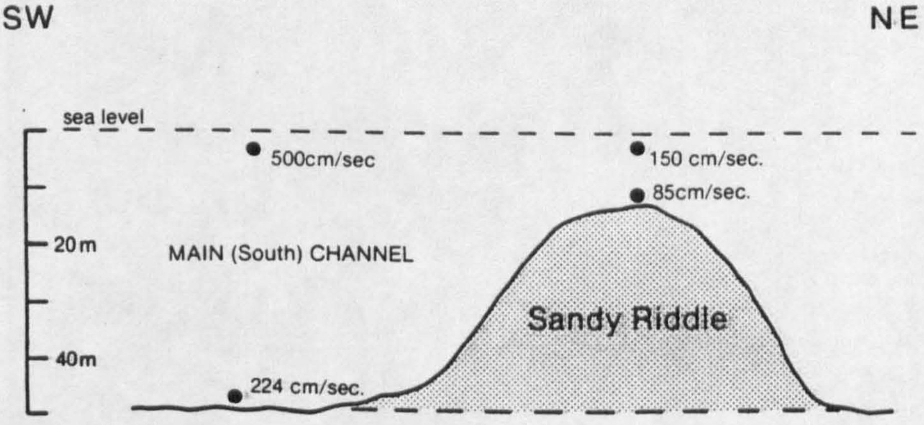


Figure 142 Schematic illustration in variation of surface and near-seabed tidal current velocities from channel to sandbank, Sandy Riddle

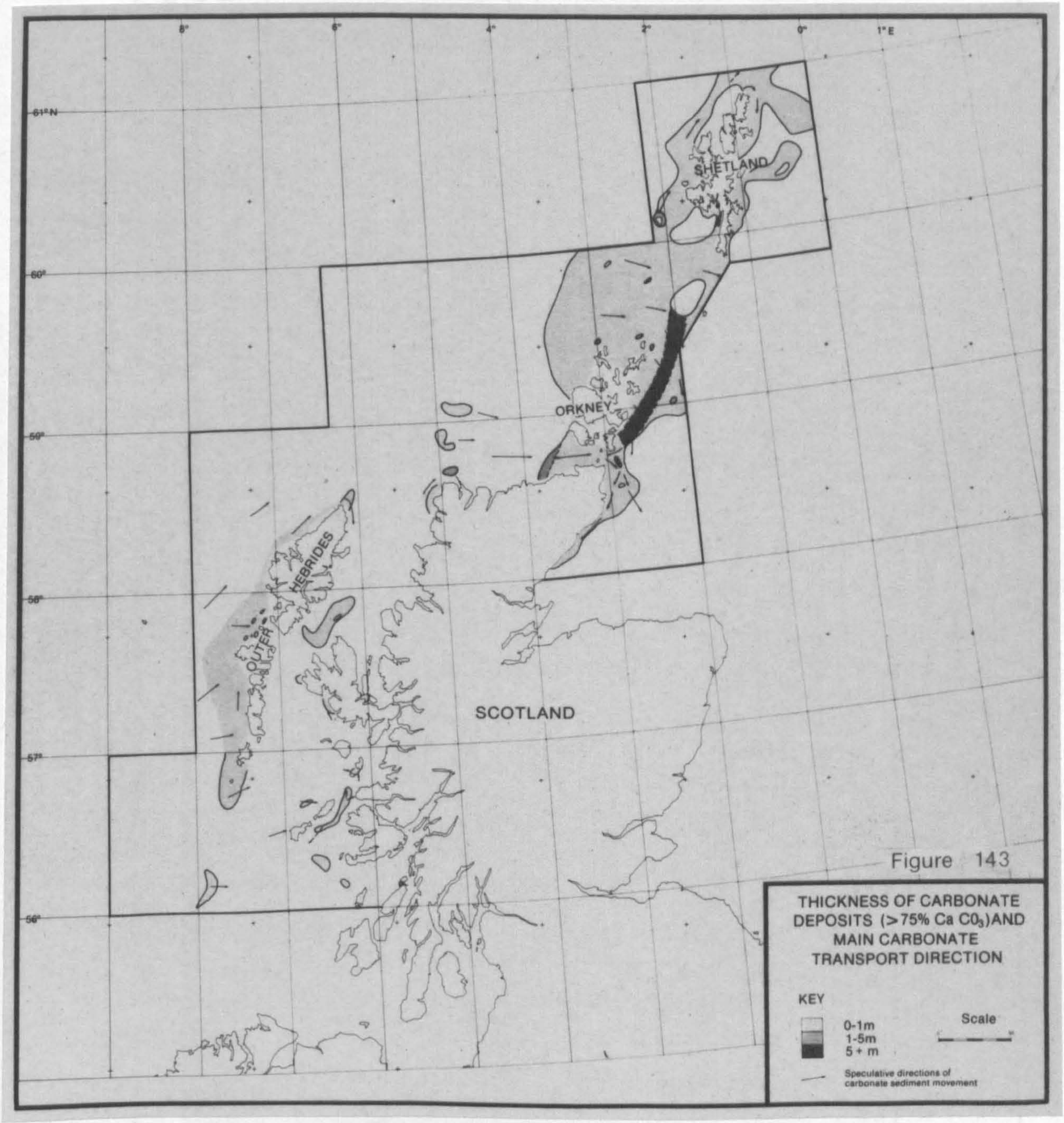


Figure 143

THICKNESS OF CARBONATE DEPOSITS (>75% Ca CO_3) AND MAIN CARBONATE TRANSPORT DIRECTION

Figure 144 Decay curve for ^{14}C isotope, indicating the average radiometric ages of perfectly mixed bulk samples of sediment accumulating over certain periods.

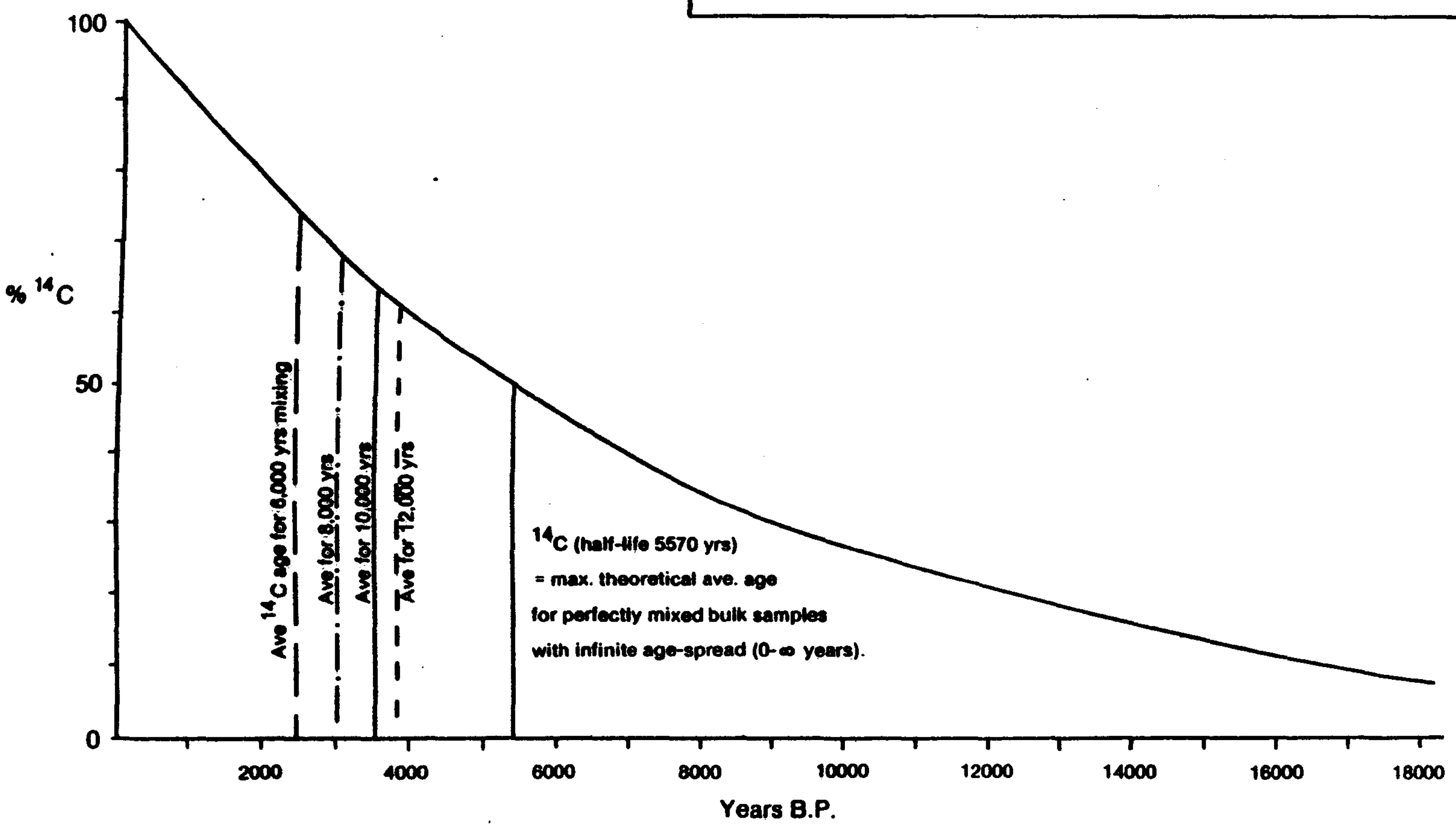


Figure 145 Subsample from 58-03/2 (East Orkney deposit): heavily bored bivalve fragments. Yielded a ^{14}C age of 4570 yrs BP.

Figure 146 Subsample from 53-03/2 (East Orkney deposit): rounded bivalve fragments. Yielded a ^{14}C age of 4410 yrs. BP.

Figure 147 Subsample from 58-03/2 (East Orkney deposit): angular bivalve fragments. Yielded a ^{14}C age of 3780 yrs BP. NB. The echinoid fragment is a contaminant which was removed prior to dating.

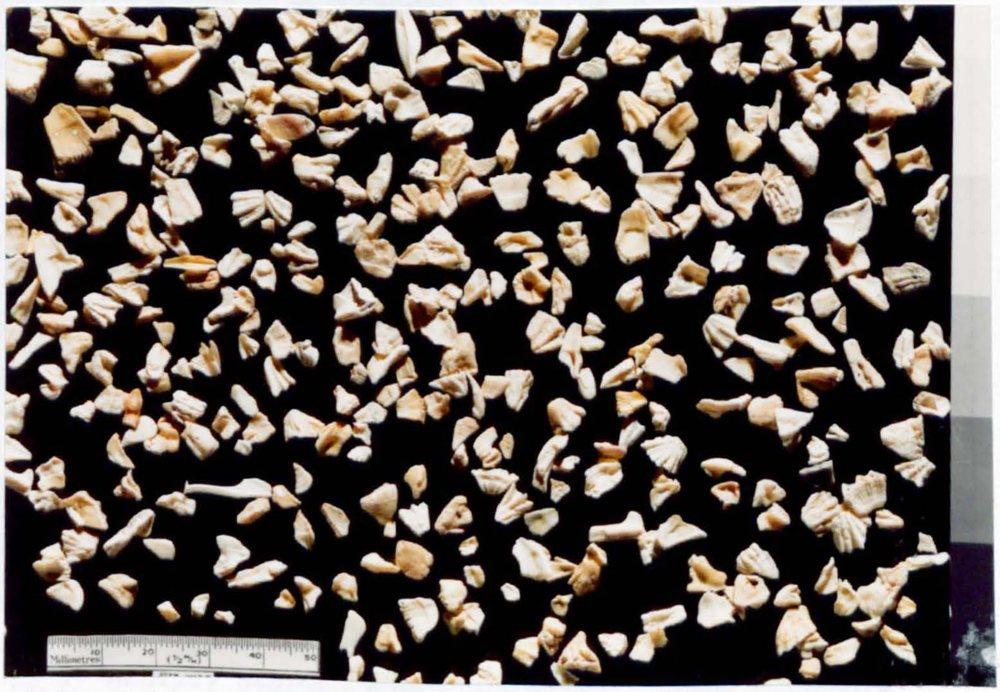
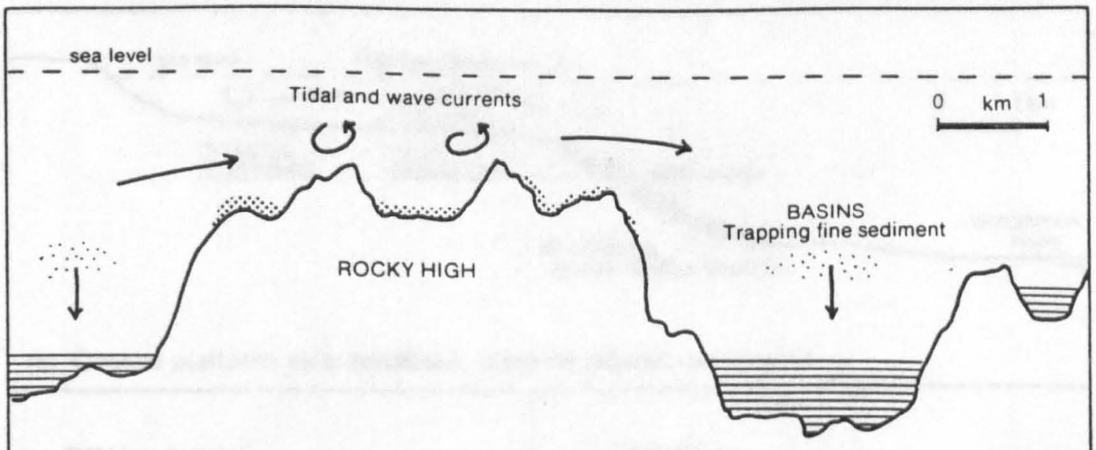


Figure 148 Subsample from 58-03/2 (East Orkney deposit): unbored relatively unabraded barnacle fragments. Yielded a ^{14}C age of 3290 yrs BP.

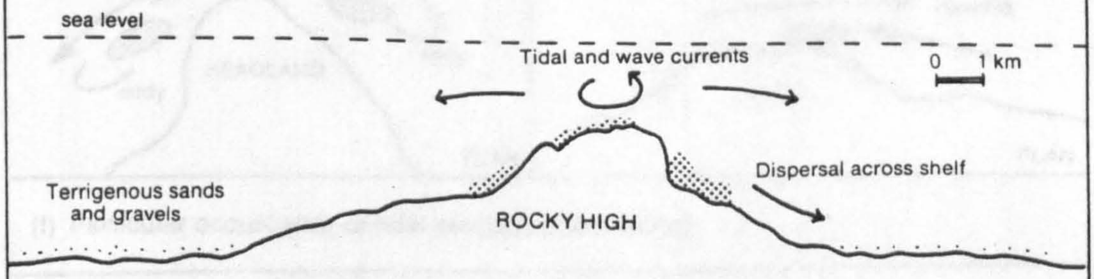
Figure 149 See below.

Figure 150 (&149) Subsample from 58-03/2 (East Orkney deposit): heavily stained and/or abraded barnacle fragments. Yielded a ^{14}C age of 3270 yrs BP.

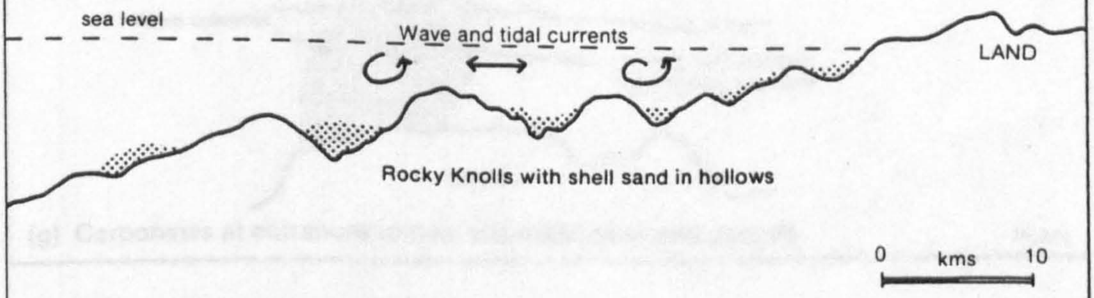
Figure 151 Subsample of 58-03/2 (East Orkney deposit); serpulid fragments. Yielded a ^{14}C age of 4060 yrs BP.



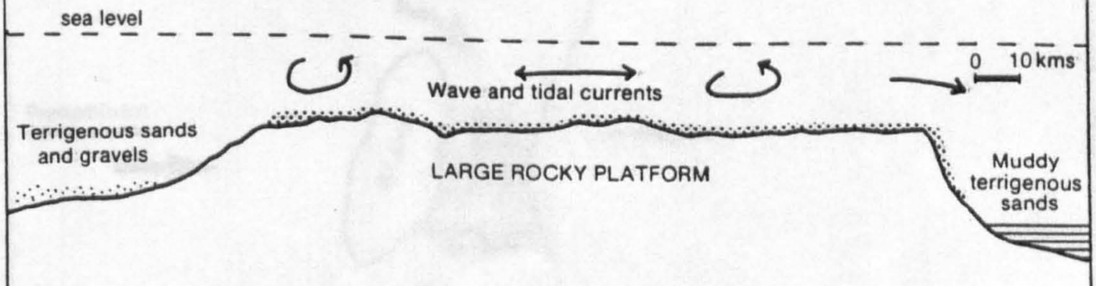
(a) Shoal carbonates - rocky highs separated by deep basins.



(b) Shoal carbonates - rocky highs on flattish shelf

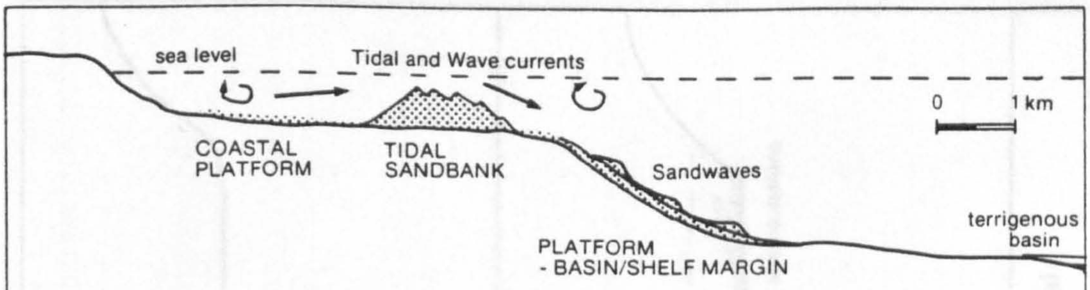


(c) Oceanward hummocky platform carbonates

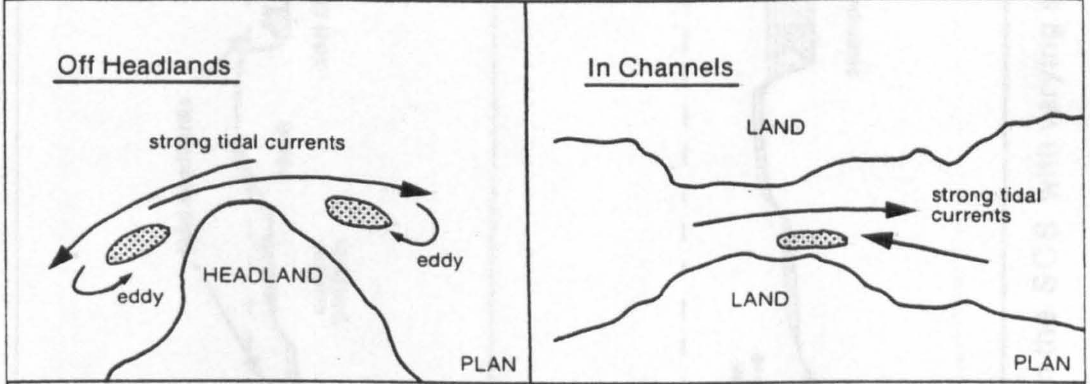


(d) Platform - rock pavement carbonates

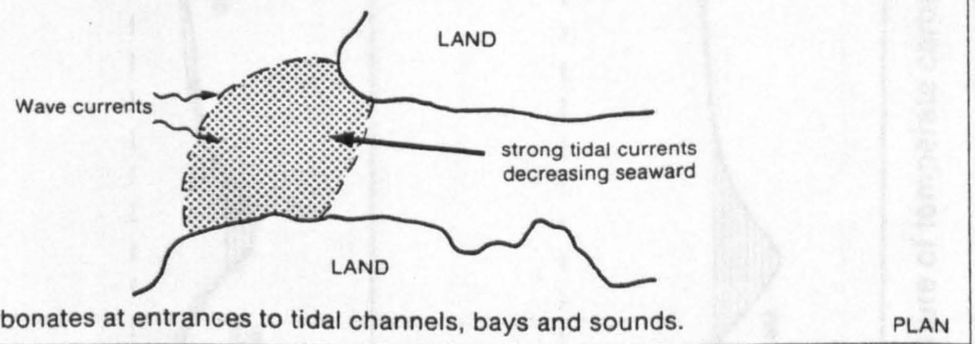
Figure 152A. Types of carbonate deposit on the SCS



(e) Coastal platform, tidal sandbank, platform margin carbonates



(f) Particular occurences of tidal sandbank carbonates



(g) Carbonates at entrances to tidal channels, bays and sounds.

(h) Island-coast channel carbonates

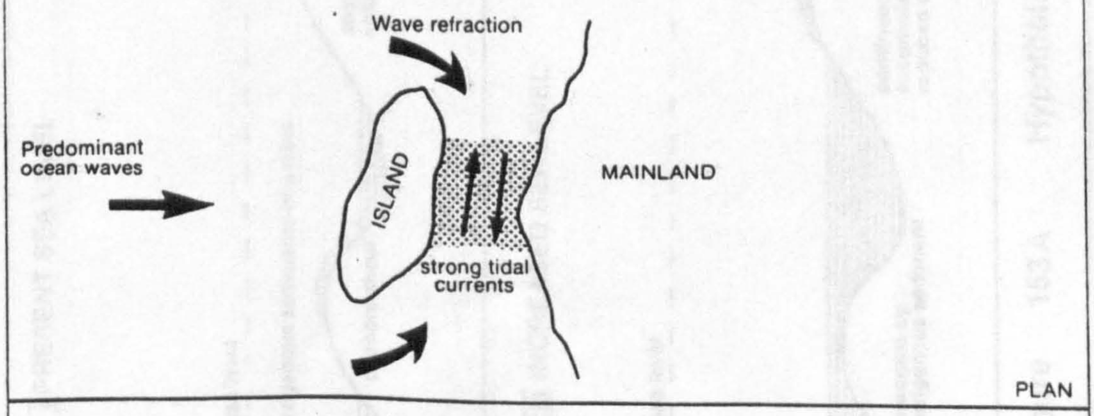


Figure 152B. Types of carbonate deposit on the SCS

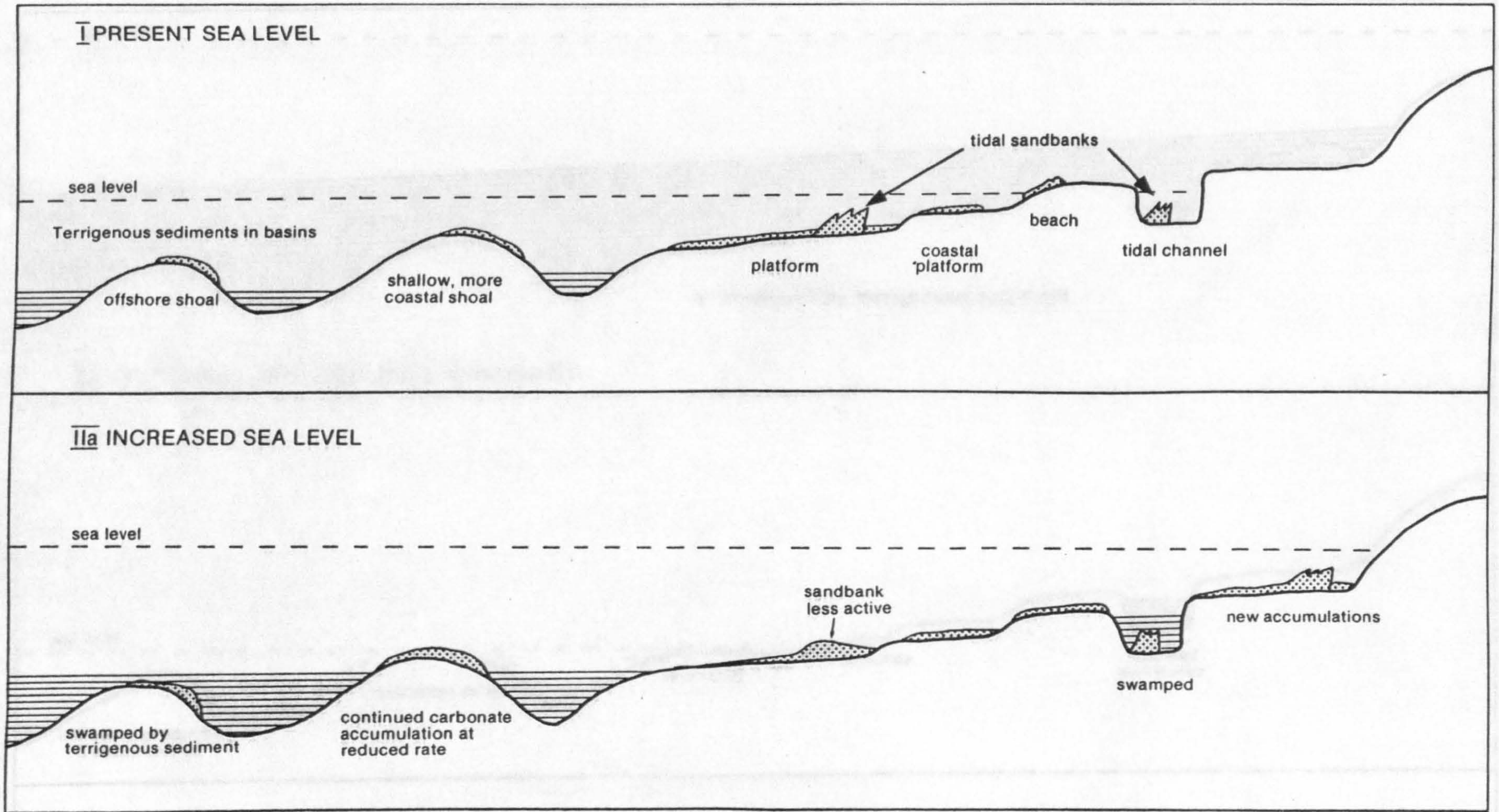


Figure 153 A Hypothetical future of temperate carbonates on the SCS with varying sea level

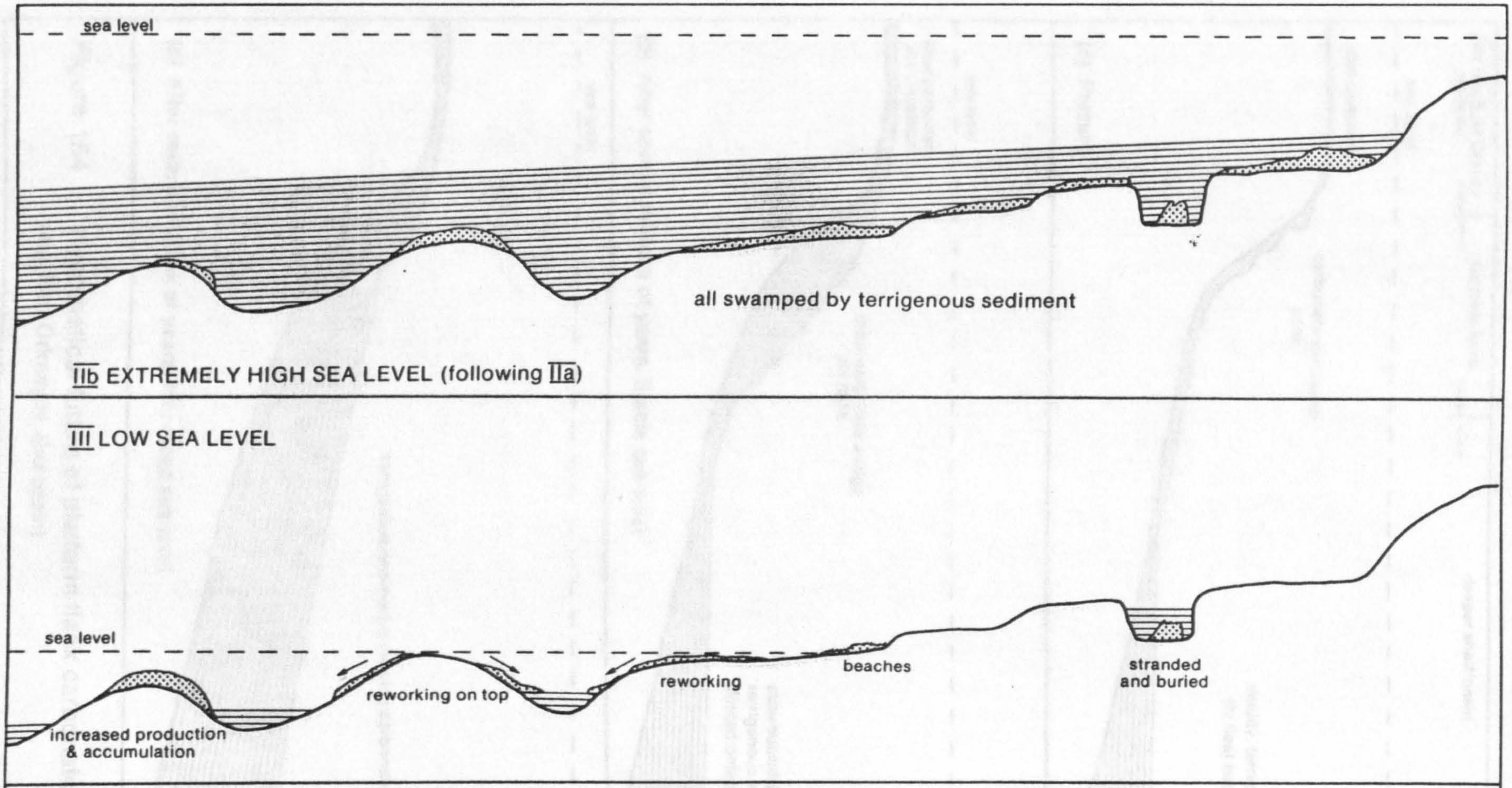


Figure 153 B Hypothetical future of temperate carbonates on the SCS with varying sea level

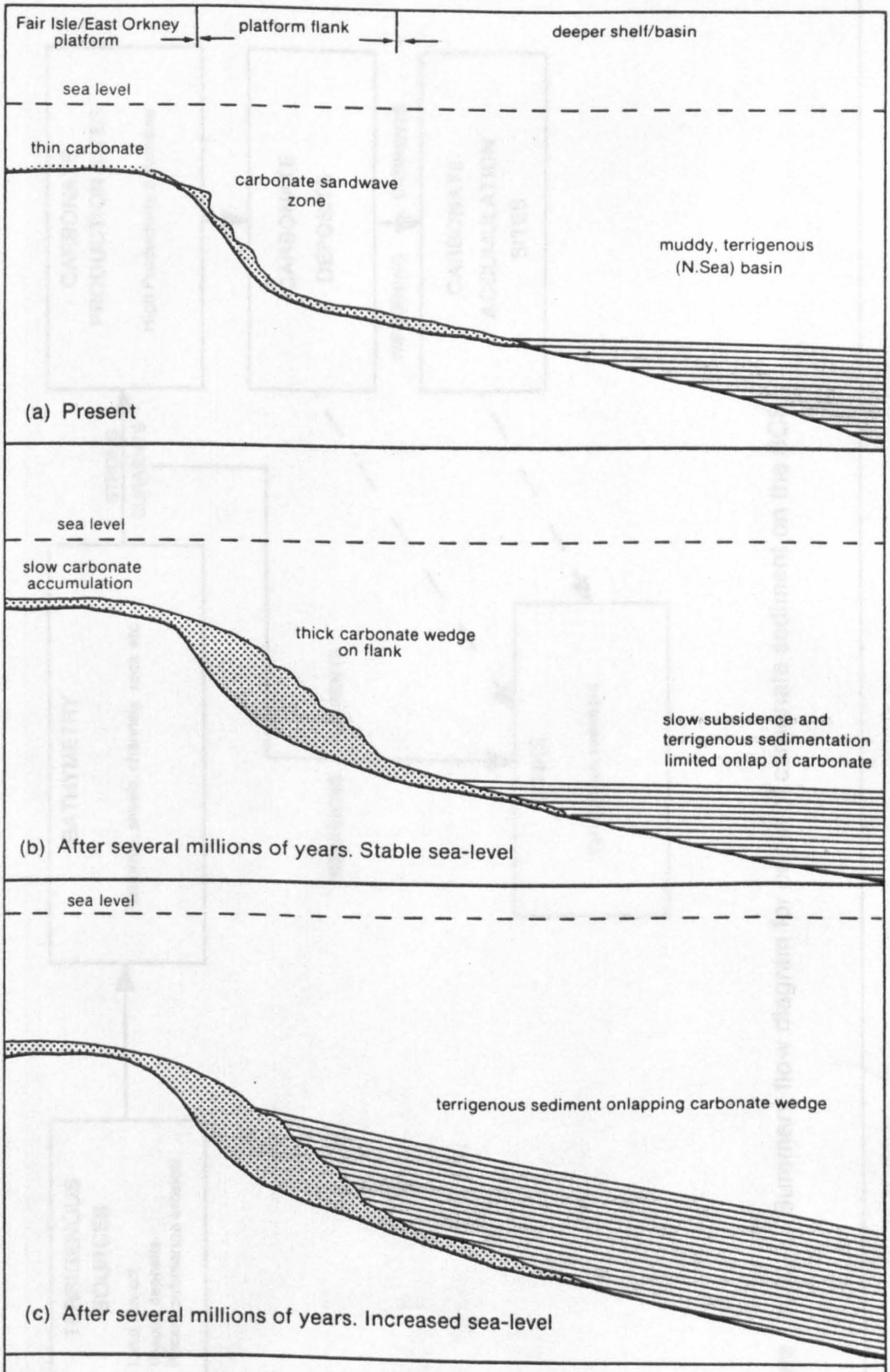


Figure 154 Hypothetical future of platform flank carbonates (e.g. East Orkney/N. Sea basin)

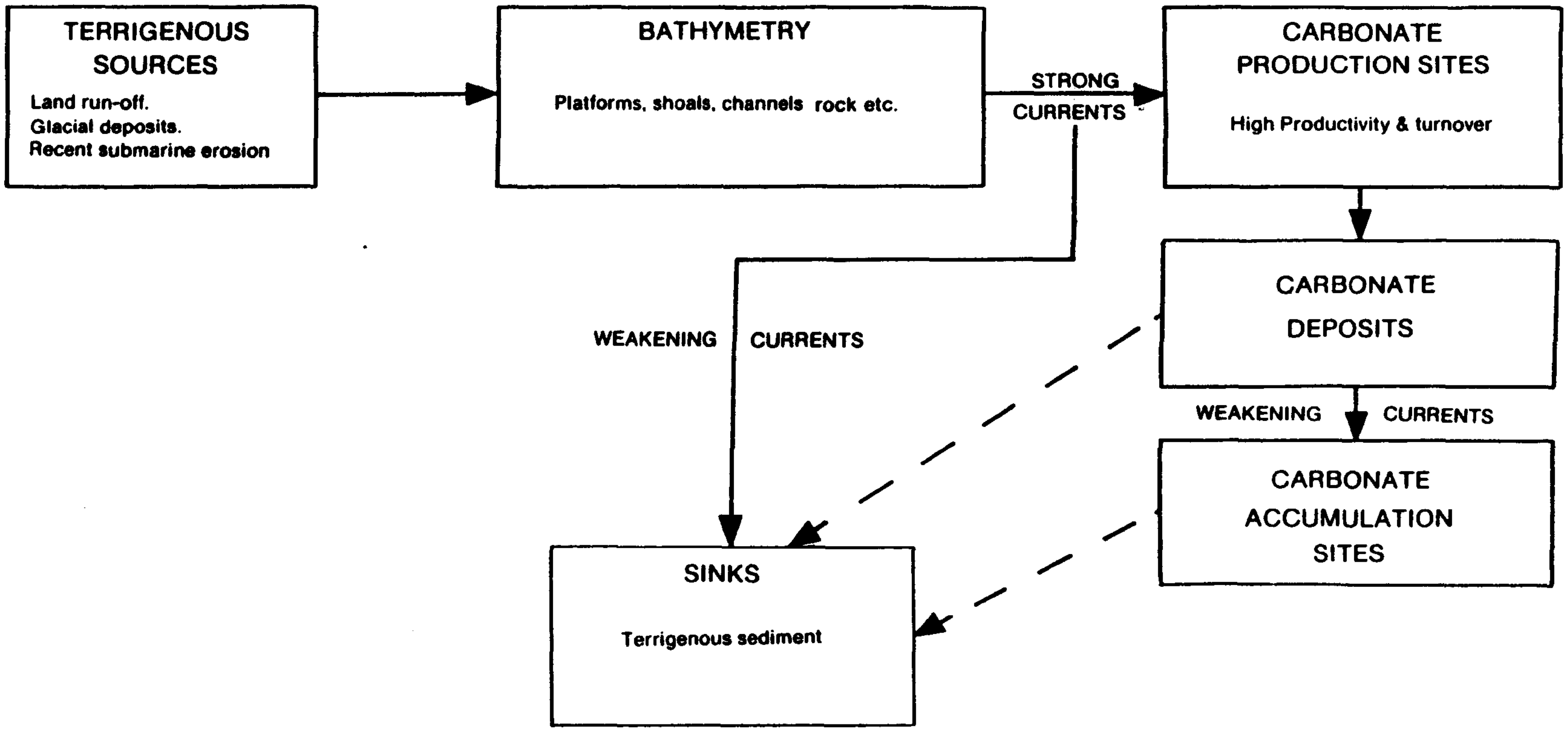


Figure 155 Summary flow diagram for origin of carbonate sediment on the SCS.

TABLES

Area	Reference
Sutherland	Ritchie & Mather 1969
Caithness	Mather 1970
Lewis and Harris	Ritchie & Mather 1970
Barra and Uist	Ritchie 1971
West Inverness-shire & N. Argyll	Mather & Crofts 1972
Wester Ross	Crofts & Mather 1972
Mainland Argyll	Crofts & Ritchie 1973
Orkney	Mather et al. 1974
Shetland	Mather & Smith 1974
Islay, Jura and Colonsay	Ritchie & Crofts 1974
Northern Inner Hebrides	Mather et al. 1975

TABLE 1. Main sources of beach data

TEXTURAL SCALES

Grain size (GnSz)

Dia(mm)	Description	Numerical Value
.0625-.125	Very fine sand	1
.125 - .25	Fine sand	2
.25 - 1	Medium sand	3
1 - 2	Coarse sand	4
2+	Gravel	5

ROUNDNESS (Round)

Description	Numerical Value
very angular	1
angular	2
subangular	3
subrounded	4
rounded	5
well rounded	6

DEGREE OF BORING (Bor)

Description	Numerical Value
No borings	0
Little boring	1
Some boring	2
Moderate boring	3
Heavily bored	4

POLISH (Pol)

Description	Numerical Value
No polish	0
Little polish	1
Some polish	2
Mod polish	3
Well polished	4

SORTING (Sort)

Description	Numerical Value
Poorly sorted	1
Moderately sorted	2
Well sorted	3

MATURITY INDEX (M, See p.35)

Description	Numerical Value
Extremely high	>13
Very high	12-13
High	11-12
Moderate	10-11
Low	9-10
Very low	8-9
Extremely low	<8

STAINING (Stain)

Description	Numerical Value
No staining	0
Little staining	1
Some staining	2
Moderate staining	3
Heavily stained	4

TABLE 2. Summary of scales used for describing textural characteristics of bioclastic carbonate grains.

Composition

	Barn	Biv	Ech	Gast	Serp	Bry	C. Alg	Foram	Ditrupa
Iona Spit %	42	27	11	7	3	5	0	1	-
Hebridean Slope %	1	37	9	4	1	19	0	6	22
Northern Slope %	2	42	7	3	6	12	0	7	18

Texture

	Grv	Sand	Mud	GnSz	Sort	Rnd	Pol	Stain	Bor	M
Iona Spit	2%	95%	3%	3.5	1.0	4.0	3.0	4.0	0	11.25
Hebridean Slope	6%	94%	N	4	2.0	3.0	3.0	1.0	0.8	11.96
Northern Slope	8%	92%	N	3.1	1.9	3.0	2.1	1.6	1.1	9.6

TABLE 3. Petrographic averages of some areas of carbonate-rich (50-75% $CaCO_3$) sediment,

CDSS NO.	NAME OF DEPOSIT	SYMBOL	WATER DEPTH m		% BARNACLES		% BIVALVES		% ECHINOIDS		% GASTROPODS		% SERPULIDS		% BRYOZOA		% CALC ALGAE		% FORAMS		% CARB		% GRAVEL		% SAND		% MUD		GN S2		SORT		ROUND		POL		STAIN		BOR		MATURITY INDEX (m)	
			Deposit >75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%	>75%	<75%
1	Gulf of Corryvreckan	CO	150		14		68		1		3		3		9		1		0		85		65		35		N		4.5		2.0		3.0		3.0		2.0		1.0		9.75	
2	Passage of Tiree	PT	58	92	45	30	29	44	4	4	6	4	7	3	6	10	2	4	3	2	91	54	30	15	67	69	3	16	3.8	3.2	1.0	1.3	3.2	2.3	2.5	1.0	2.9	2.6	1.8	2.0	10.75	9.60
3	Hawes Bank	HB	58	57	41	19	23	47	4	2	4	10	22	14	2	4	1	1	1	3	83	46	15	34	85	65	N	1	3.8	3.3	1.5	1.2	5.0	3.6	4.0	2.8	4.0	2.2	1.0	1.0	14.10	10.25
4	Sound of Eigg	SE	21	43	43	34	32	42	3	4	6	8	6	3	2	3	6	1	1	3	90	48	31	24	64	63	5	12	3.5	3.2	1.0	1.2	3.0	2.3	2.0	2.1	3.0	1.9	1.0	1.2	9.75	8.45
5	Sligachan - Scalpay	RA	16																		86																					
6	Rubha Nan Clach	RU	50	55	51	34	24	41	4	6	8	3	8	2	3	8	1	1	1	5	85	31	21	39	78	58	2	2	3.8	2.8	1.0	1.8	2.5	2.0	1.0	2.0	2.0	0.5	2.0	0.5	8.60	6.90
7	Shiant	SI	50																		86																					
8	Southeast Shiant Sandbank	BS	30																		80																					
9	Sound of Iona	IN	8		77		12		3		N				N		1		N																							
10	Stanton Banks	SB	137	138	4	10	33	50	5	5	6	2	36	21	14	9	0	0	2	2	88	73	9	1	91	95	0	4	4.0	3.5	1.5	1.0	4.3	4.0	3.0	3.0	3.0	2.0	2.0	1.0	12.80	10.25
11	Barra Head	BH	70	102	15	10	34	50	4	4	5	4	9	6	25	12	2	2	6	11	90	42	7	11	92	76	1	13	3.0	3.0	1.8	1.3	3.6	2.3	3.6	2.3	0.9	1.3	0.2	1.5	9.09	7.75
12	West Hebridean Platform	WH	60	57	13	6	25	39	13	10	11	8	23	13	12	19	1	1	N	20	87	39	25	36	75	64	0	0	3.7	3.7	1.4	1.0	4.0	4.3	3.2	2.7	0.8	2.3	0.8	0.3	9.30	9.90
13	Butt of Lewis	BL	64	65	10	8	41	58	7	6	7	5	8	3	21	15	0	0	5	6	87	61	6	3	94	96	N	N	2.9	2.4	1.8	2.1	3.5	2.5	3.6	3.5	1.0	2.1	0.2	0.1	9.35	9.85
14	Cape Wrath	CW	70	70	27	11	40	53	5	7	5	14	9	10	7	8	1	2	6	7	86	43	15	19	85	81	1	N	3.8	3.6	1.3	1.4	3.7	3.8	2.7	2.7	1.7	1.9	0.7	1.1	9.35	10.25
15	Nun Bank	NR	70	75	13	7	34	45	10	10	4	3	16	15	17	12	0	0	5	8	84	47	15	11	84	89	0	0	3.9	3.7	1.6	1.2	3.9	3.6	2.9	2.6	0.4	1.2	0.0	0.9	7.90	8.85
16	Solan Bank	NN	78	115	6	2	40	32	9	5	8	3	16	0	17	12	0	0	2	2	78	63	5	19	95	81	0	0	4.2	3.5	2.3	1.0	4.5	2.5	3.3	1.0	0.7	4.0	1.3	4.0	10.85	12.75
17	Fair Isle Channel	OS	100		6		34		9		5		14		26		0	0	5		84		21		79		0		3.9		1.3		3.4		2.3		0.8		0.5		7.70	
18	Fair Isle Sandwave Field	FI	100																		84																					
19	North Orkney	NO	48		27		43		5		6		13		6		0		1		95		25		75		0		3.9		1.1		5.1		3.8		1.8		1.4		11.85	
20	North Ronaldsay - North Bank	RN	49		24		37		2		4		29		3		0		0		98		32		68		0		4.0		1.0		5.3		4.0		2.3		1.3		12.40	
21	East Orkney	EO	61		16		51		4		2		4		16		0		7		88		9		91		0.1		2.8		1.6		2.7		2.7		2.3		1.0		10.05	
22	North Ronaldsay - East Bank	RE	40																		95																					
23	Orkney Sounds	SO	20		18		60		5		2		6		3		4		1		85		31	2	69	98	0		4.0		1.3		4.5		2.7		1.3		1.7		10.65	
24	Baas of Linton	LT	8		34		47		5		2		6		2		2		1		96		3		97		0		4.0		2.0		5.0		4.0		3.0		1.0		13.50	
25	Dowie Sand	DS	16																		85																					
26	West Pentland Firth	PW	71	77	28	23	44	39	4	3	6	5	8	7	7	21	0	0	3	3	84	66	18	10	82	90	N	N	3.7	2.5	1.2	1.0	3.9	2.0	3.4	4.0	2.8	0.0	1.0	0.0	11.25	6.25
27	Sandy Riddle	SR	51	78	37	22	32	29	3	3	5	2	17	21	10	14	0	0	1	0	94	67	34	40	66	60	0	0	3.9	3.4	1.8	2.3	4.3	3.1	3.9	3.0	2.4	2.3	0.4	0.8	11.40	10.65
28	Moray Firth	FM	70	68	19	21	44	36	6	6	2	4	5	4	16	5	0	0	8	13	86	60	12	11	88	88	N	1.0	3.3	3.0	1.0	1.0	3.0	2.0	2.6	1.0	1.4	2.5	1.8	4.0	9.35	11.00
29	West Shetland	WS	91	98	9	6	47	44	8	12	3	3	18	12	8	8	0	0	7	14	84	47	24	16	76	84	N	N	3.8	3.2	1.3	1.3	3.6	2.8	1.8	2.1	2.4	1.8	2.6	2.1	11.40	9.95
30	Foula	FO	40																		85																					
31	Northeast Shetland	ST	100																		85																					
32	Shetland - Out Skerries	SK	64	42	11	13	46	54	12	7	4	5	14	4	6	3	0	0	7	14	85	69	15	15	85	81	N	4	3.8	3.0	1.3	1.3	3.4	2.9	2.1	2.3	2.4	1.5	2.1	2.0	10.85	9.85
33	Yell Sound	SS	74	73	5	5	59	53	13	15	1	3	11	5	5	10	0	0	5	10	87	57	14	7	86	92	N	1	3.5	3.3	1.0	1.3	2.7	2.1	1.3	2.0	1.6	1.5	3.3	2.3	9.20	9.00
	REGIONAL AVERAGES																																							
	Inner Hebrides (exclud. CO)		47	62	45	29	27	44	4	4	6	6	11	6	3	6	3	2	1	3	86	45	24	28	73	64	3	6	3.7	3.1	1.1	1.4	3.4	2.6	2.4	2.0	3.0	1.8	1.5	1.2	10.80	8.80
	Hebridean Shelf		83	91	11	9	33	49	7	6	7	5	19	11	18	14	1	1	3	10	88	54	12	13	88	83	0	4	3.4	3.2	1.6	1.4	3.9	3.3	3.4	2.7	1.4	1.9	0.8	0.7	10.14	9.44
	Northern Shelf		80	87	13	7	37	43	8	7	6	7	14	8	17	11	0	0	5	6	83	51	14	16	86	84	0	0	4.0	3.6	1.6	1.2	3.9	3.3	2.8	2.1	0.9	2.4	0.6	2.0	8.95	10.62
	Orkney (N)		49		26		40		3		5		21		4		0		1		97		29		71		0		4.0		1.1		5.2		3.9		2.0		1.4		12.13	
	Orkney (E-S) & Moray Firth		63	74	25	22	43	35	5	4	4	4	7	11	12	17	0	0	5	5	88	64	21	16	80	84	N	N	3.4	3.0	1.4	1.4	3.5	2.4	3.3	2.7	2.2	1.6	1.1	1.6	10.51	9.30
	Shetland (W&E)		82	67	10	10	45	51	10	9	4	4	16	8	8	5	0	0	7	13	85	58	18	13	82	86	N	1	3.7	3.2	1.3	1.4	3.2	3.2	1.9	2.4	2.4	1.6	2.3	2.3	10.62	10.60

Table 4. Summary of petrographic data for carbonate deposits (> 75% $CaCO_3$) and surrounding sediments (<75% $CaCO_3$).

NB. Figures quoted are normally 'averages' from several samples. However they are not statistically rigorous (see pp. 31-32).

N means <1%

RANK	DEPOSIT	% BARNACLES	ENVIRONMENT	MAIN INFLUENCE
1	Rubha Nan Clach	51	Atlantic influenced tidal coastal platform	
2	Passage of Tiree	45	Atlantic influenced tidal passage, platform	COASTLINE DOMINATED
3	Sound of Eigg	43	Tidal Channel - some Atlantic influence	
4	Hawes Bank	41	Atlantic dominated coastal shoal	
5	Sandy Riddle	37	Tidal coastal sandbank, N. Sea influenced	
6	Baas of Linton	34	Tidal coastal sandbank, N. Sea influenced	
7	West Pentland Firth	28	Tidal passage, Atlantic dominated	
8=	Cape Wrath	27	Atlantic influenced tidal coastal shelf	
8=	North Orkney	27	Atlantic dominated tidal coastal platform	
10	N. Ronaldsay North Bank	24	Tidal, coastal sandbank, Atlantic & N. Sea influenced	
11	Moray Firth	19	North Sea dominated, tidal, coastal shelf	
12	Orkney Sounds	18	Tidal channels - some N. Sea influence	
13	East Orkney	16	North Sea dominated, tidal coastal platform & shelf	COASTAL EFFECT
14	Barra Head	15	Atlantic dominated tidal platform	
15	Gulf of Corryvreckan	14	Deep tidal channel	
16=	West Hebridean Platform	13	Atlantic dominated platform	
16=	Nun Bank	13	Atlantic dominated shoal	
18	Shetland-Out Skerries	11	N. Sea & NE Atlantic dominated platform	
19	Butt of Lewis	10	Atlantic dominated tidal platform	
20	West Shetland	9	Atlantic dominated platform	
21=	Solan Bank	6	Atlantic dominated offshore shoal	
21=	Fair Isle Channel	6	Atlantic dominated offshore tidal platform	
23	Yell Sound	5	Tidal channel-NE Atlantic & N. Sea influenced	
24	Stanton Banks	4	Atlantic dominated offshore shoal	OFFSHORE

TABLE 5. Carbonate deposits and their environments ranked by barnacle content.

Accumulation site (sand banks)	Ave % Barnacles	'Upstream'	Ave % Barnacles
North Ronaldsay - north bank	24	North Orkney	27
Sandy Riddle	37	West Pentland Firth East Orkney	37 16

TABLE 6.. Variation in barnacle content between apparent sites of carbonate accumulation and sediment supplying them.

Carbonate sandbank	Ave Stain	Nearby carbonates	Ave Stain
Baas of Linton	3.0	Orkney Sounds	1.3
Sandy Riddle	2.4	Moray Firth	1.4
North Ronaldsay - north bank	2.3	North Orkney	1.8

TABLE 7. Variation in degree of staining between carbonate sandbanks and surrounding, or nearby carbonate sediment.

RANK	DEPOSIT	% BIVALVES	ENVIRONMENT	MAIN INFLUENCE
1	Gulf of Corryvreckan	68	Deep tidal channel	
2	Orkney Sounds	60	Tidal channels, some N. Sea influence	?GEOGRAPHICAL EFFECT TIDAL CURRENT EFFECT
3	Yell Sound	59	Tidal channel, NE Atlantic & N. Sea influenced	
4	East Orkney	51	N. Sea dominated tidal coastal platform & shelf	
5=	Baas of Linton	47	Tidal coastal sandbank, N. Sea influenced	
5=	West Shetland	47	Atlantic dominated platform	
7	Shetland-Out Skerries	46	N. Sea & N.E. Atlantic dominated platform	
8=	West Pentland Firth	44	Tidal passage, Atlantic dominated	
8=	Moray Firth	44	N. Sea dominated tidal coastal shelf	
10	North Orkney	43	Atlantic dominated tidal coastal platform	
11	Butt of Lewis	41	Atlantic dominated tidal platform	
12=	Cape Wrath	40	Atlantic influenced tidal coastal shelf	-
12=	Solan Bank	40	Atlantic dominated offshore shoal	-
14	N. Ronaldsay North Bank	37	Tidal coastal sandbank, Atlantic & N. Sea influenced	
15=	Nun Bank	34	Atlantic dominated shoal	
15=	Fair Isle Channel	34	Atlantic dominated offshore tidal platform	
15=	Barra Head	34	Atlantic dominated tidal platform	
18	Stanton Banks	33	Atlantic dominated offshore shoal	
19=	Sandy Riddle	32	Tidal coastal sandbank, N. Sea influenced	?GEOGRAPHICAL EFFECT
19=	Sound of Eigg	32	Tidal channel, some Atlantic influence	
21	Passage of Tiree	29	Atlantic influenced tidal passage, platform	
22	West Hebridean Platform	25	Atlantic dominated platform	
23	Rubha Nan Clach	24	Atlantic influenced tidal coastal platform	
24	Hawes Bank	23	Atlantic dominated coastal shoal	

TABLE 8. Carbonate deposits and their environments ranked by bivalve content.

RANK	DEPOSIT	% ECHINOIDS	ENVIRONMENT
1=	West Hebridean Platform	13	Atlantic dominated platform
1=	Yell Sound	13	Tidal channel, NE Atlantic & N. Sea influenced
3	Shetland-Out Skerries	12	N. Sea & N.E. Atlantic dominated platform
4	Nun Bank	10	Atlantic dominated shoal
5=	Solan Bank	9	Atlantic dominated offshore shoal
5=	Fair Isle Channel	9	Atlantic dominated offshore tidal platform
7	West Shetland	8	Atlantic dominated platform
8	Butt of Lewis	7	Atlantic dominated platform
9	Moray Firth	6	N. Sea dominated tidal coastal shelf
10=	Stanton Banks	5	Atlantic dominated offshore shoal
10=	Cape Wrath	5	Atlantic influenced tidal coastal shelf
10=	North Orkney	5	Atlantic dominated tidal coastal platform
10=	Orkney Sounds	5	Tidal channels-some N. Sea influence
10=	Baas of Linton	5	Tidal coastal sandbank, N. Sea influenced
15=	Passage of Tiree	4	Atlantic influenced tidal passage, platform
15=	Hawes Bank	4	Atlantic dominated coastal shoal
15=	Rubha Nan Clach	4	Atlantic influenced tidal coastal platform
15=	Barra Head	4	Atlantic dominated tidal platform
15=	East Orkney	4	N. Sea dominated, tidal, coastal platform & shelf
15=	West Pentland Firth	4	Tidal passage, Atlantic dominated
21=	Sound of Eigg	3	Tidal channel, some Atlantic effect
21=	Sandy Riddle	3	Tidal coastal sandbank, N. Sea influenced
23	N. Ronaldsay North Bank	2	Tidal, coastal sandbank, Atlantic & N. Sea influenced
24	Gulf of Corryvreckan	1	Deep tidal channel

MAIN INFLUENCE

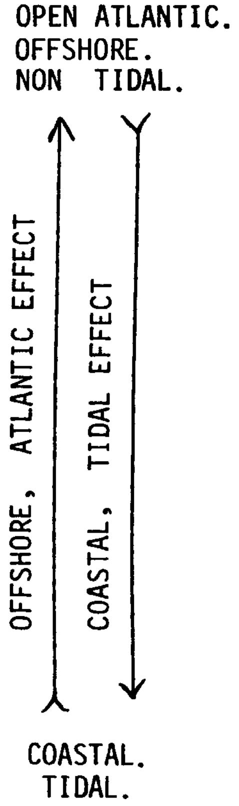


TABLE 9. Carbonate deposits and their environments ranked by echinoid content.

RANK	DEPOSIT	% GASTROPODS	ENVIRONMENT	MAIN INFLUENCE
1	West Hebridean Platform	11	Atlantic dominated platform	
2=	Rubha Nan Clach	8	Atlantic influenced tidal coastal platform	
2=	Solan Bank	8	Atlantic dominated offshore shoal	
4	Butt of Lewis	7	Atlantic dominated tidal platform	
5=	Passage of Tiree	6	Atlantic dominated coastal passage/platform	
5=	Sound of Eigg	6	Tidal channel - some Atlantic influence	
5=	Stanton Banks	6	Atlantic dominated offshore shoal	
5=	North Orkney	6	Atlantic dominated tidal coastal platform	
5=	West Pentland Firth	6	Tidal passage, Atlantic dominated	
10=	Barra Head	5	Atlantic dominated - tidal platform	
10=	Cape Wrath	5	Atlantic influenced tidal coastal shelf	
10=	Fair Isle Channel	5	Atlantic dominated offshore tidal platform	?
10=	Sandy Riddle	5	Tidal coastal sandbank, N. Sea influenced	NOT RECOGNISABLE
14=	Hawes Bank	4	Atlantic dominated coastal shoal	
14=	Nun Bank	4	Atlantic dominated shoal	
14=	N. Ronaldsay North Bank	4	Tidal, coastal sandbank, Atlantic & N. Sea influenced	
14=	Shetland-Out Skerries	4	N. Sea & NE Atlantic dominated platform	
18=	Gulf of Corryvreckan	3	Deep tidal channel	
18=	West Shetland	3	Atlantic dominated platform	
20=	East Orkney	2	N. Sea dominated, tidal coastal platform & shelf	
20=	Orkney Sounds	2	Tidal channels, some N. Sea influence	
20=	Baas of Linton	2	Tidal coastal sandbank, N. Sea influenced	
20=	Moray Firth	2	N. Sea dominated tidal coastal shelf	
24	Yell Sound	1	Tidal channel, NE Atlantic and N. Sea influenced	

TABLE 10. Carbonate deposits and their environments ranked by gastropod content.

RANK	DEPOSIT	% SERPULIDS	ENVIRONMENT	MAIN INFLUENCE
1	Stanton Banks	36	Atlantic dominated offshore shoal	ATLANTIC.
2	N. Ronaldsay North Bank	29	Tidal, coastal sandbank, Atlantic & N. Sea influenced	OFFSHORE.
3	West Hebridean Platform	23	Atlantic dominated platform	
4	Hawes Bank	22	Atlantic dominated coastal shoal	
5	West Shetland	18	Atlantic dominated platform	
6=	Nun Bank	16	Atlantic dominated shoal	
6=	Solan Bank	16	Atlantic dominated offshore shoal	
8=	Shetland - Out Skerries	14	N. Sea and NE Atlantic dominated platform	
8=	Fair Isle Channel	14	Atlantic dominated offshore tidal platform	
10	North Orkney	13	Atlantic dominated, tidal coastal platform	
11	Sandy Riddle	12	Tidal coastal sandbank, N. Sea influenced	
12	Yell Sound	11	Tidal channel, NE Atlantic & N. Sea influenced	
13=	Barra Head	9	Atlantic dominated tidal platform	
13=	Cape Wrath	9	Atlantic influenced tidal coastal shelf	
15=	W. Pentland Firth	8	Tidal passage, Atlantic dominated	
15=	Butt of Lewis	8	Atlantic dominated tidal platform	
15=	Rubha Nan Clach	8	Atlantic influenced tidal coastal platform	
18	Passage of Tiree	7	Atlantic influenced tidal passage, platform	
19=	Sound of Eigg	6	Tidal channel, some Atlantic influence	
19=	Orkney Sounds	6	Tidal channels, some N. Sea influence	
19=	Baas of Linton	6	Tidal coastal sandbank N. Sea influenced	
22	Moray Firth	5	North Sea dominated tidal coastal shelf	
23	East Orkney	4	N. Sea dominated, tidal coastal platform & shelf	N. SEA.
24	Gulf of Corryvreckan	3	Deep tidal channel	COASTAL.

↑ OFFSHORE AND ATLANTIC EFFECT

↓ COASTAL AND N. SEA EFFECT

TABLE 11. Carbonate deposits and their environments ranked by serpulid content.

RANK	DEPOSIT	% BRYOZOA	ENVIRONMENT	MAIN INFLUENCE
1	Fair Isle Channel	26	Atlantic dominated offshore tidal platform	"DEEP".
2	Barra Head	25	Atlantic dominated tidal platform	OFFSHORE
3	Butt of Lewis	21	Atlantic dominated tidal platform	
4=	Nun Bank	17	Atlantic dominated shoal	
4=	Solan Bank	17	Atlantic dominated offshore shoal	
6=	Moray Firth	16	N. Sea dominated tidal coastal shelf	
6=	East Orkney	16	N. Sea dominated tidal coastal platform & shelf	
8	Stanton Banks	14	Atlantic dominated offshore shoal	
9	West Hebridean Platform	12	Atlantic dominated platform	
10	Sandy Riddle	10	Tidal coastal sandbank, N. Sea influenced	
11	Gulf of Corryvreckan	9	Deep tidal channel	
12	West Shetland	8	Atlantic dominated platform	
13=	West Pentland Firth	7	Tidal passage, Atlantic dominated	
13=	Cape Wrath	7	Atlantic influenced tidal coastal shelf	
15=	Passage of Tiree	6	Atlantic influenced tidal passage, platform	↑ WATER DEPTH EFFECT ↓ COASTAL EFFECT
15=	North Orkney	6	Atlantic dominated, tidal coastal platform	
15=	Shetland - Out Skerries	6	N. Sea & NE Atlantic dominated platform	
18	Yell Sound	5	Tidal channel, NE Atlantic & N. Sea influenced	
19=	Rubha Nan Clach	3	Atlantic influenced tidal coastal platform	
19=	N. Ronaldsay North Bank	3	Tidal, coastal sandbank, Atlantic & N. Sea influenced	
19=	Orkney Sounds	3	Tidal channels, some N. Sea influence	
22=	Hawes Bank	2	Atlantic dominated coastal shoal	
22=	Sound of Eigg	2	Tidal channel - some Atlantic influence	"SHALLOW"
22=	Baas of Linton	2	Tidal coastal sandbank, N. Sea influenced	INSHORE

TABLE 12. Carbonate deposits and their environments ranked by bryozoan content.

RANK	DEPOSIT	% FORAMINIFERA	ENVIRONMENT	MAIN INFLUENCE
1	Moray Firth	8	N. Sea dominated tidal coastal shelf	OPEN SHELF. LOWER CURRENTS
2=	West Shetland	7	Atlantic dominated platform	
2=	Shetland - Out Skerries	7	N. Sea & NE Atlantic dominated platform	
2=	East Orkney	7	N. Sea dominated, tidal coastal platform & shelf	
5=	Cape Wrath	6	Atlantic influenced tidal coastal shelf	↑ OPEN SHELF EFFECT COASTAL CURRENT EFFECT ↓
5=	Barra Head	6	Atlantic dominated tidal platform	
7=	Butt of Lewis	5	Atlantic dominated tidal platform	
7=	Nun Bank	5	Atlantic dominated shoal	
7=	Fair Isle Channel	5	Atlantic dominated offshore tidal platform	
7=	Yell Sound	5	Tidal channel, NE Atlantic & N. Sea influenced	
11=	Passage of Tiree	3	Atlantic influenced tidal passage/platform	
11=	West Pentland Firth	3	Tidal passage, Atlantic dominated	
13=	Stanton Banks	2	Atlantic dominated offshore shoal	
13=	Solan Bank	2	Atlantic dominated offshore shoal	
15=	Hawes Bank	1	Atlantic dominated coastal shoal	
15=	Sound of Eigg	1	Tidal channel, some Atlantic influence	
15=	Rubha Nan Clach	1	Atlantic influenced tidal coastal platform	
15=	North Orkney	1	Atlantic dominated tidal coastal platform	
15=	Orkney Sounds	1	Tidal channels, some N. Sea influence	
15=	Baas of Linton	1	Tidal coastal sandbank, N. Sea influenced	
15=	Sandy Riddle	1	Tidal coastal sandbank, N. Sea influenced	
22=	West Hebridean Platform	0	Atlantic dominated platform	
22=	Gulf of Corryvreckan	0	Deep tidal channel	
22=	N. Ronaldsay North Bank	0	Tidal coastal sandbank, Atlantic & N. Sea influenced	COASTAL HIGH CURRENTS

TABLE 13. Carbonate deposits and their environments ranked by foraminifera content.

RANK	DEPOSIT	GRAIN SIZE	ENVIRONMENT	MAIN INFLUENCE
1	Gulf of Corryvreckan	4.5	Deep tidal channel	EXTREME CURRENTS
2	Solan Bank	4.2	Atlantic dominated offshore shoal	
3=	Stanton Banks	4.0	Atlantic dominated offshore shoal	
3=	N. Ronaldsay N. Bank	4.0	Tidal coastal sandbank, Atlantic & N. Sea influenced	
3=	Orkney Sounds	4.0	Tidal channels, some N. Sea influence	
3=	Baas of Linton	4.0	Tidal coastal sandbank, N. Sea influenced	
7=	Nun Bank	3.9	Atlantic dominated shoal	
7=	Fair Isle Channel	3.9	Atlantic dominated offshore tidal platform	
7=	North Orkney	3.9	Atlantic dominated tidal coastal platform	
7=	Sandy Riddle	3.9	Tidal coastal sandbank, N. Sea influenced	
11=	Passage of Tiree	3.8	Atlantic influenced todal passage/platform	
11=	Hawes Bank	3.8	Atlantic dominated coastal shoal	
11=	Rubha Nan Clach	3.8	Atlantic influenced tidal coastal platform	
11=	Cape Wrath	3.8	Atlantic influenced tidal coastal shelf	CURRENT & TRANSPORT EFFECT
11=	West Shetland	3.8	Atlantic dominated platform	
11=	Shetland - Out Skerries	3.8	N. Sea & Atlantic dominated platform	
17=	West Hebridean Platform	3.7	Atlantic dominated platform	
17=	West Pentland Firth	3.7	Tidal passage, Atlantic dominated	
19=	Sound of Eigg	3.5	Tidal channel, some Atlantic influence	
19=	Yell Sound	3.5	Tidal channel, NE Atlantic & N. Sea influenced	
21	Moray Firth	3.3	N. Sea dominated tidal coastal shelf	
22	Barra Head	3.0	Atlantic dominated tidal platform	
23	Butt of Lewis	2.9	Atlantic dominated tidal platform	
24	East Orkney	2.8	N. Sea dominated, tidal coastal platform & shelf	LOWER CURRENTS

TABLE 14. Carbonate deposits and their environments ranked by average grain size.

RANK	DEPOSIT	SORTING	ENVIRONMENT	MAIN INFLUENCE
1	Solan Bank	2.3	Atlantic dominated offshore shoal	
2=	Gulf of Corryvrechan	2.0	Deep tidal channel	
2=	Baas of Linton	2.0	Tidal coastal sandbank, N. Sea influenced	
4=	Barra Head	1.8	Atlantic dominated tidal platform	
4=	Butt of Lewis	1.8	Atlantic dominated tidal platform	
4=	Sandy Riddle	1.8	Tidal coastal sandbank, N. Sea influenced	
7=	Nun Bank	1.6	Atlantic dominated shoal	
7=	East Orkney	1.6	N. Sea dominated, tidal coastal platform & shelf	
9=	Hawes Bank	1.5	Tidal channel - some Atlantic influence	
9=	Stanton Banks	1.5	Atlantic dominated offshore shoal	?
11	West Hebridean Platform	1.4	Atlantic dominated platform	
12=	Cape Wrath	1.3	Atlantic influenced tidal coastal shelf	NOT RECOGNISABLE
12=	Fair Isle Channel	1.3	Atlantic dominated offshore tidal platform	
12=	Orkney Sounds	1.3	Tidal channels, some N. Sea influence	
12=	West Shetland	1.3	Atlantic dominated platform	
12=	Shetland - Out Skerries	1.3	N. Sea & NE Atlantic dominated platform	
17	West Pentland Firth	1.2	Tidal passage, Atlantic dominated	
18	North Orkney	1.1	Atlantic dominated, tidal coastal platform	
19=	Passage of Tiree	1.0	Atlantic influenced tidal passage/platform	
19=	Sound of Eigg	1.0		
19=	Rubha Nan Clach	1.0	Atlantic influenced tidal coastal platform	
19=	N. Ronaldsay North Bank	1.0	Tidal coastal sandbank, Atlantic & N. Sea influenced	
19=	Moray Firth	1.0	N. Sea dominated tidal coastal shelf	
19=	Yell Sound	1.0	Tidal channel, NE Atlantic & N. Sea influenced	

TABLE 15. Carbonate deposits and their environments ranked by sorting (visually assessed)

RANK	DEPOSIT	ROUNDNESS	ENVIRONMENT	MAIN INFLUENCE
1	N. Ronaldsay North Bank	5.3	Tidal, coastal sandbank, Atlantic & N. Sea influenced	EXPOSURE TO CURRENTS
2	North Orkney	5.1	Atlantic dominated, tidal, coastal platform	STRONG CURRENTS
3=	Hawes Bank	5.0	Atlantic dominated coastal shoal	DEGREE OF EXPOSURE TO CURRENTS CURRENT STRENGTH EFFECT
3=	Baas of Linton	5.0	Tidal coastal sandbank, N. Sea influenced	
5=	Solan Bank	4.5	Atlantic dominated offshore shoal	
5=	Orkney Sounds	4.5	Tidal Channels, some N. Sea influence	
7=	Stanton Banks	4.3	Atlantic dominated offshore shoal	
7=	Sandy Riddle	4.3	Tidal coastal sandbank, N. Sea influenced	
9	West Hebridean Platform	4.0	Atlantic dominated platform	
10=	Nun Bank	3.9	Atlantic dominated shoal	
10=	West Pentland Firth	3.9	Tidal passage, Atlantic dominated	
12	West Shetland	3.8	Atlantic dominated platform	
13	Cape Wrath	3.7	Atlantic influenced tidal coastal shelf	
14	Barra Head	3.6	Atlantic dominated tidal platform	
15	Butt of Lewis	3.5	Atlantic dominated tidal platform	
16=	Fair Isle Channel	3.4	Atlantic dominated offshore tidal platform	
16=	Shetland - Out Skerries	3.4	N. Sea & NE Atlantic dominated platform	
18	Passage of Tiree	3.2	Atlantic dominated tidal passage/platform	
19=	Gulf of Corryvreckan	3.0	Deep tidal channel	
19=	Sound of Eigg	3.0	Tidal channel - some Atlantic influence	
19=	Moray Firth	3.0	N. Sea dominated tidal coastal shelf	
22=	East Orkney	2.7	N. Sea dominated, tidal coastal platform & shelf	
22=	Yell Sound	2.7	Tidal channel, NE Atlantic & N. Sea influenced	
22=	Rubha Nan Clach	2.7	Atlantic influenced tidal coastal platform	

TABLE 16. Carbonate deposits and their environments ranked by carbonate grain roundness.

RANK	DEPOSIT	POLISH	ENVIRONMENT	MAIN INFLUENCE
1=	Hawes Bank	4.0	Atlantic dominated coastal shoal	EXPOSURE TO CURRENTS
1=	N. Ronaldsay North Bank	4.0	Tidal, coastal sandbank, Atlantic & N. Sea influenced	
1=	Baas of Linton	4.0	Tidal, coastal sandbank, N. Sea influenced	STRONG CURRENTS
4	Sandy Riddle	3.9	Tidal coastal sandbank, N. Sea influenced	↑
5	North Orkney	3.8	Atlantic dominated tidal coastal platform	
6=	Butt of Lewis	3.6	Atlantic dominated tidal platform	
6=	Barra Head	3.6	Atlantic dominated tidal platform	
8	West Pentland Firth	3.4	Tidal passage, Atlantic dominated	DEGREE OF EXPOSURE TO CURRENTS CURRENT STRENGTH EFFECT
9	Solan Bank	3.3	Atlantic dominated offshore shoal	
10	West Hebridean Platform	3.2	Atlantic dominated platform	
11=	Gulf of Corryvreckan	3.0	Deep tidal channel	
11=	Stanton Banks	3.0	Atlantic dominated offshore shoal	
13	Nun Bank	2.9	Atlantic dominated shoal	
14=	Cape Wrath	2.7	Atlantic influenced tidal coastal shelf	
14=	East Orkney	2.7	N. Sea dominated, tidal coastal platform & shelf	
14=	Orkney Sounds	2.7	Tidal channels, some N. Sea influence	
17	Moray Firth	2.6	N. Sea dominated tidal coastal shelf	
18	Passage of Tiree	2.5	Atlantic influenced tidal passage/platform	
19	Fair Isle Channel	2.3	Atlantic dominated offshore tidal platform	
20	Shetland - Out Skerries	2.1	N. Sea & NE Atlantic dominated platform	
21	Sound of Eigg	2.0	Tidal channel, some Atlantic influence	
22	West Shetland	1.8	Atlantic dominated platform	
23	Yell Sound	1.3	Tidal channel, NE Atlantic & N. Sea influenced	
24	Rubha Nan Clach	1.0	Atlantic influenced tidal coastal platform	

TABLE 17. Carbonate deposits and their environments ranked by degree of polish of carbonate grains.

RANK	DEPOSIT	STAINING	ENVIRONMENT	MAIN INFLUENCE
1	Hawes Bank	4.0	Atlantic dominated coastal shoal	BANKS & SHOALS ↑
2=	Stanton Banks	3.0	Atlantic dominated offshore shoal	
2=	Sound of Eigg	3.0	Tidal channel, some Atlantic influence	
2=	Baas of Linton	3.0	Tidal coastal sandbank, N. Sea influenced	
5	Passage of Tiree	2.9	Atlantic influenced tidal passage/platform	
6	West Pentland Firth	2.8	Tidal passage, Atlantic dominated	
7=	Sandy Riddle	2.4	Tidal coastal sandbank, N. Sea influenced	
7=	West Shetland	2.4	Atlantic dominated platform	
7=	Shetland - Out Skerries	2.4	N. Sea & NE Atlantic dominated platform	
10=	N. Ronaldsay North Bank	2.3	Tidal coastal sandbank, Atlantic & N. Sea influenced	
10=	East Orkney	2.3	N. Sea dominated, tidal coastal platform & shelf	
12=	Gulf of Corryvreckan	2.0	Deep tidal channel	? DEGREE OF WAVE AGITATION
12=	Rubha Nan Clach	2.0	Atlantic influenced tidal coastal platform	
14	North Orkney	1.8	Atlantic dominated tidal coastal platform	
15	Cape Wrath	1.7	Atlantic influenced tidal coastal shelf	
16	Yell Sound	1.6	Tidal channel, NE Atlantic & N. Sea influenced	
17	Moray Firth	1.4	N. Sea dominated tidal coastal shelf	
18	Orkney Sounds	1.3	Tidal channels, some N. Sea influence	
19	Butt of Lewis	1.0	Atlantic dominated tidal platform	
20	Barra Head	0.9	Atlantic dominated tidal paltform	↓
21=	West Hebridean Platform	0.8	Atlantic dominated platform	
21=	Fair Isle Channel	0.8	Atlantic dominated offshore tidal platform	SOUNDS & PLATFORMS
23	Solan Bank	0.7	Atlantic dominated offshore shoal	
24	Nun Bank	0.4	Atlantic dominated shoal	

TABLE 18. Carbonate deposits and their environments ranked by degree of staining of carbonate grains.

RANK	DEPOSIT	DEGREE OF BORING	ENVIRONMENT	MAIN INFLUENCE
1	Yell Sound	3.6	Tidal channel, NE Atlantic & N. Sea influenced	
2	West Shetland	2.6	Atlantic dominated platforms	SHETLAND ↑
3	Shetland - Out Skerries	2.1	N. Sea & NE Atlantic dominated platform	
4=	Rubha Nan Clach	2.0	Atlantic influenced tidal coastal platform	
4=	Stanton Banks	2.0	Atlantic dominated offshore shoal	
6=	Passage of Tiree	1.8	Atlantic influenced tidal passage/platform	
6=	Moray Firth	1.8	N. Sea dominated tidal coastal shelf	
8	Orkney Sounds	1.7	Tidal channels, some N. Sea influence	
9	North Orkney	1.4	Atlantic dominated tidal coastal platform	
10=	Solan Bank	1.3	Atlantic dominated offshore shoal	ORKNEY
10=	N. Ronaldsay North Bank	1.3	Tidal coastal sandbank, Atlantic & N. Sea influenced	
12=	Gulf of Corryvreckan	1.0	Deep tidal channel	?GEOGRAPHICAL
12=	Hawes Bank	1.0	Atlantic dominated coastal shoal	
12=	Sound of Eigg	1.0	Tidal channel, some Atlantic influence	
12=	East Orkney	1.0	N. Sea dominated tidal coastal platform & shelf	
12=	Baas of Linton	1.0	Tidal coastal sandbank, N. Sea influenced	
12=	West Pentland Firth	1.0	Tidal passage, Atlantic dominated	
18	West Hebridean Platform	0.8	Atlantic dominated platform	HEBRIDES & NORTHERN SHELF
19	Cape Wrath	0.7	Atlantic influenced tidal coastal shelf	
20	Fair Isle Channel	0.5	Atlantic dominated offshore tidal platform	
21	Sandy Riddle	0.4	Tidal coastal sandbank, N. Sea influenced	
22=	Barra Head	0.2	Atlantic dominated tidal platform	
22=	Butt of Lewis	0.2	Atlantic dominated tidal platform	
22=	Nun Bank	0.2	Atlantic dominated shoal	↓

TABLE 19. Carbonate deposits and their environments ranked by degree of boring.

RANK	DEPOSIT	MATURITY INDEX	ENVIRONMENT	MAIN INFLUENCE
1	Hawes Bank	14.10	Atlantic dominated coastal shoal	HIGH EXPOSURES TO CURRENTS. STRONG CURRENTS ACCUMULATION SITES
2	Baas of Linton	13.50	Tidal coastal sandbank, N. Sea influenced	
3	Stanton Banks	12.80	Atlantic dominated offshore shoal	
4	N. Ronaldsay North Bank	12.40	Tidal coastal sandbank, Atlantic & N. Sea influenced	
5	North Orkney	11.85	Atlantic dominated tidal coastal platform	
6=	Sandy Riddle	11.40	Tidal coastal sandbank, N. Sea influenced	DEGREE OF EXPOSURE TO CURRENTS
6=	West Shetland	11.40	Atlantic dominated platform	
8	West Pentland Firth	11.25	Tidal passage, Atlantic dominated	
9=	Solan Bank	10.85	Atlantic dominated offshore shoal	
9=	Shetland - Out Skerries	10.85	N. Sea & NE Atlantic dominated platform	
11	Passage of Tiree	10.75	Atlantic influenced tidal passage/platform	
12	Orkney Sounds	10.65	Tidal channels, some N. Sea influence	
13	East Orkney	10.05	N. Sea dominated, tidal coastal platform/shelf	
14=	Gulf of Corryvreckan	9.75	Deep tidal channel	
14=	Sound of Eigg	9.75	Tidal channel, some Atlantic influence	
16=	Butt of Lewis	9.35	Atlantic dominated tidal platform	
16=	Cape Wrath	9.35	Atlantic influenced coastal shelf	
16=	Moray Firth	9.35	N. Sea dominated coastal shelf	
19	West Hebridean Platform	9.30	Atlantic dominated platform	
20	Yell Sound	9.20	Tidal channel, NE Atlantic & N. Sea influenced	EXPOSURE TO CURRENTS. WEAKER CURRENTS. SLOWER, LOCAL TRANSPORT.
21	Barra Head	9.09	Atlantic dominated tidal platform	
22	Rubha Nan Clach	8.60	Atlantic influenced tidal coastal platform	
23	Nun Bank	7.90	Atlantic dominated shoal	
24	Fair Isle Channel	7.70	Atlantic dominated offshore tidal platform	

TABLE 20. Carbonate deposits and their environments ranked by Maturity Index (M)

	Deposit		Δ GN S2	Δ SORT	Δ ROUND	Δ OL	Δ STAIN	Δ BOR	Δ M
1.	Gulf of Corryvreckan		-	-	-	-	-	-	-
2.	Passage of Tiree		+0.6	-0.3	+0.9	+1.5	+0.3	-0.2	+1.15
3.	Hawes Bank		+0.5	+0.3	+1.4	+1.2	+1.8	0.0	+3.85
4.	Sound of Eigg		+0.3	-0.2	+0.7	+0.1	+1.1	-0.2	+1.30
5.	Sligachan - Scalpay		-	-	Insufficient data			-	-
6.	Rubha Nan Clach		+1.0	-0.8	+0.5	-1.0	+1.5	+1.5	+1.7
7.	Shiant		-	-	Insufficient data			-	-
8.	Southeast Shiant Sandbank		-	-	Insufficient data			-	-
9.	Sound of Iona		-	-	Insufficient data			-	-
10.	Stanton Banks	*	+0.5	+0.5	+0.3	0.0	-1.0	+1.0	+2.55
11.	Barra Head		0.0	+0.5	+1.3	+1.3	-1.4	-1.3	+1.36
12.	West Hebridean Platform	*	0.0	+0.4	-0.3	+0.5	-1.5	+0.5	-0.60
13.	Butt of Lewis		+0.5	-0.3	+1.0	+0.1	-1.1	+0.1	-0.50
14.	Cape Wrath		+0.2	-0.1	-0.1	0.0	-0.2	-0.4	-0.90
15.	Nun Bank		+0.2	+0.4	+0.3	+0.3	-0.8	+0.9	0.95
16.	Solan Bank	*	+0.7	+1.3	+2.0	+2.3	-3.3	-2.7	-1.90
17.	Fair Isle Channel		All sediments in vicinity are > 75% $CaCO_3$						
18.	Fair Isle Sandwave Field		"	"	"	"	"	"	
19.	North Orkney		"	"	"	"	"	"	
20.	N. Ronaldsay North Bank		"	"	"	"	"	"	(-0.55)
21.	East Orkney		"	"	"	"	"	"	
22.	N. Ronaldsay East Bank		"	"	"	"	"	"	
23.	Orkney Sounds		"	"	"	"	"	"	
24.	Baas of Linton		"	"	"	"	"	"	(-2.85)
25.	Dowie Sand		-	-	Insufficient data			-	-
26.	West Pentland Firth	*	+1.2	+0.2	+1.9	-0.6	+2.8	+1.0	+4.00
27.	Sandy Riddle		+0.5	-0.5	+1.2	+0.9	+0.1	-0.4	+0.75
28.	Moray Firth	*	+0.3	+0.0	+1.0	+1.6	-1.1	-2.2	-1.65
29.	West Shetland		+0.6	+0.0	+0.8	-0.3	+0.6	-0.5	+1.45
30.	Foula		-	-	Insufficient data			-	-
31.	Northeast Shetland		-	-	Insufficient data			-	-
32.	Shetland - Out Skerries		+0.8	0.0	+0.5	-0.2	+0.9	+0.1	+1.00
33.	Yell Sound		+0.2	-0.3	+0.6	-2.7	+0.1	+1.0	+0.20

<u>NB</u>. (a) $\Delta \text{TEX} = \text{TEX}_{(75)} - \text{TEX}_{(50)}$

(b) *implies that data on surrounding carbonate rich (50-75%) sediment is very limited - eg. only one sample.

(c) values for M in brackets are difference between M for the carbonate sandbank and surrounding carbonate sediments.

TABLE 21. DIFFERENCES BETWEEN TEXTURAL PROPERTIES OF DEPOSITS (> 75% $CaCO_3$) AND SURROUNDING SEDIMENTS (50-75% $CaCO_3$)

	DEPTH	BARN	BIV	ECH	GAST	SERP	BRY	CALAL	FORAM	GNSI	SORT	ROUND	POL	STAIN	BOR	MI
DEPTH		-0.5598 P=0.002	0.1878 P=0.190	0.0732 P=0.367	0.0166 P=0.469	0.2993 P=0.078	0.4346 P=0.017	-0.4912 P=0.007	0.2049 P=0.168	0.2226 P=0.148	0.2129 P=0.159	-0.2844 P=0.089	-0.1419 P=0.254	-0.1177 P=0.292	0.1012 P=0.319	-0.1905 P=0.186
BARN			-0.4323 P=0.017	-0.5794 P=0.002	0.1444 P=0.250	-0.2863 P=0.087	-0.5974 P=0.001	0.4448 P=0.015	-0.4290 P=0.018	0.0726 P=0.368	-0.3043 P=0.074	0.0737 P=0.366	0.0534 P=0.402	0.5587 P=0.002	-0.0917 P=0.335	0.2768 P=0.095
BIV				0.0019 P=0.497	-0.6517 P=0.000	-0.4322 P=0.017	-0.0939 P=0.331	-0.0295 P=0.446	0.1675 P=0.217	0.0950 P=0.329	0.1647 P=0.221	-0.1657 P=0.220	-0.1128 P=0.300	-0.1220 P=0.285	0.2979 P=0.079	-0.0485 P=0.411
ECH					0.1225 P=0.284	0.2247 P=0.146	0.2397 P=0.130	-0.3168 P=0.066	0.3819 P=0.033	-0.0821 P=0.351	-0.0389 P=0.429	-0.1649 P=0.221	-0.3580 P=0.043	-0.4774 P=0.009	0.2701 P=0.101	-0.3564 P=0.044
GAST						0.2873 P=0.087	0.1652 P=0.220	0.0047 P=0.491	-0.3717 P=0.037	0.0620 P=0.387	0.0547 P=0.400	0.0939 P=0.331	0.1054 P=0.312	-0.2042 P=0.169	-0.2949 P=0.081	-0.1306 P=0.271
SERP							0.0198 P=0.463	-0.3452 P=0.049	-0.2085 P=0.164	0.2820 P=0.091	-0.0455 P=0.416	0.4866 P=0.008	0.2142 P=0.157	0.1199 P=0.288	0.1242 P=0.282	0.3806 P=0.033
BRY								-0.3637 P=0.040	0.4741 P=0.010	-0.3919 P=0.029	0.3990 P=0.027	-0.2115 P=0.161	0.1080 P=0.308	-0.6501 P=0.000	-0.4644 P=0.011	-0.5190 P=0.005
CALAL									-0.3346 P=0.055	-0.0018 P=0.497	-0.1435 P=0.252	-0.0523 P=0.404	-0.1284 P=0.275	0.1991 P=0.175	-0.0723 P=0.369	-0.0006 P=0.499
FORAM										-0.5815 P=0.001	-0.1082 P=0.307	-0.5238 P=0.004	-0.3761 P=0.035	-0.2505 P=0.119	0.1261 P=0.279	-0.4311 P=0.018
GNSI											0.1364 P=0.263	0.4171 P=0.021	0.0909 P=0.336	0.1257 P=0.279	0.1302 P=0.272	0.2975 P=0.079
SORT												0.2487 P=0.121	0.4967 P=0.007	-0.2045 P=0.169	-0.4813 P=0.009	0.1400 P=0.257
ROUND													0.7960 P=0.000	0.1475 P=0.246	-0.2617 P=0.108	0.7057 P=0.000
POL														0.0888 P=0.340	-0.6058 P=0.001	0.5668 P=0.002
STAIN															0.2825 P=0.091	0.7353 P=0.000
BOR																0.1593 P=0.229
MI																

TABLE 22. Pearson Correlation Coefficients for average petrographic characteristics of carbonate deposits.

	Factor 1 (35.7%)	Factor 2 (28.8%)	Factor 3 (18.6%)	Factor 4 (16.9%)
Depth	0.58786	0.01700	-0.01399	-0.08850
Barnacles	-0.93494	0.10175	-0.11669	0.25396
Bivalves	0.16519	-0.01582	0.00956	-0.97821
Echinoids	0.56004	-0.17637	-0.24263	0.11011
Gastropods	0.02787	0.04659	0.12466	0.66991
Serpulids	0.48350	0.60192	-0.10093	0.47464
Bryozoa	0.60607	-0.56187	0.49704	0.19210
Calc. Algae	-0.59617	-0.05048	-0.05388	-0.03417
Foraminifera	0.38557	-0.62756	-0.17003	-0.17332
Grain size	0.02548	0.62156	-0.01962	-0.06895
Sorting	0.21615	0.07163	0.64265	-0.12781
Roundness	-0.06213	0.72721	0.44187	0.14133
Polish	-0.09315	0.43493	0.79530	0.08215
Staining	-0.45637	0.38462	-0.24983	-0.05441
Boring	0.14881	0.18823	-0.83918	-0.28298

Factor 1 : Nearshore versus offshore conditions
Factor 2 : Maturity - current activity/age, etc.
Factor 3 & 4 : Not determined

TABLE 23. Factor analysis of petrographical characteristics using a Varimax rotated factor matrix.

COMPOSITION

	%		%
Barnacle	0	COASTAL AND ROCK EFFECT →	51+
Echinoid	0	OFFSHORE AND ATLANTIC EFFECT → ← COASTAL AND TIDAL EFFECT	13+
Serpulid	0	ROCK AND OFFSHORE OR ATLANTIC EFFECT → ← COASTAL AND NORTH SEA EFFECT	36+
Bryozoa	0	WATER DEPTH EFFECT → ← OPEN SHELF EFFECT	26+
Foraminifera	0	OPEN SHELF EFFECT → ← COASTAL AND TIDAL CURRENT EFFECT	8+

	WAVES	TIDAL CHANNELS
Bivalve	23 → 33	47 — 68
	WEST SCS	NE SCS

TEXTURE

Grain Size	1.0 – – – ► 2.8	→	4.5 – – – ► 5.0 EXTREME CURRENTS
Roundness	1.0 – – – ► 2.7	→	5.3 – – – ► 6.0
	RARE OR SHORT DURATION OF EXPOSURE TO CURRENTS		FREQUENT AND/OR LONG DURATION OF EXPOSURE TO CURRENTS
Polish	0 – – – ► 1.0	→	4.0
	CURRENTS A/A		CURRENTS A/A

Table 24 Summary of petrographical variation of carbonates on the SCS in relation to their environments. Percentages quoted refer to maximum 'averages' of deposits. Locally values can be higher.

	Critical Threshold Velocities			Critical threshold combinations of velocities				Empirical "Combined equivalent unidirectional velocity" (CV). Compare this with "unidirectional current only"	
				Wave period = 5 secs		Wave period = 15 secs			
Mean sediment grain diameter (mm)	Unidirectional current only cm/sec	Wave currents only (5 sec) cm/sec	Wave currents only (10 sec) cm/sec	Wave current velocity cm/sec (WV)	Unidirectional current velocity cm/sec (TV)	Wave Current velocity cm/sec (WV)	Unidirectional current velocity cm/sec (TV)	5 sec waves CV=TV+0.3WV	15 sec waves CV=TV + 0.7WV
1.134	26.7	35.0	30.3*	4.00	27.1	2.67	24.7	28.3	26.6
				8.00	24.6	4.20	24.1	27.0	27.0
				12.00	22.9	6.00	23.1	26.5	27.3
				18.0	21.5	9.45	19.4	26.9	26.0
				24.0	20.3	10.0	18.9	27.5	25.9
						12.0	17.5		25.9
						16.8	13.9		25.7
						20.0	12.7		26.7
						20.9	9.3		23.9
0.771	24.3	31.9	†	4.00	23.5	2.67	21.6	24.7	23.5
				8.00	22.5	6.00	19.8	24.9	24.0
				12.00	21.3	10.0	17.7	24.9	24.7
				18.00	19.8	12.0	15.9	25.2	24.3
				24.00	17.4	16.0	13.1	24.6	24.3
						20.0	10.9		24.9
0.363	21.9	27.0	27.0	4.00	21.6	2.67	19.4	22.8	21.3
				8.00	20.4	6.00	17.4	22.8	21.6
				12.0	18.0	10.0	15.9	21.6	22.6
				18.0	15.5	12.0	14.3	20.9	22.7
						16.0	11.2		22.4
						20.0	9.2		23.2
0.142	15.6	17.3	25.4	4.0	18.3	2.67	15.6	19.5	17.4
				8.0	17.7	6.00	14.0	20.1	18.2
				12.0	16.4	10.00	12.5	20.0	19.5
				18.0	8.1	12.0	10.9	13.5	19.3
						16.0	9.6		20.8
						20.0	6.9		20.9

* Affected by flume resonance   † Restricted by flume resonance

TABLE 25. Results of the flume experiments of Hammond & Collins (1979) for combined unidirectional and oscillatory current thresholds. Values in the two right hand columns are derived from the empirical formulae for 'CV', originated in this thesis to estimate an equivalent unidirectional current threshold, given a wave current velocity, and a superimposed unidirectional current velocity.

Sieved grain size (mm)	Threshold current for quartz sand (cm/sec)	Threshold current for shell sand (cm/sec)
0.5-1.0	27	13
1.0-2.0	36	20
2.0-4.0	39	22

TABLE 26. Crude threshold velocities for shell sand (sample 58-03/2) and quartz sand, derived at Strathclyde.

	Water Depth	W. Fair Isle Channel 60 m	W. Fair Isle Channel 110 m	N. Fair Isle Channel 60 m	N. Fair Isle Channel 110 m
Tidal Current (cm/sec)	$PN_{1.0}$	21	19	32	29
	$PS_{1.0}$	37	33	58	51
Wave Current (cm/sec)	0.1% exceedance	75	40	75	40
	1.0% exceedance	50	30	50	30
	50% exceedance	5	1	5	1
CV (cm/sec)	0.1%, PN	126	75	137	85
	0.1% max, PS	268	156	289	174
	1%, PN	91	60	102	71
	1% max, PS	191	122	212	143
	50% PN	28	22	39	30
	50% max, PS	52	36	73	54
	PNET	41%		38%	

Table 27. Tidal, wave, and combined equivalent unidrectional (CV) current velocities in N&W Fair Isle Channel. (For S. Fair Isle Channel see North Orkney).

CASE	OCCURRENCE	INCIDENCE	$CV_{1.0}$ (cm/sec)	THRESHOLD size (mm)		SUSPENSION GRAIN SIZE (mm)	
				Quartz	Carbonate	Quartz	Carbonate
0.1%, PN -	Extreme winter storm once in 3 years	-Exceeded by at least 1 wave in 4.	90	2.5	20+	0.26	0.9 - 2.0
0.1% max, PS -		-maximum attained	189	12	100+	0.6	2 - 20*
1%, PN	Severe winter storm 3-4 times per year	-Exceeded by at least 1 wave in 4.	69	1.4	4+	0.25	0.77- 1.8
1% max, PS		-maximum attained	142	9	100+	0.43	1 - 3
50%, PN	'Rough' sea 178 days per year	-Exceeded by at least 1 wave in 4	23	0.04	0.05	0.04	0.05
50% max, PS		-maximum attained	41	0.23	0.5-1	0.23	.5-1

TABLE 28. Particle size thresholds for varying weather conditions in the west Fair Isle Channel at 80-90 m depth. (See also Figs.55-57Tables27,29and Appendix 3 , Tables46 & 47).

		NORTH ORKNEY (60m)			NORTH RONALDSAY north bank and North Orkney (30m)		
		Current cm/sec	Carbonate Theshold Gn Sz (mm)	Carbonate Suspension Gn Sz (mm)	Current	Carbonate Threshold Gn Sz (mm)	Carbonate Suspension Gn Sz (mm)
Tidal	$PN_{1.0}$	46			53		
	$PS_{1.0}$	69			80		
Wave	0.1%	75			120		
	1.0%	45			85		
	50%	5			17		
CV	0.1%, PN	151	100+	1-3	214	100+	2-5
	0.1%max, PS	300	100+	3+	450	100+	4+
	1%, PN	116	100+	1-2	172	100+	1.5-4.5
	1%max, PS	208	100+	2-5	342	100+	3+
	50%, PN	53	1-3	0.6-1.2	77	2	.7-1.5
	50%max, PS	84	10+	0.7-1.5	132	7-100+	.8-1.8

Table 29. Tidal, wave and combined equivalent unidirectional (CV) velocities, with carbonate particle size thresholds, for North Orkney.

		Nearshore (E. of Stronsay Firth)		Offshore	
	Water Depth	30m	50m	70m	90m
Tidal Current (cm/sec)	$PN_{1.0}$	52	47	40	38
	$PS_{1.0}$	76	69	25	23
Wave current (cm/sec)	0.1% exceedance	45-125	35-95	25-70	10-45
	1% exceedance	30-90	20-60	10-40	5-30
	50% exceedance	8-20	4-10	0-4	0
CV (cm/sec)	0.1%, PN	112-227	96-180	60-723	37-86
	0.1% max, PS	214-461	177-362	117-256	69-177
	1%, PN	94-178	79-131	39-81	30-65
	1% max, PS	168-353	131-254	71-163	53-92
	50%, PN	63-80	53-61	25-30	23
	50% max, PS	101-158	81-100	40-52	38
	PNET	41%			

Table 30. Tidal, wave and combined equivalent unidirectional (CV) bottom current velocities, East Orkney.

	Location Water Depth	WPF 80m	S-S 70m	SR/CH 50m	SR 20m	EPF/MF 30m	MF 50m
Tidal current (cm/sec)	PN$_{1.0}$	39	139	148	57	21	19
	PS$_{1.0}$	72	224	239	85	39	23
Wave current (cm/sec)	0.1% exceedance	50	50	25+	75+	45+	25+
	1% exceedance	35	35	15+	50+	35+	15+
	50% exceedance	4	4	0+	15+	7+	0+
CV (cm/sec)	0.1%, PN	109	209	183	162	84	54
	0.1% max, PS	226	378	306	316	178	100
	1%, PN	88	188	169	127	70	40
	1% max, PS	180	332	285	239	147	46
	50%, PN	45	145	148	78	31	19
	50% max, PS	84	236	239	131	61	23
	PNET	40%	33%			65%	

Table 31. Tidal, wave, and combined equivalent unidirectional (CV) bottom current velocity, Pentland Firth and Moray Firth area.

Key to Localities: WPF= West Pentland Firth, S-S=Stroma-Stroma gap, SR/CH= channel west of Sandy Riddle, SP=Sandy Riddle, EPF/MF=East Pentland Firth-Moray Firth transition, MF=Moray Firth. Refer also to Figs.52b & 71

		Water Depth = 120 m
Tidal Current (cm/sec)	$PN_{1.0}$	85
	$PS_{1.0}$	170
Wave Current (cm/sec)	0.1% exceedance	25
	1% exceedance	15
	50% exceedance	0
CV (cm/sec)	0.1%, PN	120
	0.1% max, PS	247
	1%, PN	106
	1% max, PS	216
	50%, PN	85
	50% max, PS	170

Table 32. Tidal, wave and combined equivalent unidirectional (CV) bottom-current velocities, Gulf of Corryvreckan.

		SOUTH END	NORTH END
	Water Depth	55m	55m
Tidal current (cm/sec)	$PN_{1.0}$	20	30
	$PS_{1.0}$	35	55
Wave current (cm/sec)	0.1% exceedance	75	60
	1% exceedance	50	45
	50% exceedance	5	5
CV (cm/sec)	.1%, PN	114	98
	.1% max, PS	247	211
	1%, PN	79	77
	1% max, PS	170	165
	50%, PN	16	21
	50% max, PS	31	41
	PNET	75%	60%

Table 33. Tidal, wave, and combined equivalent unidirectional bottom-current velocities, Passage of Tiree.

	Water Depth	130m	90m	40m
Tidal current (cm/sec)	PN	12	13	15
	PS	20	21	25
Wave current (cm/sec)	0.1% exceedance	40	50	110
	1% exceedance	25	40	90
	0% exceedance	0	5	15
CV (cm/sec)	0.1%, PN	68	83	169
	0.1% max, PS	143	175	354
	1%, PN	47	69	141
	1% max, PS	97	144	302
	50% PN	12	20	36
	50% max, PS	20	36	71
	PNET	38%		

Table 34. Tidal, wave, and combined equivalent unidirectional (CV) bottom-current velocities, Stanton Banks.

	Location	BH	IWHP	OWHP	BL
	Water Depth	60	40	80	60
Tidal current	PN	18	12	5	12
(cm/sec)	PS	32	22	10	21
	0.1% exceedance	75	100	50	75
Wave current	1% exceedance	50	75	30	50
(cm/sec)	50% exceedance	8	10	5	8
	0.1%, PN	123	152	75	117
CV	0.1% max, PS	263	330	164	252
(cm/sec)	1%, PN	88	117	47	91
	1% max, PS	186	253	102	175
	50% PN	29	26	12	23
	50% max, PS	57	53	25	46
	PNET	57%	46%	46%	39%

Table 35. Tidal, wave, and combined equivalent unidirectional(CV) bottom current velocities, Outer Hebrides.

Key to Locations: BH= Barra Head, IWHP= Inner West Hebridean Platform, OWHP=Outer West Hebridean Platform, BL= Butt of Lewis.

	Location Water Depth	Cape Wrath 60m	Nun & Solan Banks 70m
Tidal current (cm/sec)	$PN_{1.0}$	35	18
	$PS_{1.0}$	69	34
Wave current (cm/sec)	0.1% exceedance	75	70
	1% exceedance	50	50
	50% exceedance	8	8
CV (cm/sec)	0.1%, PN	140	116
	0.1% max, PS	300	250
	1%, PN	105	88
	1% max, PS	223	188
	50%, PN	46	29
	50% max, PS	94	59
	PNET	55%	

Table 36. Tidal, wave and combined equivalent unidirectional (CV) bottom-current velocities, Northern Shelf.

SAMPLE NO.	SAMPLE DESCRIPTION	LOCATION	POSITION LAT.	LONG.	WATER DEPTH (m)	MEAN RADIOMETRIC AGE	'CORRECTED' AGE	REFERENCE
C74 144/1	Bulk sample, gravel only	N. Fair Isle Channel	59-53-06N	2-04-03W	92	5406±50	5006	Wilson (1979a
JM 72 97/1	Bulk sample, gravel only	W. Pentland Firth	58-40-00N	3-27-82W	75	2752±55	2352	"
S71 142/1	Bulk sample, gravel only	W. Barra Head	56-45-16N	7-54-34W	99	4072±55	3672	"
JM 109	*Glycymeris glycymeris*, valve	N.E. Passage of Tiree	56-40N	6-16W	30	789±86	389	Cucci (1979)
JM 36	Arctica islandica valve	Colonsay-Jura	55-59N	6-3W	23	828±86	428	"
027	Barnacle plates from shell gravel	Oronsay-Islay	55-59N	6-15W	20	558±86	158	"
035	*Pecten maximus* valve	Sound of Jura	55-51N	5-50W	42	632±86	232	"
DF7	Balanid fragments, worn, abraided and strongly iron stained	N.W. North Sea	56-26N	01-53W	60	10865±160	10465	Owens (1981)
DF 13	*Acanthiocardia echinata* value, worn, abraded, strongly iron stained.	N.W. North Sea	56-47N	01-17W	68	6370±160	5970	"
SF 43	Bulk sample, dominantly *Mollusca*, worn, abraded & mostly iron stained	N.W. North Sea	57-05N	01-12W	62	3070±80	2670	"
SF 44	Bulk sample, *Balanus* fragmentary, worn and commonly iron stained.	N.W. North Sea	57-02N	01-10W	61	4270±90	3870	"
SF 46	Bulk sample, sand, badly worn & commonly iron stained	N.W. North Sea	57-08N	01-08W	63	4220±100	3820	"
SF 215	Bulk sample, sand, badly worn & commonly iron stained	N.W. North Sea	57-21N	01-39W	65	6170±100	5770	"
?	Shell gravel, fragments grey and pitted	Western SCS	?		130	8335±60	7935	Wilson 1982
Same as above	Selected barnacle plates	Same as above	Same as above		130	11560±80	11160	"
58 03/2	Bulk sample, shell sand & gravel (see Table)	4 km E or Copinsay, Orkney	58-54N	2-36W	64	3900±60	3500	Allen This Thesis
58 03/2	Heavily bored bivalve fragments	"	"	"	"	4570±70	4170	"
58 03/2	Rounded bivalve fragments, not bored.	"	"	"	"	4410±60	4010	"
58 03/2	Angular bivalve fragments, not bored.	"	"	"	"	3780±70	3380	"
58 03/2	Barnacle fragments, abraded and stained.	"	"	"	"	3270±110	2870	"
58 03/2	Barnacle fragments, not abraded not stained.	"	"	"	"	3290±60	2890	"
58 03/2	Serpulid fragments	"	"	"	"	4060±70	3660	"
58 03/2	Gastropod fragments	"	"	"	"	3480±60	3080	"
58 03/2	Bivalves alive on collection	"	"	"	"	158±10.5%	-	"
NS 15 SD (A)	Whole single value of *Actica Islandica* not bored	Northern Shelf	59-06N	4-09W	80	1460±70	1060	"
NS 15 SD (B)	" "	"	"	"	"	1590±250	1190	"
NS 15 SD (C)	Two fragments heavily bored *Artica Islandica*	"	"	"	"	5860±140	5460	"
NS 15 SD (D)	" "	"	"	"	"	5340±210	4940	"

Table 37 Summary of ^{14}C radiometric ages for carbonate collected from surface sediments on the SCS

Sample 58-03/2

Position: 58° 54.1'N, 2° 36.3'W. E. of Copinsay, Orkney
Water Depth: 64 m
Gravel: 55%. Sand: 45%. Mud: 0%. Carbonate: 84%
Carbonate components - Barnacles: 14%, Bivalves: 50%, Echinoids: 3%,
Gastropods: 7%, Serpulids: 24%, Bryozoa: 1%.
Taxonomic identifications (by D.K. Graham, IGS):

GASTROPODA

Balcis?
Calliostoma zizyphinum (Linné)
Cantharidus montagui (Wood)
Cingula semicostata (Montagu)
Emarginula reticula (Sowerby)
Gibbula cineraria (Linné)
G. tumida (Montagu)
Mangelia costulata (Risso)
Nassarius incrassatus (Ström)
Natica montagui (Forbes)
Rissoa parva (da Costa)
Trophon truncatus (Ström)

BIVALVIA

Arca tetragona (Poli)
Astarte triangularis (Montagu)
Crenella decussata (Montagu)
Gari tellinella (Lamarck)
Glycymeris glycymeris (Linné)
Heteranomia squamula (Linné)
Modiolus phaseolinus (Philippi)
Modiolus sp
Nucula turgida (Leckenby & Marshall)
Parvicardium ovale (Sowerby)
Spisula elliptica (Brown)
Venus fasciata (da Costa)
V. ovata (Pennant)
V. striatula (da Costa)

ECHINODERMATA

Echinocardium cordatum
Echinocyamus pusillus
Echinus ?

Table 38. Compositional details of IGS sample 53-03/2 GS, which was used for ^{14}C dating experiments (pp.224-233) and flume studies (pp. 179,182).

SHOALS - ROCKY HIGHS

Stanton Banks	Offshore	Pobie Banks (Northeast Shetland) (and Shetland Out Skerries)
Solan Bank	↓	
Nun Bank		Shiant
Hawes Banks	Coastal	{Passage of Tiree}

OCEANWARD HUMMOCKY PLATFORM

Barra Head	West Shetlands
West Hebridean Platform	
Butt of Lewis	

PLATFORMS - ROCKY PAVEMENTS

Fair Isle Channel	Passage of Tiree

COASTAL PLATFORMS

Sligachan-Scalpay	{Butt of Lewis}
Rubha Nan Clach	{Sound of Eigg}
Cape Wrath	
North Orkney	
East Orkney	
Moray Firth	
Greenstone Point	

TIDAL SANDBANKS

N. Ronaldsay north bank	Baas of Linton
N. Ronaldsay east bank	Dowie Sand
Sandy Riddle	Dunnet Bay {West Pentland Firth}
	{Cape Wrath}

PLATFORM FLANK & ADJOINING SHELF

Fair Isle - Orkney sandwave field and adjoining N. Sea Basin.

TIDAL CHANNELS BAYS AND SOUNDS

(i) Entrance to Tidal Channels and Bays and Sounds

- West Pentland Firth
- Gulf of Corryvreckan
- Yell Sound
- Orkney Sounds
- Sligachan - Scalpay
- Loch Brackadale
- Loch Dunvegan
- Plockton-Kyle of Lochalsh
- Loch Broom

(ii) Within Tidal Channels and Bays and Sounds

- Yell Sound
- Orkney Sounds

(iii) Island - Coast Channels

Sound of Iona	Summer Isles (Loch Broom)
Sound of Eigg	Balta Sound
Loch Eishort	St. Ninian (Tombolo)
Loch Dunvegan	Sound of Taransay

BEACHES

Colonsay	(Ritchie & Crofts 1974)
Coll & Tiree	(Mather et al. 1975)
Mull & Ardnamurchan	(Mather & Crofts 1972)
Eigg	(Mather et. al. 1975)
Outer Hebrides	(Ritchie 1971,& Ritchie&Mather 1970)
Loch Dunvegan (Skye)	(Mather et. al. 1975)
Greenstone Point	(Crofts & Mather 1972)
Faraid Head	(Ritchie & Mather 1969)
Caithness	(Mather 1970)
Orkney	(Mather et. al. 1974)
Shetland	(Mather & Smith 1974)

TABLE 39. Carbonate deposits on the SCS classified according to type. NB. A few fit more than one category. Those in curly brackets are less clear-cut cases.

Table 40. CARBONATE SEDIMENTATION RATES

AREA	g/m^2/yr		cm/1000 yrs	
	Range	Most Likely	Range	Most Likely
SCS Whole Area >50% $CaCO_3$	4-135	24	0.5-76.9	3.0
SCS Offshore deposits >75% $CaCO_3$	4-173	37	0.5-21.6	4.6
SCS Orkney area >75% $CaCO_3$	18-312	77	1.8-39.0	9.6
SCS Sandy Riddle >75% $CaCO_3$	125-1834	581	15.7-229.3	72.6
SCS East Orkney, FIC platform edge	114-646	248	14.3-80.8	31
New Zealand Cenozoic (Nelson 1978)	8-40	16	1-5	2
Warm Water Shelf Carbonates. (Nelson 1978)	80-800	-	10-100	-

NB. FIC = Fair Isle Channel

Table 41. CARBONATE PRODUCTIVITY

	g/m^2/yr range	most likely
Whole SCS >50% $CaCO_3$	4-135	24
Orkney Area	14-312	97
Sound of Iona Barnacles	-	30
Sound of Iona Calc Algae (Cucci 1979)	20-40	-
Barbados tropical fringing reef (Stearn et. al. 1977)	-	1500

Component	Mineralogy
Barnacles	LMC
Bivalves	A&LMC
Echinoids	Mainly HMC (spines are LMC)
Gastropods	A or LMC
Serpulids	Mostly HMC (trace A)
Bryozoa	A
Calcareous Alga	HMC
Foraminifera	HMC&LMC

TABLE 42. Summary of $CaCO_3$ mineralogy of the main bioclastic components.

A= aragonite; LMC= low magnesium calcite;
HMC= high magnesium calcite.

TABLE 43. Inferred Composition of Carbonate Deposits.

	Mineralogy	Mg Levels	Main Components
Gulf of Corryvreckan	Dominantly A&LMC	very low	Biv & Barn
Passage of Tiree	" A&LMC. Some HMC.	low	Biv & Barn
Hawes Bank	A, LMC&HMC	mod-high	Barn,Serp,Biv.
Sound of Eigg	Dominantly A&LMC Some HMC	low	Barn, Biv.
Rubha Nan Clach	Dominantly A&LMC Some HMC	low-mod	Barn&Biv, Serp & Foram
Stanton Banks	HMC, LMC & A	mod-high	Biv,Serp,Bry
Barra Head	Dominantly A, LMC, Some HMC	low	Biv,Bry,Barn
W Heb. Platform	A, HMC, LMC	mod-high	Serp,Biv,Ech, Barn.
Butt of Lewis	LMC, A, HMC	low-mod	Biv,Bry,Serp, Barn,Foram
Cape Wrath	Dominantly LMC&A, Some HMC	low-mod	Barn,Biv, Serp, Foram
Nun Bank	LMC, A, HMC	mod	Biv,Barn,Bry, Serp, Ech
Solan Bank	LMC, A, HMC	low-mod	Biv,Bry,Serp, Ech
Fair Isle Channel	LMC, A, HMC	mod	Biv,Bry,Serp, Ech
North Orkney	LMC, A, HMC	low-mod	Biv,Barn, Serp.
N. Ronaldsay, N. Bank	LMC, A, HMC	mod-high	Biv,Serp,Barn
East Orkney	Dominantly LMC&A Some HMC	low	Biv,Barn,Bry
Orkney Sounds	Dominantly LMC&A locally high HML	low-high	Biv,Barn, locally Cal Al
W. Pentland Firth	LMC, A, HMC	low-mod	Biv,Barn,Serp, Bry
Sandy Riddle	LMC, A, HMC	low-mod	Biv,Barn,Bry, Serp
Moray Firth	Dominantly LMC,A Some HMC	low	Biv,Barn,Bry
West Shetland	LMC, HMC, A	mod-high	Biv,Serp,Bry, Ech, Barn.
Shetland-Out Skerries	LMC, A, HMC	mod	Biv,Ech,Serp, Barn, Foram
Yell Sound	LMC,HMC, A	mod	Biv,Serp, Ech, Foram

V. low, mod, and high are all relative.

'High' may still involve MgO levels of <4%.

Sample No:	SH 305 Barra Head	MF 840	MF 2060 (Moray Firth)	MF 2078	60/01 297 Shetland Out Skerries	Commercial Maerl Brittany, France
CaO	47.7	47.4	48.3	49.6	27.5?	42.33
MgO	1.9	1.5	1.6	1.2	3.0	3.19
Al_2O_3	1.5	1.1	1.0	0.8	0.1	1.16
Fe_2O_3	0.4	0.7	0.6	0.4	0.6	0.68
K_2O	0.2	0.3	0.2	0.4	0.1	0.18
Na_2O	-	-	-	-		0.35
SiO_2	6.1	7.9	6.7	6.4	3.1	9.76
P_2O_5	0.07	0.10	0.89	0.06	-	0.08
SO_3	0.50	0.64	0.65	0.56	-	1.10
CO_2	37.6	37.7	38.6	39.4	40.6	39.01

Table 44. Major element analyses for samples of carbonate sediment.
(IGS 'in-house' data).

Deposit	Total Reserves (tonnes or 10^6g)	Likely net accumulation rate=equilibrium extraction rate (tonnes/day)	10 year extraction rate (tonnes/day)	50 year extraction rate (tonnes/day)	100 year extraction rate (tonnes/day)
Hawes Bank	2.8×10^6	1.3	768	156	79
Passage of Tiree	18.6×10^6	8.5	5104	1028	579
Barra Head-West Hebridean Platform-Butt of Lewis	401×10^6	183	110046	22101	11188
Cape Wrath	102×10^6	47	27992	5674	2841
East Orkney & Fair Isle Channel	1721×10^6	786	472293	95087	47937
Sandy Riddle	104×10^6	48	28541	5746	2897
Whole Orkney Area	2920×10^6	1333	801333	161333	81333

Table 45. Estimated extraction rates for a selection of deposits and areas of different sizes.

APPENDIX 1

List of acronyms and abbreviations

List of acronyms and abbreviations

Barn	barnacle
Biv	bivalve
Bor	boring
Bry	bryozoan
C. Alg	calcareous alga
CDSS	Carbonate Deposit Summary Sheet
CV	combined equivalent unidirectional current velocity
Ech	echinoid
Foram	foraminifera
Gast	gastropod
GnSz	grain size
Grv	gravel
IGS	Institute of Geological Sciences
IOS	Institute of Oceanographical Sciences
M	Maturity Index
N	negligible (<<<1%)
OWS	ocean weather ship
P	probability (of a correlation co-efficient being 'correct')
PN	peak neap tidal current velocity
PNET	peak neap exceedance time
Pol	polish
PS	peak spring tidal current velocity
PSA	particle size analysis
Rnd	roundness
SCS	Scottish Continental Shelf
Serp	serpulid
sort	sorting
SPPS	significant peak particle speed
stain	staining
TV	tidal (unidirectional) current velocity
UKCS	United Kingdom Continental Shelf
WV	wave (oscillatory) current velocity

APPENDIX 2

Summary of research cruises

Summary of research cruises

During the research period I took part in the following offshore work.

Date	Ship	Operator	Location
1977	R.R.S. *Challenger*	N.E.R.C. (Dr J Hall)	Firth of Lorne
1977	R.R.S. *John Murray*	N.E.R.C. (Dr G Farrow & T P Scoffin)	Orkney
1977	F.R.V. *Scotia*	D.A.F.S. (Dr R G J Shelton)	W. Heb. Shelf
1977	M.V. *Emerald*	I.G.S. (Dr D Evans)	Central N.Sea
1978	M.V. *Cape Shore*	I.G.S. (Dr J A Chesher)	W. Shetland
1978	F.R.V. *Scotia*	D.A.F.S. (Dr R G J Shelton)	Rockall and Nun Bank
1979	M.V. *Whitehorn*	I.G.S. (Dr D Evans)	Orkney and N.Shelf

APPENDIX 3

Sediment mobility calculations, Fair Isle Channel

Table: 46

Gravelly carbonate megaripples: mobility calculation (see Figs. 55,56)

Location: TV 2, Fair Isle Channel (Fig.52c).

Depth: 80m

GnSz: Up to 2-20mm Equiv. Qz GnSz : 1mm

$PN_{1.0}$:20 cm/sec PNET: 41%

Required threshold current (from Fig.139) : 70cm/sec

Using $TV_{1.0} = PN_{1.0}$

$CV_{1.0} = TV_{1.0} + 1.4$ WV (assuming long period waves)

Hence the WV required to move all sizes of sediment $= \frac{70-20}{1.4}$ cm/sec

= 36 cm/sec.

Using Draper's 90m curve (Fig.13) for Sevenstones (an underestimate for this location).

% exceedance for 36cm/sec = 0.5%; equivalent to about 2 days per year for 41% of the time. In other words, the sediment at this location will be moving for at least 20 hours per year.

For the other 59% of these 2 days, when TV <PN, assume TV = 0,

Then CV = 1.4 WV

WV = 50cm/sec, which has a 0.1% exceedance time

i.e. 1 day in 3 years, or on average at least 8 hrs./year

so total movement time = at least 20 + 8 hrs.

= 28 hrs/year minimum

Table: 47

'Sprinkling' of fine, carbonate sand: mobility calculation (see Fig. 57)

Location: TV2, Fair Isle Channel (Fig. 52c).

Depth: 80m

GnSz: 0.25 - 1mm	Equiv. Qz GnSz : 0.15 - .3mm
$PN_{1.0}$:20 cm/sec	PNET: 41%

Required threshold current (from Fig. 139): 40cm/sec

This is also the suspension threshold

Using $TV_{1.0} = PN_{1.0}$

and $CV_{1.0} = TV_{1.0} + 1.4WV$

then $WV = \frac{40-20}{1.4} = 14$cm/sec

% exceedance for 14 cm/sec = 4%; equivalent to 14½ days per year for 41% of the time. That is at least 143 hours/year.

For the other 59% of the time when TV <PN, assume TV = 0

Then CV = 1.4 WV

WV = 29 cm/sec - which has a 1% exceedance time.

i.e. 3½ days/year, or 84 hrs/year.

Also, for 96% of time when WV not exceeding 14 cm/sec, assume WV = 0, and PS_{max} = 37 cm/sec

So even in calm weather some transport takes place during peak spring tides, say 1-2 hrs/day on 8 days/month i.e. 144 hrs/year.

So total movement (suspension) time = 143 + 84 144 hrs/year

= 371 hrs/year.

APPENDIX 4

Hydraulic analysis of megaripples

Table: 48

Hydraulic analysis of megaripples, using bedforms only

Location: TV2, Fair Isle Channel (Fig.52c).

Data: photographs, Figs. 55 & 56

Wavelength (L): 2m
Height: 0.2m
GnSz: 0.002 -.02m Equiv. Qz GnSz (D):0.001m
Vertical Form Index (VFI): 10
$\frac{L}{D}$: 2×10^3

Referring to J.R.L. Allen (1979)
Reading from Fig.157 (J.R.L.A's. fig. 2):
Possible range for $\frac{d}{D} = 2.0 \times 10^3$ to 5×10^4

and for near-bed orbital diameter (d) = 2.0 to 50m

Reading from Fig.156 (J.R.L.A's. fig. 1):

for VFI = 10 and D = 0.001m,
Ripple formation is possible for orbital velocities between 0.25 and 0.78m/sec.
Plane bed with sediment movement will develop in currents above 0.78 cm/sec. VFI suggests that the megaripples are rolling grain ripples.

Also, using $T = \frac{\pi d}{U_{max}}$,

If U_{max}=0.78m/sec, & if d = 2.0 then <u>T = 8 secs</u>.
& if d = 50m, then <u>T = 200 secs</u>.
& if T = 15 secs, <u>d = 3.7m</u>

Table: 49 Hydraulic analysis of megaripple using known surface conditions.

From Fig. 13 (Sevenstones), orbital velocities at 80m are:
0.5m/sec at 0.1% exceedance (max = 1.1 m/sec).
0.35m/sec at 1.0% exceedance (max = 0.77 m/sec).

Thus conditions are right for formation of these bedforms during at least three or four storms per year. During the more severe storms, velocities will frequently exceed 0.78cm/sec, thus initiating plane bed movement.

Also, from Komar (1976b), p. 45:

$$d = H_e{}^{kz_o}$$

$$\text{and } k = \frac{2\Pi}{(9/_{2\Pi})T^2}$$

where d = orbital diameter near seabed
H = wave height
z_o= - (water depth)
T = wave period (secs)
g = acceleration due to gravity = 098 m/sec^2

For the severe storms

Assume H = 25m
T = 15 secs

$$\text{then } k = \frac{2\pi}{(.98/_{2\Pi})\ 15^2} = 1.79 \times 10^{-2}$$

$$d = 25e^{(1.79 \times 10^{-2} \times -80)}$$

d = 5.9m (i.e. in the range predicted in Table 48)

Cross checking with J.R.L. Allen (1979):

$$T = \frac{\Pi d}{U_{max}}$$

$$T = \frac{\Pi \times 5.9}{.78}$$

$$\underline{T = 23 \text{ secs}}.$$

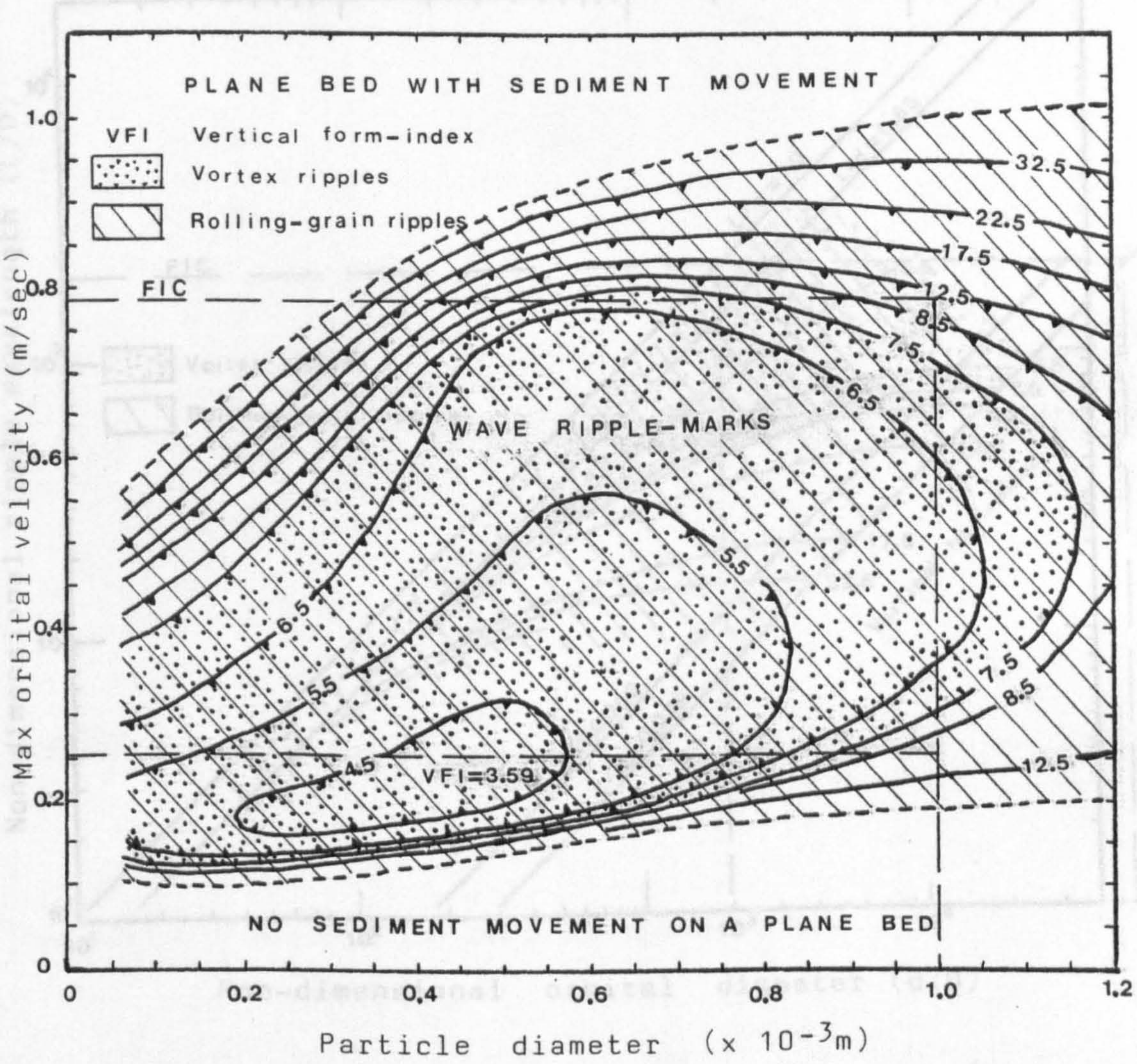


Figure 156. Summary of the occurrence of wave ripple marks, from J.R.L.Allen(1979a), fig.1.

For the Fair Isle Channel (FIC) megaripples, the equivalent quartz diameter for the carbonate particles is 1 x 10^{-3} which suggests that oscillatory currents of between 0.25 & 0.78 m/sec could produce rolling grain ripples with a VFI of 10.

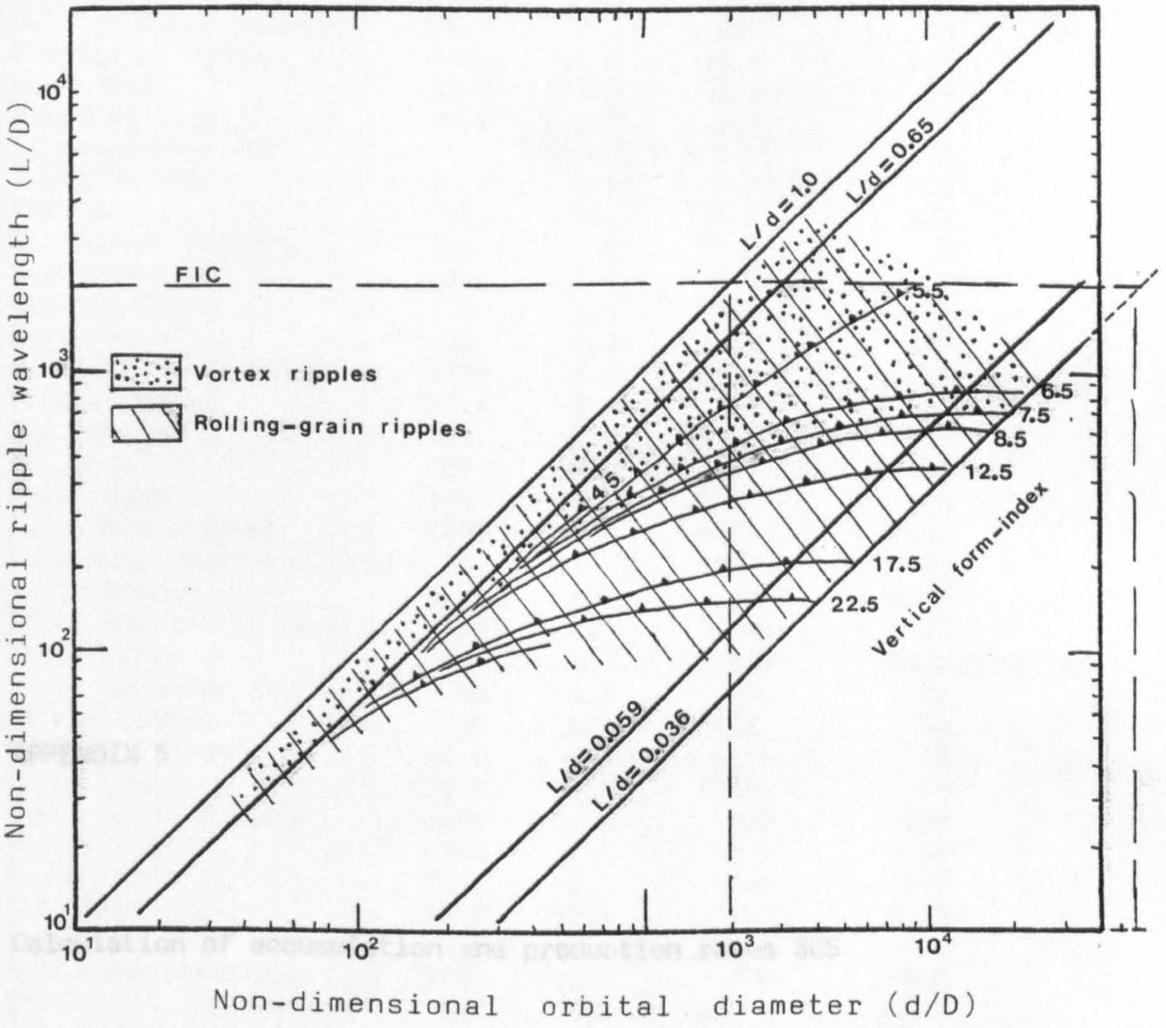


Figure 157. Summary diagram of the occurrence of wave ripple marks, from J.R.L.Allen(1979a),fig.2.

For the Fair Isle Channel (FIC) megaripples, L/d is 2×10^3 so that theoretical range of d/L is 2×10^3 to 5×10^4.

APPENDIX 5

Calculation of accumulation and production rates SCS

Table: 50. Total carbonate in SCS deposits (>75% $CaCO_3$)

NAME	Total Weight ($x10^{12}g$) MAX.	MIN.	LIKELY	AREA ($x10^6 m^2$)
Gulf of Corryvreckan	14.7	0.7	3.7	10
Passage of Tiree	155	1.4	18.6	200
Hawes Bank	29.3	0.3	2.8	39
Sound of Eigg	6.9	0.1	6.8	9
Sligachan-Scalpay		Minimal		?
Rubha Nan Clach	20.1	0.18	1.93	26
Shiant	394	3.5	37.8	509
SE Shiant Sandbank	242	5.8	59.9	8
Sound of Iona	15.5	1.4	7.1	20
Station Banks	133	1.3	12.9	172
Barra Head	305	2.8	30.0	390
West Hebridean Platform	3739	35.0	366	4920
Butt of Lewis	50.1	0.5	4.8	66
Cape Wrath	311	9.5	102.7	138
Nun Bank	909.8	0.6	6.7	90
Solan Bank	155	1.4	15.4	216
Fair Isle Channel	5319	47.2	510	6855
Fair Isle Sandwave Field	291	51.6	112	75
North Orkney	1824	8.7	885	1140
North Ronaldsay N bank	158	21	88	27
East Orkney	3984	583	1609	1480+700=2180
North Ronaldsay E bank	64	8.8	270	12
Orkney Sounds	112	4.8	27.2	70
Baas of Linton	30.4	2.7	9.3	43
Dowie Sand	31.8	5.0	11.3	73
West Pentland Firth	620	11.6	123	234
Sandy Riddle	328	22.4	104	30
Moray Firth	1680	48.7	260	700
West Shetland	1552	13.8	148	2000
Foula	147	6.5	70.7	95
Northeast Shetland	1358	12.0	130	1750
Shetland - Out Skerries	673	6.0	64.5	867
Yell Sound		NOT ESTIMATED		
Total wt. g	$23811x10^{12}$	$919x10^{12}$	$5099x10^{12}$	$22963x10^6$
Wt./area g/m^2	$1037\ x10^3$	$40x10^3$	$22x10^3$	
Accumulation over 6000yrs. $g/m^2/yr$	173	7	3.7	
-ditto over 10,000 yrs $g/m^2/yr$.	104	4	22	

Table: 51. Total $CaCO_3$ in high-carbonate (50-100% $CaCO_3$) N & W Scottish beaches

Using, for convenience, beaches >40% $CaCO_3$

Assume average $CaCO_3$ of 70% by wt.

Total area = $181 \times 10^6 m^2$ (from Mather & Ritchie 1977)

	Max.	Min.	Likely
Possible thickness(m)	4	1	2
Volume (m^3)	724×10^6	181×10^6	362×10^6
wt. (g)	474×10^{12}	119×10^{12}	237×10^{12}
Accumulation rate (g/m^2/yr over 6000 yrs)	436	109	218

Table: 52 Orkney area carbonates

Total area of deposits = $3809 \times 10^6 m^2$

	Max.	Min.	Likely
Total wt. (g)	7152×10^{12}	687×10^{12}	2920×10^{12}
Wt./area (g/m^2)	1878×10^3	180×10^3	767×10^3
Accumulation rate:			
(g/m^2/yr. over 6000 yrs)	312	30	128
(g/m^2/yr. over 10,000 yrs)	188	18	77

If area of carbonate production is similar to area of accumulation then these will also be production rates.

But if debris brought in from wide area of production, say $5000 \times 10^6 m^2$, then

	Max.	Min.	Likely
Wt/area (g/m^2)	1430×10^3	137×10^3	584×10^3
Production rates			
(g/m^2/yr over 6000 yrs)	238	23	97
(g/m^2/yr over 10,000 yrs)	143	14	58

Table:53. Accumulation/Production rates for SCS high-carbonate sediments (50-100% $CaCO_3$)

	Max. ($\times 10^{12}$g)	Min. ($\times 10^{12}$g)	Likely ($\times 10^{12}$g)	Area ($\times 10^6 m^2$)
All deposits (> 75%$CaCO_3$)	23811	919	5099	22963
Carbonate-rich (50-75% " ")	13783	689	1378	21808
Beaches (40/50-100%)	474	119	237	200
(Nearshore production areas)				(+1800)
Total weight	38068×10^{12}g	1727×10^{12}g	6714×10^{12}g	$46771 \times 10^6 m^2$
wt./area (g/m^2)	813.9	36.9	143.6	

Accumulation rates ($g/m^2/yr$)

	Max.	Min.	Likely
over 6000 yrs.	135	6	24
over 10,000 yrs	81	4	14

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APPENDIX 7

Bioclastic carbonate sedimentation on a high-latitude, tide-dominated shelf : northeast Orkney Islands, Scotland.

Farrow, G. E., Allen, N. H. and Akpan, E. B.
Submitted to *J. sediment. Petrol.*, April 1983.

BIOCLASTIC CARBONATE SEDIMENTATION ON A HIGH-LATITUDE, TIDE-DOMINATED SHELF : NORTHEAST ORKNEY ISLANDS, SCOTLAND

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paper received: December 27, 1982
revision accepted:

Abstract: Shell-sands and gravels cover much of the shallow Orkneys shelf at 59°N, accumulating locally into 30 m-high banks at rates up to 540 $g/m^2/yr$. Overall the Orkney shelf sedimentation rate is approximately 10 cm/1000 yrs, compared with 3 cm/1000 yrs for the entire Scottish continental shelf. Major sandbanks are located off headlands that produce circulation loops in the tidal flow. Regional sandwave orientations reveal a clockwise transport of sediment around the islands, probably resulting from storm-wave reinforcement of the tidal asymmetry combined with the net inflow of Atlantic water into the North Sea.

Carbonate production is high from the *Modiolus* Epifauna. *Modiolus* shell gravels, commonly containing *Glycymeris*, pass laterally into comminuted shell-sands. Within the euphotic zone (down to 40 m) dead shells are weakened by echinoid biting, algal boring and limpet grazing. Boring by fungi and clionid sponges and grazing by chitons is common but not depth restricted.

Sediments contain 89-95 percent carbonate on the level bottom offshore, but 94-99 percent in sandwaves. Mean values for the main skeletal components are:- bivalves 46%, barnacles 18%, bryozoans 11%, serpulids 7%. Calcareous algal gravels occur in sheltered areas less than 20 m deep. Bryozoa typify lower-energy offshore environments, while more durable barnacle and serpulid debris is concentrated in sandwave fields. The sediments are dominantly calcitic and have a high preservation potential.

Key Words: sediment transport, sandwaves, sedimentation rate, bioerosion, *Modiolus*.

INTRODUCTION

Background and Aims

Carbonate sediments are forming widely on continental shelves in high latitudes, both north and south of the Equator (Scoffin et al., 1980, p.345; Rao, 1981a, b). Almost half the entire Scottish continental shelf is covered with carbonate-dominated sediment, that around the Orkneys being the purest.

The present paper has five aims:- 1. To demonstrate the mobility of the carbonate sands; 2. To identify the dominant skeletal contributors; 3. To describe the agents of bioerosion; 4. To produce a sedimentation model; 5. To assess rates of carbonate accumulation.

Geological Setting

The Orkneys contrast sharply with other Scottish areas that have been strongly glaciated, like the Inner Hebrides (Farrow et al., 1978; Farrow, 1983) for here the sea floor has a smoother topography. A shallow platform of Devonian rocks borders the eastern side of the Orkneys. Within a few kilometres of the coast the seabed drops steeply to a generally flat area that coincides with the edge of a Permo-Triassic subcrop. Depth increases gradually offshore from 30 m to 100 m: within the Sounds it is generally less than 30 m (Fig. 1). Fig. 1

Patches of Quaternary boulder clay crop out locally on the islands, giving rise to arkosic beach sands and stretches of lithic gravel with isolated boulders.

Physical Conditions

The following summary is extracted from the excellent series of maps published recently by Lee and Ramster (1981).

Temperature and Salinity.—The mean surface temperature in winter is 7°C (February) and in summer 12.5°C (August). Bottom temperatures are identical to the surface temperature in winter but one degree cooler in August. The salinity is constant at 35‰ throughout the year.

Tides.—In the Atlantic Ocean tidal currents are very weak, but as the tidal wave reaches the shallower areas of the European continental shelf their magnitude increases greatly. This effect is particularly noticeable where the tide is forced through narrow channels, as in the Orkneys (Fig. 2a). It should be noted that these areas with strong tidal currents are not generally associated with an abnormally large tidal range (Fig. 2b). Maximum spring-tide currents are more than four knots (2 m/sec) between the northern islands although the tidal range is only 2.5 m. With such a strong tidal flux there is no summer stratification of the water column. Fig. 2

Winds and Waves.—January is the most gale-prone month, with winds setting from the south or southeast. Substantial currents are associated with winds (Johnson, 1978, p.215). The worst wave to be expected in 50 years is predicted to reach a height of 30 m and possess a period of 15.5 seconds.

Methods of Study

The area was studied during July 1977 on R.R.S. John Murray Cruise 10. Extensive ORE Pinger (3.5 kHz), Kelvin Hughes MS 47 Side-Scan Sonar and SIMRAD echo-sounder lines were run. Bedforms were mapped and their distribution compared with that obtained from analysis of lines run in the spring of 1974. Fig. 3 150 bottom samples were collected (Fig. 3). Stations on rock were sampled with a large rock dredge; the soft grounds with a Day grab or anchor dredge. Much of the terrain was rough, with several dredges being lost and eight stations yielding no samples.

Shipboard identifications of the larger macrofauna included both live and dead molluscs, the densities recorded being at best semi-quantitative, though valuable in showing the abundance of living Glycymeris over much of the area. Because of variable recovery with the Day grab, deeply buried living infauna such as Lutraria must have been missed; their presence being indicated by dead shells.

Sediment samples were returned to the laboratory, where percent $CaCO_3$ was determined by acid digestion, and principal components identified in the 63 μm - 2 mm fraction, following splitting and slit sieving (Lees et al., 1969). More than 333 grains were scattered onto a sticky plate, and identified and counted under the binocular microscope according to Milliman's (1974) criteria.

366 shells from 26 stations were examined for bioerosion. All were studied under the binocular microscope: some were X-rayed, others impregnated with Epo-tex resin for study of boring casts, and many were prepared for SEM examination.

SIDE-SCAN SONAR ANALYSIS

Good geophysical coverage (particularly side-scan sonar) is available to assess seabed morphology, sediment distribution and sediment thickness (Fig. 4). The quality of the sidescan data is generally good enough to delineate the main boundaries. Comparison of the 1974 and 1977 records reveals major differences in sediment distribution, highlighting the mobility of the carbonate sediment (Allen, 1983).

Rock and Sediment Distribution

Large areas of bare rock are exposed around the islands where tidal and storm currents are particularly strong as a result of shallowing, narrowing or obstructions such as islands and peninsulas. A rocky platform 3 to 10 km wide extends along the eastern sides of North Ronaldsay, Sanday, Stronsay and Mainland. Localised patches of sand and gravel lie in hollows and crevices.

Fig. 4 A much larger area of rock was exposed in Spring 1974 than was seen in July 1977 (Fig. 4). Similarly, the broad ridge running northeast from Papa Westray (clearly seen in the bathymetry, Fig. 1) was mantled in sediment covered with megaripples in July 1977 (Fig. 4) but was exposed rock in the Spring of 1974. This again illustrates the extreme mobility of the carbonate material.

Extensive tracts of shelly coarse sands and gravels frequently occur adjacent to the current-swept rocky areas. They may have a maximum thickness of up to 30 m (e.g. sand bank northwest of North Ronaldsay), but on average the material is probably between 2 and 5 m thick (Allen et al. 1979). Fine and medium sands occur on the open, deeper shelf where currents are weaker: their thickness is unknown but is unlikely to be more than a few metres. Muddy sands and sandy muds occur inshore in sheltered backwaters such as Wide Firth and the Bay of Kirkwall where they blanket an uneven rocky substratum to a depth of more than 10 m in places.

Bedforms and Sediment Transport

Open Shelf.—On the flat, open shelf there are sand waves, sand ribbons and megaripples which indicate clockwise sediment movement around the islands (Fig. 4). On the northern side the sand waves strike north - south and face east: megaripples have an oblique orientation, striking north-northeast - south-southwest: sand ribbons trend west - east. East of the islands the sand waves strike west - east and face south: megaripples have a northeast - southwest strike: sand ribbons trend north - south.

Sand Banks.—The large sand banks all have dense sand wave systems on their backs; a good example being the bank 5 km northwest of North Ronaldsay (Fig. 5). Fig. 5 Here the sand waves are up to 15 m high with wavelengths of 200 m: all strike northwest - southeast and most face southwest. However the sand waves on the southeastern side of the bank are facing northeast. This indicates a circulation of sediment around the bank similar to that described from North Sea banks (Houbolt, 1968; McCave, 1971). Megaripples associated with the sand waves are orientated north - south. Both surveys show the bank to be ovoid in plan, but in 1974 it was totally surrounded by bare rock, whereas in 1977 it was distinctly narrower and connected with the sand field in the west by a tongue of sediment (Fig. 4). The 1974 sparker profiles show the bank to be about 20 m thick. A substantial thickness of carbonate sediment is contained within this feature, the whole of which may well consist of carbonate sand. However it could have a core of moraine, or even reworked terrigenous sand produced during and immediately after the initial, rapid Holocene transgressive period. Taking this into account, the thickness adopted for the sand bank is 5 m (Table 3). Other banks exist east of Shapinsay, south of Stronsay, east of North Ronaldsay and northeast of Westray (Fig. 4). Their origin must likewise remain in doubt until long vibrocores have been recovered from them.

Margins of the Rocky Platform.—East of Sanday and Stronsay pockets and thin veneers of sediment cover the rocky platform. At the edge of this platform there are wide sediment-filled crevices and gulleys controlled by fractures and faults in the bedrock (Fig. 4). The gulleys lead southeastwards to a slope which is covered with sediment. At the base of the slope where the seabed levels off there is an extensive field of sand waves that face southwards. This pattern suggests that sediment is migrating from the rocky platform onto the shelf, where it joins the southerly-moving system described above.

Bays and Sounds.—The distribution and orientation of bedforms in the inner areas is more complex and the sonar coverage less adequate for detailed discussion. However, it can be noted that in North Sound there occur many sand waves, megaripples and sand ribbons which reflect complex current patterns produced by the convergence of many different channels. Some of the sand waves have sinuous crests and are lunate, while many are virtually symmetrical.

SEDIMENT MOBILITY AND AREAS OF ACCUMULATION

North Ronaldsay North Bank

Very pure carbonate (98%) sediment is widespread in this area. It is coarse with a high gravel content (25%). Tidal current conditions are not well documented, but they are strong over these nearshore areas (up to 150 cm/sec) and extreme in some places (300 cm/sec off the northern end of North Ronaldsay) Admiralty Pilot, 1975. During most weather conditions, material up to coarse sand size will be moved as bedload and suspended load by peak tidal current flow, along with gravel - grade material as bedload (Allen 1983). During severe and extreme storms even considerable quantities of gravel - grade material may be moving as suspended load. This calculated high mobility explains the radical difference in sediment distribution recorded by surveys taken during different seasons in different years, and it also explains the existence of large areas of bare rock.

The high predicted mobility is compatible with the existence of many large-scale bedforms in the area (Figs 4, 5). In the deeper more offshore parts there are low (1-2 m height), asymmetrical sand waves indicating eastward sediment transport, but the North Ronaldsay North sand bank has a large sand-wave field on it with west-facing steep slopes indicating sediment transport in that direction (Fig. 5). Only on the southeastern tip of the bank are east-facing sand waves recorded. Thus the sand bank is located where the local transport direction is west-going, opposing the predominant east-going path to the north. The bank may therefore be sited in a large-scale tidal vortex of the kind often associated with tidal flow round headlands (Pingree and Maddock, 1979) so that the bank was generated and sustained as a result of a sediment circulation loop resulting in net sediment accumulation. The sediment on this sand bank is considerably more mature than the sediment in the surrounding area, again suggesting that it is a depositional site, where sediment, once captured by the sand bank, remains trapped in a circulatory system for some considerable time.

Essentially the bedforms are formed by tidal currents, presumably at times assisted by oscillatory currents which increase the suspended load. However, the extreme currents generated by waves during storms are probably very destructive, particularly in shallow water such as at the tops of sand waves on the North Ronaldsay North sand bank, where sediment is probably removed from the top of the bank. This explains why at the end of the winter in 1974 it was broader, with lower sand waves (5-7 m) than in the summer of 1977 (sand waves 7-10 m). The destructive effect of storm waves on sand waves has been noted by McCave and Langhorne (1982) and Johnson (1978, p.251-5). Farrow (1974, pl. 6) has noted similar flattening of shellbanks in the shallow waters of Barra, Outer Hebrides.

East Orkney Shelf

This sand-wave zone (Fig. 4) lies on the slope at the edge of the Orkney platform (Fig. 1), where currents are such that carbonate sediment up to 1 mm in diameter will be commonly moved, much of it in suspension(Allen 1983).Sand greater than 1 mm and gravel - grade material will be moved as bedload during the stronger tidal currents and storms, and a certain amount will also be in suspension. The slope is the immediate'dumping ground' for material being swept off the platform. Depending on the time, weather, water depth, and grain size, more and more of the sediment is dropped out of suspension and moved on into deeper water as bedload, at progressively slower rates. At any one locality the highest currents will occur at the crests of the sand waves, explaining the marked difference in grain size between the sand waves and the surrounding sediment.

There is no doubt that sand-wave formation is a result of complex physical inter-relationships. The existence of the sand-wave field appears to fit the criteria of McCave (1971) for sand-wave formation which are (1) adequate tidal current velocity, (2) low-moderate wave activity, (3) a strong elongation of the tidal current ellipse. He also pointed out that the existence of megaripples superimposed on sand waves indicates a combination of bedload and suspension transport.

On the deeper-water limits of this particular field, the formation of sand waves appears to have been closely related to original seabed morphology. All along the slope at a depth of about 80 m, a series of strong bedrock seismic reflectors outcrop on the seabed and presumably originally formed marked ridges. Large sand waves are invariably seen lying superimposed on these features. Before the formation of the sand waves these features would themselves have acted as large 'bedforms' causing flow separation at their crests and relatively low currents in their lees, providing ideal conditions for sand wave formation.

Mapped bedform orientations and facing directions consistently indicate southward sediment transport on the east side of Orkney (Fig. 6). However, further to the north and east the zone of carbonate spreads out eastwards into the North Sea beyond the limits of the investigated area, indicating a stronger east and southeast component as a result of the currents coming through the Fair Isle Channel. These currents are essentially non-tidal in origin (Stride, in Lee and Ramster, 1981, p.2.26) and long-term sand transport is ascribed to the net flow of Atlantic water into the North Sea, essentially caused by the North Atlantic Drift.

Fig. 6

Craig (1959, fig. 11, p.16) estimated near-bottom water drift as 3 km per day to the south, (compared with 6 km per day northwest of Orkney).

On the basis of this, a sediment transport rate of several kilometres per year is possible.

DISTRIBUTION OF CARBONATE-PRODUCING ORGANISMS

Having established that large bodies of mobile carbonate sand exist around the Orkneys we now outline the distribution of the major producers of skeletal carbonate. 150 bottom samples were collected for this purpose and have been categorized into eight broad groups that depend only on gross characteristics for their differentiation (Fig. 7). It is important that their occurrence be set in the dynamic context of the mobile carbonate carpet indicated by the side-scan analysis. Faunal details will be found in Appendix Table 1.

Fig. 7

Rocky Areas

Carbonate production is high from shallow kelp-dominated rocky regions (Fig. 8). Herbivorous gastropods and echinoids are common. Below 24 m ophiuroids dominate, with accessory echinoids and molluscs. A variety of bivalves dominates the rocky open shelf at about 80 m, including *Arca tetragona*.

Fig. 8

The type of substratum most heavily encrusted with carbonate-producing epifauna is a floor of lithic cobbles, especially when shallower than 30 m. Here barnacles and serpulids are very abundant. Offshore, *Alcyonium digitatum* and hydroids dominate, neither of which produce significant carbonate. Certain bryozoa encrust the hydroids and form distinctive hollow-centred nodules (Fig. 9 right): they also form compound structures with serpulids (Fig. 9 left).

Fig. 9

Calcareous Algal Gravels

Extremely prolific beds of free-living calcareous algae occur in Wide Firth (Figs 1, 7, 10) in a tidally-swept but island-encircled situation less than 20 m deep. No deposits were sampled on the open shelf, however. There is considerable variation in growth form, not directly depth related but more probably current related (Fig. 10). A typical shallow gravel fauna of sturdy

Fig. 10

bivalves and gastropods is associated (Appendix Table 1).

The facies variants described by Bosence (1976, 1979) are present, with his clean algal gravel (1979, p.456-8) better developed than in Ireland in the more strongly tidal Firths as in the Sound of Islay (Farrow et al., 1979, fig. 4).

Modiolus Epifauna

Fig. 11

Living spreads of the byssally attached horse mussel *Modiolus modiolus* form a highly characteristic type of sea-bottom, with very high carbonate production from the bivalves. Side-scan records show them to be living on rock. The *Modiolus* Epifauna is fully developed, as classically illustrated by Thorson (1957, p.462) with associated serpulids, ophiuroids and gastropods. *Modiolus* was more commonly encountered living in the Sounds than on the open shelf, where its debris was widely dispersed (Fig. 11).

Modiolus Shell Gravels

Fig. 12

Gravels composed of *Modiolus* debris (Fig. 12) were the second most frequently encountered type of sediment after the shell-sands. They occur over a similar depth range to the living *Modiolus* (20 to 80 m), but are best developed between 20 and 50 m. Half the stations yielded the living bivalve *Glycymeris glycymeris* (Fig. 11) which was more abundant at the greater depths ($50/m^2$ between 60 and 80 m; $28/m^2$ between 20 and 40 m). This is the second major carbonate-producing bivalve. Other faunal elements were distinctly rarer but included other robust filter-feeding bivalves.

Shell-sands

Shell-sands were the most frequently encountered type of sea-bottom, generally found in the form of sand waves (Figs 4, 5). They occur down to and below 100 m. Sand eels (*Ammodytes* sp.) were sometimes encountered in high densities but the sand waves were generally barren. Where the sand was of medium grain-size and the bottom level, an infauna of bivalves, irregular echinoids and worm tubes was developed.

Although they are accumulations of remarkably pure carbonate, the shell-sands themselves support a negligible carbonate-producing fauna. All the carbonate has been transported from elsewhere.

Muddy Sands

These are developed in very shallow backwaters of the Firths (Fig. 7) and on deeper parts of the open shelf away from the main tidal streams. The shallow regions are characterized by a range of agglutinated worm tubes and thin-shelled infaunal bivalves with low carbonate-producing potential. Scaphopods and serpulids appear offshore.

CARBONATE PETROGRAPHY

Carbonate supplied by the living biota is likely to be dominated by bivalves; with barnacles, serpulids, gastropods and echinoids associated in shallower water. We now assess the petrographic evidence for the relative significance of these contrasted skeletal groups as sediment contributors.

Total Percentage Carbonate and its Areal Variation

All sediment samples showed very high $CaCO_3$ percentages except for some nearshore sediments in the Wide Firth Area, and a group of samples in North Sound (Fig. 13). The abnormally low 45-55% $CaCO_3$ level in the latter area may be due to dilution by the reworking of glacial drift, or due to its sheltered position. Elsewhere values range from 90 to 100% $CaCO_3$. Sand-wave fields, where the sediment is coarser, have higher values than adjacent level-bottom sands. Fig. 13

Bioclastic Components

The following components were counted for each sample:- barnacles, bivalves, gastropods, echinoderms, calcareous worm-tubes, bryozoans, calcareous algae, terrigenes and unknown (the last category varying from 0 to 20%). Figures quoted have not been adjusted to allow for the unknowns, but have been recalculated as a percentage of the total carbonate fraction.

Four constituents make up the bulk of the carbonate, means of all samples being:- bivalves (46%), barnacles (18%), bryozoans (11%) and calcareous worms (7%). Accessory components include gastropods and echinoderms, with only very few foraminifera; calcareous algae are locally important.

Bivalve debris is the dominant carbonate component of nearly all samples, Fig. 14 commonly reaching more than 50% in the sands (Fig. 14a), and almost 100% in many *Modiolus* shell gravels (Table 1). The bivalve fraction is less in sand-wave fields than in level sand areas.

Barnacles show a nearshore distribution (Fig. 14b), particularly east of Stronsay, and are also enriched in the sand-wave area off North Ronaldsay, but only rarely do they make up more than 30% of the carbonate fraction. They are less common on level sand areas.

Bryozoa, in contrast, show an offshore distribution (Fig. 14c) and are highest in level sand areas, particularly in the deeper water though they also occur in the shelter of North Sound. Bryozoan values are much reduced in sand-wave sediments.

Calcareous worms include both serpulids and spirorbids. Values are generally rather low, especially in offshore level sands, though they increase sharply in sand waves, reaching 35% at one station (Fig. 14d).

Calcareous algae cover a restricted area compared with the previous components, being limited to the Sounds at depths of less than 20 m (Figs 1, 7). Debris is localised around living patches and has not been recorded from the open shelf. Gravels may be 95% algal in some instances, but in others 16% Table 1 regular echinoid remains may occur: average figures are shown in Table 2.

The carbonates of North Orkney contain abundant bivalves (43%) barnacles (27%) and serpulids (13%) (Table 1). Those on the North Ronaldsay north bank are much richer in serpulid debris (29%) than the surrounding carbonates. This may be due to the greater resistance of serpulid material to biological and mechanical breakdown, or may simply reflect the proximity to a large area of current-swept rock platform where there is high serpulid productivity.

Northwest of the bank there is also a large area of shell gravel made up of living and dead Modiolus shells, the latter rapidly degrading. This probably makes an important contribution to the sediment on the bank.

The average petrography of the East Orkney carbonates suggests that they are not very mature, because of the predominance of the deeper water material. Once sediment is swept there from shallower water it is not extensively reworked but infaunal production (e.g. irregular echinoids and foraminifera) continues to add material to the sand.

Sediment Component Distribution
as a Function of Depth

Fig. 14 shows clearly the nearshore distribution of barnacles contrasted with the offshore bryozoan distribution. This may be explained by contrasts in energy level, perhaps related to wave base. Barnacles settle preferentially and grow faster in stronger current areas (Crisp, 1955, 1960). Many bryozoans do not flourish in such conditions (Ryland, 1970) and additionally stand a poor chance of preservation, judging from Chave's (1964) tumble-mill experiments.

Apparent Absence of Relict Carbonates

The palaeogeographic configuration of the Orkneys archipelago during the Flandrian transgression must have resulted in what is now open shelf having resembled the inter-island Sounds, where today calcareous algal gravels are characteristic. However, nowhere on the open shelf of today were unattached coralline algae found. It may be that such deposits exist but have been overlapped by transgressive sand waves, though it must be remembered that the rate of transgression was initially rapid, and there was possibly insufficient time to form thick accumulations, for the coralline algae are slow growers (Adey, 1970). Relatively fresh pieces of *Phymatolithon calcareum* from the Sound of Iona (Inner Hebrides) have been dated at approximately 4000 B.P.

^{14}C dates have been obtained for the Orkney carbonates (Allen, 1983) but their interpretation is by no means straightforward: they will be written up separately in due course. Subsamples may show a difference of 1300 years, supporting the idea already gained for sonar study that the sediments have undergone frequent mixing. Furthermore, different biogenic components give different ages: bivalves > serpulids > gastropods > barnacles. No date, however, was earlier than Holocene.

BIOEROSION

In attempting to understand the manner in which the gravel-sized material becomes broken down before being readily transported by wave and tidal currents a total of 366 shells and algal fragments were studied from 26 stations spanning a depth range of 12 to 102m (Appendix Table 2). Stations are numbered on Fig. 3. Shell-boring algae, fungi, worms, phoronids and sponges were identified, plus grazing echinoids and molluscs.

Shell-boring algae were totally dominated by two species of chlorophytes,
Fig.15 *Ostreobium queketii* and *Eugomontia sacculata* (Fig. 15). This contrasts with
other areas of the Scottish shelf where the rhodophyte "conchocelis" is
dominant (Clokie et al., 1979; Farrow and Clokie, 1979). Fungal borings
were also widely identified.

X-ray radiography, particularly of the larger *Modiolus* shells, revealed
widespread damage inflicted by the boring sponges *Cliona celata* and *C. vastifica*
Fig.16 (Fig. 16). Commonly those parts of a shell not showing sponge borings were
affected by phoronid or *Polydora* borings.

Fig.17 Two common types of radula marks were seen on shells, those of the limpet *Acmaea virginea* (Fig. 17a) being readily distinguished from those of the chiton *Lepidopleurus asellus* (Fig. 17b). The bites of regular echinoids were also identified.

Bathymetric Distribution of Bioerosion Processes

Fig.18 The effects of the several dominant kinds of bioerosion are not randomly
distributed across the shelf (Fig. 18). The maximum depth from which boring
algae were recovered was 38 m, a limit shared by the limpet which feeds on the
algae (Farrow and Clokie, 1979). This relationship, established in the Firth
of Clyde, is further substantiated in the Orkneys, where a depth relationship
between the area of shell bored by algae and that grazed by limpets can be
Fig.19 demonstrated (Fig. 19). The biologically measured limit of the euphotic zone
around the Orkneys is thus 39 m. or slightly deeper since the normal indicator
"conchocelis" is not present. Echinoid teeth marks were found only on shells
from depths shallower than 30m, which also implies a herbivorous diet.

Boring by fungi, phoronids, *Polydora* and sponges was not seen to be limited by the euphotic zone, nor were the effects of chiton grazing (Fig. 18). Chiton radula marks were sporadically found at greater depth where they typically nibble muscle scars of *Glycymeris* (Fig. 17b), possibly polishing off decaying muscle fibres. Such localisation of activity has already been reported by Voigt (1977), p.377) from a *Glycymeris* dredged from 120 m in the western English Channel and we have subsequently discovered it on *Glycymeris* from the Pleistocene Red Crag of Walton-on-the-Naze.

These contrasted bathymetric distributions appear to hold some palaeoecological promise; Akpan et al. (1982) having recently demonstrated that the algal boring/limpet grazing relationship was in existence in the Albian.

CARBONATE SEDIMENT PRODUCTION BY THE *Modiolus* EPIFAUNA

Epifaunal communities tend to be richer than infaunal ones, both in numbers of species and in total biomass. Kay and Knights (1975) have shown this for intertidal mussel beds in Southeast England, which have an average total biomass of 125 grams/m^2 compared with 21 grams/m^2 for adjacent cockle sand fauna. There are no figures for sublittoral production by the Scottish Modiolus Community, but in the parallel community in the lower Bay of Fundy, Wildish and Peer (1983, p.311-313) show that Modiolus modiolus is by far the most important organism, accounting for 88% of the production. Peak production measured was a staggering 1769 g/m^2/yr: the average for the whole fauna, 193 g/m^2/yr, is higher than for the intertidal mussel bed. It is of interest in terms of carbonate sediment production that the top four producers are all strongly calcified:- Modiolus modiolus, Balanus crenatus, Chlamys islandica and Placopecten magellanicus: bivalves and barnacles, the two dominant skeletal components in high-latitude carbonates. Comely(1978), in an important paper on Scottish Modiolus occurrences, has noted that populations are only viable in strong current areas where faster growth rate offsets the effects of boring sponge attack.

Fig.20 Live and entire dead shell occurrences of Modiolus in the Orkneys are typically peripheral to major sand banks. This is well seen northwest of North Ronaldsay and again in Stronsay Firth, where a central area of live Modiolus is surrounded by bioclastic sand heaped into sand waves (Fig. 20a). In such situations the living populations are prone to sediment inundation during storms, especially from the east during winter. This would result in their catastrophic death (cf. Schäfer, 1972, p.159), together with their adnate epifauna of barnacles and serpulids. Subsequent winnowing would leave a deposit of Modiolus shell gravel, soon to be settled by new recruits. Adjacent infaunal populations of Glycymeris, Solecurtis and Spisula would not be so susceptible to storm or megaripple inundation, for aquarium experiments on anastrophic burial show that these bivalves have high escape potential: in contrast to their sessile epifaunal neighbours, they can escape through 20 cm. of sand.

These populations are within the euphotic zone and hence subject to the maximum effects of bioerosion (Fig. 18). This biological weakening, together with the process of maceration (Alexandersson, 1979), results in a rapid *in situ* breakdown of the skeletal carbonate, accounting for the rapid diminution of grain size towards the sand waves (Fig. 20b).

Rates of Carbonate Production

Quantification of the amount of carbonate present is difficult because of the inherent thickness variations across the shelf. However it has been possible to put a range on the likely thicknesses and hence volume and mass Table 2 of carbonate present (Table 2). Another problem has been to determine the time period over which carbonate accumulation has taken place. Sea level has remained relatively stable for the last 6000 years (Flint, 1971, p.333), but prior to that, it was rising and progressively encroaching on the Scottish landmass, and at the same time submerging large areas of the shelf under deeper and deeper water. These deeper, outer parts of the shelf were therefore probably supporting some carbonate production from at least 10,000 yrs. BP. However present carbonate production in the shallower areas probably did not establish itself fully until 6000 yrsa. BP., while there is also some evidence suggesting that productivity in the deeper parts of the shelf is now considerably less than it was prior to 6000 yrs. BP. Thus the minimum accumulation period is taken as 6000 years and the maximum as 10,000 years. On balance, because the sedimentary regime is likely to have reached a state of equilibrium only after 6000 BP., it seems likely that the average carbonate sedimentation rates based on a 6000 year accumulation period will be more realistic.

Rates of accumulation in the Orkneys have been faster than average for the Scottish shelf (Table 3). Highest rates for the major sandbanks reach 540 $g/m^2/yr$ (Table 2). Even the values of 125 $g/m^2/yr$ for the entire North Orkney Platform and East Orkney shelf (Table 2) are within the range quoted by Nelson (1978) for warm-water shelf carbonates (Table 3). The value for Table 3 Orkney Sounds, however, where wave action is much reduced, is half that for the open shelf (Table 2). This demonstrates clearly the importance of high energy in achieving high rates of carbonate production.

This is illustrated most spectacularly much farther north than Orkney by the carbonate deposit on the wave-dominated Iceland shelf at Fakse. Here perennial dredging sufficient to support the entire Iceland cement industry has failed to deplete the bioclastic reserve (Bramwell, 1977, p.118).

CONCLUSIONS

1. Bioclastic carbonates more than 90% $CaCO_3$ cover many 1000s of Km^2 of continental shelf at 59°N.
2. Bivalves, barnacles, bryozoans and serpulids dominate.
3. Production is highest from the Modiolus Epifauna.
4. Bioerosion by algal boring, limpet and echinoid grazing is intense within the euphotic zone (down to 40m): sponge boring is ubiquitous.
5. Sediment is mobile down to 100m under the combined influence of wave and tidal currents: sandbanks are lower and surrounded by bare rock in winter but higher in summer.
6. A net clockwise sediment-transport path is indicated by sandwave facing directions.
7. Major sandbanks build up in circulation loops caused by headlands obstructing the tidal flow, (cf. Yellow Sea example recently described by Klein et al., 1982).
8. Carbonate accumulates at up to 340 $g/m^2/yr$ in sandbanks but at an average of 97 $g/m^2/yr$ for the entire Orkney shelf. Local rates may thus reach those attained in the tropics as a result of the concentrating effects of wave and tidal transport (Table 4).

9. Sedimentation rates are of the same order as those estimated for New Zealand Oligocene skeletal carbonates by Nelson (1978), approximately 10 cm/1000yrs compared with 3 cm/1000 yrs for the entire Scottish shelf and 2 cm/1000 yrs for the New Zealand Cenozoic (Table 3).
10. Orkney bioclastic carbonates have a high preservation potential, being dominantly composed of low-Magnesian Calcite, and represent an excellent modern analogue for ancient high-energy, carbonate sandwave complexes.

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Figure Captions

Fig. 1. — Bathymetric map of the Northeast Orkney Islands: (redrawn, with permission, from I. G. S. data).

Fig. 2. — Maps showing that although tidal currents (a) increase around the Orkneys, the tidal range (b) does not: (after Lee and Ramster, 1981).

Fig. 3. — Map showing tracks of pinger and side-scan sonar traverses, and stations from which faunal and sediment samples were obtained. Numbered stations are those from which bioerosion studies were undertaken, and those which have samples illustrated in this paper.

Fig. 4. — Map showing sea-bed characteristics determined by analysis of side-scan sonar records obtained in July 1977.

Fig. 5. — Simrad echo-sounder trace obtained in July 1977 across North Ronaldsay North Bank, showing west-facing sandwaves. These consist of 99% bioclastic carbonate rich in bivalves, serpulids and barnacles (see Table 2: for location see Fig. 4).

Fig. 6. — Map showing tidal currents, fetch and sediment transport paths deduced from side-scan sonar survey of July 1977.

Fig. 7. — Generalised map showing sea-bed characteristics based on grab and dredge samples (cf. Fig. 4). Notice the broad correspondence between the rocky area shown on the side-scan sonar map and the distribution of Laminaria (kelp) and ophiuroids.

Fig. 8. — Common elements of the rock biota, plotted in 20 m blocks, showing the range over which they were recorded as dominant: (maximum width corresponds to seven occurrences).

Fig. 9. — Bryozoan growth forms: on left, encrusting bivalve shell and developing interlamination with serpulids: on right, nodular with hollow axes where attached to hydroids (Station 35, 56 m) x1.

Fig. 10. — Calcareous algal gravels: bulk sediment (left) and algal growth form (right). a) Station 96, 14 m, with robust growth forms. b) Station 92, 8.5 m, with more delicate, branching growth forms. Left x1.0. Right x0.6.

Fig. 11. — Map showing the distribution of live *Modiolus* Epifauna, *Modiolus* shell gravel and densities of live *Glycymeris glycymeris* (infauna).

Fig. 12. — Shell gravels composed principally of fragmented shell debris from the byssate bivalve *Modiolus modiolus*. a) coarse gravel that was inhabited by abundant *Glycymeris glycymeris*, several *Venerupis rhomboides*, with the tubes of *Lanice conchilega* and *in situ* *Laminaria saccharina* (Station 89, 24 m). b) finer gravel from a level bottom inhabited by *Ophiura texturata*, *Venus fasciata* and *Spisula elliptica*: notice the small well-preserved but transported *Arca* sp. (Station 61, 35 m). c) fine gravel/ coarse sand from the crest of a sandwave — no fauna (Station 79, 8 m). x1.

Fig. 13. — Map of calcium carbonate percentages in the surface sediments, determined by acid digestion. Notice the normally very high values of well over 90% (reduced in stippled area possibly because of reworking of local glacial drift).

Fig. 14. — Maps showing the precentages of the principal skeletal contributors to the bioclastic sediments (areas with above-average concentrations are shaded). a) Bivalves. b) Barnacles. c) Bryozoa. d) Calcareous worm-tubes. Notice that barnacle debris is highest nearshore, in exposed situations, whereas bryozoan debris occurs principally offshore. Worm-tubes are concentrated in sandwave areas.

Fig. 15. — Epo-tex resin cast of vegetative filaments of the boring chlorophyte alga *Eugomontia sacculata*, 13 µm in diameter. Smaller borings are probably fungal. Host shell is a fragment of the bivalve *Ensis* sp. Station 49, 16 m.

Fig. 16. — X-Ray radiographs of dead shells of *Modiolus modiolus* and *Venerupis rhomboides* revealing extensive damage by the boring sponges *Cliona celata* and *C. vastifica* (much the commoner). Notice also the much finer-scale borings of phoronids. Station 108, 24 m. x1.

Fig. 17. — Grazing traces made by the radulae of — a) the limpet *Acmaea virginea* on the surface of a *Modiolus* shell: notice the truncated "pin-pricks" of the cropped boring algae (Station 109, 18 m). b) the chiton *Lepidopleurus asellus* on the muscle-scar region of a *Glycymeris glycymeris* (Station 116, 79 m).

Fig. 18. — Diagram showing the bathymetric distribution of the dominant agents of bioerosion on the Orkney shelf. The limit of the euphotic zone may be taken as 39 m. Data shown in Appendix table~~s~~ 2 stations plotted on Fig. 3. (from Akpan, 1981).

Fig. 19. — Graph showing the close relationship between the degree of algal boring (x) and limpet grazing (o) and water depth. The limit of the euphotic zone may be taken as 39 m. (from Akpan, 1981).

Fig. 20. — Bioclastic carbonate sediment production from the *Modiolus* Epifauna. a) Upper right, integrates evidence presented earlier, 1. Location of dredge or grab samples yielding live or whole *Modiolus*, 2. Direction of dominant tidal transport, 3. Location of major sandbank. b) Processes involved, from high initial epifaunal production, through biologically weakened gravel to mature bioclastic sand, rounded and sorted by tidal transport in circulation loop caused by headland.

TABLE 1. Skeletal contributors to Orkney shelf carbonate sands and gravels (in parenthesis)

	Average Sample Depth	Barnacle	Bivalve	Echinoid	Gastropod	Serpulid	Bryozoa	Calcareous Algae	Foraminifera
North Ronaldsay North Bank	**48 m**	24	37	2	4	29	3	0	0
North Orkney Platform	**48 m**	27	43	5	6	13	6	0	1
East Orkney Shelf (*Modiolus* Gravels)	**57 m (67 m)**	16 (3)	51 (77)	4 (5)	2 (3)	6 (6)	16 (3)	0 (0)	7 (3)
Orkney Sounds (Algal Gravels)	**13 m (13 m)**	18 (2)	60 (6)	5 (7)	2 (4)	6 (2)	3 (2)	4 (76)	1 (1)

Latitude	59°25' N	59°25' N	59°00' N	59°04' N
Longitude	2°27' W	2°40' W	2°30' W	2°57' W
Area	North Ronaldsay North Bank	North Orkney Platform	East Orkney Shelf	Orkney Sounds
Water Depth	27 - 50 m	30 - 70 m	30 - 90 m	0 - 50 m
Area of deposit (m^2)	27.1 x 10^6	1140 x 10^6	700 - 1480 x 10^6	>70 x 10^6 *
Carbonate Content (%)	99	90 - 99 (95)	75 - 98 (88)	75 - 98 (85)
Thickness (m)	1 - 23 (5)	0.01 - 2 (1)	0.1 - 6 (3)	0.1 - 2 (0.5)*
Total volume (m^2 x 10^6)	26 - 191 (110)	11 - 2280 (1140)	848 - 4980 (1609)	7 - 140 (35)
Total weight (g x 10^{12})	21 - 158 (88)	9 - 1824 (995)	583 - 3984 (1609)	5 - 112 (27)
Accumulation rate (g/m^2/yr over 6000 yrs)	130 - 940 (541)	1 - 266 (129)	45 - 305 (123)	11 - 267 (65)
	range average	range average	range average	range average

* no good indications of thickness or area.

Table 2. Calculation of carbonate accumulation rates for four Orkney localities (after Allen, 1983)

TABLE 3. Comparative Carbonate Production Rates for high-and low-latitude continental shelves (Allen 1983)

Area	$g/m^2/year$		cm/1000 years	
	range	most likely	range	most likely
Entire Scottish Continental Shelf with >50% $CaCO_3$	4 - 135	24	0.5 - 16.9	3.0
Orkney Islands >75% $CaCO_3$	m14 - 312	97	1.8 - 39.0	9.6
North Ronaldsay North Bank	130 - 940	540		
East Orkney Platform Edge	114 - 646	248	14.3 - 80.8	31.0
Stronsay Firth Banks	250 - 400	400		
New Zealand Cenozoic (Nelson 1978)	8 - 40	16	1 - 5	2
Warm water Shelf $CaCO_3$ (Nelson 1978)	80 - 800		10 - 100	
Barbados Fringing Reef (Stearn et al. 1977)		1500		

Appendix 1 Important carbonate-producing species on the Orkneys shelf, arranged by habitat.

Rocky areas < 24m

Echinoid: *Echinus esculentus*

Gastropods: *Gibbula cineraria*, *Rissoa parva*, *Patina pellucida*

Bivalve: *Hiatella arctica* Barnacles: *Balanus* spp.

Rocky areas > 24m

Echinoid: *Strongylocentrotus droebachiensis*

Ophiuroids: *Ophiothrix fragilis* (dominant), *Ophiocomina nigra*, *Ophiopholis aculeata*, *Ophiura albida*, *Ophiactis balli*.

Gastropods: *Gibbula* spp., *Calliostoma zizyphinum*, *Acmaea tessulata*

Bivalve: *Chlamys varia*. Chiton: *Tonicella marmorea*. Bryozoan: *Flustra foliacea*

Calcareous worms: *Spirorbis* sp., *Filograna implexa*

Rocky areas c.80m

Bivalves: *Arca tetragona*, *Anomia ephippium*, *Chlamys distorta*, *Modiolus barbatus* *Hiatella artica*, *Musculus discors*.

Crinoids: *Antedon bifida*. Brachiopods: *Crania anomala*.

Algal Gravel 20m

Algae: *Phymatolithon calcareum*. Echinoid: *Echinus esculentus*

Bivalves: *Venerupis rhomboides*, *Venus fasciata*, *Gari tellinella*, *Ensis* sp., *Mytilus edulis*

Gastropods: *Gibbula cineraria*, *G. magus*, *Patina pellucida*, *Acmaea virginea*

Modiolus Shell Gravel

Bivalves: *Modiolus modiolus*, *Glycymeris glycymeris*, *Venerupis rhomboides*, *Venus fasciata*, *Tellina crassa*, *Dosinia exoleta*.

Gastropods: *Calliostoma zizyphinum*, *Gibbula cineraria*

Ophiuroid: *Ophiura texturata*. Serpulids, Barnacles

Shellsand

None

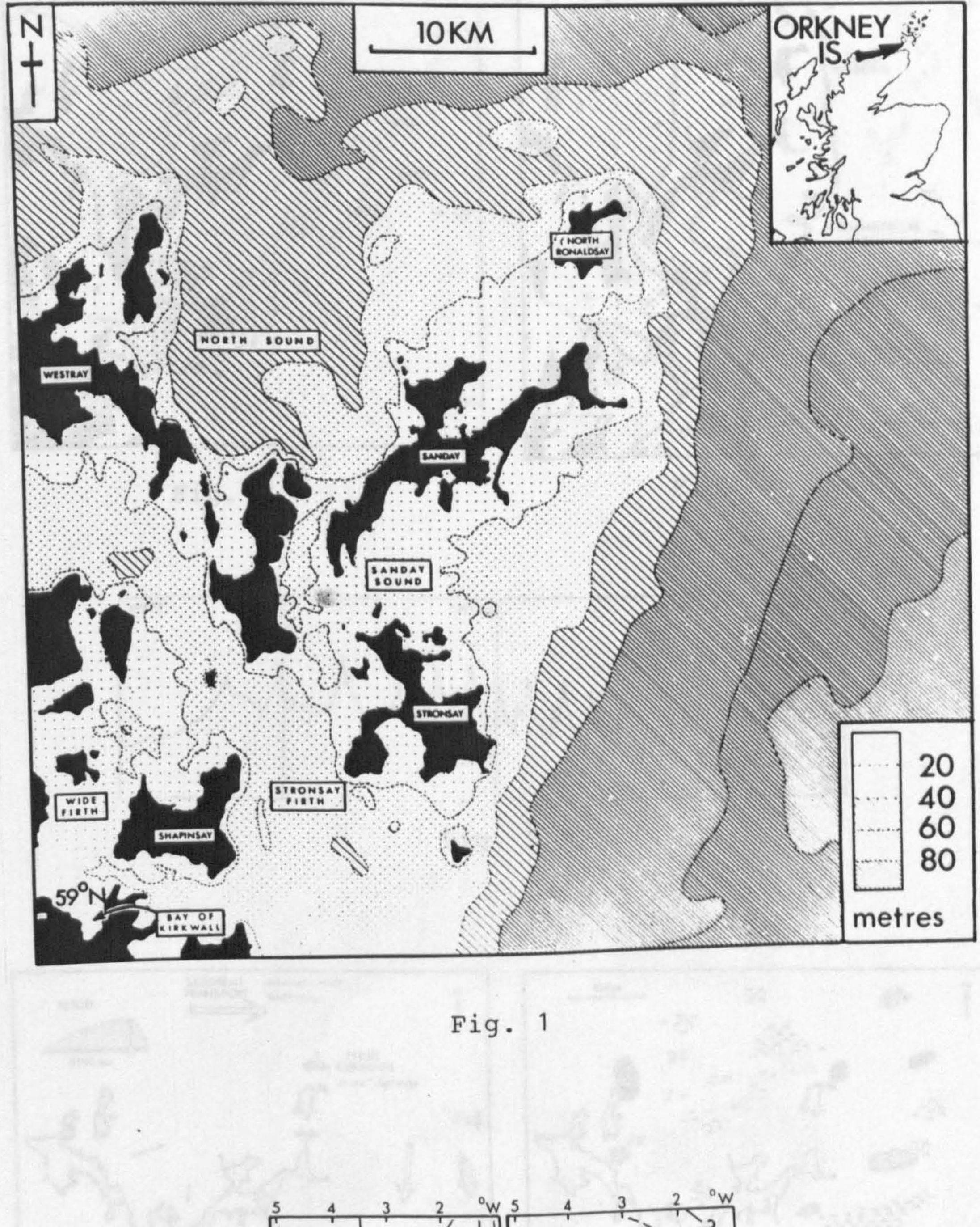
Muddy Sand

Bivalves thin-shelled, e.g. *Thyasira flexuosa*, *Gari fervensis*, not major producers.

Station Number	Depth (m)	Characteristic of sea bottom	No. of shells examined	% of shell bored by algae	Type of algae	% of shell grazed by *Acmaea*	% of shell grazed by Chiton	Regular echinoid bitings	Sponge borings	Phoronid borings	*Polydora* borings	
88	12	Muddy sand	3	100%	Green	0	0	A	X	-	-	High bryozoan encrustation probably impedes grazing
124	12.5	Maerl	mainly calcareous algae (lithos)	very high intensity of boring	Green	-	-	-	-	-	-	
85	14	Maerl	-	-	Green	-	-	-	-	-	-	
95	15.5	*Modiolus* gravel	12	87	Green	87	33	C	C	-	-	High degree of bryozoan encrustation is probably responsible for low limpet grazing
153	16	Maerl	mainly lithos	very high intensity of algal boring	Green	grazing on shell fragments	no chiton grazing	C	C	-	-	
49	16		18	83	Green	61	39	C	C	X	P	
109	18	*Modiolus* gravel	38	87	Green	82	38	P	A	P	P	
94	19	Maerl	mainly lithos + 2 shells	very high intensity of algal boring	Green	shells grazed	no chiton trace	P	X	-	-	
91	19	Cobbles	13	100	Green	77	31	C	C	-	-	
108	24	*Modiolus* gravel	10	80	Green	70	40	C	C	P	P	
142	24	*Modiolus* gravel	50	52	Green	0	0	P	A	P	P	
29	29		mainly lithos + a few shell fragments	high algal boring intensity	Green	grazing on shell fragments	chiton grazing present	X	X	-	-	
100	30	Coarse *Modiolus* gravel	16	56	Green	25	12.5	X	C	-	-	
104	30	Coarse *Modiolus* gravel	30	70	Green	70	50	P	A	P	P	
27	37		24	58	Green	24	8*	X	A	C	P	
106	38	*Modiolus* gravel + stones	12	25	Green	25	8*	X	C	-	-	
132	38	Clean coarse sand	3	0	-	0	0	X	X	X	X	Shells probably not exhumed prior to sampling
105	40	ant. cobble	5	0	-	0	0	X	P	X	X	
133	46	very clean *Modiolus* gravel	15	6	-	0	0	X	C	-	-	
16	61	shelly muddy sand	4	0	-	0	0	X	X	X	P	Shells probably not exhumed prior to sampling
43	65		mainly fragments	0	-	0	0	X	P	-	-	
42	76		20	0	-	0	10*	X	A	P	X	
116	79	shell gravel	15	0	-	0	7*	X	C	C	P	
1	80		3	0	-	0	0	X	P	X	X	
117	96	sand	43	0	-	0	19*	X	C	C	P	
12	102	soft ground	30	0	-	0	0	X	X	X	X	

* = Chiton grazing on muscle scar only
X = Absent i.e. 0%
P = Present 1–45%
C = Common 46–60%
A = Abundant i.e. above 60%

Appendix 2. Table summarizing the agents and processes of calcium carbonate bioerosion in the Orkney sea area.


3°W
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10KM
ORKNEY IS.
NORTH SOUND
WESTRAY
NORTH RONALDSAY
SANDAY
SANDAY SOUND
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WIDE FIRTH
SHAPINSAY
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BAY OF KIRKWALL
20
40
60
80
metres

Fig. 1

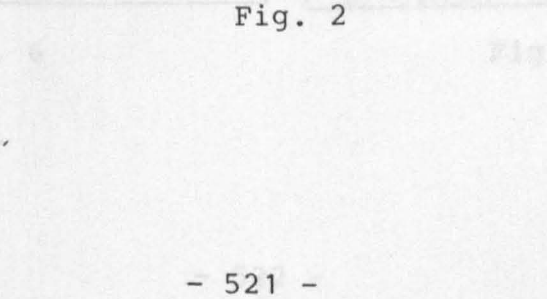
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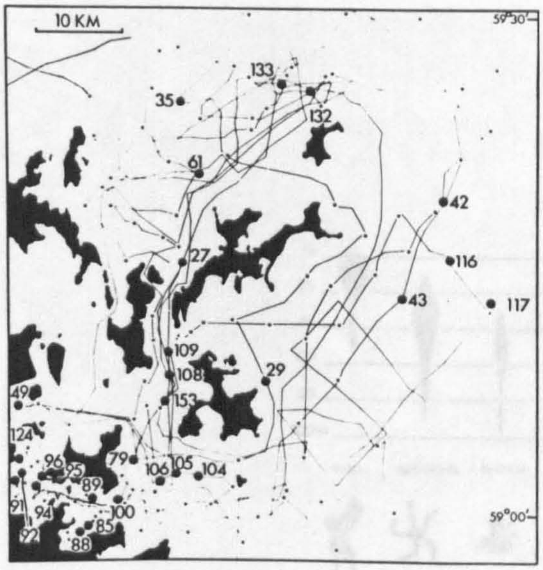
Fig. 2



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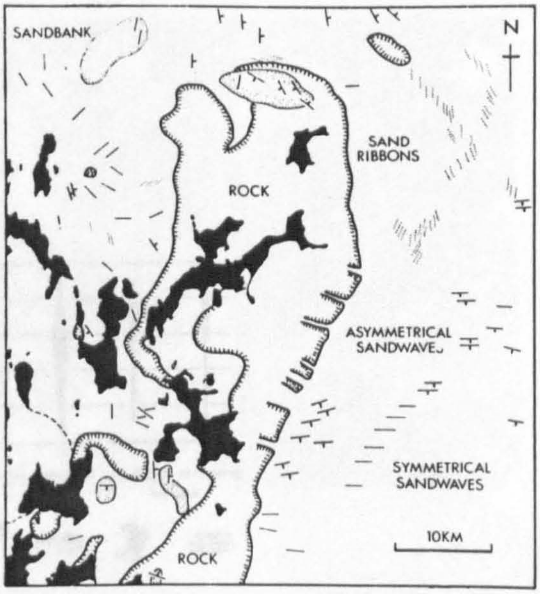

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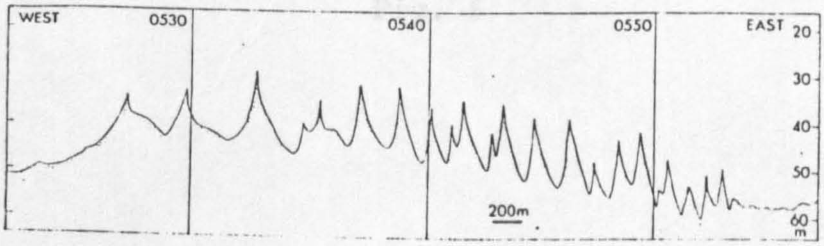

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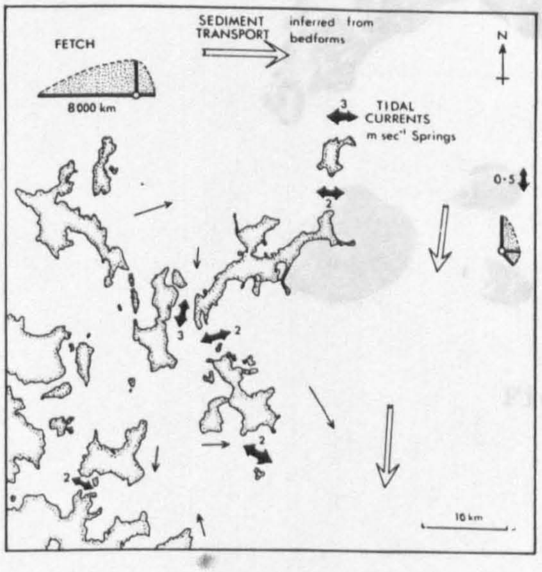
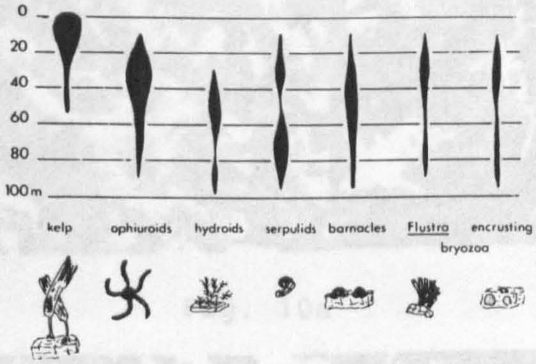


Fig. 6

Fig. 7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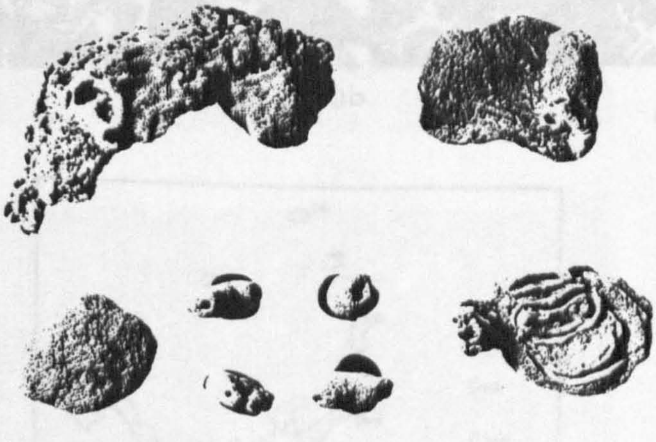
serpulids
barnacles
Flustra
encrusting bryozoa

Fig. 8



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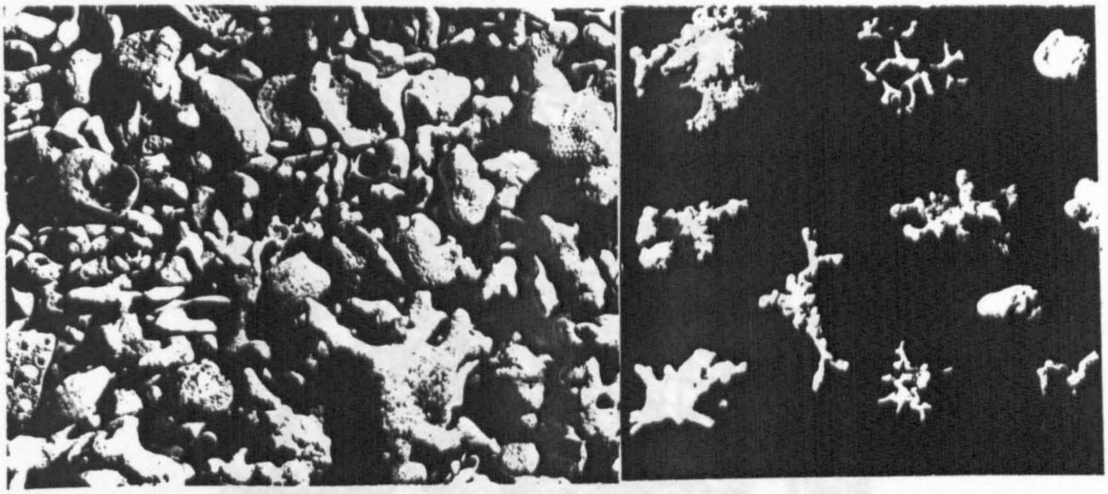


Fig. 10a

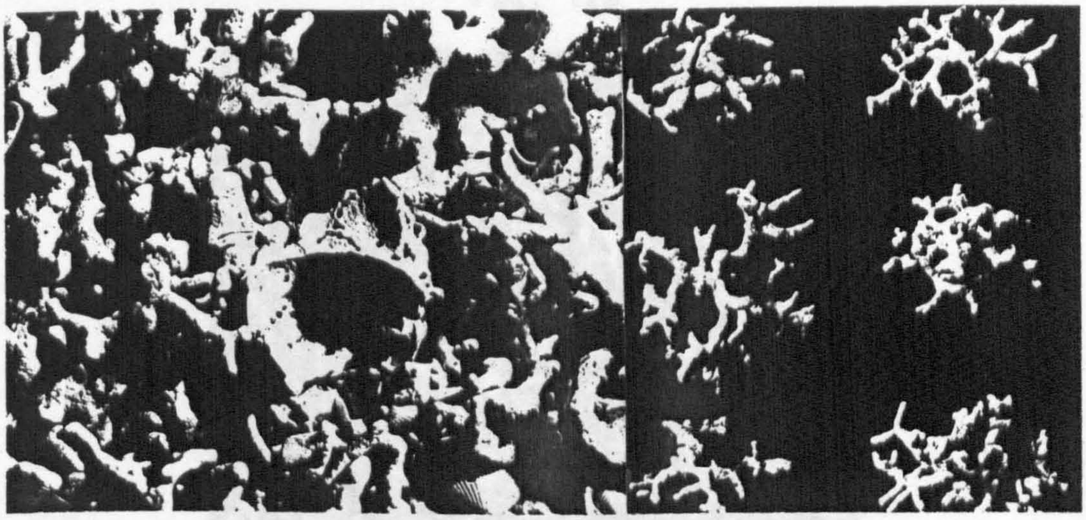


Fig. 10b

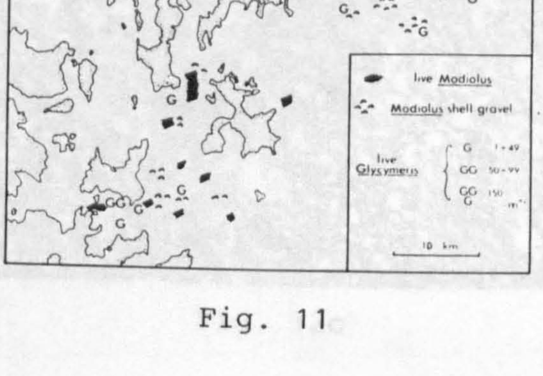
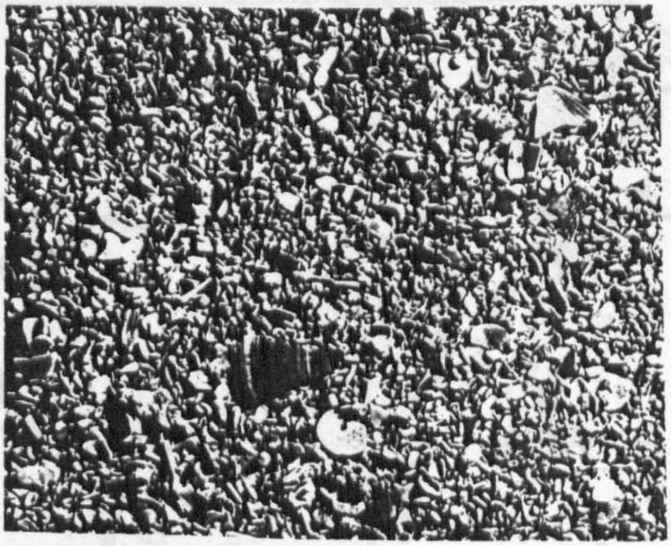


Fig. 11

Fig. 12a

Fig. 12b



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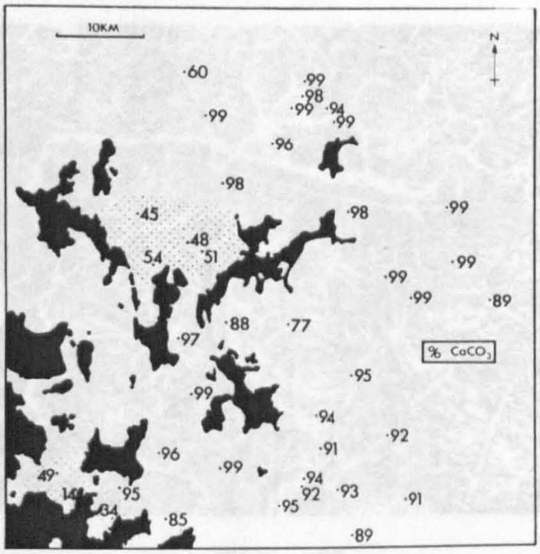
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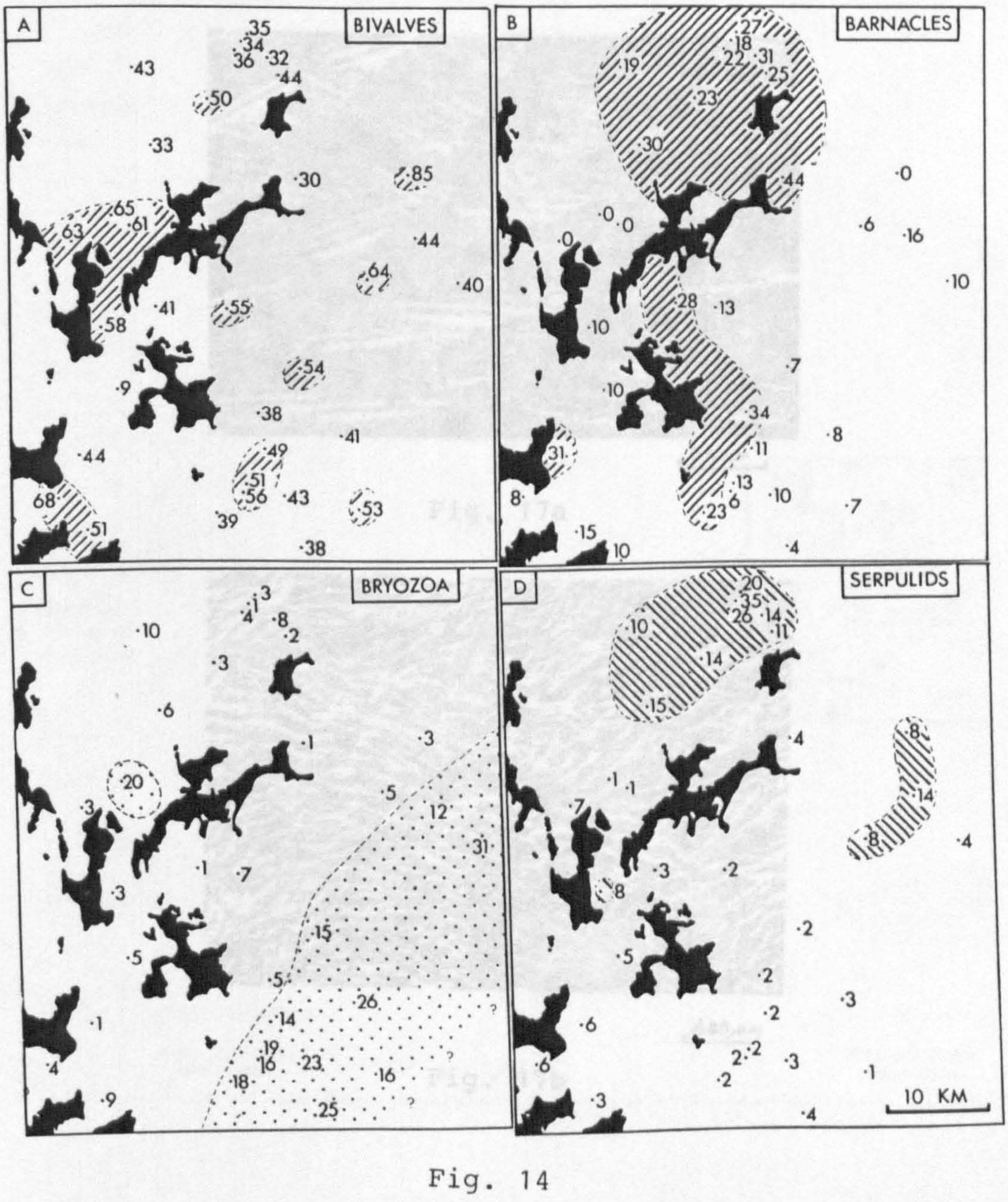
Fig. 13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B
BARNACLES
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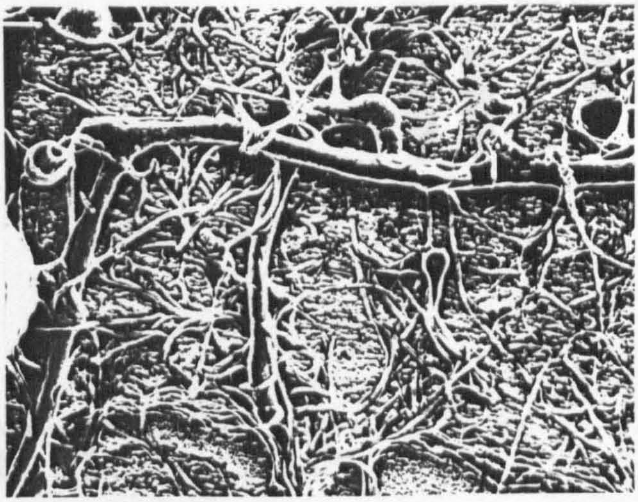
D
SERPULIDS
10 KM

Fig. 14



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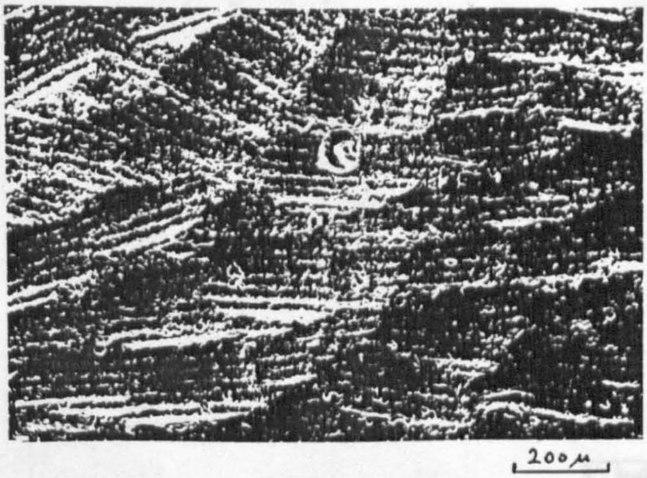

Fig. 17a

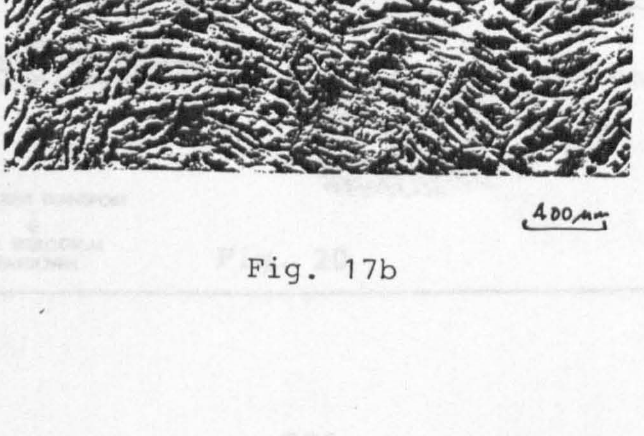

Fig. 17b

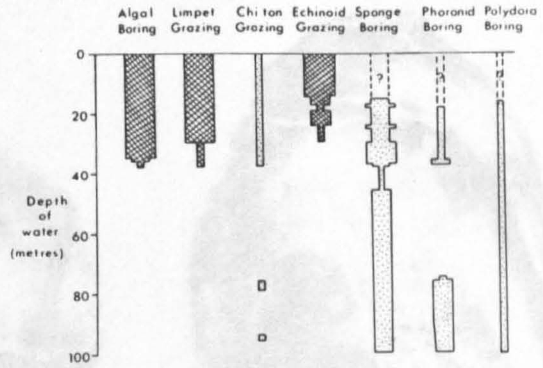

Fig. 18

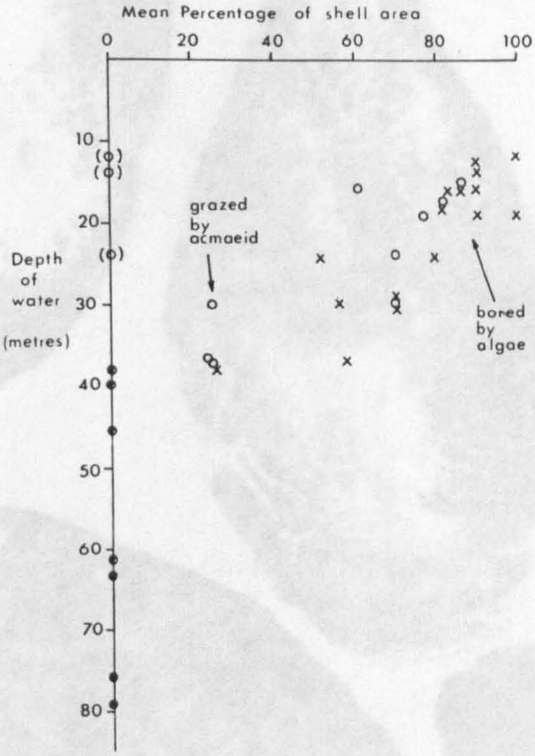

Fig. 19

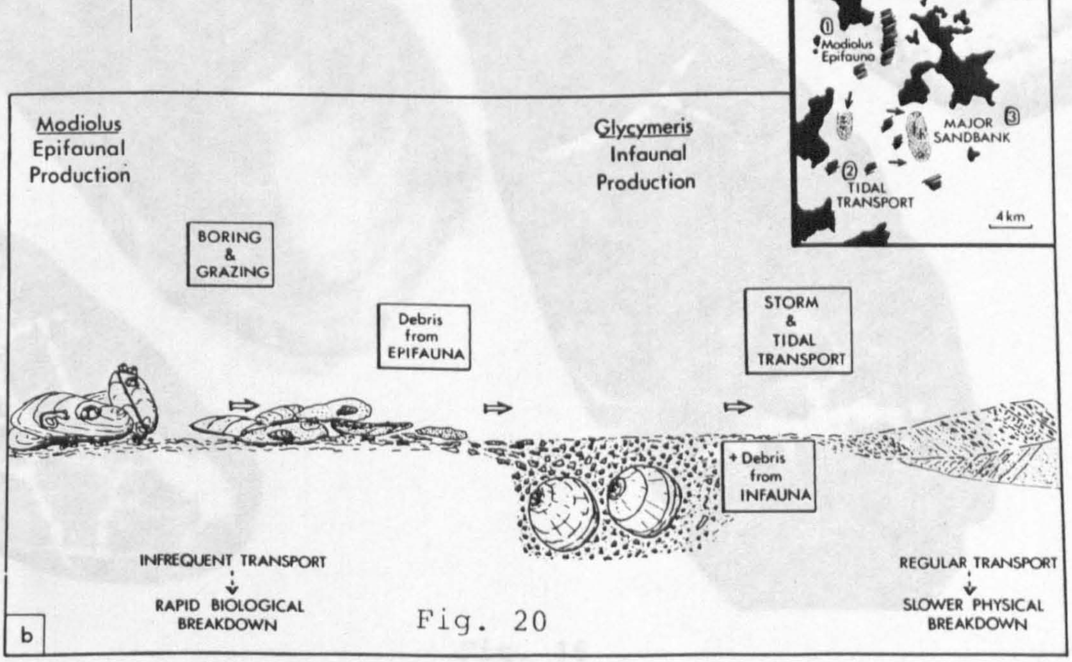

Fig. 20

Fig. 16

APPENDIX 8

Proposed wave energy schemes for the west coast of the Outer Hebrides : their effects on sedimentation.

Proposed wave energy schemes for the west coast of the Outer Hebrides effects on sedimentation.

(based on a report prepared in 1979)

The area west of the Outer Hebrides has accumulations of very pure $CaCO_3$ occurring on a hummocky, rocky, waveswept platform which is a site of present-day $CaCO_3$ production by rock dwelling organisms. (see main thesis). As it is the possible test site for full scale wave energy converters, consideration of the effects on sedimentation is appropriate.

One of the most popular ideas for meeting future energy needs for the world is to capture energy from extra-terrestrial sources. The Moon induces tides, and the Sun produces radiation which can be captured directly, and also indirectly as the wind and wind-driven waves. It is commonly argued that these are 'free' and effectively inexhaustable sources of energy which have none of the environmental problems associated with the burning of fuels. However, the extra-terrestrial energy which falls on the Earth at present drives the circulation in the atmosphere and oceans. This circulation controls our climate and is the main physical process affecting sedimentation. If, for instance, solar energy is diverted out of these systems, then side effects on our environments must be expected. For example 5×10^{24}J/YR of solar radiation falls on the upper atmosphere of the Earth. Present world consumption is about 3×10^{20} J/YR, so that if technology enabled us to depend entirely on solar energy in the form of radiation, wind and waves, then we would be using of the order of $\frac{1}{10,000}$th of the energy that is falling on the Earth's upper atmosphere.

The use of the waves is one of the most promising methods of capturing the Sun's energy, and waves play a crucial role in shallow marine sedimentation. Any significant removal of wave energy from the sea along a coastline will cause changes in the pattern of sedimentation. It is possible that the changes might lead to either considerable net erosion or sediment accumulation.

In the past six years methods of converting wave energy into electrical energy have advanced so far that it is now a serious proposition. The main problems still to be overcome are the reduction of production, installation and maintenance costs. A test site, west of the Outer Hebrides has the best conditions in Britain for the harnessing of wave energy (Salter 1977) (Fig.158) and several workers are considering the environmental effects of such a scheme (Probert & Mitchell 1979), with the main concern being the effects on the ecosystem. Of prime importance to this is the pattern of sedimentation. Hydraulics Research Station (Wallingford) have stated that there should be little detrimental effect and may be some build up of the beaches (Probert pers. comm.).

Several types of wave driven generators are being developed in Britain (Clark 1977). Only two types will be discussed here but it is likely that others will have similar effects because they all extract the same energy from the system.

Salter's 'nodding ducks' (Fig.159) are floating concrete devices which would be anchored in water about 100m deep, probably as a 'string' parallel to the coastline about 10km offshore (Salter *et al.* 1976). The arrays would not be continuous but the spacing is as yet undecided. They are expected to be extremely efficient at removing energy (up to 80%) from the entire water column during calm spells, while during storms they would have a much lower efficiency and nearly all the wave energy will pass the devices (Mollison 1976).

The Oscillating Water Columns (OWC Fig.160) are solid concrete structures which would be mounted on the seabed in up to 25m of water and project above sea level (Pickin pers comm, Roxburgh Engineering pers. comm.). They would form a barrier parallel to the coastline about 3km offshore. Again, the spacing of these devices is undecided. They would be very effective at preventing the waves reaching the sea behind them, but this sheltered area will be much smaller than that produced by the nodding ducks.

Carbonate sedimentation in the area is discussed in the main thesis. For the nodding ducks, the effect on the degree of sediment movement by reduction in wave energy may not be great, as most of the movement takes place during storms. The ducks take only a small proportion of the energy from storm waves, so the reduction in bottom oscillatory storm currents will be small, producing little decrease in grainsize moved and rate of movement.

Nevertheless the energy converters will significantly change the hydraulic regime for the entire region between themselves and the shore, so that for either type of device, the nearshore and beach environments will experience immediate changes and may be the most affected parts of the coastal marine system. Many of the beach-machair complexes are considered to be already undergoing erosion (Mather & Ritchie 1977), and Ritchie (1971) has pointed out that the shore is in a delicate equilibrium which could easily be disturbed by artificial alterations to the coastline. Thus the installation of a wave energy scheme may have major implications for the shoreline and the machair which lies behind.

Normally sand is blown permanently behind the foreshore into the dune area and machair, while this lost sand is replenished from a nearshore bank or 'reservoir' of sediment which lies seaward of the intertidal zone (Mather & Ritchie 1977 and Fig. 161) If it is assumed that the Hebridean beaches behave as typical beaches facing an open ocean, then sediment should migrate seasonally between the nearshore bank and the beach (Komar 1976) with the net losses to the dunes and machair being replaced by supply from further offshore.

During the winter, when high energy, storm waves are common, sediment is moved seaward from the beach, onto the nearshore bank. Thus at the end of the winter the beach is in its most eroded state (Fig. 162). During the summer, lower energy swells derived from a long distance predominate. Sediment moves from the nearshore zone back onto the beach during this period. The beach therefore undergoes an erosive phase to produce a 'storm profile' in the winter, and a constructive phase to produce a 'swell profile' in the summer (Fig.162). The net process is actually determined by the balance between the destructive and constructive types of waves.

The Salter-type wave energy devices are designed to remove almost all the energy of the constructive, summer swells, but to leave the powerful destructive storm waves almost unaffected (Mollison *et al.* 1976, Salter 1976, Fig. 163). Thus the balance may be shifted in favour of the 'storm profile' leaving the coastline prone to extensive erosion.

The OWC can be mounted on the seabed comparatively nearshore and therefore has considerable operational advantages. It would act as a breakwater and very little wave energy would get past the structure. Hence it should protect the coastline from erosion. There is likely to be accumulation of sediment in the quiet lagoonal area between the devices and the shore which at present is rocky. Sediment may pile up on either side of the devices and this could cause severe engineering problems. The ecological implications are also considerable. The rocky seabed at present supports a very important kelp and lobster industry and these could be irreparably damaged.

It is very difficult to determine how quickly the sediment would accumulate in the lagoon. Many of the calcium carbonate secreting organisms may also be affected by the changes in the hydrodynamic environment and the production rate of $CaCO_3$ may change. Also as the rocky substrate becomes buried under sediment, so the nature of the $CaCO_3$ producing fauna will change.

These suggestions are based on the assumptions that near-continuous lines of barriers will be built, and that the beaches obey the Komar-type seasonal variation. It has not been decided how many and how big the gaps will be, and it is not known how the Hebridean beaches vary with the seasons (Ritchie pers. comm.). It is clear that further study of the beaches and the nearshore and offshore zones is necessary before any decision is made on the energy converters to be installed and that if any full scale scheme is implemented the sedimentary processes should be carefully monitored both on the beaches and offshore.

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Figure 158 Sites of highest available wave energy (from Clarke, 1977).

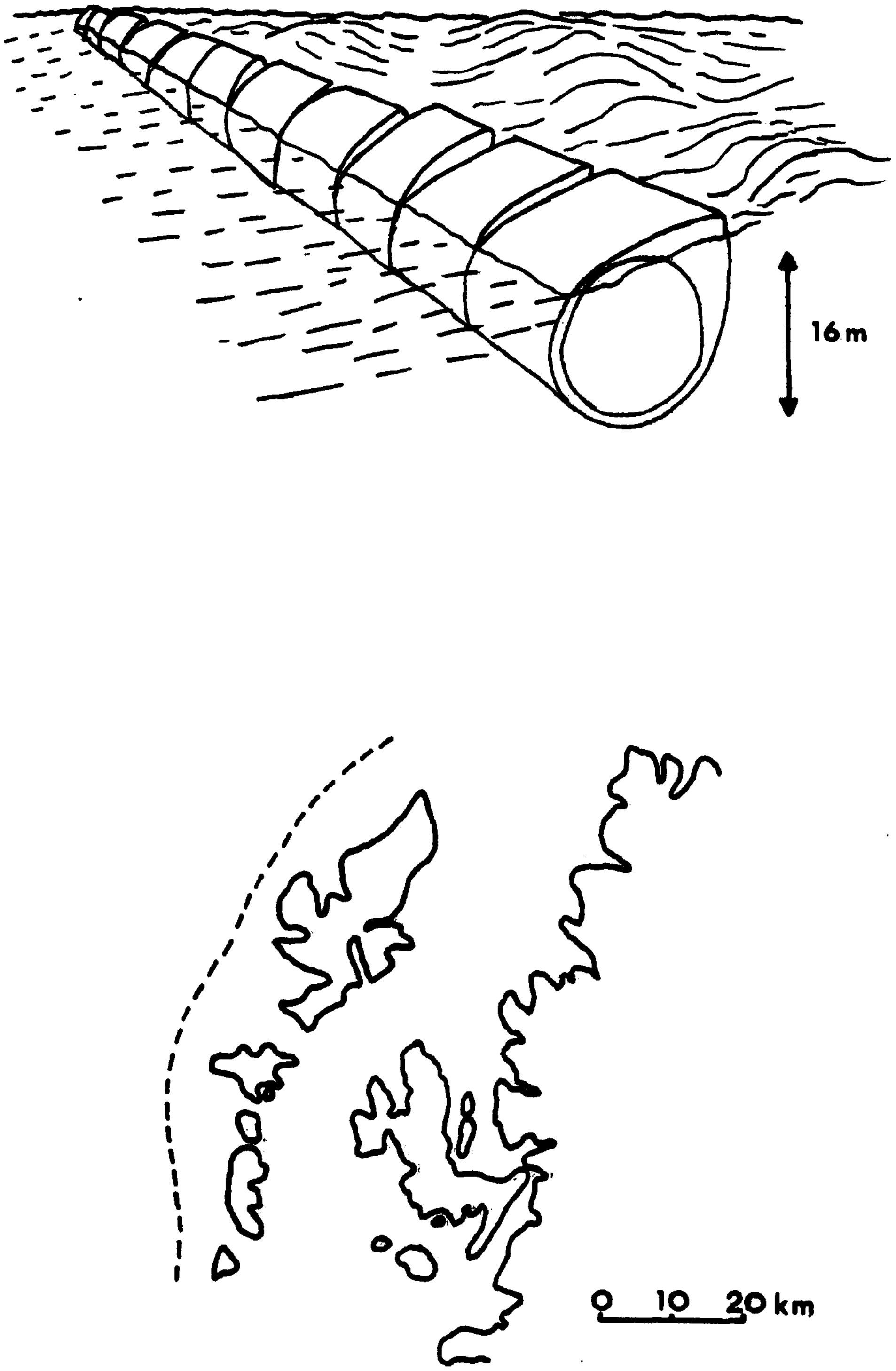


Figure 159 Artist's impression and possible location of Salter's 'ducks' based on Salter et al. (1976).

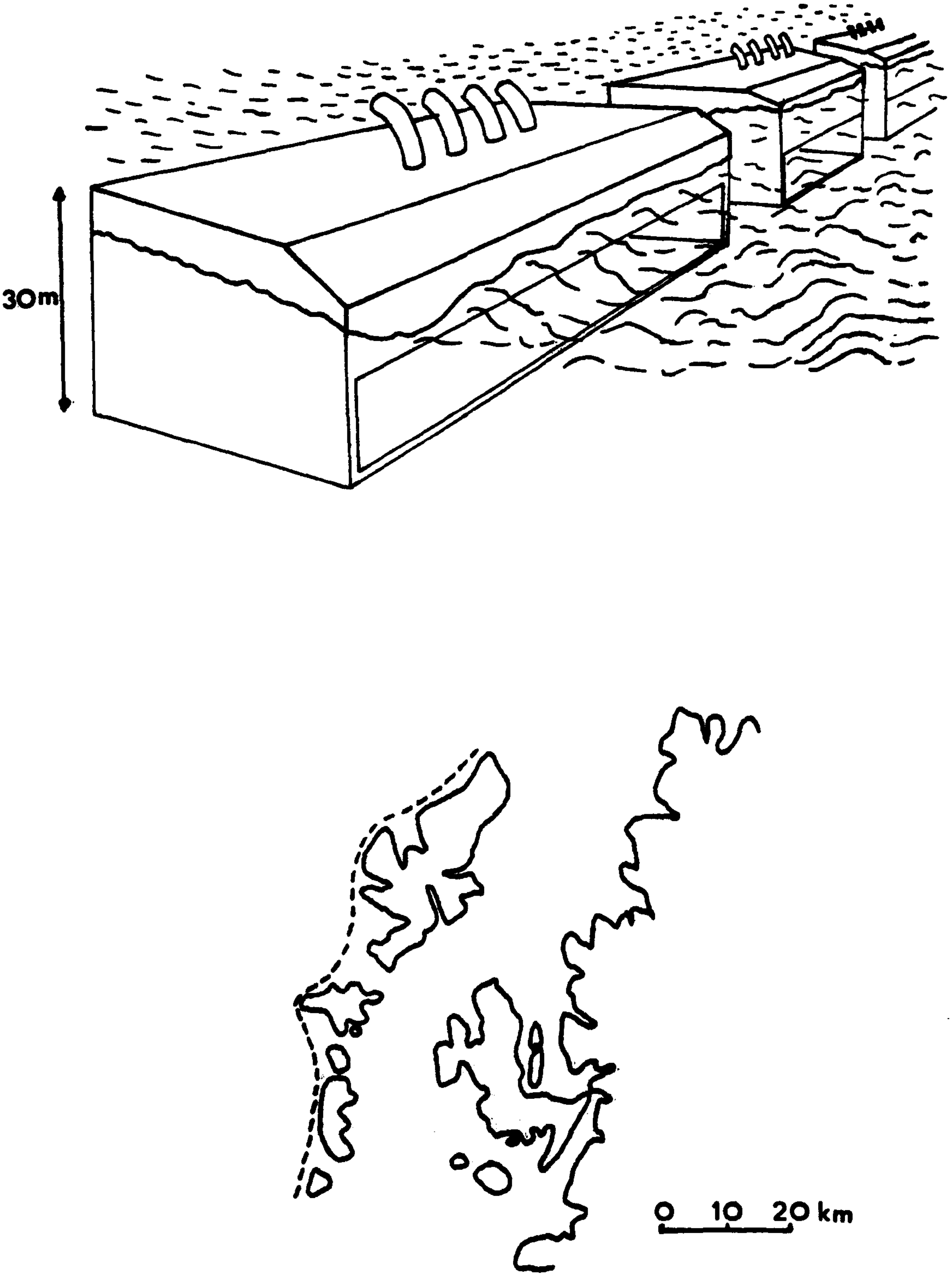


Figure 160 Artist's impression and possible location Oscillating Water Column (OWC) generators based on Roxburgh Engineering (pers.comm.) and NERC Newsjournal, 2, No. 7.

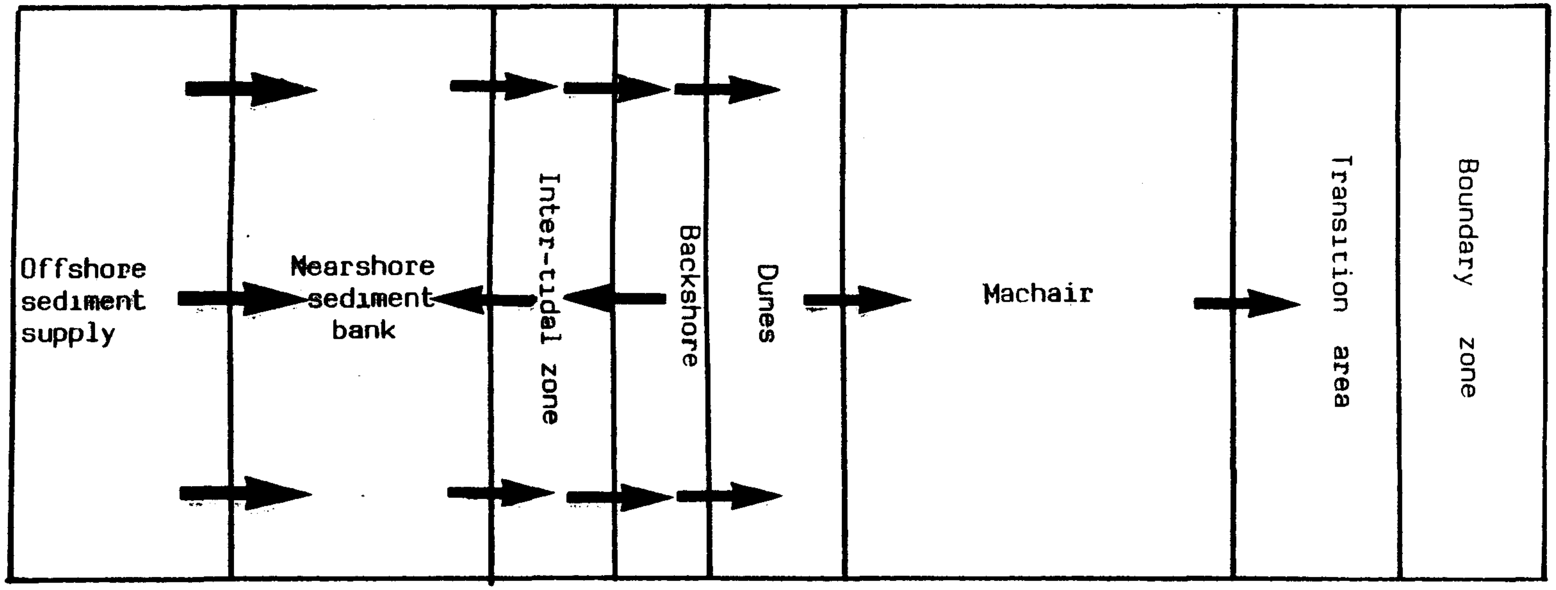
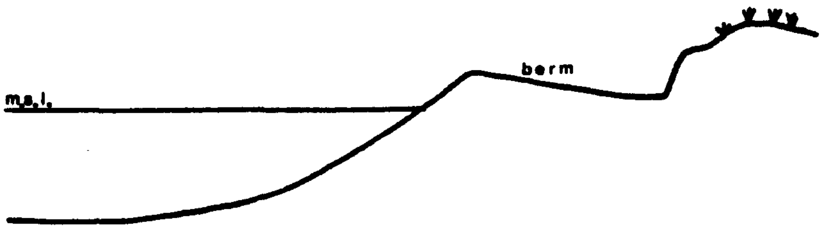
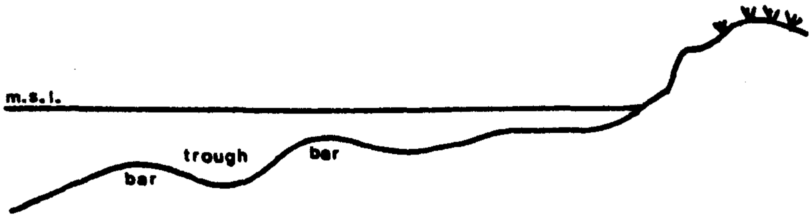


Figure 161 The sand - beach system. Modified from Mather and Ritchie (1977).



(a) Summer (swell) profile.



(b) Winter (storm) profile.

Figure 162 Variation of a beach profile with the seasons, from Komar (1976).

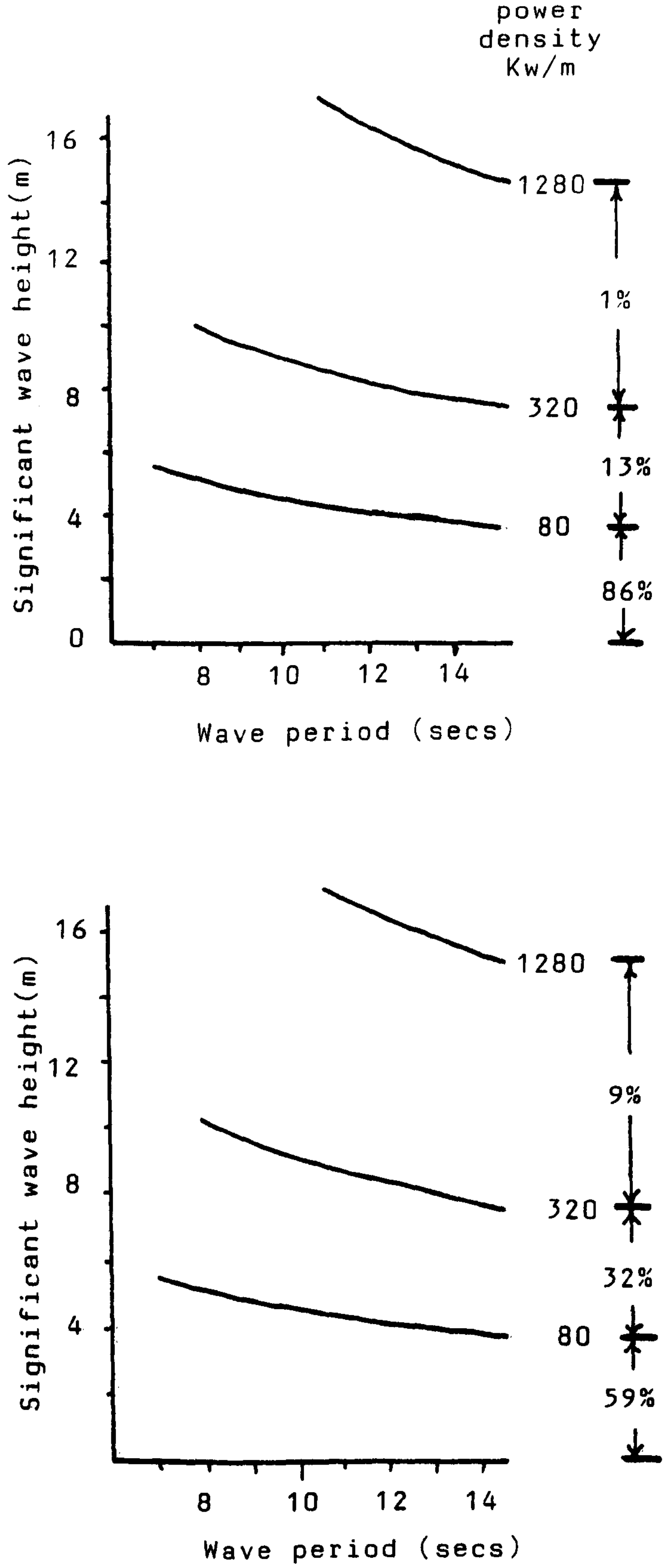


Figure 163 Power density diagrams based on data from OWS station 'India'. Percentages on the right-hand side of the diagrams represent total frequency of occurrence of the power density ranges. Salter's devices would remove most waves between 0-80, reduce wave size between 80-320, and above 320 will have neglible effect. Based on Salter et al.(1976).

APPENDIX 9

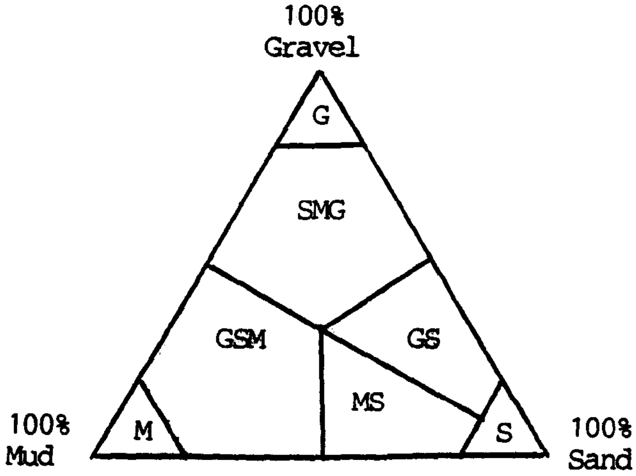
Particle size and carbonate analyses of samples from the SCS study-area.

Sediment PSA & Carbonate Data

Explanation:

SAMPLE NUMBER is the IGS labelling system as at 1/12/79
NB.1 Samples are grab samples

LAT & LONG are °N latitude and °W(-) & °E(+) of the station position
DEPTH is the water depth in metres
SED TYPE refers to the ternary diagram for gravel:sand:mud;-



%G	is the % by weight of gravel(2+mm) in the sample
%S	is the % " " " sand(0.0625-2mm) in the sample
%M	is the % " " " mud (0-0.0625mm) " " "
%CC S&G	is the % " " " carbonate in the sand and gravel
%CC S	is the % " " " " " " sand only
%CC M	is the % " " " " " " mud only
%CC TOTAL	is the % " " " " " " in the whole sample

NB.2 Where a significant size-fraction has not been analysed for carbonate, this total can only be an approximation.
NB.3 Where a figure is preceeded by 'E' it has been derived from a visual shipboard estimate only

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
M 43.	57,5053	-6,9600	147.	S	1	82	17	--	--	--	--
M 44.	57,5024	-6,9284	190.	S	0	98	2	--	--	--	--
M 48.	57,5207	-7,0832	99.	S	3	86	11	--	52	--	52
M 52.	57,5285	-7,0131	77.	MS	16	59	25	--	49	--	49
M 56.	57,5932	-7,1458	14.	M	1	6	93	--	--	--	--
M 59.	57,5279	-7,0962	28.	MS	3	70	27	--	--	--	--
M 60.	57,5756	-6,7746	150.	S	0	98	2	--	20	--	20
M 63.	57,5297	-6,6975	160.	MS	0	71	29	--	--	--	--
M 68.	57,6142	-6,9805	165.	S	0	85	15	--	30	--	30
M 69.	57,5722	-7,0386	128.	S	1	90	9	--	--	--	--
M 77.	57,7196	-6,8035	146.	GSM	0	27	73	--	--	--	--
M 82.	57,7315	-6,5448	33.	GS	39	58	3	--	90	--	90
M 83.	57,7576	-6,6087	27.	S	10	90	0	--	87	--	87
M 84.	57,7227	-6,7147	46.	GS	34	66	0	--	77	--	77
M 85.	57,9396	-5,4965	33.	S	5	91	4	--	--	--	--
M 87.	57,9464	-5,5460	80.	S	9	83	8	--	--	--	--
M 88.	57,9431	-5,7546	91.	S	1	85	14	--	21	--	21
M 90.	57,8913	-5,8367	50.	S	20	80	0	--	--	--	--
M 93.	57,8640	-5,9881	113.	MS	1	73	26	--	--	--	--
M 95.	57,8276	-5,9983	135.	GSM	0	42	58	--	--	--	--
M 97.	57,9019	-6,1279	38.	MS	2	54	44	--	88	--	88
M 100.	57,8442	-6,4099	21.	GS	25	75	0	--	91	--	91
M 101.	57,8343	-6,3864	85.	GS	34	64	2	--	92	--	92
M 103.	57,7751	-6,3092	70.	GS	48	51	1	--	85	--	85
M 105.	57,7789	-6,3431	82.	S	33	67	0	--	91	--	91
M 108.	57,7715	-5,9797	147.	M	0	5	95	--	--	--	--
M 109.	57,3654	-5,3967	44.	SMG	57	36	7	--	44	--	44
M 110.	57,3511	-5,9873	96.	MS	3	64	33	--	--	--	--
M 111.	57,3277	-5,9825	32.	SMG	70	26	4	--	92	--	92
M 115.	57,4219	-5,8597	66.	MS	10	47	43	--	--	--	--
M 116.	57,4205	-5,8915	198.	GSM	5	19	76	--	--	--	--
M 119.	57,4172	-5,9654	162.	M	0	2	98	--	--	--	--
M 122.	57,4891	-5,9547	236.	M	0	1	99	--	--	--	--
M 129.	57,5798	-6,0484	165.	M	0	1	99	--	--	--	--
M 141.	57,6983	-5,9539	138.	M	0	3	97	--	--	--	--
M 144.	57,9939	-5,7084	86.	S	7	86	7	--	28	--	28
M 145.	57,9989	-5,7862	124.	MS	0	54	46	--	--	--	--
M 151.	57,8190	-6,4329	87.	S	19	81	0	--	91	--	91
M 152.	57,5543	-6,5256	68.	GSM	3	24	73	--	23	--	23
M 153.	57,5306	-6,4952	70.	M	0	3	97	--	--	--	--
M 154.	57,5278	-6,4598	59.	M	0	7	93	--	--	--	--
M 156.	57,4179	-6,4593	63.	GSM	0	32	68	--	--	--	--
M 157.	57,5923	-6,4599	62.	M	0	17	83	--	--	--	--
M 158.	57,5710	-6,4565	53.	GSM	0	39	61	--	--	--	--
M 159.	57,5437	-6,4564	67.	M	0	3	97	--	--	--	--
M 160.	57,6044	-6,5753	60.	GS	46	51	3	--	66	--	66
M 165.	57,3580	-5,7083	88.	GSM	9	42	49	--	--	--	--
M 166.	57,3480	-5,7317	78.	M	0	14	86	--	--	--	--
M 168.	57,3250	-6,7625	123.	M	0	11	89	--	--	--	--
M 169.	57,3188	-5,8067	154.	M	0	4	96	--	--	--	--
M 170.	57,2967	-5,8317	73.	MS	1	65	34	--	13	--	13
M 171.	57,3088	-5,8583	48.	MS	38	53	9	--	26	--	26
M 172.	57,2933	-5,9017	58.	S	0	82	18	--	--	--	--
M 176.	57,5202	-6,1298	60.	MS	17	58	25	--	65	--	65
M 177.	57,5210	-6,0927	128.	M	0	4	96	--	--	--	--
M 178.	57,5283	-6,0626	132.	M	0	2	98	--	--	--	--
M 179.	57,5244	-6,0399	78.	MS	14	63	23	--	--	--	--
M 180.	57,5215	-6,0215	165.	S	1	15	84	--	--	--	--
M 181.	57,5740	-5,7548	94.	GS	16	70	15	--	58	--	58
M 182.	57,5980	-5,7935	46.	MS	0	6	94	--	--	--	--
M 185.	57,6158	-6,5107	66.	S	2	84	14	--	52	--	52
M 186.	57,6367	-6,5087	76.	GS	14	75	11	--	47	--	47
M 187.	57,6485	-6,5350	67.	GS	24	74	2	--	81	--	81
M 189.	57,6733	-6,5992	63.	S	12	86	2	--	75	--	75
M 190.	57,7089	-6,5874	85.	S	10	88	2	--	78	--	78
M 191.	57,7140	-6,6040	89.	S	11	86	3	--	37	--	37
M 192.	57,7313	-6,6131	108.	S	3	97	0	--	29	--	29
M 193.	57,7456	-6,6339	91.	GS	16	64	15	--	42	--	42
M 194.	57,7583	-6,6041	117.	GS	18	74	8	--	35	--	35
M 196.	57,7878	-6,6944	110.	MS	7	57	36	--	74	--	74
M 197.	57,7963	-6,7388	43.	GS	19	72	9	--	50	--	50
M 198.	57,8165	-6,8488	34.	GS	18	72	10	--	48	--	48
M 201.	57,8634	-5,9138	154.	MS	0	63	37	--	--	--	--
M 205.	57,9298	-6,0507	73.	MS	6	78	16	--	79	--	79
M 208.	57,9569	-6,0977	81.	SMG	56	44	0	--	92	--	92
M 209.	57,9705	-6,1247	56.	GS	46	54	0	--	60	--	60

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
M 212.	58.2090	-6.2183	40.	M	0	11	89	--	--	--	--
M 213.	58.2221	-6.2400	110.	M	0	16	84	--	--	--	--
M 214.	58.2351	-6.2645	90.	SMG	47	29	24	--	44	--	44
M 215.	58.2470	-6.2083	114.	MS	1	61	38	--	41	--	41
M 216.	58.2513	-6.3585	145.	MS	2	51	47	--	47	--	47
M 217.	58.1377	-6.2390	130.	M	N	12	88	--	--	--	--
M 218.	58.1637	-6.2099	98.	S	N	86	14	--	38	--	38
M 219.	58.2253	-6.1115	134.	MS	N	63	37	--	--	--	--
M 220.	58.1989	-6.0900	130.	GSM	0	22	78	--	--	--	--
M 221.	58.1934	-6.0752	130.	M	0	20	80	--	--	--	--
M 222.	58.1893	-6.0278	127.	M	0	4	96	--	--	--	--
M 223.	58.1841	-6.0024	123.	M	0	3	97	--	--	--	--
M 224.	58.1770	-5.9815	114.	M	0	20	80	--	--	--	--
M 227.	58.1606	-5.9011	112.	M	0	15	85	--	--	--	--
M 228.	58.1541	-5.8925	112.	M	0	17	83	--	--	--	--
M 229.	58.1483	-5.8758	114.	GSM	0	26	74	--	--	--	--
M 230.	58.1412	-5.8018	110.	MS	0	58	42	--	--	--	--
M 232.	58.1317	-5.8117	99.	MS	6	64	29	--	--	--	--
M 235.	57.8535	-5.8786	80.	S	8	90	2	--	59	--	59
M 236.	57.8550	-5.8592	50.	S	18	82	N	--	31	--	31
M 237.	57.7670	-6.2913	73.	GS	40	58	2	--	71	--	71
M 238.	58.1031	-5.7218	96.	MS	1	73	26	--	1	--	1
M 239.	58.0927	-5.6826	80.	MS	5	75	20	--	16	--	16
M 241.	58.2714	-5.6149	0.	MS	0	73	27	--	--	--	--
M 242.	58.2606	-5.5883	0.	MS	N	53	47	--	--	--	--
M 243.	58.2508	-5.5535	128.	MS	1	66	33	--	--	--	--
M 244.	58.2488	-5.5218	128.	S	1	89	10	--	11	--	11
M 247.	57.9570	-6.2523	100.	GSM	N	25	75	--	--	--	--
M 248.	57.9688	-6.1916	76.	MS	4	79	17	--	24	--	24
M 251.	58.2355	-5.8608	111.	MS	N	58	42	--	--	--	--
M 252.	58.0506	-5.7812	116.	M	0	16	84	--	--	--	--
M 253.	58.0692	-5.7069	94.	MS	2	76	22	--	14	--	14
M 254.	58.0840	-5.5745	164.	MS	0	71	29	--	--	--	--
M 255.	58.1837	-5.5221	51.	MSG	57	43	N	--	71	--	71
M 256.	57.7991	-6.2686	84.	GS	31	68	1	--	92	--	92
M 257.	57.9428	-6.0429	85.	GS	41	52	7	--	53	--	53
M 259.	57.3130	-5.8161	90.	MS	10	64	26	--	10	--	10
M 260.	57.3780	-5.6747	40.	S	2	88	10	--	10	--	10
M 267.	57.2456	-5.9028	36.	MS	N	72	28	--	--	--	--
M 278.	57.5455	-6.6557	27.	S	10	85	5	74	--	33	72
M 285.	58.4686	-5.2036	80.	S	N	99	N	38	--	--	38
M 297.	58.1764	-5.6095	94.	MS	2	71	27	23	--	13	21
M 316.	58.2884	-5.7382	180.	S	1	87	12	20	--	19	20
M 325.	57.5250	-6.0817	144.	M	1	15	84	--	--	--	--
MF 13.	58.2269	-3.1274	63.	S	1	97	2	--	--	--	--
MF 14.	58.2626	-3.2113	47.	S	49	51	N	--	62	--	62
MF 18.	58.2346	-3.6940	31.	S	N	98	2	--	--	--	--
MF 27.	58.1586	-3.2070	62.	S	N	99	N	--	--	--	--
MF 81.	58.1475	-3.0096	52.	S	12	87	N	--	15	--	15
MF 85.	58.2798	-3.2933	25.	S	15	85	N	--	80	--	80
MF 102.	58.1974	-2.9143	37.	S	N	99	N	--	8	--	8
MF 106.	58.2970	-3.1443	80.	S	27	73	N	--	67	--	67
MF 109.	58.2516	-3.0017	39.	S	3	97	N	--	8	--	8
MF 110.	58.1932	-2.9309	40.	S	4	96	N	--	27	--	27
MF 112.	58.3919	-2.8651	46.	S	6	94	N	--	--	--	--
MF 199.	58.2696	-2.1412	68.	S	3	97	N	--	--	--	--
MF 209.	58.4022	-3.0382	52.	SMG	72	28	N	--	83	--	83
MF 210.	58.3437	-3.0843	52.	GS	40	60	N	--	83	--	83
MF 211.	58.3474	-2.9122	73.	S	1	99	N	--	77	--	77
MF 212.	58.2449	-2.9185	52.	S	1	99	N	--	15	--	15
MF 213.	58.1786	-2.7502	43.	S	N	99	N	--	17	--	17
MF 217.	58.1702	-2.9481	38.	S	N	99	N	--	4	--	4
MF 327.	58.5472	-2.9936	73.	S	8	92	N	83	--	--	83
MF 328.	58.5148	-2.9119	64.	S	19	80	N	88	--	--	88
MF 330.	58.4701	-2.2343	69.	S	11	89	N	--	86	--	86
MF 381.	58.3528	-2.7946	62.	S	1	99	N	--	56	--	56
MF 382.	58.3709	-2.8688	72.	S	1	99	N	--	60	--	60
MF 383.	58.4781	-2.7151	69.	S	4	96	N	--	68	--	68
MF 384.	58.4224	-2.5716	69.	S	1	98	1	--	62	--	62
MF 387.	58.4538	-2.7227	60.	S	7	93	N	--	74	--	74
MF 388.	58.5170	-2.7292	73.	S	4	96	N	81	--	--	81
MF 391.	58.6130	-2.6054	70.	S	9	90	1	60	--	--	60
MF 393.	58.5747	-2.7576	57.	GS	41	59	N	89	--	--	89
MF 395.	58.5319	-2.9265	73.	GS	25	75	N	84	--	--	84
MF 396.	58.5163	-3.0081	62.	S	34	66	N	--	92	--	92
MF 397.	58.4819	-2.9659	82.	S	5	95	N	--	98	--	96
MF 398.	58.4151	-2.8923	72.	S	9	91	N	--	84	--	84
MF 399.	58.3672	-2.9857	70.	S	6	94	N	--	97	--	97
MF 403.	58.2160	-3.2956	44.	S	9	90	1	--	--	--	--
MF 405.	58.3197	-3.0801	66.	S	1	99	N	--	54	--	54
MF 425.	58.3744	-2.9764	77.	S	2	98	N	--	47	--	47

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
MF 408.	58.6088	-2.8065	90.	GS	79	21	0	72	--	--	72
MF 409.	58.6433	-2.7321	75.	S	6	94	0	67	--	--	67
MF 413.	58.4037	-2.4853	70.	S	7	92	1	--	44	--	44
MF 416.	58.6597	-2.3746	72.	GS	37	63	N	--	82	--	82
MF 417.	58.6022	-2.2527	75.	GS	45	55	N	--	--	--	--
MF 421.	58.3970	-2.3622	67.	S	2	97	1	--	--	--	--
MF 422.	58.3701	-2.4087	60.	S	19	81	N	--	52	--	52
MF 423.	58.3488	-2.5865	46.	S	7	93	N	--	35	--	35
MF 424.	58.3080	-2.4739	60.	S	1	99	N	--	27	--	27
MF 429.	58.2451	-2.2987	55.	S	1	99	N	--	23	--	23
MF 458.	58.2903	-3.0693	65.	S	1	99	N	--	53	--	53
MF 459.	58.2491	-3.1529	64.	S	N	98	2	--	58	--	58
MF 460.	58.1937	-3.2969	49.	S	6	94	0	--	--	--	--
MF 477.	58.2527	-3.2923	42.	GS	28	72	N	--	57	--	57
MF 481.	58.4463	-2.8475	66.	GS	27	73	N	--	95	--	95
MF 486.	58.7626	-2.4225	78.	S	1	.98	1	--	45	--	45
MF 487.	58.7513	-2.7263	77.	S	7	93	0	61	--	--	61
MF 490.	58.8126	-2.7568	64.	GS	45	53	2	71	--	--	71
MF 491.	58.8201	-2.6079	75.	S	1	97	2	78	--	--	78
MF 492.	58.8216	-2.4671	76.	S	2	97	N	--	--	--	--
MF 499.	58.7147	-2.0567	78.	S	9	90	1	--	--	--	--
MF 500.	58.7356	-2.2462	76.	S	1	99	N	--	--	--	--
MF 642.	58.1513	-2.1499	70.	S	0	97	3	--	--	--	--
MF 659.	58.2010	-2.7429	48.	S	1	99	N	--	10	--	10
MF 674.	58.2980	-2.2580	66.	S	6	94	N	--	18	--	18
MF 790.	58.5296	-2.6240	65.	S	5	94	1	61	--	--	61
MF 791.	58.5734	-2.5967	66.	S	12	87	1	59	--	--	59
MF 800.	58.7181	-2.5984	64.	--	--	--	--	21	--	--	21
MF 872.	58.6833	-2.4427	66.	--	--	--	--	48	--	--	48
MF 879.	58.8245	-2.6562	69.	S	5	95	0	78	--	--	78
MF 810.	58.9159	-2.5911	57.	GS	2	98	N	82	--	--	88
NS 2.	58.1555	-5.9945	110.	GSM	0	34	66	--	36	--	36
NS 5.	58.3583	-5.8793	110.	S	1	95	4	--	16	--	16
NS 7.	58.4943	-5.6060	135.	S	0	97	3	--	40	--	40
NS 9.	58.7445	-4.8058	79.	GS	36	64	N	38	--	--	38
NS 10.	58.8235	-4.6767	85.	GS	24	75	N	--	45	--	45
NS 11.	58.9240	-4.5468	83.	S	5	95	N	--	59	--	59
NS 12.	58.9668	-4.4262	77.	--	--	--	--	--	44	--	44
NS 14.	59.0407	-4.2843	56.	--	--	--	--	43	81	--	43
NS 15.	59.1005	-4.1597	80.	S	N	99	N	17	16	--	17
NS 16.	59.1867	-4.0133	123.	S	1	99	N	56	--	--	56
NS 18.	59.2592	-3.6437	70.	S	9	91	0	86	--	--	86
NS 21.	59.5222	-3.2386	70.	GS	70	30	0	84	--	--	84
NS 22.	59.5250	-3.0939	95.	S	5	95	0	87	--	--	87
NS 24.	59.4190	-3.1133	0.	GS	25	75	0	81	87	--	81
NS 25.	59.3172	-3.2593	110.	S	4	96	N	77	--	--	77
NS 26.	59.2587	-3.4252	93.	S	13	85	2	68	--	--	68
NS 27.	59.1973	-3.4325	85.	SMG	55	44	N	--	63	--	63
NS 28.	59.1155	-3.5827	92.	SMG	58	41	1	--	37	--	37
NS 31.	58.8943	-4.0013	60.	SMG	68	32	N	--	43	--	43
NS 32.	58.8103	-4.1325	70.	S	13	87	N	46	--	--	46
NS 34.	58.6792	-4.4137	95.	S	1	99	N	--	31	--	31
NS 35.	58.5955	-4.1082	102.	S	2	98	N	--	23	--	23
NS 37.	58.6626	-3.6655	0.	S	17	83	N	86	--	--	86
NS 38.	58.6136	-3.5066	25.	S	N	99	N	15	71	--	15/71
NS 39.	58.6519	-3.4789	40.	GS	26	74	0	87	--	--	87
NS 40.	58.7260	-3.5650	76.	GS	39	61	N	77	--	--	77
NS 41.	58.7725	-3.7389	88.	--	--	--	--	21	--	--	21
NS 42.	58.7558	-4.0027	90.	--	--	--	--	36	36	--	36
NS 43.	58.6297	-4.0468	75.	--	--	--	--	54	--	--	54
NS 44.	58.6033	-4.2900	60.	--	--	--	--	40	--	--	40
NS 45.	59.6138	-4.5472	40.	--	--	--	--	58	--	--	58
NS 46.	58.6207	-4.8025	45.	S	3	97	0	47	43	--	47
NS 47.	58.6812	-4.9515	65.	S	7	93	1	88	--	--	88
NS 48.	58.5973	-5.1035	58.	SMG	44	56	N	--	70	--	70
NS 49.	58.5733	-5.2427	80.	S	·1	99	0	62	--	--	62
NS 50.	58.7387	-5.3645	90.	G	80	20	N	2	--	--	2
NS 51.	58.8188	-5.5185	0.	GS	57	43	N	--	24	--	24
NS 52.	58.8992	-5.6452	0.	GS	20	79	1	--	13	--	13
NS 53.	58.9727	-5.7080	100.	S	N	99	N	--	17	--	17
NS 54.	59.0580	-5.9137	80.	--	--	--	--	41	--	--	41
NS 55.	59.1250	-6.0860	100.	GS	42	58	N	--	73	--	73
NS 56.	59.1825	-6.1875	122.	GS	37	63	N	59	73	--	59
NS 57.	59.1042	-6.3350	110.	S	5	95	0	72	88	--	72
NS 61.	58.5052	-5.3575	87.	--	--	--	--	--	40	--	40
NS 62.	58.5330	-5.2310	50.	--	--	--	--	--	76	--	76
NS 67.	59.2370	-5.3645	115.	S	N	99	N	--	8	--	8
NS 68.	59.1282	-5.5803	85.	--	--	--	--	--	84	--	84
NS 69.	59.1700	-5.6492	0.	S	3	97	0	58	--	--	58
NS 70.	59.2543	-5.7818	100.	--	--	--	--	--	66	--	66
NS 72.	59.4013	-6.0588	150.	S	7	93	0	61	34	--	61

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
NS 73.	59,4040	-6,1085	170.	--	--	--	--	--	59	--	59
NS 74.	59,6173	-5,9349	155.	--	--	--	--	--	96	--	96
NS 75.	59,5415	-5,7063	135.	--	--	--	--	--	41	--	41
NS 76.	59,4685	-5,6512	130.	--	--	--	--	38	--	--	38
NS 78.	59,3202	-5,3650	120.	--	--	--	--	25	38	--	25
NS 79.	59,2538	-5,2258	145.	--	--	--	--	34	48	--	34
NS 80.	59,1760	-5,0825	90.	SMG	60	39	1	--	29	--	29
NS 81.	59,1113	-4,9468	75.	S	1	99	0	81	--	--	81
NS 82.	59,0417	-4,8063	95.	S	4	96	N	79	--	--	79
NS 83.	58,9713	-4,6733	60.	S	2	98	N	48	31	--	48
NS 84.	59,0405	-4,5383	65.	S	9	91	0	75	60	--	75
NS 85.	59,1953	-4,5498	90.	--	--	--	--	--	35	--	35
NS 86.	59,2517	-4,6780	115.	S	19	81	0	63	62	--	63
NS 87.	59,3273	-4,8292	0.	--	--	--	--	33	--	--	33
NS 88.	59,4028	-4,9442	145.	S	1	99	N	26	--	--	26
NS 89.	59,4833	-5,1172	148.	S	1	99	1	36	--	--	36
NS 90.	59,5520	-5,2505	0.	S	1	99	N	60	51	--	60
NS 91.	59,6158	-5,3885	128.	S	3	97	N	57	--	--	57
NS 92.	59,6795	-5,5113	137.	--	--	--	--	42	64	--	42
NS 93.	59,7488	-5,3825	160.	S	1	99	0	73	--	--	73
NS 94.	59,7487	-5,0967	155.	S	19	81	N	85	--	--	85
NS 95.	59,8858	-4,9793	130.	S	0	100	0	57	39	--	57
NS 96.	59,8168	-4,8373	145.	--	--	--	--	35	--	--	35
NS 97.	59,5437	-4,6687	130.	--	--	--	--	--	14	--	14
NS 98.	59,4778	-4,5592	110.	--	--	--	--	--	19	--	19
NS 99.	59,4827	-4,4293	185.	GS	37	62	1	--	23	--	23
NS 100.	59,3335	-4,2933	125.	--	--	--	--	--	36	--	36
NS 101.	59,2617	-4,1523	115.	--	--	--	--	27	25	--	27
NS 102.	59,3237	-4,0053	123.	S	N	99	N	--	18	--	18
NS 103.	59,3093	-4,1200	97.	GS	31	69	N	--	22	--	22
NS 104.	59,2502	-3,8465	135.	--	--	--	--	44	--	--	44
NS 106.	59,3995	-3,8590	150.	--	--	--	--	--	78	--	78
NS 107.	59,4660	-4,0198	145.	S	1	99	N	--	33	--	33
NS 109.	59,6022	-4,2065	110.	S	N	100	0	50	--	--	50
NS 111.	59,7460	-4,5400	110.	SMG	50	50	N	--	22	--	22
NS 112.	59,8188	-4,6835	130.	GS	25	75	N	--	29	--	29
NS 113.	59,9950	-4,8125	155.	--	--	--	--	46	--	--	46
NS 114.	59,9632	-4,6745	140.	SMG	55	45	N	41	--	--	41
NS 115.	59,9613	-4,4307	155.	G	100	0	0	0	--	--	0
NS 117.	59,7998	-4,2612	122.	S	10	90	N	55	--	--	55
NS 118.	59,8190	-4,1352	128.	GS	21	79	N	--	38	--	38
NS 119.	59,7532	-4,0080	126.	S	2	97	N	37	--	--	37
NS 120.	59,6833	-3,8492	143.	S	2	97	1	--	23	--	23
NS 122.	59,5482	-3,5598	132.	--	--	--	--	--	59	--	58
NS 123.	59,4710	-3,4483	95.	S	2	98	N	81	--	--	81
NS 124.	59,4182	-3,2782	75.	--	--	--	--	--	95	--	95
NS 126.	59,5577	-2,9967	80.	GS	42	58	N	--	86	--	86
NS 127.	59,6253	-3,1487	115.	S	8	92	N	82	--	--	82
NS 130.	59,9297	-3,5778	125.	S	3	97	N	25	--	--	25
NS 131.	59,8988	-3,7223	120.	S	1	99	N	16	--	--	16
NS 132.	59,9683	-3,8552	132.	--	--	--	--	--	62	--	62
NS 134.	59,8950	-3,4237	145.	S	6	94	N	37	--	--	37
NS 135.	59,8245	-3,2943	88.	S	3	97	0	88	--	--	88
NS 136.	59,7570	-3,1668	68.	SMG	65	35	0	82	--	--	82
NS 137.	59,6703	-3,0453	80.	S	19	81	0	86	--	--	86
NS 138.	59,6193	-3,0435	75.	GS	26	74	0	87	--	--	87
NS 139.	59,8980	-3,1927	75.	S	17	83	0	86	--	--	86
NS 140.	59,9563	-3,3725	160.	S	3	95	2	--	31	--	31
NS 141.	59,9873	-3,0815	108.	GS	32	68	N	84	--	--	84
NS 142.	59,8868	-3,0157	70.	S	16	84	0	88	--	--	88
NS 144.	59,6720	-3,1595	70.	S	4	96	N	86	--	--	86
NS 145.	58,9673	-3,5028	98.	S	1	99	N	23	19	--	23
NS 147.	58,8688	-3,4932	77.	S	10	92	N	66	59	--	66
NS 148.	58,8082	-3,4954	85.	S	2	98	0	85	86	--	85
NS 149.	58,7392	-3,4452	87.	S	17	83	N	84	--	--	84
NS 151.	58,8127	-3,8452	98.	--	--	--	--	47	39	--	47
NS 152.	58,8246	-3,9931	85.	--	--	--	--	42	33	--	42
NS 154.	58,6258	-4,3705	80.	S	3	97	N	65	49	--	65
NS 155.	58,6972	-4,8263	77.	GS	31	68	1	83	69	--	83
NS 156.	58,6455	-4,9565	65.	GS	38	62	0	--	64	--	64
NS 157.	58,5263	-5,2222	65.	SGM	76	24	N	--	48	--	48
NS 158.	58,5202	-5,5047	115.	--	--	--	--	--	24	--	24
NS 160.	58,6897	-5,7982	120.	--	--	--	--	--	17	--	17
NS 161.	58,7556	-5,9415	122.	GS	41	59	N	--	9	--	9
NS 162.	58,8173	-6,0578	115.	GS	35	37	28	37	--	17	32
NS 163.	58,8535	-6,1598	112.	--	--	--	--	--	32	--	32
NS 164.	58,9740	-6,3572	0.	--	--	--	--	--	99	--	99
NS 165.	59,0430	-6,4977	125.	--	--	--	--	46	--	--	46
NS 166.	59,1817	-6,7473	155.	GS	42	58	N	--	47	--	47
NS 168.	59,0350	-6,7565	162.	--	--	--	--	48	--	--	48
NS 169.	58,9625	-6,5870	130.	S	2	98	N	--	--	--	--

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
NS 170.	58,9240	-6,4670	130.	--	--	--	--	46	40	--	40
NS 171.	58,8293	-6,3687	127.	--	--	--	--	--	63	--	63
NS 172.	58,7316	-6,2143	120.	S	N	100	N	--	37	--	37
NS 173.	58,0757	-6,1137	127.	--	--	--	--	--	71	--	71
NS 174.	58,6248	-5,9340	115.	S	1	98	1	--	37	--	37
NS 175.	58,5250	-5,7787	115.	S	0	99	1	--	12	--	12
NS 176.	58,5235	-6,0747	92.	S	1	98	1	59	--	--	59
NS 177.	58,6058	-6,2198	110.	M	0	12	88	--	--	--	37
NS 178.	58,1402	-6,2573	90.	GSM	N	27	73	--	37	--	37
NS 179.	58,0005	-6,1237	120.	GSM	0	30	70	--	41	--	41
NS 180.	57,9930	-6,0236	68.	GS	41	55	4	--	--	--	--
NS 181.	57,9243	-5,8541	135.	GS	40	56	4	--	18	--	18
NS 183.	57,9380	-5,6271	75.	GS	29	66	5	--	--	--	--
NS 184.	58,2017	-5,7340	135.	MS	0	70	30	--	--	--	--
NS 185.	58,2693	-5,8720	108.	GSM	N	45	55	--	--	--	--
NS 186.	58,3847	-5,9108	115.	M	0	5	95	--	--	--	--
NS 187.	58,2037	-6,1337	130.	S	N	89	11	60	--	32	57
NS 189.	58,2832	-6,1440	35.	S	2	98	0	46	--	--	46
NS 190.	58,3442	-6,0358	105.	S	1	96	3	--	--	--	--
NS 195.	58,5152	-5,4170	66.	GS	43	57	N	54	75	--	54
NS 197.	58,3983	-5,6360	110.	S	0	95	5	--	11	--	11
NS 199.	58,2840	-5,8530	115.	S	1	81	18	--	15	--	15
NS 200.	58,2272	-5,9083	128.	MS	N	52	48	--	26	--	26
NS 201.	58,1669	-6,0645	135.	M	0	4	96	--	--	--	--
NS 202.	58,1748	-5,9388	110.	MS	0	52	48	--	26	--	26
NS 203.	58,1038	-5,8017	105.	MS	N	68	32	--	16	--	16
NS 204.	58,2280	-5,6735	95.	S	1	95	3	--	9	--	9
NS 206.	58,3298	-5,5222	110.	S	0	84	16	--	11	--	11
NS 207.	58,0763	-5,6010	145.	GSM	0	49	51	--	19	--	19
NS 208.	59,1425	-5,7275	110.	MS	1	73	26	--	15	--	15
NS 209.	58,2123	-5,8725	120.	MS	N	54	46	19	--	22	20
NS 210.	58,2826	-6,0293	115.	MS	N	57	43	--	19	--	19
NS 211.	58,3582	-6,1347	35.	S	N	100	N	68	--	--	58
NS 216.	58,5790	-5,6015	130.	S	0	98	2	--	20	--	20
NS 218.	58,6097	-5,2983	0.	GS	29	71	N	--	--	--	--
NS 219.	58,6113	-5,1232	0.	MSG	74	26	0	--	76	--	76
NS 220.	58,6170	-5,8432	0.	S	0	100	0	39	--	--	39
NS 222.	58,4097	-5,2373	0.	S	6	94	N	87	--	--	87
NS 223.	58,4287	-5,3542	72.	GS	49	50	1	--	63	--	63
NS 225.	58,1715	-6,2108	35.	S	16	82	2	--	75	--	75
NS 226.	58,2833	-6,0623	120.	MS	0	81	19	--	19	--	19
NS 229.	59,3290	-6,0029	23.	S	N	100	N	--	72	--	72
NS 230.	58,3062	-6,0493	0.	S	1	86	13	--	22	--	22
NS 231.	58,3060	-5,8913	0.	MS	2	73	24	--	16	--	16
NS 232.	58,3080	-5,7277	118.	S	2	94	4	--	18	--	18
NS 233.	58,3842	-5,5648	0.	S	1	96	3	--	19	--	19
NS 235.	58,2985	-5,2342	103.	S	1	84	15	--	25	--	25
NS 237.	58,6565	-4,4487	84.	S	3	97	N	35	--	--	35
NS 238.	58,7493	-4,2740	91.	S	2	97	1	51	--	--	51
NS 241.	59,0778	-3,6295	107.	S	N	99	1	54	--	--	54
NS 244.	58,8562	-4,9035	92.	S	4	96	N	55	--	--	56
NS 245.	59,2285	-6,9753	82.	GS	44	56	0	36	--	--	36
NS 252.	58,0897	-4,2787	53.	S	11	89	0	65	--	--	65
NS 257.	58,7505	-4,5442	67.	S	N	100	N	19	--	--	19
NS 262.	58,7318	-5,0995	88.	S	5	95	N	62	--	--	62
NS 284.	59,0843	-5,3715	100.	--	--	--	--	27	--	--	27
NS 285.	58,9423	-5,4023	82.	--	--	--	--	27	--	--	27
NS 286.	59,2240	-5,6303	86.	--	--	--	--	28	--	--	28
NS 287.	59,9402	-6,0770	105.	--	--	--	--	25	--	--	25
NS 288.	59,0002	-5,7302	105.	--	--	--	--	--	--	--	21
NS 289.	58,6912	-5,5108	100.	--	--	--	--	--	--	--	68
NS 293.	58,0877	-5,2485	72.	GS	18	79	3	47	--	71	43
NS 296.	58,6633	-5,9047	120.	S	0	99	1	--	--	--	--
NS 297.	58,6947	-6,0243	122.	S	N	96	4	64	--	40	63
NS 298.	58,7445	-6,0672	110.	--	--	--	--	57	--	--	57
NS 299.	58,7717	-6,1258	123.	--	--	--	--	48	--	--	48
NS 300.	58,8165	-6,2090	115.	--	--	--	--	34	--	--	34
NS 301.	58,5840	-6,0928	111.	S	N	98	2	80	--	--	80
NS 303.	59,3187	-2,8783	31.	S	4	96	N	--	69	38	69
NS 304.	59,2905	-2,7290	0.	GS	24	76	N	--	87	61	87
NS 305.	59,3189	-2,6892	0.	GS	22	69	9	--	66	66	66
NS 306.	59,3288	-2,7213	41.	GS	47	53	0	--	90	--	90
NS 307.	59,3390	-2,7592	40.	GS	22	78	N	--	74	65	74
NS 309.	59,3674	-2,8140	52.	G	80	20	N	--	90	68	90
NS 311.	59,3379	-2,8137	45.	GS	46	54	N	--	84	62	84
NS 312.	59,3230	-2,7613	50.	GS	42	58	N	--	93	56	93
NS 313.	59,3125	-2,7492	50.	S	N	100	N	--	83	60	83
NS 314.	59,2047	-2,6874	50.	SMG	52	48	N	--	78	44	78
NS 315.	59,2715	-2,6533	47.	G	87	13	N	--	86	64	86
NS 316.	59,4807	-2,4069	67.	GS	42	58	N	--	96	71	96
NS 317.	59,3342	-2,2420	92.	GS	25	75	N	--	87	83	87

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC SEG	%CC S	%CC M	APP %CC TOTAL
NS 319.	59.6504	-1.9380	107.	GS	32	68	N	--	41	55	41
NS 320.	59.7035	-1.7754	115.	S	12	88	N	--	58	79	58
NS 321.	59.7598	-1.6135	118.	S	16	84	N	--	75	73	75
NS 322.	59.7750	-1.4131	84.	GS	33	67	N	--	99	88	99
NU 1.	58.8545	-4.9733	76.	GS	22	78	N	58	--	--	58
NU 2.	58.8723	-5.0078	56.	GS	44	56	0	86	--	--	86
NU 5.	58.8852	-4.9230	53.	S	4	96	0	83	--	--	83
NU 6.	58.8643	-4.9332	70.	S	2	98	0	53	--	--	53
NU 7.	58.8390	-4.9865	78.	S	9	91	N	77	--	--	77
NU 10.	58.9165	-5.0387	71.	S	12	87	N	68	--	--	68
NU 11.	58.8713	-5.0758	74.	S	1	99	N	27	--	--	27
NU 12.	58.8247	-4.9928	87.	S	10	90	N	43	--	--	43
NU 13.	58.8367	-4.8798	85.	S	2	97	N	72	--	--	72
NU 14.	58.8988	-4.8633	67.	S	9	91	N	60	--	--	60
NU 15.	58.8900	-4.8317	73.	GS	30	70	N	53	--	--	53
NU 16.	58.8302	-4.8598	84.	S	4	96	0	84	--	--	84
NU 17.	58.8260	-5.0025	96.	S	1	99	0	27	--	--	27
NU 18.	58.8548	-5.0918	79.	S	N	100	0	25	--	--	25
NU 19.	58.9270	-5.0652	79.	GS	29	71	0	43	--	--	43
NU 20.	58.9372	-5.0922	79.	GS	31	69	0	65	--	--	65
NU 21.	58.9638	-4.9155	58.	S	1	99	0	29	--	--	29
NU 23.	58.9318	-4.9338	48.	GS	34	66	0	57	--	--	57
NU 24.	58.9177	-4.9435	42.	GS	41	59	0	94	--	--	94
NU 26.	58.9095	-4.8063	71.	S	3	97	0	57	--	--	57
NU 27.	58.8172	-4.8420	92.	S	2	98	0	78	--	--	78
NU 28.	58.7928	-5.0113	91.	S	1	99	0	29	--	--	29
NU 29.	58.8342	-5.1128	77.	S	7	93	0	24	--	--	24
OR 26	59.254	-2.788	37.	S	4	96	0	42	--	--	42
OR 33	59.311	-2.387	13.	S	11	89	0	98	--	--	98
OR 35	59.413	-2.678	56.	GS	40	60	0	99	--	--	99
OR 37	59.447	-2.470	56.	GS	30	70	0	99	--	--	99
OR 44	59.134	-2.382	110.	S	1	99	0	95	--	--	95
OR 45	59.090	-2.457	65.	S	18	82	0	94	--	--	94
OR 46	58.995	-2.575	55.	S	18	82	0	95	--	--	95
OR 48	58.982	-2.758	24.	S	1	99	0	85	--	--	85
OR 54	59.173	-2.735	9.	GS	40	60	0	97	--	--	97
OR 56	59.267	-2.687	44.	S	N	100	0	51	--	--	51
OR 57	59.277	-2.717	39.	--	--	--	--	45	--	--	45
OR 59	59.307	-2.818	50.	S	N	100	N	48	--	--	48
OR 61	59.342	-2.646	35.	GS	27	73	0	98	--	--	98
OR 76	59.387	-2.447	65.	S	1	99	0	98	--	--	98
OR 79	59.352	-2.775	8.	S	3	97	0	96	--	--	96
OR 85	58.989	-2.863	15.	--	--	--	--	34	--	--	34
OR 89	59.016	-2.856	23.	GS	49	51	0	95	--	--	95
OR 93	59.032	-2.982	13.	--	--	--	--	49	--	--	49
OR 98	59.013	-2.945	15.	--	--	--	--	14	--	--	14
OR 104	59.036	-2.649	24.	--	--	--	--	83	--	--	83
OR 111	59.192	-2.639	12.	S	4	96	0	80	--	--	80
OR 112	59.180	-2.510	32.	S	N	99	N	77	--	--	77
OR 116	59.265	-2.168	79.	S	23	77	0	99	--	--	99
OR 117	59.211	-2.089	95.	S	8	92	0	89	--	--	89
OR 118	59.067	-2.310	75.	S	4	96	0	92	--	--	92
OR 119	59.003	-2.277	81.	S	5	95	0	91	--	--	91
OR 120	59.012	-2.444	73.	S	N	100	0	93	--	--	93
OR 121	59.023	-2.481	66.	S	1	99	0	94	--	--	94
OR 131	59.415	-2.413	48.	S	11	89	0	99	--	--	99
OR 132	59.425	-2.435	39.	S	11	89	0	99	--	--	99
OR 134	59.439	-2.479	49.	GS	32	68	0	98	--	--	98
OR 135	59.431	-2.492	31.	GS	35	65	0	99	--	--	99
OR 137	59.385	-2.545	63.	GS	36	64	0	96	--	--	96
OR 138	58.879	-2.868	12.	S	N	100	N	64	--	--	64
OR 140	58.952	-2.760	58.	S	1	99	0	87	--	--	87
OR 141	58.958	-2.682	16.	S	N	100	N	95	--	--	95
OR 160	59.216	-2.484	67.	S	1	99	0	89	--	--	89
OR 161	58.954	-2.387	78.	S	N	100	0	99	--	--	90
OR 162	58.902	-2.520	75.	S	3	97	N	86	--	--	86
OR 163	58.836	-2.566	77.	S	1	98	1	75	--	--	75
PS 1.	58.6249	-2.7986	72.	S	8	92	0	94	--	--	94
PS 2.	58.6153	-2.8092	0.	S	8	92	0	97	--	--	97
PS 3.	58.6389	-2.8220	0.	S	14	85	0	96	--	--	96
PS 4.	58.6422	-2.8003	0.	SMG	58	43	N	66	--	--	66
PS 5.	58.5377	-2.8326	0.	S	15	85	0	95	--	--	95
PS 8.	58.6487	-2.6528	42.	GS	30	70	0	96	--	--	96
PS 9.	58.5561	-2.8241	74.	SMG	52	48	N	72	--	51	72
PS 10.	58.6567	-2.8021	34.	GS	36	64	0	97	--	--	97
PS 11.	58.5773	-2.8387	0.	SMG	64	36	0	91	--	--	91
PS 12.	58.5660	-2.8851	36.	SMG	56	44	0	94	--	--	94
SC 30.	58.4012	-6.0043	56.	GS	30	70	N	80	--	--	80
SC 32.	58.4437	-6.0017	59.	GS	42	58	0	47	--	--	47
SC 37.	58.5244	-6.1078	125.	--	--	--	--	31	--	--	31
SC 38.	58.4699	-6.0974	78.	S	1	99	N	69	--	--	69

SAMPLE NUMBER		LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
SC	41.	57,9341	-9,1744	135.	--	--	--	--	23	--	--	23
SC	46.	57,8611	-7,3701	42.	G	39	61	N	--	80	--	80
SC	47.	57,8300	-7,3816	44.	G	75	37	N	--	84	--	84
SC	50.	57,9222	-7,3118	39.	S	6	94	0	90	--	--	90
SC	51.	57,9808	-7,3082	101.	S	13	87	N	91	--	--	91
SC	56.	57,8349	-7,5264	75.	S	1	99	0	89	--	--	89
SC	60.	58,2829	-6,1924	29.	S	3	97	N	81	--	--	81
SC	61.	58,2891	-6,1552	34.	GS	25	75	N	--	64	--	64
SC	62.	58,3136	-6,0450	107.	--	--	--	--	26	--	17	26
SC	64.	58,3105	-6,1839	18.	S	N	100	0	66	--	--	66
SC	65.	58,3370	-6,1015	52.	S	1	99	N	74	--	--	74
SC	66.	58,3660	-6,1229	41.	N	--	100	N	72	--	--	72
SC	67.	58,3768	-6,2775	72.	--	--	--	--	24	--	--	24
SC	68.	58,3588	-6,0171	99.	--	--	--	--	14	--	--	14
SC	69.	58,4193	-5,9467	123.	--	--	--	--	14	--	--	14
SC	70.	58,4216	-5,9945	92.	--	--	--	--	8	--	--	8
SC	71.	58,4181	-6,0607	80.	--	--	--	--	11	--	--	11
SC	72.	58,4217	-6,1228	48.	S	5	95	N	58	--	--	58
SC	73.	58,4672	-6,1217	68.	S	7	93	N	49	--	--	49
SC	74.	58,4686	-6,0595	80.	--	--	--	--	35	--	--	35
SC	75.	58,4690	-6,0292	18.	--	--	--	--	25	--	--	25
SC	76.	58,5154	-6,0575	82.	S	N	99	1	65	--	--	65
SC	77.	58,5198	-6,1244	8.	S	N	99	N	72	--	--	72
SC	78.	58,5175	-6,1679	0.	S	N	100	N	89	--	--	89
SC	79.	58,5686	-6,1921	72.	S	25	74	1	89	--	--	89
SC	80.	58,5802	-6,1561	125.	--	--	--	--	28	--	--	28
SC	81.	58,5163	-6,2162	125.	--	--	--	--	16	--	--	16
SH	1.	56,6770	-6,3582	56.	GS	22	77	1	88	--	--	88
SH	2.	56,7416	-6,2583	128.	S	1	94	5	75	--	29	73
SH	5.	57,4527	-6,8313	98.	GS	38	61	1	--	73	53	73
SH	7.	57,3993	-6,7737	64.	GS	28	72	N	57	--	--	57
SH	8.	57,3588	-6,7372	62.	GS	20	66	14	52	--	19	57
SH	9.	57,3260	-6,6818	36.	GS	42	56	2	57	--	49	57
SH	10.	57,3183	-5,6252	112.	MS	0	63	37	14	--	13	24
SH	11.	57,3148	-6,5618	48.	SMG	77	23	N	19	--	--	19
SH	12.	57,2918	-6,5258	56.	GS	30	69	1	95	--	--	95
SH	13.	57,2663	-6,4898	48.	--	--	--	--	61	--	--	61
SH	14.	57,2385	-6,4515	44.	S	11	87	2	76	--	--	76
SH	15.	57,2892	-6,4192	58.	S	N	93	7	17	--	17	14
SH	18.	57,1318	-6,3285	100.	GSM	0	37	64	--	28	53	50
SH	20.	57,3747	-6,2448	100.	GSM	1	22	77	--	28	23	24
SH	21.	57,2447	-6,2138	46.	S	1	94	5	32	--	22	31
SH	25.	56,9183	-6,1200	42.	M	N	15	85	--	44	22	25
SH	27.	56,8417	-6,1115	32.	GS	40	58	1	70	--	--	70
SH	29.	56,8435	-6,3675	43.	GS	34	66	N	--	73	--	73
SH	31.	56,8088	-6,0752	14.	M	7	93	N	--	18	27	16
SH	32.	56,3790	-6,0922	27.	S	N	95	5	--	39	24	38
SH	38.	56,1673	-5,8113	150.	SMG	65	35	N	88	--	--	85
SH	43.	56,4777	-5,4192	35.	MS	0	71	29	--	8	23	10
SH	46.	56,7715	-6,2155	116.	MS	4	65	31	68	--	29	53
SH	47.	56,7675	-6,2118	78.	MS	5	63	32	70	--	26	52
SH	49.	56,8472	-6,1220	27.	GS	40	49	11	65	--	21	66
SH	59.	56,8770	-6,2233	35.	GS	16	70	14	45	--	21	42
SH	61.	56,8187	-6,1593	99.	MS	14	62	24	38	--	17	33
SH	63.	56,7168	-6,2788	79.	GS	16	76	9	92	--	18	85
SH	64.	56,6942	-6,3088	40.	GS	23	75	2	94	--	--	94
SH	66.	56,5558	-6,4735	40.	S	6	93	1	96	--	--	96
SH	69.	56,3738	-6,3292	58.	M	0	19	81	--	42	42	42
SH	85.	56,7832	-6,2913	155.	MS	11	55	34	81	--	24	49
SH	89.	56,8747	-6,5385	52.	S	7	89	4	36	--	--	36
SH	90.	56,8897	-6,5782	102.	GSM	0	22	78	--	58	67	63
SH	91.	56,9575	-6,5532	91.	M	N	18	82	--	41	62	60
SH	96.	57,3128	-6,2593	7.	S	7	88	5	1	--	15	2
SH	101.	57,0632	-6,2220	98.	GSM	2	23	75	--	32	29	29
SH	102.	57,0632	-6,1167	77.	GSM	26	32	44	--	22	22	22
SH	115.	56,9937	-6,0217	91.	GSM	0	22	78	--	40	29	31
SH	121.	56,9995	-6,7093	53.	GS	23	66	11	61	--	10	56
SH	125.	57,2413	-6,8848	151.	GSM	N	32	68	--	29	27	28
SH	127.	57,0665	-6,9288	139.	GSM	N	22	78	--	31	67	56
SH	128.	57,2583	-7,1156	151.	MS	1	73	26	18	--	28	18
SH	131.	56,9078	-7,4328	78.	GS	21	60	19	67	--	33	60
SH	141.	56,9368	-7,0358	132.	GSM	6	18	75	--	17	25	23
SH	142.	56,8712	-6,9352	146.	GSM	7	19	73	--	30	78	67
SH	143.	56,0218	-6,9313	148.	--	--	--	--	--	--	--	28
SH	145.	56,2172	-6,5252	83.	GSM	22	18	60	--	64	21	31
SH	150.	56,3943	-6,4607	101.	MS	0	57	44	--	51	34	42
SH	158.	56,3400	-7,0350	59.	S	1	96	3	70	--	73	72
SH	163.	56,7253	-6,8198	80.	--	--	--	--	--	--	--	17
SH	164.	56,7687	-6,8137	157.	GSM	N	27	73	--	36	44	47
SH	165.	56,7950	-6,0133	70.	M	N	14	86	--	34	24	25
SH	166.	56,8033	-6,0285	49.	MS	16	49	35	15	--	7	32

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
SH 172.	57,2593	-6,8850	92.	SMG	51	39	10	--	--	--	--
SH 175.	57,7153	-7,1887	181.	M	2	9	49	--	14	23	22
SH 177.	56,9158	-7,2922	195.	GSM	N	44	56	--	30	34	35
SH 178.	56,8673	-7,4793	126.	S	2	87	11	40	--	29	39
SH 179.	57,0038	-6,9135	0.	M	4	14	82	--	13	60	58
SH 182.	57,1935	-6,4845	90.	MS	12	67	21	--	--	--	--
SH 185.	57,3820	-6,7983	35.	GSM	22	37	41	--	27	21	24
SH 186.	57,3735	-6,9038	90.	GS	19	72	9	--	32	32	32
SH 187.	57,3093	-7,0768	0.	S	N	80	20	--	21	30	24
SH 188.	57,2437	-7,1032	126.	MS	10	46	44	--	7	28	17
SH 190.	57,2010	-7,1283	114.	MS	2	66	32	--	7	34	16
SH 193.	56,9597	-7,3455	68.	MS	2	79	19	46	--	34	44
SH 195.	56,8155	-7,4235	183.	MS	N	60	40	--	40	29	36
SH 196.	56,8900	-7,3832	159.	M	0	3	97	--	12	58	58
SH 197.	56,9742	-7,2918	131.	SMG	55	28	19	--	32	71	48
SH 199.	57,2557	-7,1447	175.	MS	N	67	33	--	11	31	18
SH 201.	57,0523	-7,1977	195.	MS	5	63	31	--	3	3	3
SH 231.	56,2783	-6,1842	0.	S	3	90	7	--	18	26	19
SH 234.	56,2415	-5,9853	26.	S	1	92	7	--	--	--	--
SH 236.	56,2640	-6,0418	38.	S	0	91	9	--	--	--	--
SH 238.	56,2690	-6,1838	22.	GS	44	52	4	91	--	--	91
SH 239.	56,2762	-6,0908	27.	GS	27	70	3	--	--	--	49
SH 240.	56,0843	-6,1243	23.	S	0	83	17	--	38	52	34
SH 241.	56,3095	-6,1423	29.	MS	3	67	30	--	33	25	38
SH 250.	56,6672	-6,0408	59.	S	16	84	N	87	--	--	87
SH 256.	56,4692	-6,5878	50.	GS	47	51	2	49	--	--	49
SH 258.	56,5287	-6,6722	58.	S	11	89	0	66	--	3	61
SH 259.	56,5140	-6,6815	55.	SMG	59	32	9	92	--	36	87
SH 263.	56,4113	-6,4382	86.	GSM	8	29	11	--	48	26	38
SH 265.	56,4612	-5,6180	58.	SMG	75	10	15	--	--	--	--
SH 266.	56,4748	-5,6372	132.	SMG	51	32	17	--	49	28	40
SH 268.	56,4737	-5,6995	20.	MS	19	51	30	--	--	--	--
SH 269.	56,1215	-6,2212	36.	S	N	100	N	--	11	32	11
SH 272.	56,2982	-6,3085	47.	S	N	99	1	--	17	49	17
SH 273.	56,2957	-6,3283	48.	S	N	99	1	--	13	39	13
SH 274.	56,1540	-6,5553	56.	S	N	97	3	--	22	56	22
SH 280.	56,6252	-6,4378.	70.	S	0	97	3	--	77	80	76
SH 282.	56,5817	-6,4833	89.	MS	17	63	20	35	--	33	35
SH 283.	56,5672	-6,5377	108.	GS	37	54	9	40	--	28	39
SH 287.	56,5602	-6,7908	20.	S	10	90	0	67	--	--	67
SH 288.	56,5698	-6,7990	20.	S	2	30	68	66	--	--	66
SH 292.	56,3927	-7,1730	55.	S	N	90	10	--	64	60	64
SH 296.	56,3235	-6,9213	73.	S	0	85	15	--	42	28	39
SH 298.	56,1977	-6,6723	66.	S	1	93	7	--	21	25	21
SH 300.	56,2745	-6,5838	78.	GS	35	64	1	--	28	42	28
SH 301.	56,3223	-6,7048	74.	S	2	95	3	74	--	--	74
SH 302.	56,3678	-6,8392	75.	MS	0	76	24	--	46	43	45
SH 305.	56,8278	-7,5257	39.	S	4	96	0	90	--	--	90
SH 306.	56,8210	-7,5292	77.	S	4	96	N	93	--	--	93
SH 307.	56,8157	-7,4998	66.	MS	45	50	5	27	--	--	27
SH 308.	56,8058	-7,4780	135.	MS	1	75	24	57	--	31	51
SH 311.	56,7707	-7,4142	222.	MS	0	79	21	--	--	--	--
SH 312.	56,7487	-7,5010	216.	S	0	82	18	--	--	--	--
SH 313.	56,6858	-7,3738	163.	MS	0	69	31	--	--	--	--
SH 314.	56,6285	-7,2412	201.	MS	1	54	45	--	53	35	44
SH 315.	56,6047	-7,1967	139.	S	0	99	1	--	--	--	--
SH 318.	56,5120	-5,7385	0.	GS	15	71	14	--	--	--	--
SH 319.	56,5168	-5,7678	132.	MS	0	62	38	--	--	--	--
SH 320.	56,5290	-5,9535	34.	MS	0	76	24	--	--	--	--
SH 321.	56,5188	-6,0300	59.	MS	11	53	36	--	--	--	--
SH 322.	56,5240	-6,0380	114.	S	0	92	8	--	--	--	--
SH 323.	56,5383	-5,8292	66.	GS	23	60	17	--	--	--	--
SH 324.	56,5338	-5,8287	22.	MS	5	67	28	--	--	--	--
SH 325.	56,5608	-5,9388	48.	S	0	88	12	--	--	--	--
SH 326.	56,5492	-5,9217	82.	GS.	22	73	5	--	--	--	--
SH 327.	56,5445	-5,9278	40.	MS	4	49	46	--	--	--	--
SH 328.	56,5393	-5,9348	30.	MS	14	59	27	45	--	5	31
SH 329.	56,5348	-5,9413	31.	S	0	85	15	--	--	--	--
SH 334.	56,6150	-6,0235	76.	MS	0	75	25	--	--	--	--
SH 335.	56,6320	-6,0333	40.	S	0	80	20	--	--	--	--
SH 337.	56,8558	-6,2262	20.	GS	36	55	9	92	--	--	92
SH 338.	56,7092	-6,2727	97.	M	0	45	55	--	--	--	--
SH 339.	56,7978	-6,2618	43.	GS	76	22	2	74	--	18	73
SH 340.	56,9472	-6,2528	22.	GS	26	72	2	80	--	19	67
SH 343.	56,7948	-6,4198	99.	S	0	83	17	--	--	--	--
SH 344.	56,7962	-6,4487	86.	S	0	94	6	--	--	--	--
SH 345.	56,7937	-6,4602	93.	MS	N	65	35	39	--	29	36
SH 346.	56,7673	-6,4988	80.	SMG	70	15	5	--	--	--	--
SH 347.	56,7735	-6,3560	39.	GS	16	76	8	67	--	29	64
SH 348.	56,7637	-6,3347	40.	G	78	21	1	94	--	--	94
SH 351.	56,7730	-6.2497	101.	MS	12	57	31	--	--	--	--

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
SH 352.	56,7635	-6,2340	102.	S	0	85	15	75	--	20	67
SH 353.	56,7630	-6,2020	37.	GS	29	71	0	97	--	--	97
SH 355.	56,7613	-6,0713	94.	GSM	0	25	75	--	--	--	--
SH 356.	56,7957	-6,0337	68.	M	0	19	81	--	--	--	--
SH 357.	56,8063	-6,0315	44.	GS	44	40	16	82	--	13	71
SH 358.	56,8178	-6,0420	62.	M	0	16	84	--	--	--	--
SH 359.	56,8513	-6,0478	56.	M	0	19	81	--	--	--	--
SH 360.	56,8740	-6,0490	56.	M	0	10	90	--	--	--	--
SH 361.	56,8582	-6,0507	53.	M	0	18	82	--	--	--	--
SH 362.	56,8000	-6,0490	55.	M	0	13	87	--	--	--	--
SH 363.	56,9323	-6,0573	51.	M	0	7	93	--	--	--	--
SH 364.	56,9537	-6,0520	62.	M	0	10	90	--	--	--	--
SH 365.	56,9337	-5,9915	78.	GSM	0	30	70	--	--	--	--
SH 366.	56,9120	-6,1063	16.	S	N	93	7	19	--	12	19
SH 367.	56,9120	-6,1063	18.	GS	16	69	14	33	--	--	33
SH 368.	56,9120	-6,1063	18.	GSM	0	45	55	--	--	--	--
SH 369.	56,8633	-6,5002	87.	MS	0	74	26	--	--	--	--
SH 371.	56,9170	-6,5067	100.	GSM	0	44	56	--	--	--	--
SH 372.	56,9398	-6,5067	91.	MS	0	73	27	--	--	--	--
SH 375.	57,0265	-6,5272	100.	MS	0	60	40	--	--	--	--
SH 377.	56,9707	-6,5753	83.	GSM	0	43	57	--	--	--	--
SH 378.	56,9252	-6,5830	92.	GSM	0	24	76	--	--	--	--
SH 380.	56,8653	-6,5668	46.	SMG	66	32	2	--	17	55	19
SH 381.	56,8478	-6,5673	70.	S	0	82	18	--	17	26	19
SH 391.	56,5878	-6,9928	66.	GS	26	69	5	25	--	--	25
SH 395.	56,6963	-7,1908	102.	GSM	0	48	52	--	49	47	48
SH 403.	56,6107	-7,4667	187.	MS	N	58	42	--	--	--	40
SH 404.	56,5492	-7,3515	140.	S	1	97	2	39	--	--	39
SH 413.	56,5565	-6,7397	61.	S	1	99	N	32	--	--	32
SH 414.	56,6747	-6,7107	95.	S	0	92	8	--	--	--	--
SH 415.	56,6913	-6,6823	85.	S	0	87	13	--	--	--	--
SH 417.	56,7237	-6,6418	52.	G	81	19	N	58	--	--	58
SH 418.	56,7702	-7,1473	108.	GS	40	53	7	--	--	--	--
SH 420.	56,7908	-7,2045	154.	GS	28	64	8	37	--	27	36
SH 421.	56,8765	-6,4215	65.	GS	22	58	20	--	63	28	54
SH 422.	56,9858	-6,2052	67.	S	N	83	17	20	--	10	17
SH 423.	56,9973	-6,2622	155.	GSM	0	49	51	--	--	--	--
SH 424.	56,9183	-6,2142	37.	S	10	89	1	64	--	--	64
SH 426.	56,9157	-6,2278	132.	M	0	30	70	--	--	--	--
SH 427.	56,9202	-6,2438	156.	M	0	2	98	--	--	--	--
SH 429.	56,9327	-6,2072	102.	M	0	5	95	--	--	--	--
SH 430.	56,8772	-6,3200	94.	GSM	0	29	71	--	--	--	--
SH 432.	56,9317	-6,3332	50.	S	1	95	4	53	--	26	51
SH 433.	56,8040	-6,3510	30.	MS	7	50	43	--	--	--	--
SH 435.	56,6452	-6,3273	60.	S	10	89	1	88	--	--	88
SH 437.	56,3908	-6,5795	37.	S	0	91	9	--	--	--	--
SH 438.	56,4000	-5,5065	95.	GSM	0	42	58	--	--	--	--
SH 439.	56,4057	-5,6198	208.	MS	0	77	23	--	--	--	--
SH 440.	56,4110	-5,6440	24.	S	0	88	12	--	--	--	--
SH 441.	56,0325	-6,5160	48.	S	N	99	1	--	23	37	23
SH 442.	56,1338	-6,7680	31.	S	N	99	1	--	12	33	12
SH 443.	56,1793	-6,8840	68.	S	0	99	1	--	44	--	44
SH 444.	56,2272	-6,9903	77.	S	N	98	2	--	21	29	21
SH 445.	56,2808	-7,1325	90.	S	N	95	5	--	58	44	57
SH 447.	56,3758	-7,3948	75.	S	N	94	6	--	69	45	68
SH 449.	57,0073	-6,3943	161.	GSM	0	37	63	--	--	--	--
SH 450.	57,2845	-6,3317	57.	MS	9	65	26	89	--	25	73
SH 452.	57,3973	-6,2308	61.	MS	0	73	27	--	--	--	--
SH 453.	57,0808	-6,1795	81.	M	0	7	93	--	--	--	--
SH 454.	57,2818	-6,1128	61.	GSM	0	45	55	--	--	--	--
SH 455.	57,2843	-6,0547	70.	M	0	N	100	--	--	--	--
SH 457.	56,9723	-5,8433	36.	S	0	95	5	--	--	--	--
SH 458.	56,9834	-5,8585	38.	MS	0	78	22	--	--	--	--
SH 459.	57,0003	-5,8778	50.	GSM	0	46	54	--	--	--	--
SH 461.	57,2783	-5,8415	79.	M	0	2	98	--	--	--	--
SH 462.	57,3602	-6,8145	144.	M	0	2	98	--	--	--	--
SH 463.	57,3574	-5,7946	65.	GSM	0	40	60	--	--	--	--
SH 464.	57,1138	-6,5206	67.	MS	0	70	30	--	--	--	--
SH 465.	57,1165	-6,4020	54.	MS	0	77	23	--	--	--	--
SH 467.	57,1590	-6,3848	118.	S	0	87	13	--	--	--	--
SH 468.	57,2378	-6,4962	58.	MS	12	67	20	--	--	--	--
SH 470.	57,2367	-6,5478	69.	S	4	89	7	--	--	--	--
SH 471.	57,2360	-6,5718	117.	M	0	9	91	--	--	--	--
SH 472.	57,2355	-6,5058	88.	S	0	94	6	--	--	--	--
SH 474.	57,2383	-6,6142	85.	MS	11	77	13	--	--	--	--
SH 476.	57,2025	-6,6218	86.	S	7	84	10	--	--	--	--
SH 477.	57,2430	-6,7160	68.	MS	11	55	34	--	--	--	--
SH 478.	57,2196	-6,8318	101.	S	0	95	5	--	--	--	--
SH 479.	57,2293	-7,0132	139.	MS	0	60	40	--	--	--	--
SH 480.	57,1415	-7,0972	136.	MS	0	80	20	--	--	--	--
SH 482.	57,1190	-7,1200	132.	S	0	92	8	--	--	--	--

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
SH 484.	56,7775	-6,4732	115.	S	0	83	19	--	--	--	--
SH 485.	56,7653	-6,4950	84.	MS	1	76	23	36	--	34	35
SH 487.	56,7272	-6,4742	145.	MS	0	68	32	--	--	--	--
SH 489.	56,4345	-6,6745	83.	S	0	81	19	--	--	--	--
SH 490.	56,8127	-6,7002	64.	S	0	99	1	--	27	--	27
SH 491.	56,1095	-5,8967	42.	MS	26	42	32	--	--	--	--
SH 492.	56,1348	-5,9497	69.	GSM	5	29	66	--	68	22	39
SH 494.	56,1688	-6,0503	70.	S	0	86	14	--	38	29	37
SH 495.	56,1760	-6,1218	26.	S	2	97	1	--	--	--	--
SH 496.	56,1083	-6,0540	43.	GSM	0	28	72	--	--	--	--
SH 497.	56,1787	-6,0152	49.	GSM	0	28	72	--	--	--	--
SH 498.	56,1567	-5,9595	70.	GS	19	65	16	--	25	45	29
SH 499.	56,3143	-5,8995	26.	GSM	59	41	N	--	--	--	--
SH 500.	56,3002	-5,9752	85.	MS	0	57	43	--	12	19	15
SH 502.	56,2805	-6,1360	30.	GS	23	74	3	60	--	--	60
SH 503.	56,2593	-6,1735	74.	GSM	N	33	67	--	24	20	21
SH 504.	56,2438	-6,2455	65.	S	0	93	7	--	46	50	46
SH 506.	56,3688	-6,0507	37.	M	0	4	96	--	14	9	9
SH 508.	56,3627	-6,0902	42.	M	0	2	98	--	13	12	12
SH 509.	56,3603	-6,1005	49.	M	0	N	100	--	30	50	50
SH 510.	56,3580	-6,1165	48.	M	0	2	98	--	24	18	18
SH 511.	56,3552	-6,1313	54.	M	0	1	99	--	30	16	16
SH 516.	56,7657	-7,1363	190.	M	N	10	90	--	58	34	36
SH 517.	56,7865	-7,1768	158.	GSM	N	41	59	--	30	28	33
SH 518.	56,8487	-7,3275	196.	GSM	N	43	57	--	40	62	56
SH 521.	57,2618	-5,6280	93.	GS	20	78	2	--	--	--	--
SH 522.	57,2683	-5,6494	87.	GS	27	72	1	--	--	--	--
SH 524.	57,2692	-5,6883	42.	S	14	82	4	--	--	--	--
SH 525.	57,2614	-5,7156	63.	GS	19	63	18	--	--	--	--
SH 526.	57,1267	-5,5583	92.	GSM	N	23	77	--	--	--	--
SH 527.	57,1242	-5,5767	70.	S	2	89	9	--	--	--	--
SH 530.	57,1333	-5,6917	0.	MS	11	46	42	--	--	--	--
SH 532.	56,6572	-5,9885	58.	M	0	1	99	--	61	20	28
SH 533.	56,6683	-6,0177	48.	GSM	0	40	60	--	11	25	19
SH 534.	56,6632	-6,0967	64.	M	0	4	96	--	51	25	26
SH 535.	56,6682	-6,1475	106.	M	0	3	91	--	58	49	46
SH 536.	56,6638	-6,0585	335.	S	N	99	1	23	--	--	23
SH 537.	56,4757	-5,7347	22.	GSM	9	41	50	--	--	--	--
SH 538.	56,1252	-6,1000	34.	S	2	97	1	--	--	--	29
SH 540.	56,1107	-6,0133	43.	S	0	86	14	--	--	--	--
SH 541.	56,1082	-5,9880	58.	GSM	0	33	67	--	--	--	--
SH 542.	56,0983	-5,9438	41.	S	N	85	15	--	--	--	--
SH 543.	56,1005	-5,8653	129.	MS	3	57	40	--	46	46	45
SH 545.	56,1295	-5,8667	88.	GSM	26	31	43	--	--	--	--
SH 546.	56,1402	-5,9132	107.	MS	2	75	23	--	--	--	--
SH 548.	56,2080	-6,9063	94.	GSM	0	37	63	--	48	21	31
SH 551.	57,4093	-6,8613	107.	GS	25	74	N	--	--	--	--
SH 552.	57,3932	-6,8223	82.	GS	44	55	1	63	--	--	63
SH 553.	57,3500	-6,7912	66.	GS	29	70	1	--	--	--	--
SH 554.	57,2780	-6,7677	124.	MS	N	77	23	--	--	--	--
SH 560.	56,5265	-5,5515	69.	M	0	1	99	--	30	20	20
SH 563.	56,6232	-6,7660	45.	S	17	82	N	35	--	--	35
SH 564.	56,6043	-6,8267	58.	S	14	86	N	78	--	--	78
SH 566.	56,6183	-6,9220	60.	M	0	15	85	--	53	36	36
SH 567.	56,4428	-7,0625	156.	MS	1	63	37	--	17	20	21
SH 568.	56,4350	-7,2345	130.	GSM	N	34	66	--	34	28	30
SH 569.	56,4920	-7,1743	220.	GSM	24	24	52	--	50	28	39
SH 570.	57,1178	-7,0410	143.	MS	1	63	36	--	4	20	12
SH 571.	57,2152	-7,0285	125.	SMG	42	30	29	--	29	25	28
SH 572.	56,3042	-7,4742	124.	S	N	99	1	--	15	--	15
SH 574.	56,1648	-7,6385	115.	S	1	99	N	--	8	--	8
SH 575.	56,0955	-7,7287	109.	GS	48	51	1	--	25	--	25
SH 576.	56,1183	-7,5038	115.	S	N	100	N	--	14	--	14
SH 577.	56,1842	-7,4275	144.	S	N	99	N	--	10	--	10
SH 582.	56,0025	-6,7687	62.	S	0	99	N	--	70	--	90
SH 583.	56,2530	-6,8747	68.	S	0	95	5	--	12	--	12
SH 584.	56,1058	-6,9883	82.	S	3	97	--	--	56	--	56
SH 585.	56,1542	-7,0883	85.	S	1	99	N	62	--	--	62
SH 586.	56,2025	-7,2167	183.	--	0	100	--	--	19	--	19
SH 587.	56,2533	-7,3192	173.	--	78	22	--	--	49	--	49
SH 591.	56,4833	-7,4030	183.	S	1	99	N	--	38	--	38
SH 592.	56,5363	-7,5345	195.	S	N	95	5	--	43	--	43
SH 593.	56,7883	-7,6010	32.	S	1	99	N	89	--	--	89
SH 596.	56,9583	-8,0717	120.	S	N	100	N	--	19	--	19
SH 645.	55,5400	-7,8167	84.	S	15	84	1	96	--	--	96
SH 651.	56,4533	-7,6283	137.	S	0	93	7	--	74	--	74
SH 652.	56,4233	-7,6250	144.	S	16	84	0	--	72	--	72
SH 653.	55,7067	-7,8550	173.	GS	45	55	N	44	--	--	44
SH 654.	56,7550	-7,9717	120.	S	1	99	1	43	--	--	43
SH 655.	56,8025	-8,0833	145.	S	0	99	1	--	9	--	9
SH 656.	56,8667	-6,7000	155.	S	0	97	3	--	14	--	14

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
SH 657.	56,9040	-8,3258	153.	S	0	99	1	--	10	--	10
SH 658.	56,9667	-8,4687	155.	S	0	99	1	--	15	--	15
SH 659.	56,9575	-8,2525	154.	S	0	98	2	--	10	--	10
SH 660.	56,9167	-8,1067	153.	S	3	97	0	--	19	--	19
SH 661.	56,8570	-8,0417	153.	S	0	97	2	--	13	--	13
SH 664.	56,5650	-7,8217	140.	--	1	99	--	--	81	--	81
SH 666.	56,6058	-8,0833	155.	--	0	100	--	--	81	--	81
SH 667.	56,7533	-8,2167	155.	S	13	87	0	--	11	--	11
SH 668.	56,8025	-8,3350	155.	S	0	100	0	--	10	--	10
SH 669.	56,8500	-8,4358	150.	S	2	98	0	--	24	--	24
SH 670.	56,9000	-8,5692	154.	S	0	100	0	--	27	--	27
SH 671.	56,9500	-8,6908	153.	S	0	99	1	--	37	--	37
SH 672.	56,9383	-8,9076	152.	SMG	57	43	0	--	59	--	59
SH 673.	56,8583	-8,7667	153.	S	0	100	0	--	63	--	63
SH 674.	56,8400	-8,6587	153.	S	3	96	1	--	28	--	28
SH 677.	56,6692	-8,2833	163.	S	8	91	0	--	18	--	18
SH 678.	56,6192	-8,1667	158.	--	1	99	--	--	19	--	19
SH 679.	56,5717	-8,2588	155.	S	0	100	0	--	43	--	43
SH 680.	56,4667	-8,0333	193.	S	0	96	4	--	48	--	48
SH 681.	56,5167	-8,1408	190.	S	0	99	1	--	55	--	55
SH 682.	56,5725	-8,2717	200.	S	0	96	4	--	46	--	45
SH 683.	56,6075	-8,3833	183.	--	0	100	--	--	21	--	21
SH 684.	56,6683	-8,5082	152.	--	3	97	--	--	20	--	20
SH 685.	56,7183	-8,6192	138.	--	2	98	--	--	29	--	29
SH 686.	56,7683	-8,7400	145.	S	11	88	0	--	23	--	23
SH 690.	56,7025	-8,8333	138.	S	7	93	0	--	37	--	37
SH 691.	56,6500	-8,7183	153.	--	0	100	--	--	26	--	26
SH 692.	56,5900	-8,5867	170.	--	1	99	--	--	23	--	23
SH 693.	56,5383	-8,4683	198.	S	0	95	5	--	30	--	30
SH 694.	56,5000	-8,3667	183.	MS	0	73	27	--	23	--	23
SH 695.	56,4500	-8,2583	183.	S	1	82	17	--	32	--	32
SH 696.	56,3883	-8,1333	160.	S	3	95	2	--	36	--	36
SH 697.	56,3358	-8,0075	215.	MS	0	58	42	--	44	--	44
SH 699.	56,3717	-8,3350	198.	S	0	99	1	--	19	--	19
SH 700.	56,4242	-8,4500	165.	--	1	99	--	--	33	--	33
SH 701.	56,3583	-8,5358	162.	--	0	100	--	--	21	--	21
SH 702.	56,4075	-8,6500	168.	--	8	92	--	--	30	--	30
SH 703.	56,4717	-8,5667	163.	--	1	99	--	--	24	--	24
SH 704.	56,5358	-8,6833	198.	--	2	98	--	--	30	--	30
SH 705.	56,5883	-8,8033	198.	--	0	98	--	--	35	--	35
SH 706.	56,5192	-8,8083	166.	--	5	95	--	--	49	--	49
SH 709.	56,4575	-8,7500	135.	S	1	98	1	--	23	--	23
SH 710.	56,4167	-7,9167	210.	S	0	93	7	--	42	--	42
SH 711.	56,4667	-7,8050	185.	S	0	99	1	--	14	--	14
SH 713.	56,5392	-7,7383	230.	MS	1	74	25	--	41	--	41
SH 714.	56,4883	-7,6183	173.	S	2	93	5	--	35	--	35
SH 715.	56,4875	-7,6908	188.	S	0	99	1	--	33	--	33
SH 717.	56,2087	-7,8858	145.	S	7	93	0	83	--	--	83
SH 718.	56,2383	-7,7742	183.	SMG	52	48	0	--	36	--	36
SH 719.	56,3167	-7,6692	173.	S	0	99	0	--	22	--	22
SH 720.	56,3575	-7,5717	183.	S	0	98	2	--	23	--	23
SH 721.	56,4383	-7,4908	158.	S	0	100	0	--	34	--	34
SH 722.	56,3675	-7,3742	73.	G	88	12	0	--	82	--	82
SH 723.	56,2692	-7,1242	110.	S	2	96	2	--	55	--	56
SH 724.	56,2225	-7,0067	93.	S	0	99	1	--	22	--	22
SH 726.	56,4075	-6,9525	33.	G	95	5	0	--	78	--	78
SH 728.	56,3667	-6,8383	88.	S	0	85	15	--	42	--	42
SH 729.	56,3167	-6,7000	95.	--	6	94	--	--	58	--	58
SH 730.	56,2667	-6,5058	88.	S	13	87	0	--	62	--	62
SH 731.	56,3833	-6,6183	118.	--	0	100	--	--	54	--	54
SH 732.	56,4358	-6,7508	180.	MS	0	67	33	--	32	--	32
SH 735.	56,0533	-7,0908	117.	S	0	91	9	69	67	72	69
SH 736.	56,2542	-7,5408	168.	S	1	98	1	--	16	--	16
SH 737.	56,2250	-7,4333	120.	S	0	100	0	--	14	--	14
SH 738.	56,1533	-7,3075	118.	S	1	99	0	--	23	--	23
SH 740.	56,2400	-7,3033	133.	S	3	97	0	--	26	--	26
SH 741.	56,2033	-7,4217	123.	--	82	18	--	--	27	--	27
SH 742.	56,1350	-7,8008	148.	S	0	99	1	--	14	--	14
SH 743.	56,1908	-7,7250	148.	S	0	97	3	--	44	80	44
SH 744.	56,1758	-7,6502	110.	S	0	100	0	--	11	--	11
SH 745.	56,1167	-7,7408	130.	S	1	95	4	73	--	--	73
SH 746.	56,2667	-7,6358	148.	S	1	96	3	--	39	--	39
SH 747.	56,0875	-7,5050	163.	S	0	100	0	--	19	--	19
SH 748.	56,4550	-8,9500	205.	GS	34	66	0	--	52	--	52
SH 749.	56,4217	-8,8717	183.	S	7	93	0	--	47	--	47
SH 750.	56,3500	-8,7383	166.	--	2	98	--	--	55	--	55
SH 751.	56,3075	-8,6167	158.	--	2	98	--	--	33	--	33
SH 753.	56,3192	-8,4200	150.	--	0	100	--	--	39	--	39
SH 754.	56,2683	-8,3250	183.	SMG	63	37	2	--	48	--	48
SH 755.	56,2063	-8,1858	193.	S	0	98	2	--	22	--	22
SH 756.	56,1575	-8,0700	146.	SMG	74	26	0	--	15	--	15

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
SH 757.	55,1083	-7,9700	128.	S	12	88	0	93	--	--	93
SH 759.	56,2200	-8,0242	140.	S	N	100	N	--	35	--	35
SH 760.	56,2742	-8,1[illegible]	220.	--	0	100	--	--	24	--	24
SH 761.	56,1912	-8,3092	167.	S	1	98	1	--	24	--	24
SH 762.	56,1500	-8,2717	139.	GS	42	58	N	--	17	--	17
SH 763.	56,2317	-8,1553	128.	GS	28	72	N	--	46	--	46
SH 764.	56,2408	-8,0367	137.	--	7	93	--	--	81	--	81
SH 765.	56,2533	-7,8258	140.	GS	1	99	--	--	21	--	21
SH 766.	56,2075	-7,7192	195.	--	0	100	--	--	45	--	45
SH 769.	56,2250	-6,5067	58.	S	N	100	N	--	17	--	17
SH 770.	56,1042	-6,4217	55.	S	N	100	N	--	21	--	21
SH 771.	56,1733	-6,3863	66.	GS	34	46	20	--	69	--	69
SH 772.	56,1513	-6,5558	65.	S	0	98	2	--	25	--	25
SH 773.	55,2750	-6,65[illegible]	70.	S	N	99	N	--	27	--	27
SH 774.	56,7075	-6,7758	75.	GS	45	54	1	48	--	--	48
SH 777.	56,2423	-8,2393	185.	S	0	99	1	--	19	--	19
SH 778.	56,0833	-8,3517	185.	--	--	100	--	--	24	--	24
SH 779.	56,1378	-8,4873	143.	S	10	88	2	--	28	--	28
SH 780.	56,1008	-8,6167	148.	MSG	40	60	N	--	18	--	18
SH 781.	56,2400	-8,7347	158.	S	14	86	N	--	84	--	84
SH 782.	56,2933	-8,8500	160.	S	4	96	N	--	56	--	56
SH 783.	56,3358	-8,9575	168.	S	6	94	N	54	--	--	54
SH 784.	56,2850	-9,0242	183.	GS	30	70	N	--	33	--	33
SH 785.	56,2343	-8,9368	173.	--	1	99	--	--	45	--	45
SH 786.	56,1517	-9,0375	185.	S	12	88	N	--	40	--	40
SH 787.	56,0530	-9,0000	175.	MSG	69	31	N	--	63	--	63
SH 788.	56,1187	-8,9008	182.	--	12	88	--	--	54	--	54
SH 791.	56,2583	-8,7740	163.	S	12	88	N	--	55	--	55
SH 792.	56,3025	-8,8667	150.	S	5	95	0	--	60	--	60
SH 794.	56,2762	-8,5742	173.	MSG	64	36	N	90	--	--	90
SH 795.	56,8233	-8,4550	163.	S	3	97	N	--	13	--	13
SH 796.	56,7042	-7,4833	180.	S	N	88	12	--	49	--	49
SH 797.	56,7367	-7,2838	110.	S	1	92	7	--	26	--	26
SH 798.	56,6658	-7,1567	153.	MS	N	51	49	--	41	--	41
SH 799.	55,6383	-7,2358	68.	S	1	99	N	--	35	--	35
SH 800.	56,5867	-6,9075	35.	--	32	68	--	--	42	--	42
SH 821.	56,6042	-6,7708	15.	--	84	16	--	--	66	--	66
SH 826.	56,6550	-7,7383	93.	GS	33	67	N	83	--	--	83
SH 838.	57,3612	-7,1497	116.	MS	2	72	26	--	14	31	19
SH 839.	57,3332	-7,1013	196.	S	1	83	16	--	24	20	25
SH 840.	56,9054	-7,3008	181.	GSM	N	47	53	--	46	30	37
SH 841.	56,8854	-7,3025	194.	GSM	N	43	57	--	34	29	31
SH 842.	56,8756	-7,2664	179.	GSM	N	34	66	--	41	29	33
SH 844.	56,7624	-7,5435	79.	S	2	94	4	86	--	--	86
SH 845.	56,7766	-7,5533	64.	S	0	100	N	89	--	--	89
SH 846.	56,7784	-7,5368	96.	S	N	99	1	92	--	--	92
SH 848.	56,7727	-7,5138	143.	S	2	94	4	61	--	42	61
58,-3. 1.	59,9014	-2,6048	64.	SMG	61	39	N	94	--	--	94
58,-3. 2.	58,5011	-2,6551	64.	MSG	55	45	0	84	--	--	84
58,-3. 4.	58,7577	-2,6523	71.	S	2	91	7	39	--	--	39
58,-3. 5.	58,7440	-2,6465	71.	S	9	84	7	44	--	--	44
58,-3. 7.	58,8129	-2,4840	78.	S	1	98	1	31	--	--	31
58,-3. 8.	58,5534	-2,4622	79.	S	1	95	4	41	--	--	41
58,-3. 11.	58,2017	-2,9366	53.	E,MS	--	--	--	--	--	--	E,50
58,-3. 37.	58,9865	-2,8232	79.	E,S	--	--	--	--	--	--	E,99
58,-3. 38.	58,9261	-2,8214	83.	E,S	--	--	--	--	--	--	E,99
58,-3. 39.	58,9584	-2,8921	79.	E,S	--	--	--	--	--	--	E,99
58,-3. 40.	58,9882	-2,1569	83.	E,S	--	--	--	--	--	--	E,99
58,-3. 41.	58,9596	-2,1938	89.	E,S	--	--	--	--	--	--	E,99
58,-3. 42.	59,9247	-2,1553	81.	E,S	--	--	--	--	--	--	E,99
58,-3. 43.	58,9230	-2,2440	86.	E,S	--	--	--	--	--	--	E,99
58,-3. 44.	58,9598	-2,2958	87.	E,S	--	--	--	--	--	--	E,99
58,-3. 45.	58,9901	-2,3383	83.	E,S	--	--	--	--	--	--	E,99
58,-3. 46.	58,9580	-2,4245	81.	E,S	--	--	--	--	--	--	E,99
58,-3. 47.	58,9325	-2,4111	83.	E,S	--	--	--	--	--	--	E,99
58,-3. 48.	58,9234	-2,3331	86.	E,S	--	--	--	--	--	--	E,99
58,-3. 49.	58,9198	-2,4594	77.	E,S	--	--	--	--	--	--	E,95
58,-3. 50.	59,9570	-2,5741	73.	E,S	--	--	--	--	--	--	E,99
58,-3. 51.	58,9218	-2,5729	70.	E,S	--	--	--	--	--	--	E,99
58,-3. 52.	58,9627	-2,6118	50.	E,GS	--	--	--	--	--	--	E,99
58,-3. 53.	58,9327	-2,6665	42.	E,GS	--	--	--	--	--	--	E,98
58,-3. 54.	58,9012	-2,6432	50.	E,GS	--	--	--	--	--	--	E,99
58,-3. 56.	58,8547	-2,6006	69.	E,GS	--	--	--	--	--	--	E,99
58,-3. 57.	58,8517	-2,4545	79.	E,S	--	--	--	--	--	--	E,50
58,-3. 58.	58,8823	-2,4432	80.	E,S	--	--	--	--	--	--	E,50
58,-3. 59.	58,8044	-2,3447	85.	E,S	--	--	--	--	--	--	E,50
58,-3. 60.	58,8029	-2,2835	81.	E,S	--	--	--	--	--	--	E,45
58,-3. 61.	58,8800	-2,2397	83.	E,GS	--	--	--	--	--	--	E,60
58,-3. 62.	58,8302	-2,1077	80.	E,S	--	--	--	--	--	--	E,30
58,-3. 63.	58,8690	-2,1387	45.	E,S	--	--	--	--	--	--	E,50
58,-3. 64.	58,8474	-2,0640	85.	E,S	--	--	--	--	--	--	E,60

SAMPLE NUMBER		LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
58.-3.	65.	58,8874	-2,0395	84.	E,S	--	--	--	--	--	--	E,40
58.-3.	67.	58,9177	-2,6702	22.	E,SMG	--	--	--	--	--	--	E,49
58.-3.	91.	58,9210	-2,9768	29.	E,S	--	--	--	--	--	--	E,50
58.-4.	4.	58,9140	-3,0822	37.	E,MS	--	--	--	--	--	--	E,80
58.-4.	5.	58,9247	-3,0523	37.	E,MS	--	--	--	--	--	--	E,80
58.-4.	6.	58,9306	-3,0090	33.	E,MS	--	--	--	--	--	--	E,80
58.-4.	7.	58,9035	-3,0144	30.	E,MS	--	--	--	--	--	--	E,70
58.-4.	8.	58,8885	-3,0297	27.	E,MS	--	--	--	--	--	--	E,70
58.-4.	9.	58,8952	-3,0949	33.	E,GSM	--	--	--	--	--	--	E,40
58.-4.	10.	58,9065	-3,1207	37.	E,GSM	--	--	--	--	--	--	E,50
58.-4.	11.	58,8891	-3,1526	40.	E,GSM	--	--	--	--	--	--	E,50
58.-4.	12.	58,9012	-3,2088	57.	E,S	--	--	--	--	--	--	E,70
59.-1.	1.	59,5842	-0,1083	118.	GS	25	73	2	--	9	30	10
59.-1.	2.	59,6798	-0,1242	128.	S	N	97	3	--	2	21	3
59.-1.	3.	59,6658	-0,1537	142.	S	N	89	11	--	4	13	5
59.-1.	4.	59,6438	-0,1592	133.	S	0	98	2	--	3	11	3
59.-1.	5.	59,5558	-0,2250	144.	MS	N	74	26	--	5	18	7
59.-1.	6.	59,5433	-0,2617	137.	S	N	86	14	--	4	20	6
59.-1.	7.	59,4685	-0,3382	131.	S	N	98	2	--	2	20	2
59.-1.	8.	59,2887	-0,5123	140.	S	0	89	11	--	5	13	6
59.-1.	9.	59,1030	-0,7602	140.	MS	N	74	26	--	9	19	12
59.-1.	10.	59,8936	-0,7698	140.	MS	0	78	22	--	10	20	12
59.-1.	11.	59,7822	-0,7807	0.	MS	N	68	32	--	10	20	13
59.-1.	12.	59,8612	-0,7957	0.	S	0	100	0	--	14	--	14
59.-1.	13.	59,9679	-0,8728	133.	S	2	93	6	--	18	28	19
59.-1.	14.	59,9625	-0,5314	135.	S	3	90	7	--	21	30	22
59.-1.	15.	59,9728	-0,5451	132.	S.	1	94	5	--	13	26	14
59.-1.	16.	59,8727	-0,4203	137.	S	1	92	7	--	8	31	10
59.-1.	17.	59,9566	-0,4119	130.	S	2	92	6	--	9	33	10
59.-1.	18.	59,9625	-0,2505	139.	S	1	93	6	--	12	29	13
59.-1.	19.	59,8688	-0,2534	130.	S	1	96	4	--	7	30	8
59.-1.	20.	59,9063	-0,2820	0.	S	N	98	2	--	6	28	6
59.-1.	21.	59,8125	-0,3012	130.	S	1	96	3	--	46	32	46
59.-1.	22.	59,7561	-0,4804	141.	S	1	92	7	--	6	22	7
59.-1.	23.	59,5740	-0,3309	120.	S	1	98	1	--	4	39	4
59.-1.	24.	59,9599	-0,3268	126.	S	1	97	1	--	46	31	46
59.-1.	25.	59,9557	-0,5869	130.	S	3	95	2	--	20	27	20
59.-1.	26.	59,8725	-0,5776	134.	S	2	92	6	--	13	29	14
59.-1.	27.	59,8685	-0,7808	121.	S	2	96	2	--	74	35	74
59.-1.	28.	59,9635	-0,7386	126.	S	1	96	3	--	19	28	19
59.-1.	29.	59,9842	-0,9229	110.	S	1	97	2	--	21	37	21
59.-1.	30.	59,8632	-0,9528	115.	S	1	97	2	--	30	36	30
59.-1.	31.	59,9246	-0,8141	124.	S	N	96	4	--	15	33	16
59.-1.	32.	59,9180	-0,6579	135.	S	2	94	4	--	14	31	15
59.-1.	33.	59,5807	-0,5852	121.	S	N	99	1	--	100	--	100
59.-1.	35.	59,7661	-0,0479	135.	S	1	85	14	--	100	--	100
59.-1.	36.	59,5005	-0,0874	136.	MS	N	62	38	--	92	--	92
59.-2.	1.	59,9827	-1,0263	106.	S	3	94	3	--	37	43	37
59.-2.	2.	59,9444	-1,0173	113.	S	1	96	3	--	27	39	27
59.-2.	4.	59,8644	-1,1329	102.	S	4	95	1	--	51	52	51
59.-2.	5.	59,8911	-1,0895	111.	S	2	97	1	--	39	44	39
59.-2.	6.	59,8673	-1,1722	108.	S	4	96	1	--	47	48	47
59.-2.	7.	59,8674	-1,2327	95.	GS	31	69	N	--	80	60	80
59.-2.	8.	59,8879	-1,2816	73.	SMG	55	44	1	--	73	--	73
59.-2.	9.	59,9187	-1,1849	97.	GS	44	55	1	--	69	46	69
59.-2.	10.	59,9323	-1,0952	104.	S	2	97	1	--	44	35	44
59.-2.	11.	59,9595	-1,1295	101.	S	1	99	1	--	61	44	61
59.-2.	12.	59,9360	-1,2221	79.	G	94	5	1	--	91	52	91
59.-2.	13.	59,9608	-1,2024	66.	GS	24	75	N	--	92	50	92
59.-2.	15.	59,4995	-1,4996	82.	SMG	66	34	0	--	96	--	96
59.-2.	16.	59,7563	-1,5256	85.	SMG	65	35	N	--	87	--	87
59.-2.	17.	59,7455	-1,9935	109.	S	3	97	0	--	99	--	99
59.-2.	18.	59,9934	-1,9906	86.	S	4	96	0	--	99	--	99
59.-2.	19.	59,9968	-1,4015	139.	S	N	95	3	--	100	--	100
59.-2.	20.	59,7444	-1,0215	124.	S	2	97	N	--	58	--	58
59.-3.	10.	59,1400	-2,4303	0.	E,GS	--	--	--	--	--	--	E,99
59.-3.	11.	59,2089	-2,4113	40.	E,GS	--	--	--	--	--	--	E,99
59.-3.	12.	59,2089	-2,2115	80.	E,S	--	--	--	--	--	--	E,99
59.-3.	13.	59,2576	-2,4481	10.	E,GS	--	--	--	--	--	--	E,95
59.-3.	14.	59,2087	-2,5114	21.	E,GS	--	--	--	--	--	--	E,95
59.-3.	15.	59,2004	-2,5099	15.	E,S	--	--	--	--	--	--	E,95
59.-3.	16.	59,1787	-2,5339	25.	E,SMG	--	--	--	--	--	--	E,99
59.-3.	17.	59,1582	-2,4690	40.	E,S	--	--	--	--	--	--	E,99
59.-3.	18.	59,1050	-2,4896	41.	E,SMG	--	--	--	--	--	--	E,99
59.-3.	19.	59,0574	-2,5046	56.	E,S	--	--	--	--	--	--	E,99
59.-3.	20.	59,0991	-2,8585	12.	E,GS	--	--	--	--	--	--	E,97
59.-3.	21.	59,1011	-2,9454	21.	E,SMG	--	--	--	--	--	--	E,90
59.-3.	26.	59,0056	-2,5968	43.	E,GS	--	--	--	--	--	--	E,99
59.-3.	27.	59,1008	-2,4258	70.	E,GS	--	--	--	--	--	--	E,99
59.-3.	28.	59,1566	-2,3168	78.	E,GS	--	--	--	--	--	--	E,98
59.-3.	29.	59,2050	-2,3028	72.	E,GS	--	--	--	--	--	--	E,90

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
59,-3. 30.	59,2469	-2,3061	65.	E,G	--	--	--	--	--	--	E,99
59,-3. 31.	59,2565	-2,2098	70.	E,GS	--	--	--	--	--	--	E,99
59,-3. 32.	59,2553	-2,1145	93.	E,GS	--	--	--	--	--	--	E,99
59,-3. 33.	59,2594	-2,2056	0.	E,GS	--	--	--	--	--	--	E,90
59,-3. 34.	59,2119	-2,2121	0.	E,GS	--	--	--	--	--	--	E,99
59,-3. 35.	59,2105	-2,2917	86.	E,S	--	--	--	--	--	--	E,97
59,-3. 36.	59,2124	-2,1522	89.	E,S	--	--	--	--	--	--	E,97
59,-3. 37.	59,2252	-2,0319	79.	E,GS	--	--	--	--	--	--	E,99
59,-3. 38.	59,1302	-2,1032	84.	E,GS	--	--	--	--	--	--	E,97
59,-3. 39.	59,2398	-2,0678	99.	E,SMG	--	--	--	--	--	--	E,99
59,-3. 40.	59,3084	-2,1193	93.	E,GS	--	--	--	--	--	--	E,99
59,-3. 41.	59,4146	-2,1072	62.	E,GS	--	--	--	--	--	--	E,99
59,-3. 42.	59,4746	-2,1108	100.	E,GS	--	--	--	--	--	--	E,20
59,-3. 43.	59,4755	-2,2154	81.	E,GS	--	--	--	--	--	--	E,99
59,-3. 44.	59,5164	-2,2876	96.	E,GS	--	--	--	--	--	--	E,95
59,-3. 45.	59,5680	-2,4132	83.	E,SMG	--	--	--	--	--	--	E,98
59,-3. 46.	59,5971	-2,5913	96.	E,GS	--	--	--	--	--	--	E,98
59,-3. 47.	59,5917	-2,8122	74.	E,S	--	--	--	--	--	--	E,99
59,-3. 48.	59,5993	-2,9316	79.	E,GS	--	--	--	--	--	--	E,99
59,-3. 49.	59,3680	-2,3131	42.	E,GS	--	--	--	--	--	--	E,99
59,-3. 50.	59,3628	-2,2072	75.	E,GS	--	--	--	--	--	--	E,40
59,-3. 51.	59,2608	-2,0177	103.	E,GS	--	--	--	--	--	--	E,99
59,-3. 52.	59,1611	-2,0042	83.	E,GS	--	--	--	--	--	--	E,99
59,-3. 53.	59,1086	-2,0089	75.	E,GS	--	--	--	--	--	--	E,99
59,-3. 54.	59,2562	-2,0069	74.	E,SMG	--	--	--	--	--	--	E,99
59,-3. 55.	59,2621	-2,0908	76.	E,GS	--	--	--	--	--	--	E,99
59,-3. 56.	59,2348	-2,0936	75.	E,S	--	--	--	--	--	--	E,99
59,-3. 57.	59,2332	-2,3548	39.	E,SMG	--	--	--	--	--	--	E,98
59,-3. 58.	59,1768	-2,3678	59.	E,S	--	--	--	--	--	--	E,99
59,-3. 59.	59,1435	-2,3783	65.	E,S	--	--	--	--	--	--	E,99
59,-3. 60.	59,1404	-2,5107	35.	E,GS	--	--	--	--	--	--	E,95
59,-3. 61.	59,3915	-2,4463	65.	E,S	--	--	--	--	--	--	E,99
59,-3. 62.	59,1073	-2,2933	80.	E,S	--	--	--	--	--	--	E,98
59,-3. 63.	59,3171	-2,0178	105.	E,GS	--	--	--	--	--	--	E,60
59,-3. 64.	59,4119	-2,0076	82.	E,GS	--	--	--	--	--	--	E,94
59,-3. 65.	59,5427	-2,0426	115.	E,GS	--	--	--	--	--	--	E,99
59,-3. 66.	59,6519	-2,0303	103.	E,S	--	--	--	--	--	--	E,97
59,-3. 67.	59,7532	-2,0401	112.	E,SMG	--	--	--	--	--	--	E,99
59,-3. 68.	59,8307	-2,1398	99.	E,S	--	--	--	--	--	--	E,99
59,-3. 69.	59,8220	-2,2233	91.	E,GS	--	--	--	--	--	--	E,99
59,-3. 70.	59,8773	-2,3286	100.	E,GS	--	--	--	--	--	--	E,99
59,-3. 72.	59,8116	-2,5993	88.	E,GS	--	--	--	--	--	--	E,99
59,-3. 73.	59,7538	-2,6027	96.	E,SMG	--	--	--	--	--	--	E,98
59,-3. 74.	59,6524	-2,5907	90.	E,GS	--	--	--	--	--	--	E,95
59,-3. 75.	59,7611	-2,8403	77.	E,S	--	--	--	--	--	--	E,99
59,-3. 76.	59,7080	-2,6448	81.	E,GS	--	--	--	--	--	--	E,98
59,-3. 77.	59,8766	-2,8126	86.	E,SMG	--	--	--	--	--	--	E,85
59,-3. 78.	59,8771	-2,6174	84.	E,SMG	--	--	--	--	--	--	E,65
59,-3. 79.	59,8816	-2,4219	96.	E,GS	--	--	--	--	--	--	E,98
59,-3. 80.	59,8777	-2,2213	102.	E,S	--	--	--	--	--	--	E,99
59,-3. 81.	59,8760	-2,0282	95.	E,S	--	--	--	--	--	--	E,97
59,-3. 82.	59,9313	-2,0315	101.	E,S	--	--	--	--	--	--	E,99
59,-3. 83.	59,9981	-2,1135	87.	E,S	--	--	--	--	--	--	E,99
59,-3. 84.	59,9370	-2,2258	93.	E,S	--	--	--	--	--	--	E,50
59,-3. 85.	59,8761	-2,2237	103.	E,S	--	--	--	--	--	--	E,99
59,-3. 86.	59,8224	-2,4134	89.	E,S	--	--	--	--	--	--	E,10
59,-3. 87.	59,7620	-2,4867	93.	E,GS	--	--	--	--	--	--	E,98
59,-3. 88.	59,7115	-2,6144	89.	E,S	--	--	--	--	--	--	E,50
59,-3. 89.	59,7082	-2,7008	82.	E,GS	--	--	--	--	--	--	E,80
59,-3. 90.	59,6600	-2,8373	87.	E,S	--	--	--	--	--	--	E,90
59,-3. 91.	59,6552	-2,9088	85.	E,S	--	--	--	--	--	--	E,50
59,-3. 92.	59,5269	-2,8971	75.	E,SMG	--	--	--	--	--	--	E,80
59,-3. 93.	59,4787	-2,9374	74.	E,SMG	--	--	--	--	--	--	E,99
59,-4. 2.	59,4670	-3,5956	80.	E,S	--	--	--	--	--	--	E,95
59,-4. 3.	59,5326	-3,4811	72.	E,S	--	--	--	--	--	--	E,95
59,-4. 4.	59,6072	-3,4092	51.	E,G	--	--	--	--	--	--	E,30
59,-4. 7.	59,2618	-3,4931	80.	E,GS	--	--	--	--	--	--	E,40
59,-4. 8.	59,1121	-3,4945	78.	E,S	--	--	--	--	--	--	E,75
59,-4. 9.	59,1594	-3,4685	79.	E,S	--	--	--	--	--	--	E,75
59,-4. 14.	59,3173	-3,4852	122.	E,S	--	--	--	--	--	--	E,90
59,-4. 15.	59,3639	-3,3913	120.	E,S	--	--	--	--	--	--	E,75
59,-4. 16.	59,3636	-3,2825	123.	E,S	--	--	--	--	--	--	E,80
59,-4. 18.	59,5300	-3,3209	81.	E,GS	--	--	--	--	--	--	E,70
59,-4. 19.	59,5285	-3,6882	150.	E,GS	--	--	--	--	--	--	E,70
59,-4. 20.	59,5748	-3,7493	150.	E,S	--	--	--	--	--	--	E,70
59,-4. 21.	59,5373	-3,8728	164.	E,S	--	--	--	--	--	--	E,70
59,-4. 22.	59,4722	-3,9823	148.	E,S	--	--	--	--	--	--	E,80
59,-4. 23.	59,3663	-3,9792	130.	E,S	--	--	--	--	--	--	E,80
59,-4. 24.	59,3100	-3,8061	135.	E,S	--	--	--	--	--	--	E,70
59,-4. 25.	59,2056	-3,8893	121.	E,S	--	--	--	--	--	--	E,70
59,-4. 26.	59,1532	-3,9806	100.	E,S	--	--	--	--	--	--	E,90

SAMPLE NUMBER		LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
59,-4.	27.	59,3405	-3,9803	91.	E,S	--	--	--	--	--	--	E,95
59,-4.	28.	59,5500	-3,0922	85.	E,GS	--	--	--	--	--	--	E,98
59,-4.	29.	59,5591	-3,1842	65.	E,S	--	--	--	--	--	--	E,98
59,-4.	33.	59,7298	-3,5604	108.	F,GS	--	--	--	--	--	--	E,50
59,-4.	34.	59,7655	-3,6823	126.	E,GS	--	--	--	--	--	--	E,40
59,-4.	35.	59,7685	-3,8737	126.	E,GS	--	--	--	--	--	--	F,99
59,-4.	36.	59,8280	-3,9746	122.	E,S	--	--	--	--	--	--	E,20
59,-4.	37.	59,8255	-3,7963	127.	E,S	--	--	--	--	--	--	E,30
59,-4.	38.	59,8307	-3,6939	142.	E,S	--	--	--	--	--	--	E,50
59,-4.	39.	59,8268	-3,4824	115.	E,GS	--	--	--	--	--	--	E,40
59,-4.	40.	59,8338	-3,3961	90.	F,GS	--	--	--	--	--	--	E,70
59,-4.	41.	59,7917	-3,2472	88.	E,GS	--	--	--	--	--	--	E,70
59,-4.	42.	59,7566	-3,1154	66.	E,GS	--	--	--	--	--	--	E,99
59,-4.	43.	59,7205	-3,0639	85.	E,S	--	--	--	--	--	--	E,99
59,-4.	44.	59,7588	-3,0136	80.	E,S	--	--	--	--	--	--	E,99
59,-4.	45.	59,5360	-3,1271	90.	E,GS	--	--	--	--	--	--	E,97
59,-4.	46.	59,4017	-3,0358	73.	E,S	--	--	--	--	--	--	E,97
59,-4.	47.	59,3025	-3,0943	82.	E,GS	--	--	--	--	--	--	E,99
60,-1.	5.	60,0051	-0,8802	121.	S	3	93	4	--	31	37	31
60,-1.	6.	60,2083	-0,8725	120.	S	6	82	12	--	48	36	46
60,-1.	7.	60,2786	-0,7555	99.	S	N	100	N	--	85	--	85
60,-1.	8.	60,3626	-0,6942	50.	GS	39	60	1	--	93	52	93
60,-1.	9.	60,3590	-0,5942	141.	GS	29	70	1	--	63	44	63
60,-1.	12.	60,5311	-0,9698	88.	S	4	91	5	--	41	33	39
60,-1.	14.	60,4539	-0,7825	88.	S	3	93	4	--	73	42	73
60,-1.	15.	60,4914	-0,7718	81.	S	1	95	4	--	15	42	15
60,-1.	16.	60,5445	-0,7928	46.	G	99	11	1	--	78	48	78
60,-1.	17.	60,5514	-0,5151	148.	S	3	85	13	--	57	57	57
60,-1.	18.	60,5303	-0,3822	84.	S	N	100	N	--	37	53	37
60,-1.	19.	60,5404	-0,2793	95.	S	2	97	1	--	92	49	92
60,-1.	20.	60,5021	-0,1555	113.	--	--	--	--	--	66	--	66
60,-1.	21.	60,5621	-0,1171	113.	S	2	97	1	--	80	47	80
60,-1.	22.	60,6210	-0,1984	85.	GS	23	77	N	--	94	60	94
60,-1.	23.	60,7125	-0,1306	92.	GS	43	57	N	--	95	50	95
60,-1.	24.	60,7505	-0,1504	100.	S	12	88	N	--	83	--	83
60,-1.	25.	60,8028	-0,3230	138.	S	11	87	2	--	46	34	46
60,-1.	26.	60,8010	-0,4684	113.	S	4	96	N	--	91	53	91
60,-1.	27.	60,7622	-0,6042	124.	S	1	99	N	--	80	70	80
60,-1.	29.	60,8574	-0,4992	117.	S	6	94	N	--	93	59	93
60,-1.	30.	59,9596	-0,2961	0.	GS	39	60	1	--	64	31	64
60,-1.	31.	60,0094	-0,0701	84.	S	2	94	4	--	48	29	44
60,-1.	32.	60,8743	-0,0987	167.	S	1	93	6	--	60	23	58
60,-1.	33.	60,9391	-0,0603	166.	S	2	91	7	--	81	38	49
60,-1.	34.	60,9053	-0,0582	139.	S	8	91	1	--	33	30	33
60,-1.	35.	60,9840	-0,1916	159.	S	2	96	2	--	53	50	53
60,-1.	36.	60,9794	-0,3213	133.	S	16	84	N	--	72	19	72
60,-1.	37.	60,9375	-0,2309	172.	S	N	97	3	--	17	40	17
60,-1.	38.	60,8967	-0,2526	153.	S	5	94	1	--	30	43	30
60,-1.	39.	60,8999	-0,3900	137.	S	13	87	N	--	66	75	66
60,-1.	40.	60,9079	-0,5000	122.	S	10	90	N	--	85	44	85
60,-1.	41.	60,9465	-0,5002	135.	S	6	94	N	--	82	56	82
60,-1.	42.	60,9823	-0,4822	140.	S	5	94	1	--	87	61	87
60,-1.	43.	60,9855	-0,6828	116.	S	16	84	N	--	81	36	81
60,-1.	44.	60,9036	-0,6827	105.	S	12	88	N	--	88	80	88
60,-1.	45.	60,9082	-0,9742	105.	S	5	95	N	--	74	50	74
60,-1.	46.	60,9637	-0,9519	119.	S	5	95	N	--	31	50	81
60,-1.	47.	60,9321	-0,7439	99.	SMG	67	31	2	--	81	31	81
60,-1.	48.	60,9757	-0,6105	97.	SMG	57	42	1	--	72	54	72
60,-1.	49.	60,9265	-0,6776	88.	SMG	60	38	3	--	59	63	61
60,-1.	50.	60,8209	-0,5684	102.	S	9	91	N	--	83	44	83
60,-1.	51.	60,7241	-0,6979	90.	GS	28	72	N	--	83	58	83
60,-1.	52.	60,5917	-0,5200	0.	S	1	97	2	--	66	4	66
60,-1.	53.	60,6546	-0,6143	117.	S	2	97	1	--	58	73	58
60,-1.	56.	60,5829	-0,7055	88.	S	5	95	N	--	79	50	79
60,-1.	57.	60,5153	-0,5759	135.	S	1	84	15	--	46	43	46
60,-1.	58.	60,4607	-0,5860	127.	S	2	95	3	--	42	36	41
60,-1.	59.	60,4184	-0,6059	0.	S	1	97	2	--	38	37	38
60,-1.	60.	60,3963	-0,6572	100.	S	4	94	2	--	87	38	87
60,-1.	61.	60,3151	-0,6099	140.	S	4	89	7	--	44	43	44
60,-1.	62.	60,2550	-0,6853	127.	S	4	95	1	--	54	53	54
60,-1.	64.	60,1595	-0,6134	127.	S	2	88	10	--	42	44	42
60,-1.	65.	60,3007	-0,5967	124.	S	1	94	5	--	17	40	17
60,-1.	66.	60,0038	-0,7015	124.	S	2	95	3	--	61	39	61
60,-1.	67.	60,2549	-0,7118	127.	S	9	85	6	--	23	43	24
60,-1.	68.	60,1182	-0,7262	118.	S	1	97	2	--	29	20	29
60,-1.	69.	60,1612	-0,7482	113.	S	1	95	4	--	48	44	48
60,-1.	70.	60,2043	-0,7763	107.	GS	38	53	9	--	55	36	52
60,-1.	71.	60,2597	-0,0217	109.	S	2	92	6	--	55	45	54
60,-1.	72.	60,3238	-0,7309	89.	GS	23	76	1	--	94	56	94
60,-1.	74.	60,3396	-0,3088	101.	S	2	98	N	--	46	13	45
60,-1.	75.	60,3064	-0,2726	111.	S	5	93	2	--	78	60	78

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
68.-1. 76.	60.2692	-0.2068	130.	S	1	94	5	--	35	56	35
68.-1. 77.	60.1051	-0.2945	119.	S	8	90	2	--	21	34	21
68.-1. 78.	60.1434	-0.2751	134.	S	3	91	6	--	36	32	36
68.-1. 79.	60.0773	-0.1979	124.	S	4	94	2	--	14	33	14
68.-1. 80.	60.0260	-0.1901	135.	S	1	94	2	--	20	25	20
68.-1. 81.	60.0152	-0.0587	137.	S	1	91	8	--	14	36	16
68.-1. 82.	60.0915	-0.0529	124.	S	3	92	5	--	24	30	24
68.-1. 84.	60.1057	-0.1155	119.	S	2	95	3	--	33	42	33
68.-1. 85.	60.2492	-0.1357	121.	S	1	94	5	--	28	40	29
68.-1. 86.	60.3047	-0.1187	124.	S	1	94	4	--	30	41	30
68.-1. 87.	60.3580	-0.1427	126.	S	3	93	4	--	40	44	40
68.-1. 88.	60.4262	-0.1147	119.	S	N	98	2	--	40	43	40
68.-1. 89.	60.4505	-0.0295	0.	S	4	95	1	--	48	50	48
68.-1. 90.	60.4829	-0.1135	114.	S	1	98	1	--	47	55	47
68.-1. 91.	60.4754	-0.2781	139.	S	17	81	2	--	85	60	85
68.-1. 92.	60.4253	-0.2489	137.	S	1	97	2	--	38	42	38
68.-1. 93.	60.3803	-0.2058	113.	S	3	96	1	--	65	56	65
68.-1. 96.	60.4089	-0.4075	92.	S	15	85	N	--	99	67	99
68.-1. 98.	60.3343	-0.3969	105.	S	1	98	1	--	77	51	77
68.-1. 99.	60.2711	-0.4437	116.	S	1	98	1	--	82	90	82
68.-1. 100.	60.2038	-0.3997	135.	S	4	90	6	--	33	69	35
68.-1. 102.	60.0917	-0.3312	139.	S	3	91	6	--	25	33	25
68.-1. 103.	60.0340	-0.2969	131.	S	3	95	2	--	12	31	12
68.-1. 104.	60.0040	-0.3919	119.	S	N	97	3	--	90	38	90
68.-1. 105.	60.0866	-0.4266	0.	SMG	74	24	2	--	35	49	35
68.-1. 106.	60.1674	-0.4976	0.	S	N	96	4	--	17	40	18
68.-1. 108.	60.2868	-0.8814	100.	S	4	90	6	--	75	20	69
68.-1. 109.	60.2633	-0.8956	98.	S	5	86	9	--	63	39	61
68.-1. 110.	60.2524	-0.8938	98.	S	2	86	12	--	58	37	55
68.-1. 111.	60.2679	-0.9393	81.	S	2	89	9	--	74	66	73
68.-1. 113.	60.2495	-0.9734	85.	S	1	93	6	--	58	34	57
68.-1. 114.	60.2176	-0.9645	65.	GS	22	76	2	--	92	51	91
68.-1. 115.	60.2409	-0.7863	106.	S	2	92	6	--	61	39	60
68.-1. 116.	60.1804	-0.8783	115.	MS	3	78	19	--	43	40	42
68.-1. 117.	60.0976	-0.9380	105.	S	6	93	1	--	57	48	57
68.-1. 118.	60.0376	-0.9211	116.	GS	16	78	6	--	42	48	42
68.-1. 119.	60.0383	-0.8268	110.	S	1	95	4	--	27	52	29
68.-1. 120.	60.1159	-0.8059	116.	S	12	84	4	--	28	38	28
68.-1. 121.	60.1838	-0.7176	103.	S	12	87	1	--	96	59	96
68.-1. 123.	60.2659	-0.5828	81.	GS	27	71	2	--	70	50	70
68.-1. 124.	60.2713	-0.6046	92.	S	18	82	N	--	98	54	98
68.-1. 125.	60.2851	-0.6138	111.	S	6	93	1	--	96	45	96
68.-1. 127.	60.3064	-0.5015	90.	S	6	94	N	--	94	64	94
68.-1. 129.	60.4112	-0.4142	83.	S	1	85	14	--	88	--	88
68.-1. 130.	60.4263	-0.4104	15.	S	3	96	1	--	94	62	94
68.-1. 131.	60.4284	-0.3056	85.	S	9	91	N	--	93	54	93
68.-1. 132.	60.4437	-0.3075	85.	S	1	95	4	--	70	--	70
68.-1. 133.	60.4632	-0.4058	83.	GS	20	69	11	--	40	28	39
68.-1. 134.	60.4643	-0.3546	81.	S	16	83	1	--	91	--	91
68.-1. 135.	60.4950	-0.3124	84.	GS	36	64	N	--	85	54	85
68.-1. 136.	60.5073	-0.2786	101.	G	83	14	4	--	45	46	45
68.-1. 137.	60.5392	-0.1531	111.	S	8	90	2	--	45	46	45
68.-1. 138.	60.5476	-0.0110	120.	S	1	97	2	--	52	51	52
68.-1. 139.	60.5957	-0.0231	109.	S	1	99	N	--	66	52	66
68.-1. 140.	60.6379	-0.0941	101.	S	4	96	N	--	83	57	83
68.-1. 141.	60.7228	-0.0432	111.	S	3	96	1	--	82	54	82
68.-1. 142.	60.7713	-0.0712	111.	S	9	90	1	--	69	58	69
68.-1. 143.	60.7415	-0.0994	101.	S	9	91	N	--	93	55	93
68.-1. 144.	60.6670	-0.0083	101.	S	3	97	N	--	88	65	88
68.-1. 145.	60.5343	-0.2273	83.	S	5	95	N	--	96	38	96
68.-1. 146.	60.7010	-0.2747	96.	S	1	99	N	--	88	48	88
68.-1. 147.	60.6709	-0.3294	131.	S	1	97	1	--	87	43	87
68.-1. 148.	60.5452	-0.3464	101.	GS	28	71	1	--	71	50	71
68.-1. 149.	60.6100	-0.2878	94.	S	6	94	N	--	90	52	90
68.-1. 151.	60.5642	-0.3365	92.	S	5	95	N	--	93	36	93
68.-1. 154.	60.3769	-0.7619	73.	--	--	--	--	--	37.	--	37
68.-1. 155.	60.3631	-0.7619	88.	GS	34	66	N	--	82	26	82
68.-1. 156.	60.3638	-0.7841	73.	GS	25	59	16	--	92	85	91
68.-1. 157.	60.3491	-0.7789	86.	S	7	93	N	--	93	51	93
68.-1. 158.	60.3391	-0.7889	91.	S	1	99	N	--	91	46	91
68.-1. 160.	60.3251	-0.7622	96.	GS	21	78	1	--	91	82	91
68.-1. 162.	60.3034	-0.7666	96.	SMG	54	29	17	--	18	22	19
68.-1. 163.	60.2936	-0.7567	94.	S	2	97	1	--	93	54	93
68.-1. 164.	60.2722	-0.8913	96.	S	1	93	6	--	76	40	74
68.-1. 165.	60.2548	-0.8836	102.	S	2	85	13	--	57	37	54
68.-1. 166.	60.2385	-0.8998	111.	S	2	94	4	--	80	40	78
68.-1. 167.	60.2660	-0.9469	72.	S	1	98	1	--	84	47	84
68.-1. 169.	60.2342	-0.9761	83.	GS	25	57	18	--	37	35	36
68.-1. 170.	60.2024	-0.9582	91.	S	1	98	1	--	88	51	88
68.-1. 171.	60.1793	-0.9041	110.	MS	2	78	20	--	46	69	51
68.-1. 172.	60.1382	-0.8936	127.	S	4	91	5	--	43	38	41

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
60.-1. 173.	60.1738	-0.8766	131.	S	1	97	2	--	26	54	27
60.-1. 174.	60.1483	-0.8217	111.	S	1	92	7	--	31	41	32
60.-1. 175.	60.1314	-0.7335	110.	S	1	96	3	--	30	40	30
60.-1. 176.	60.1751	-0.6122	118.	GS	28	72	N	--	77	N	72
60.-1. 177.	60.2314	-0.7240	115.	S	3	95	2	--	36	39	36
60.-1. 178.	60.2652	-0.7181	127.	S	6	92	2	--	60	38	60
60.-1. 180.	60.2193	-0.7902	105.	S	5	90	5	--	89	29	86
60.-1. 182.	60.1377	-0.9401	108.	GS	27	70	3	--	69	43	68
60.-1. 186.	60.3124	-0.9528	105.	S	1	98	1	--	24	38	24
60.-1. 190.	60.5552	-0.4053	90.	S	10	90	N	--	60	62	60
60.-1. 194.	60.5426	-0.7535	77.	GS	39	59	2	--	90	51	90
60.-1. 195.	60.6547	-0.8055	48.	SMG	68	32	N	--	94	50	94
60.-1. 196.	60.5859	-0.7839	66.	S	3	97	N	--	97	5	97
60.-1. 198.	60.8318	-0.5927	107.	S	16	84	N	--	84	59	84
60.-1. 200.	60.9373	-0.5920	126.	S	17	83	N	--	87	63	87
60.-1. 201.	60.9053	-0.4543	143.	S	22	80	N	--	78	59	78
60.-1. 202.	60.9941	-0.5682	137.	S	5	95	N	--	86	59	86
60.-1. 203.	60.9142	-0.8296	101.	G	93	7	N	--	81	60	81
60.-1. 204.	60.7677	-0.7372	86.	S	7	93	N	--	45	75	45
60.-1. 205.	60.7848	-0.6762	103.	G	82	18	N	--	75	71	75
60.-1. 206.	60.7253	-0.6094	116.	S	5	95	N	--	62	50	62
60.-1. 207.	60.7176	-0.5392	109.	S	1	99	N	--	84	68	84
60.-1. 208.	60.7175	-0.4941	120.	S	N	100	N	--	79	52	79
60.-1. 209.	60.7139	-0.2607	95.	S	5	95	N	--	72	72	72
60.-1. 210.	60.7587	-0.1960	97.	SMG	73	26	1	--	77	58	77
60.-1. 212.	60.8312	-0.3570	141.	S	1	98	1	--	88	51	88
60.-1. 213.	60.9433	-0.3615	108.	S	9	90	1	--	49	41	49
60.-1. 214.	60.9934	-0.5446	154.	S	5	95	N	--	93	62	93
60.-1. 215.	60.9055	-0.5801	132.	S	5	95	N	--	69	33	69
60.-1. 216.	60.9919	-0.7824	119.	S	19	81	N	--	84	57	84
60.-1. 217.	60.9527	-0.8809	110.	GS	44	55	1	--	85	47	85
60.-1. 218.	60.9553	-0.8200	100.	GS	48	52	N	--	81	64	81
60.-1. 220.	60.8631	-0.9895	102.	S	20	80	N	--	57	36	57
60.-1. 221.	60.8377	-0.9723	95.	GS	28	72	N	--	75	44	75
60.-1. 222.	60.7632	-0.9875	69.	SMG	63	37	N	--	80	54	80
60.-1. 223.	60.7984	-0.9949	86.	S	8	92	N	--	51	--	51
60.-1. 224.	60.5984	-0.9852	108.	GS	26	74	N	--	84	63	84
60.-1. 225.	60.8692	-0.9373	96.	GS	80	19	N	--	74	--	74
60.-1. 226.	60.9091	-0.7559	102.	SMG	76	23	1	--	93	49	93
60.-1. 227.	60.9055	-0.3922	141.	S	7	92	1	--	60	55	60
60.-1. 228.	60.9043	-0.1948	154.	S	7	91	2	--	43	47	43
60.-1. 229.	60.9098	-0.1533	161.	S	1	97	2	--	45	63	45
60.-1. 230.	60.8624	-0.3894	132.	S	4	95	1	--	57	49	57
60.-1. 231.	60.8269	-0.5022	100.	S	10	90	N	--	91	69	91
60.-1. 232.	60.7792	-0.5228	113.	S	1	99	N	--	89	58	89
60.-1. 233.	60.6933	-0.5594	132.	S	4	94	2	--	68	43	68
60.-1. 234.	60.6823	-0.6443	111.	S	1	99	N	--	70	44	70
60.-1. 235.	60.6538	-0.7818	79.	S	20	80	N	--	78	56	78
60.-1. 236.	60.5960	-0.7043	88.	GS	28	72	N	--	91	57	91
60.-1. 237.	60.5213	-0.4931	120.	S	2	95	3	--	72	43	71
60.-1. 238.	60.5064	-0.4285	91.	S	6	94	N	--	92	53	92
60.-1. 239.	60.5663	-0.3582	86.	S	4	95	1	--	95	62	95
60.-1. 240.	60.5693	-0.2783	99.	S	2	98	N	--	93	60	93
60.-1. 241.	60.5674	-0.2122	106.	S	N	100	N	--	91	81	91
60.-1. 242.	60.6012	-0.2063	95.	S	N	100	N	--	94	80	94
60.-1. 244.	60.6059	-0.2393	115.	S	1	98	1	--	64	73	64
60.-1. 245.	60.7120	-0.5578	102.	GS	24	75	N	--	66	50	66
60.-1. 246.	60.7143	-0.5615	101.	S	1	99	N	--	82	61	82
60.-1. 247.	60.7228	-0.6919	97.	S	15	85	N	--	83	36	83
60.-1. 248.	60.5361	-0.9266	102.	S	2	80	18	--	41	39	41
60.-1. 250.	60.5417	-0.8797	79.	GS	26	73	1	--	88	64	88
60.-1. 251.	60.5388	-0.9423	73.	S	17	81	2	--	88	87	88
60.-1. 253.	60.3860	-0.6291	97.	GS	27	72	1	--	78	40	78
60.-1. 256.	60.1802	-0.9741	81.	S	3	97	N	--	92	51	92
60.-1. 257.	60.1129	-0.9819	88.	S	19	81	N	--	69	49	69
60.-1. 258.	60.1003	-0.7093	121.	S	4	92	4	--	31	43	31
60.-1. 259.	60.1027	-0.5171	115.	S	1	98	1	--	36	43	36
60.-1. 260.	60.1232	-0.4365	132.	S	2	93	5	--	24	39	25
60.-1. 261.	60.1717	-0.3462	126.	S	1	96	3	--	23	37	23
60.-1. 262.	60.2373	-0.2243	130.	GS	33	65	2	--	23	33	23
60.-1. 264.	60.1650	-0.0241	126.	S	3	92	5	--	24	46	25
60.-1. 265.	60.2389	-0.0231	102.	S	1	98	1	--	31	42	31
60.-1. 266.	60.4061	-0.0483	120.	S	1	98	1	--	70	42	70
60.-1. 270.	60.1052	-0.7923	108.	S	2	90	8	--	53	37	52
60.-1. 271.	60.1257	-0.9269	100.	S	3	96	1	--	52	31	52
60.-1. 272.	60.1548	-0.9517	93.	--	--	--	--	--	92	--	92
60.-1. 273.	60.0273	-0.9738	110.	S	1	94	4	--	42	42	42
60.-1. 274.	60.0391	-0.7281	113.	S	1	97	2	--	35	46	35
60.-1. 275.	60.0631	-0.5183	117.	S	1	97	2	--	14	39	14
60.-1. 276.	60.0169	-0.5219	126.	S	1	97	2	--	25	32	25
60.-1. 277.	60.1027	-0.2119	119.	SMG	58	41	1	--	22	45	22

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
60.-1. 292	60.5418	-0.9642	91.	S	11	86	3	--	55	40	53
60.-1. 293.	60.5614	-0.9422	80.	S	10	89	1	--	42	44	42
60.-1. 294.	60.5852	-0.8892	47.	SMG	52	48	N	--	84	57	84
60.-1. 295.	60.5588	-0.8836	64.	GS	21	78	1	--	71	46	71
60.-1. 296.	60.5597	-0.8144	82.	GS	42	57	N	--	94	53	94
60.-1. 297.	60.5499	-0.7494	86.	GS	25	75	N	--	96	48	96
60.-1. 298.	60.5951	-0.7433	58.	S	13	87	N	--	95	63	95
60.-1. 299.	60.6179	-0.7342	78.	G	82	17	1	--	94	51	94
60.-1. 300.	60.6342	-0.8004	56.	GS	37	63	N	--	95	56	95
60.-1. 301.	60.6379	-0.8239	49.	S	8	92	N	--	83	--	83
60.-1. 302.	60.6458	-0.8532	47.	S	3	96	1	--	86	--	86
60.-1. 303.	60.6483	-0.7879	53.	SMG	76	24	N	--	94	45	94
60.-1. 304.	60.6786	-0.7153	95.	S	3	97	N	--	56	51	56
60.-1. 306.	60.2422	-0.3565	124.	S	1	97	2	--	31	44	31
60.-1. 307.	60.1472	-0.3082	135.	S	2	89	9	--	21	44	23
60.-1. 308.	60.1137	-0.4056	126.	S	1	95	4	--	20	39	21
60.-2. 1.	60.1193	-1.0435	59.	S	1	99	N	--	25	56	25
60.-2. 2.	60.1033	-1.0302	83.	GS	47	53	N	--	86	--	86
60.-2. 3.	60.0774	-1.0156	90.	SMG	66	33	1	--	91	53	91
60.-2. 4.	60.0350	-1.0481	93.	S	5	94	1	--	90	65	90
60.-2. 5.	60.0040	-1.0224	90.	SMG	57	46	3	--	85	64	84
60.-2. 6.	60.1071	-1.0069	80.	S	9	90	N	--	66	62	66
60.-2. 7.	60.0031	-1.0418	86.	GS	24	76	N	--	86	51	86
60.-2. 8.	60.0218	-1.0137	106.	S	6	91	3	--	44	50	44
60.-2. 14.	60.3829	-1.4973	120.	S	2	91	7	--	50	--	50
60.-2. 15.	60.7477	-1.5041	111.	SMG	62	38	N	--	60	--	60
60.-2. 16.	60.9869	-1.9730	213.	S	N	100	N	--	11	--	11
60.-2. 19.	60.7517	-1.0067	60.	S	78	22	N	--	77	--	77
60.-2. 22.	60.0917	-1.4750	86.	S	8	92	N	90	--	--	90
60.-2. 23.	60.0958	-1.5833	86.	S	N	100	N	76	--	--	76
60.-2. 24.	60.0917	-1.7250	70.	S	1	99	N	67	--	--	67
60.-2. 25.	60.2083	-1.7967	77.	S	6	94	N	76	--	--	76
60.-2. 26.	60.0917	-1.9450	71.	GS	22	78	N	72	--	--	72
60.-2. 27.	60.1750	-1.9667	73.	SMG	57	42	1	88	--	--	88
60.-2. 28.	60.1750	-1.8383	60.	GS	43	57	N	96	--	--	96
60.-2. 29.	60.1725	-1.7367	76.	S	18	82	N	93	--	--	93
60.-2. 30.	60.1683	-1.6617	77.	S	1	99	N	55	--	--	55
60.-2. 31.	60.2458	-1.7733	75.	S	19	81	N	83	--	--	83
60.-2. 33.	60.2472	-1.9992	25.	SMG	63	36	2	--	84	--	84
60.-2. 36.	60.4042	-1.8625	106.	S	1	98	N	37	--	--	37
60.-2. 41.	60.3961	-1.6345	85.	SMG	63	36	1	27	--	--	27
60.-2. 43.	60.4363	-1.5417	80.	S	16	84	N	72	--	--	72
60.-2. 44.	60.4308	-1.7233	84.	GS	38	62	N	90	--	--	90
60.-2. 46.	60.5317	-1.8200	116.	G	91	6	3	--	83	--	83
60.-2. 47.	60.6917	-1.6233	103.	S	2	98	--	81	--	--	81
60.-2. 50.	60.6064	-1.9024	111.	S	2	98	N	78	--	--	78
60.-2	53.	60.6050	-1.7133	113.	S	1	98	N	58	--	--	58
60.-2. 54.	60.6775	-1.4200	89.	GS	34	66	--	76	--	--	76
60.-2. 56.	60.9333	-1.3325	104.	S	6	93	1	83	--	--	83
60.-2. 58.	60.9733	-1.6633	137.	S	3	97	N	--	25	59	25
60.-2. 59.	60.9050	-1.6933	127.	S	2	98	N	55	--	--	55
60.-2. 60.	60.8367	-1.6592	137.	GS	21	79	N	34	--	--	34
60.-2. 61.	60.7583	-1.6892	104.	S	4	95	1	--	35	55	35
60.-2. 62.	60.7617	-1.4492	120.	S	1	99	N	89	--	--	89
60.-2. 63.	60.7783	-1.1667	95.	SMG	69	31	N	--	62	70	62
60.-2. 64.	60.9297	-1.1283	100.	S	20	80	N	63	--	--	63
60.-2. 67.	60.9057	-1.2458	107.	SMG	51	49	N	--	81	76	81
60.-2. 68.	60.9781	-1.3321	110.	S	15	85	N	57	--	--	57
60.-2. 69.	60.9650	-1.5083	130.	S	3	97	N	--	48	47	48
60.-2. 70.	60.9700	-1.8000	140.	S	4	96	N	--	31	49	31
60.-2. 71.	60.9050	-1.9233	133.	GS	20	79	1	--	22	50	22
60.-2. 72.	60.8292	-1.9250	113.	G	85	15	N	--	40	55	40
60.-2. 75.	60.8283	-1.7867	118.	GS	36	60	4	--	46	53	46
60.-2. 76.	60.5728	-1.2235	69.	S	12	88	N	--	83	--	83
60.-2. 78.	60.6243	-1.2363	91.	S	13	86	N	67	--	--	67
60.-2. 79.	60.5979	-1.2661	73.	S	1	97	1	--	61	--	61
60.-2. 80.	60.5873	-1.2665	76.	S	3	96	1	37	--	48	37
60.-2. 81.	60.5596	-1.2784	69.	S	19	80	1	79	--	--	79
60.-2. 82.	60.5550	-1.2460	85.	S	17	83	N	--	90	--	90
60.-2. 85.	60.4438	-1.1095	58.	S	9	89	2	62	--	46	62
60.-2. 86.	60.4400	-1.1200	62.	S	13	87	N	81	--	--	81
60.-2. 92.	60.4983	-1.1733	47.	G	99	1	N	--	83	--	83
60.-2. 94.	60.4650	-1.0833	40.	S	7	92	1	90	--	--	90
60.-2. 96.	60.4567	-1.0100	116.	S	15	84	1	90	--	--	90
60.-2. 99.	60.3890	-1.0083	87.	MS	1	69	30	--	58	46	52
60.-2. 100.	60.3233	-1.0533	66.	GS	31	69	--	88	--	--	88
60.-2. 101.	60.3233	-1.0100	49.	S	11	89	--	86	--	--	86
60.-2. 103.	60.2950	-1.0083	51.	S	5	86	9	--	91	67	89
60.-2. 105.	60.1750	-1.0067	82.	S	2	97	1	75	--	57	75
60.-2. 106.	60.1700	-1.0583	47.	S	14	86	N	90	--	--	90
60.-2. 109.	60.7067	-1.1600	38.	S	7	87	6	75	--	41	73

SAMPLE NUMBER	LAT	LONG	DEPTH M	SED TYPE	%G	%S	%M	%CC S&G	%CC S	%CC M	APP %CC TOTAL
60,-2, 110,	60,2283	-1,1017	56,	S	18	82	--	88	--	--	90
60,-2, 111,	60,2350	-1,1755	0,	S	11	81	8	70	--	39	67
60,-2, 113,	60,1033	-1,1900	40,	GS	44	56	N	60	--	--	60
60,-2, 114,	60,0767	-1,1900	64,	S	2	95	3	--	35	26	35
60,-2, 115,	60,[illegible]	-1,1400	73,	S	2	94	4	--	39	32	39
60,-2, 116,	60,2203	-1,1133	69,	S	5	93	2	80	--	50	87
60,-2, 117,	60,0267	-1,1983	47,	S	N	99	N	67	--	--	67
60,-2, 118,	60,0033	-1,1417	0,	S	22	78	N	96	--	--	96
60,-2, 119,	60,0014	-1,3890	93,	S	1	96	3	43	--	40	43
60,-2, 120,	60,1372	-1,3851	90,	GS	19	73	8	76	--	47	76
60,-2, 121,	60,1402	-1,4761	67,	SMG	78	22	N	95	--	--	95
60,-2, 122,	60,2456	-1,3913	49,	G	91	9	N	--	90	53	90
60,-2, 123,	60,0038	-1,3892	73,	S	6	94	N	--	95	48	95
60,-2, 124,	60,0023	-1,4722	127,	S	6	88	6	--	30	17	27
60,-2, 125,	60,0459	-1,4763	131,	MS	1	75	24	--	42	52	44
60,-2, 126,	60,0405	-1,5807	116,	S	1	95	4	--	50	43	50
60,-2, 127,	60,0935	-1,5483	98,	S	7	92	1	--	44	40	44
60,-2, 128,	60,0060	-1,4065	80,	S	0	100	N	--	53	52	53
60,-2, 131,	60,0071	-1,0548	93,	S	12	88	N	--	59	50	59
60,-2, 133,	60,0925	-1,8797	78,	S	25	75	N	--	93	52	93
60,-2, 134,	60,0972	-1,8031	80,	S	3	97	N	--	88	61	88
60,-2, 136,	60,0955	-1,8870	89,	GS	33	67	N	--	64	51	64
60,-2, 137,	60,0904	-1,4970	93,	S	3	96	1	--	83	54	83
60,-2, 138,	60,0024	-1,5421	127,	S	1	96	3	--	36	48	36
60,-2, 139,	60,0085	-1,7407	111,	S	6	93	1	--	69	65	69
60,-2, 140,	60,0533	-1,9261	91,	S	11	89	N	--	67	62	67
60,-2, 143,	60,1802	-1,8947	71,	S	3	97	N	--	94	87	94
60,-2, 144,	60,2197	-1,7382	84,	GS	23	77	0	--	94	61	94
60,-2, 145,	60,2848	-1,7882	35,	SMG	65	34	N	--	91	61	91
60,-2, 146,	60,2648	-1,8906	0,	G	88	12	N	--	98	76	98
60,-2, 148,	60,3752	-1,9298	96,	S	N	99	N	--	57	59	57
60,-2, 149,	60,4471	-1,9189	116,	S	0	98	2	--	28	39	28
60,-2, 150,	60,4331	-1,7914	104,	GS	33	66	1	--	69	30	66
60,-2, 151,	60,4365	-1,9080	116,	S	N	98	2	--	28	34	28
60,-2, 152,	60,6833	-1,5043	102,	S	4	95	1	--	94	60	94
60,-2, 153,	60,6476	-1,2398	85,	S	2	98	1	--	20	30	20
60,-2, 154,	60,7092	-1,2232	95,	S	N	100	N	--	32	33	32
60,-2, 155,	60,7805	-1,0450	82,	SMG	71	29	N	--	76	58	76
60,-2, 156,	60,7909	-1,2280	96,	S	3	96	1	--	77	82	77
60,-2, 157,	60,7977	-1,3740	124,	GS	46	53	1	--	66	87	66
60,-2, 158,	60,7214	-1,3703	106,	S	1	99	N	--	92	65	92
60,-2, 159,	60,7102	-1,5118	93,	G	97	2	1	--	88	75	88
60,-2, 161,	60,6303	-1,2667	82,	GS	40	60	N	--	43	46	43
60,-2, 162,	60,6200	-1,2533	71,	GS	14	84	2	--	50	38	50
60,-2, 163,	60,5750	-1,2867	102,	GS	20	78	2	--	40	36	40
60,-2, 164,	60,5503	-1,2753	96,	GS	25	74	1	--	94	87	94
60,-2, 165,	60,5203	-1,3017	91,	S	15	83	2	--	69	35	68
60,-2, 166,	60,5042	-1,3217	49,	S	N	80	20	--	30	37	31
60,-2, 167,	60,4037	-1,3617	44,	GSM	3	19	79	--	31	31	31
60,-2, 168,	60,4167	-1,3492	24,	GSM	7	32	61	--	56	29	38
60,-2, 169,	60,4308	-1,3375	46,	GSM	9	45	46	--	60	33	50
60,-2, 170,	60,4467	-1,3117	42,	MS	5	71	25	--	42	33	40
60,-2, 171,	60,4522	-1,2875	13,	GSM	7	22	70	--	47	25	30
60,-2, 172,	60,4640	-1,3117	33,	GS	25	56	19	--	34	24	31
60,-2, 173,	60,4880	-1,2975	44,	MS	2	56	43	--	24	33	20
60,-2, 174,	60,4967	-1,2083	53,	GS	30	59	11	--	38	34	38
60,-2, 175,	60,5503	-1,2667	84,	S	10	90	N	--	34	39	34
60,-2, 176,	60,5950	-1,2367	66,	S	1	99	N	--	45	43	45
60,-2, 177,	60,5317	-1,2200	68,	SMG	50	50	N	--	77	41	77
60,-2, 179,	60,6133	-1,2733	64,	S	12	88	N	--	83	51	83
60,-3, 1,	60,5042	-2,0049	129,	S	N	99	1	--	12	--	12
60,-3, 2,	60,7501	-2,0220	120,	GS	35	64	1	--	26	--	26
60,-3, 4,	60,2900	-2,0550	75,	SMG	72	27	1	--	96	33	96
60,-3, 5,	60,2542	-2,1333	98,	GS	39	60	1	--	42	42	42
60,-3, 6,	60,3300	-2,1500	120,	S	1	98	1	--	33	23	33
60,-3, 8,	60,3967	-2,1333	120,	S	1	98	1	--	38	34	38
60,-3, 9,	60,4742	-2,0067	115,	S	N	99	1	--	19	35	19
60,-3, 10,	60,4567	-2,0458	107,	S	N	99	1	--	57	83	57
60,-3, 11,	60,3084	-2,0788	93,	S	25	75	N	--	88	53	88
60,-3, 13,	60,2102	-2,0933	87,	S	3	97	N	--	85	50	85
60,-3, 14,	60,3921	-2,1537	91,	S	12	88	N	--	70	59	70
60,-3, 15,	60,3837	-2,0403	109,	S	2	97	1	--	14	38	14
60,-3, 16,	60,4637	-2,0777	109,	GS	33	66	1	--	38	46	38
60,-3, 17,	60,5370	-2,0761	137,	S	8	90	2	--	16	37	16
60,-3, 18,	60,6834	-2,0615	130,	SMG	70	29	1	--	50	50	50

APPENDIX 10

Carbonate petrography of selected samples from the SCS study-area.

Petrographic Data

Explanation:

No.	is the IGS sample number

<u>NB.1</u> Samples are grab samples unless otherwise stated(V=vibrocore)

Ba	is the % (volume) barnacle debris in the carbonate fraction
Bi	is the % " bivalve " " " " "
E	is the % " echinoid " " " " "
G	is the % " gastropod " " " " "
S	is the % " serpulid " " " " "
Br	is the % " bryozoan " " " " "
C	is the % " calcareous alga " " " "
F	is the % " foraminifera " " " "
D	is the % " *Ditrupa* " " " "

NB.2 Where these add up to less than 98% then some other (minor) carbonate constituent is present

Uk	is the %(volume) of unknown (unrecognisable) carbonate in the whole sample
NC	is the %(volume) of non-carbonate(lithic) material in the whole sample

gs	is the(average)visual grain size of the carbonate fraction
so	is the " " sorting " " " "
rd	is the " " roundness " " " "
pl	is the " " polish " " " "
st	is the " " staining " " " "
bo	is the " " boring " " " "

NB.3 See pp.31-36 and Table 2 for further explanation of textural parameters and scales used

NB.4 The data is mostly grouped under districts associated with carbonate deposits. For details of exact locations,water depths,PSA and carbonate analyses, see Appendix 9.

Gulf of Corryvreckan

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
SH38	14	68	1	3	3	9	1	0	2	2	4½	2	3	3	2	1

Passage of Tiree district

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
SH1	38	49	3	4	2	3	0	0	17	10	4	1	3	1	3	2
SH2	31	48	2	11	0	8	0	0	21	26	3	2	2	1	3	2
SH46	23	44	4	5	0	14	0	9	16	30	3½	1	1½	1	2	3
SH47	18	48	1	2	0	21	0	6	15	32	3	2	1½	1	2	0
SH63	56	27	4	4	2	4	1	2	13	4	4	1	3	3	2	1
SH64	69	22	3	3	5	7	0	0	16	2	4	1	3	3	4	3
SH66	29	33	4	0	7	18	0	6	6	4	4	1	3	3	3	2
SH85	30	43	4	1	1	6	1	5	11	26	3	1	2	1	3	3
SH256	38	42	4	5	5	6	0	0	1	56	4	1	2½	1	4	3
SH258	43	40	2	5	1	5	0	2	7	22	3	1	3½	1	2	3
SH259	52	12	3	9	9	1	14	1	10	1	3	1	2½	1	3	4
SH282	33	53	4	1	2	6	0	2	9	49	3	1	2	1	2	2
SH283	27	58	2	0	1	7	0	3	7	58	3	1	2½	1	2	2
SH347	26	34	6	4	17	6	4	4	9	37	3½	1	3½	1	3	2
SH348	27	39	6	15	11	2	1	0	2	64	3½	1	2	1	3	2
SH352	30	32	3	1	0	24	0	8	13	18	2	2	2	1	3	0
SH353	47	29	3	6	10	0	1	4	14	7	4	1	3½	4	4	0
SH435	47	22	4	6	7	10	1	3	27	8	3½	1	5½	4	1	0

Hawes Bank district

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
SH250	44	23	5	4	16	4	1	0	20	11	3½	1	4½	4	4	1
SH391	13	54	0	30	0	0	0	1	3	76	2½	1	2½	3	2	0
SH413	27	58	2	2	3	3	0	5	9	56	2	2	4	4	3	0
SH417	8	30	5	6	44	4	4	0	3	58	4	1	4½	1	2	3
SH563	27	53	1	1	9	5	0	3	12	58	4	1	3½	3	1	1
SH564	38	23	3	5	28	1	0	2	13	18	4	2	5½	4	4	1
SH774	17	28	2	16	23	6	0	7	11	62	4	1	3½	3	3	1

Sound of Eigg district

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
SH27	41	24	7	8	6	2	13	0	15	21	4	1	3	1	2	1
SH49	33	44	4	6	4	5	1	2	10	37	3½	1	1½	1	2	3
SH59	45	39	3	2	2	5	0	2	12	41	3	1	3	3	2	1
SH61	7	58	4	17	0	1	0	0	12	43	3	1	2½	3	0	0
SH166	78	19	1	1	1	0	0	0	5	52	3	1	1½	1	3	1
SH337	49	30	2	8	7	2	1	0	9	8	3½	1	2½	3	3	1
SH339	35	39	5	7	9	4	1	0	4	56	4	1	3	1	3	2
SH340	37	35	3	5	5	2	12	2	9	3	3½	1	3½	1	3	1
SH357	52	42	0	4	0	0	0	0	4	23	3½	1	1½	1	4	1
SH366	32	53	5	1	0	2	0	6	2	26	2½	2	2	-	-	-
SH367	9	43	3	28	0	2	0	8	2	51	3	1	1½	3	1	2
SH422	11	62	2	4	1	5	0	11	9	71	2	2	1½	3	0	0
SH424	42	30	3	8	8	2	1	4	12	38	3½	1	4½	3	2	0
SH432	25	50	8	4	3	4	1	4	8	45	3	1	2½	3	3	1

Rubha Nan Clach

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
SH11	52	18	4	7	7	4	2	5	4	70	4	2	3	3	1	1
SH12	48	23	4	6	12	3	1	2	10	4	4	1	3	1	2	2
SH13	25	42	8	4	0	15	0	4	3	25	3	1	1½	1	0	0
SH14	55	24	4	9	4	3	1	0	14	18	3½	1	2	1	2	2
SH15	35	48	5	1	1	2	0	7	3	70	2	2	2	1	0	0
SH16	25	54	7	1	0	10	0	2	2	47	2	2	1½	3	1	1

An Ceanich district

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
M270	25	35	5	7	2	7	13	6	16	23	4	1	3	1	1	4
SH7	42	17	8	8	18	6	0	0	9	43	4	1	2½	3	1	1
SH8	41	23	3	7	7	14	1	5	14	45	3	1	2	1	2	1
SH9	49	22	5	4	9	6	1	2	12	48	3½	1	1½	1	2	3
SH10	6	50	2	28	1	11	0	2	18	54	1	3	2	3	0	0
SH552	39	39	7	5	5	5	0	0	8	29	3½	1	3	1	2	3
SH553	31	42	9	3	8	4	1	1	5	19	4½	1	2½	1	2	2

Stanton Banks district

No.	Ba	Bi	E	G	S	Br	C	F		Uk	NC	gs	so	rd	pl	st	bo
SH717	5	32	7	8	31	13	0	3		5	19	4	2	4½	3	4	2
SH745	10	54	5	2	21	3	0	4		7	47	3½	1	4	3	2	1
SH757	2	33	2	3	41	15	0	1		9	15	4	1	4	3	2	2
Barra Head district																	
SH128	5	29	7	6	3	5	0	41		3	80	-	-	-	-	-	-
SH131	16	37	5	6	3	18	10	6		16	17	3	1	2	3	1	2
SH178	4	66	1	1	3	6	0	9		12	52	3	1	1½	1	1	3
SH193	13	55	5	2	0	5	5	12		7	43	2½	1	1½	1	1	1
SH305	22	39	4	5	5	17	0	8		17	7	3	1	5	4	1	0
SH306	9	39	3	1	2	38	0	7		13	1	3	1	3½	3	1	0
SH307	4	58	6	5	1	14	0	9		3	74	-	-	-	-	-	-
SH308	2	64	0	2	5	15	0	11		11	26	2	2	1½	3	0	0
SH328	21	70	4	1	2	2	0	1		21	46	3	1	1½	1	1	2
SH593	33	32	5	3	2	16	0	8		27	12	3½	3	3½	4	0	0
SH645	19	20	8	10	16	19	6	1		17	2	4	1	4	4	0	1
SH653	19	24	3	8	36	5	0	4		13	50	4	1	5	3	3	2
SH654	8	61	6	3	3	10	5	5		11	45	3½	1	3½	3	3	2
SH826	16	20	1	11	37	4	10	0		25	19	4	2	5	4	3	0
SH844	4	36	4	5	5	37	0	8		15	11	3	1	1½	3	0	0
SH845	10	60	4	1	1	15	0	10		31	13	1½	3	3	4	2	0
SH846	7	28	1	2	2	53	0	6		18	1	2	2	3	3	1	0
SH848	3	38	4	7	0	37	1	10		10	31	2½	2	2½	3	0	0
West Hebridean Platform																	
SC12	10	52	6	6	3	18	2	0		11	34	3	1	3½	4	4	0
SC30	5	31	11	9	18	22	0	4		6	40	4	1	5	1	1	0
SC32	3	34	17	9	17	17	0	2		6	61	4	1	4½	3	2	1
SC46	22	26	13	12	21	6	0	0		7	22	4	2	5½	4	0	0
SC47	23	23	12	14	19	9	0	1		8	9	4	1	3½	4	1	0
SC50	12	23	11	11	32	10	0	0		11	10	3½	1	4½	4	0	0
SC51	4	19	9	11	34	17	5	0		3	2	4	2	3½	1	1	4
SC56	6	35	21	8	10	18	0	1		6	5	3	1	3	3	2	0
Butt of Lewis district																	
SC38	7	43	4	8	15	24	0	0		12	13	3½	1	4	4	0	0
SC59	3	46	18	6	7	16	0	3		11	33	1½	3	1½	3	4	0
SC60	5	48	8	12	3	18	0	4		9	20	2½	2	3	3	3	0
SC61	15	52	9	6	7	10	0	1		4	32	3	1	3	3	3	0
SC64	5	71	6	5	1	11	0	1		13	38	1½	3	3½	4	3	0
SC65	9	62	6	9	3	9	0	1		11	26	3	2	3½	4	3	0
SC66	3	75	4	6	2	9	0	1		14	28	1½	3	4	4	3	0
SC72	12	52	8	9	6	9	0	4		4	35	3	2	3½	3	4	0
SC73	15	57	7	4	5	8	0	2		3	51	3	1	3	3	4	0
SC76	1	56	6	7	0	23	0	5		12	30	3	2	1½	3	0	0
SC77	5	39	2	8	3	37	0	7		9	29	2	2	1½	3	0	0
SC78	15	39	12	7	9	14	0	3		5	9	3½	2	4½	4	2	0
SC79	17	23	6	8	11	28	3	2		3	11	3½	1	3½	3	0	0
SC80	4	52	7	7	4	19	0	8		8	24	2½	2	2½	4	0	0
NS176	5	46	3	0	0	32	0	14		6	32	2	2	2	0	0	0
NS187	10	74	1	2	3	5	0	6		13	22	2½	2	2½	3	2	0
NS189	13	56	3	1	3	8	0	16		10	57	3½	1	4	4	2	1
NS211	15	75	0	0	0	7	0	3		17	49	2½	2	3½	4	3	0
NS297	5	50	6	2	3	18	0	15		18	23	1	3	1½	3	0	0
NS301	4	51	7	0	0	22	0	14		11	13	1½	3	2½	3	0	1
Hebridean Slope																	
SH783	1	37	9	4	1	19	0	6	22D	2	28	4	2	3	3	1	3

Hebrides, miscellaneous

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
M297	19	55	9	1	7	0	0	9	11	60	-	-	-	-	-	-
M316	11	60	8	3	3	4	0	11	4	78	-	-	-	-	-	-
NS209	5	30	6	0	1	4	0	55	14	66	2½	1	3	1	0	0
SH21	38	43	4	1	0	3	0	11	7	48	2½	1	2½	1	0	0
SH89	23	50	4	3	1	6	1	5	6	56	3½	1	1	2	0	1
SH96	11	74	7	7	0	0	0	0	1	96	-	-	-	-	-	-
SH121	39	42	3	2	1	7	1	1	7	14	-	-	-	-	-	-
SH158	21	56	5	0	0	11	0	6	10	37	3	2	3	3	1	0
SH238	58	27	3	3	3	5	0	0	3	2	3½	2	3	1	3	3
SH238V	41	44	3	7	2	0	0	2	1	59	-	-	-	-	-	-
SH239	54	25	3	9	2	5	0	2	2	34	-	-	-	-	-	-
SH287	39	43	3	5	5	2	0	2	15	40	2½	1	4½	4	2	0
SH288	65	22	3	7	1	2	0	0	19	35	3	2	5	4	3	0
SH345	6	62	3	1	1	7	0	15	15	58	3	3	1½	4	0	0
SH404	0	56	6	0	15	11	0	9	6	61	1½	2	1½	1	1	0
SH420	15	69	5	3	3	1	2	2	6	58	4	1	1½	3	1	1
SH450	55	29	3	7	3	1	0	3	17	7	4	1	2½	1	2	2
SH485	5	54	0	6	6	15	1	12	11	72	-	-	-	-	-	-
SH502	40	41	4	8	0	3	0	3	3	35	3½	2	3	3	3	1
SH536	9	77	0	1	1	0	0	7	7	74	2	2	1½	3	0	0
SH585	9	69	1	3	7	0	1	4	5	39	3½	3	3½	3	4	0
SH735	8	50	8	1	1	23	0	8	11	18	2	2	1½	1	0	0

Cape Wrath district

No.	Ba	Bi	E	G	S	Br	C	F		Uk	NC	gs	so	rd	pl	st	bo
M285	3	65	3	2	2	18	2	5		8	50	2	2	2½	1	2	2
NS9	14	53	5	5	17	3	0	3		10	70	4½	1	5	1	2	2
NS46	9	62	3	4	7	12	1	2		12	42	3	2	3	2	2	0
NS47	35	36	4	6	8	7	0	5		19	16	4	2	4	2	2	0
NS49	10	49	14	3	10	6	0	8		9	29	4	2	4	2	2	1
NS50	20	24	7	3	3	12	11	20		1	94	-	-	-	-	-	-
NS154	5	59	12	4	3	9	0	7		7	21	3½	1	3½	3	2	2
NS155	18	54	4	4	7	9	2	3		9	12	3½	1	3	3	2	2
NS195	12	19	2	5	54	5	1	2		11	46	4	1	5	4	3	0
NS220	7	82	5	0	0	0	0	6		6	86	3	3	5	4	2	0
NS222	29	29	8	5	13	6	1	9		12	70	4	1	4	3	1	0
NS237	19	58	13	0	0	4	0	6		17	52	3½	1	3	3	2	3
NS293	11	62	5	0	4	12	0	7		9	46	4	1	3	4	0	0

Nun Bank district

NU1	24	36	10	5	19	7	0	0		2	54	3½	1	4½	3	1	1
NU2	17	25	10	7	25	15	0	0		1	10	4	2	4½	4	0	0
NU5	14	34	10	5	10	24	0	4		2	23	4½	2	4½	4	0	0
NU6	17	45	7	2	13	12	0	3		4	44	4½	2	4	4	0	0
NU7	13	21	15	11	21	15	0	4		1	17	4	2	4½	3	1	0
NU10	4	32	4	6	39	14	0	2		1	18	4½	1	4½	3	1	0
NU11	3	52	16	2	6	3	0	18		1	63	3½	2	3	3	2	1
NU12	1	57	13	1	5	12	0	12		1	49	4	1	3	1	2	2
NU13	10	37	15	3	6	21	0	8		2	25	4	1	4	4	0	0
NU14	7	39	7	3	22	17	0	6		2	46	4	1	4	4	0	2
NU15	8	40	6	4	21	19	0	3		1	46	4	1	3½	3	2	2
NU16	8	33	13	1	12	23	0	9		1	15	4	1	3	1	2	0
NU17	4	62	12	1	4	6	0	11		0	58	3½	1	4	1	2	3
NU18	0	48	16	3	8	4	0	21		2	74	3	2	3	3	2	0
NU19	2	54	8	2	22	2	0	9		0	57	4½	1	4	1	2	1
NU20	2	31	8	4	36	8	0	9		2	28	3	1	3	1	2	2
NU21	2	33	7	1	4	48	0	5		1	14	3	1	3	1	0	0
NU23	12	34	10	3	25	13	0	3		2	45	4	1	4	3	0	0
NU24	5	37	5	3	42	4	0	3		2	2	4	1	3	3	0	0
NU26	12	47	6	3	15	12	0	6		3	34	3½	2	4	3	0	0
NU27	9	35	12	2	4	28	0	9		3	20	3	2	3	1	0	0
NU28	2	63	14	1	2	5	0	13		2	56	2½	2	3	1	2	0
NU29	1	52	14	2	8	6	0	17		1	65	3½	1	3	3	2	0
NS244	27	52	5	1	1	9	0	4		14	38	3½	1	4½	4	0	0
NS252	17	56	4	2	14	3	1	2		7	43	3½	1	4	3	2	2

Solan Bank district

NS81	7	43	8	8	23	8	0	1		5	20	4	3	5	4	1	2
NS82	4	36	8	10	17	24	0	0		6	20	4½	2	5	3	0	0
NS84	6	42	11	5	9	20	0	4		0	0	4	2	3½	3	1	2
NS86	2	32	5	3	0	12	0	2	30D	3	41	3½	1	2½	1	4	4

Northern Slope

NS72	0	22	4	1	1	8	0	5	44D	3	38	3½	2	3	1	2	2
NS109	2	44	13	1	7	0	0	2	30D	3	50	3	1	3½	3	2	0
NS115	3	36	7	3	0	10	0	16	23D	1	16	3	2	2	1	1	1
NS117	3	40	10	4	2	10	0	8	22D	2	53	3½	1	3	3	2	1

Northern Shelf, general

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
NS16	0	57	5	5	0	25	0	3	9	33	2	3	2½	3	0	0
NS32	24	67	2	1	1	2	0	4	12	55	3½	2	3	3	0	1
NS56	3	33	4	3	30	16	0	3	2	45	4	2	3½	3	2	1
NS57	3	36	9	4	19	18	0	6	8	24	3½	2	4	3	1	1
NS69	1	53	4	0	0	15	0	13	1	47	3	3	3	4	3	0
NS90	3	43	5	0	2	20	0	17	7	39	1½	3	3	3	2	0
NS91	1	46	10	2	2	10	0	8	5	44	3	1	3	1	2	0
NS93	0	41	10	8	0	12	0	8	7	21	3½	2	2	1	2	3
NS94	5	17	2	2	1	4	0	1	2	17	4½	2	3	1	1	3
NS95	0	44	14	7	1	12	0	11	5	56	3½	2	3½	1	1	2
NS238	4	72	3	0	0	13	0	9	12	70	2½	2	3	1	2	1
NS245	14	42	2	7	25	7	1	3	10	54	5	2	3	3	2	2
NS257	34	41	7	4	3	7	0	4	10	66	3	2	3½	3	0	1

Fair Isle Channel

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
NS18	8	26	10	5	5	40	0	6	6	11	3	2	2½	1	0	0
NS21	13	33	4	14	22	14	0	0	1	2	5	2	4½	3	0	0
NS22	2	37	8	4	6	37	0	5	2	3	3½	2	3	3	2	0
NS24	12	28	7	4	7	16	0	7	3	16	3½	2	3	1	2	1
NS25	9	40	10	4	7	21	0	7	5	13	3½	2	3½	3	0	1
NS26	5	47	12	3	3	16	0	7	5	28	2½	1	3½	3	0	0
NS123	0	27	12	2	3	48	0	6	16	10	2½	1	3	3	2	1
NS127	2	36	7	1	2	18	0	19	3	14	4	1	2½	1	2	1
NS135	3	42	18	3	12	23	0	0	5	13	4	1	3	4	2	1
NS136	13	27	3	8	32	17	0	0	1	2	4½	1	3½	3	0	0
NS137	5	39	8	4	21	21	0	1	2	11	4	1	4	4	0	1
NS138	6	23	12	6	17	35	0	1	3	1	4½	1	3½	1	0	0
NS139	2	33	8	6	23	26	0	0	4	3	4	1	3	4	0	0
NS141	1	29	7	8	27	23	0	6	2	10	4	1	4	1	1	1
NS144	4	39	11	3	7	29	0	7	5	6	4	1	3½	4	0	0

North Orkney

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
OR61	31	34	4	10	15	6	0	0	3	1	4	2	4½	4	0	0
OR35	20	45	7	5	11	11	0	1	3	1	3½	1	4½	3	1	4
OR37	30	38	2	3	22	4	0	0	10	2	4	1	5	4	2	2
OR131	28	48	4	5	12	2	0	1	7	2	4	1	5	4	3	1
OR132	32	34	5	6	14	8	0	1	4	0	4	1	5½	4	3	0
OR134	19	36	3	4	37	1	0	0	5	3	4	1	5½	4	3	1
OR135	24	38	2	4	28	4	0	0	5	3	4	1	5½	4	2	1
OR137	23	52	3	5	14	3	0	0	3	7	4	1	5½	3	0	2

Orkney Sounds

No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
OR26	9	68	7	5	7	3	0	2	3	59	3½	1	3½	3	2	0
OR54	11	61	4	2	8	3	10	1	5	8	4	1	4	3	1	1
OR56	6	64	3	1	1	20	0	4	3	50	2½	2	2	3	2	0
OR57	1	70	0	0	0	21	0	7	3	55	2	2	2	3	1	0
OR79	34	47	5	2	6	2	2	1	6	12	4	2	5	4	3	1
OR89	9	71	5	3	5	5	1	1	5	2	4	1	4½	1	0	4
OR138	29	60	4	1	1	0	0	5	9	44	3½	2	4	4	3	0

East Orkney

No.	Bi	Ba	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
MF490	24	49	5	2	12	4	0	4	3	14	4½	1	4	1	4	4
MF491	1	37	4	2	3	36	0	18	3	16	1	2	1½	3	2	0
MF809	12	40	5	2	6	24	0	11	3	21	3½	2	3½	3	3	2
MF810	4	39	1	1	1	36	0	18	3	19	1	2	2½	3	2	1
OR33	50	34	5	5	4	1	0	1	12	3	4	1	5	4	2	0
OR44	6	63	2	2	1	17	0	8	14	2	2	2	3	3	2	1
OR45	40	44	5	0	3	6	0	2	13	3	3	1	2½	3	2	0
OR46	25	42	5	1	0	19	0	7	6	8	3	1	3	1	2	3
OR48	16	55	5	3	1	10	0	10	7	15	3	1	4½	3	2	0
OR76	13	59	3	0	1	17	0	6	16	6	3½	1	3	3	3	0
OR111	33	49	4	4	3	1	3	2	13	22	3½	2	4	1	3	1
OR112	15	65	3	0	0	9	0	8	10	31	2	2	1½	3	0	0
OR116	16	45	5	6	14	13	0	1	4	3	3½	1	3½	3	1	3
OR118	10	48	3	0	0	31	0	9	12	10	3	2	2½	3	3	0
OR119	8	62	4	0	0	20	0	7	14	10	3	2	2	3	3	0
OR120	11	46	6	0	0	25	0	12	7	4	2½	3	2	3	3	2
OR121	14	56	3	0	0	21	0	6	7	8	3	2	2	3	3	0
OR140	18	52	2	2	2	16	0	8	17	9	2½	1	2	1	2	1
OR141	12	64	5	2	3	6	0	8	13	8	2½	2	4½	4	3	0
OR160	7	64	2	0	0	18	0	10	11	7	2½	3	1½	3	3	3
OR161	5	47	1	0	0	31	0	15	18	5	2	2	1½	3	3	0
OR162	13	61	2	0	0	16	0	7	4	12	3	1	1½	3	3	0
OR163	3	50	2	0	0	35	0	9	6	24	3	1	1½	3	3	0
58-03/1	17	57	6	5	12	2	1	0	7	5	3½	1	3	1	1	3
58-03/2	14	50	4	7	24	1	0	0	3	15	4	1	3½	3	2	3
58-03/2V	17	50	7	7	17	1	0	0	8	22	3½	1	2½	3	1	2

West Pentland Firth

NS37	32	36	3	3	7	12	0	6	15	8	4	2	4	3	2	3
NS39	38	29	5	9	13	4	0	2	3	7	4½	1	5	4	2	1
NS40	21	53	4	5	5	8	0	3	4	21	4	1	3½	3	2	1
NS147	23	39	3	5	7	21	0	3	3	38	2½	1	2	4	0	0
NS148	16	55	7	7	8	0	0	0	3	30	3½	1	3½	4	4	0
NS149	34	46	3	5	6	3	0	2	6	19	2½	1	3½	3	4	0
NS294V	23	56	3	4	4	4	0	6	5	25	4	1	2½	3	1	0

Sandy Riddle

PS1	40	37	4	3	4	10	0	1	8	1	4	2	4	4	2	0
PS2	34	27	3	4	8	23	0	1	3	1	4	2	4	4	2	0
PS3	29	27	2	6	9	25	0	1	5	1	4	2	3½	4	1	0
PS4	42	27	2	5	8	15	0	2	24	15	3½	1	3½	3	2	2
PS5	45	27	4	5	11	7	0	1	2	4	4	2	4½	4	4	0
PS8	38	39	4	4	9	6	0	0	5	3	4	2	5	4	4	0
PS9	39	34	3	3	12	6	0	4	3	23	3	1	2½	1	1	2
PS10	25	52	3	9	5	6	0	1	5	9	3½	1	5	4	3	0
PS11	53	11	2	5	25	2	0	0	3	5	4	2	5	4	2	2
PS12	45	18	3	7	26	2	0	0	4	7	-	-	-	-	-	-
MF393	21	48	6	4	9	9	0	2	1	16	4	1	3	3	1	1
MF408	13	8	1	1	75	2	0	0	1	14	4	3	5	3	3	1
MF409	15	31	5	2	7	20	0	13	3	20	3½	3	2½	3	2	0
MF487	1	45	3	1	5	20	0	23	5	39	2½	2	1½	3	2	0

Moray Firth district

MF327	29	34	8	5	9	14	0	1	4	7	3	1	2½	3	2	1
MF328	21	51	7	2	9	10	0	0	5	17	4	1	3	3	2	2
MF388	19	42	8	2	5	19	0	4	5	34	3½	1	3½	3	1	2
MF391	27	35	10	7	2	11	0	7	4	32	3½	1	2½	1	3	4
MF395	12	67	5	2	3	8	0	2	5	21	3½	1	3½	3	0	2
MF790	12	28	2	1	1	30	0	25	3	15	2½	1	1½	1	2	2
MF791	14	43	3	1	2	18	0	19	2	47	2½	1	1½	1	2	4

West Shetland district

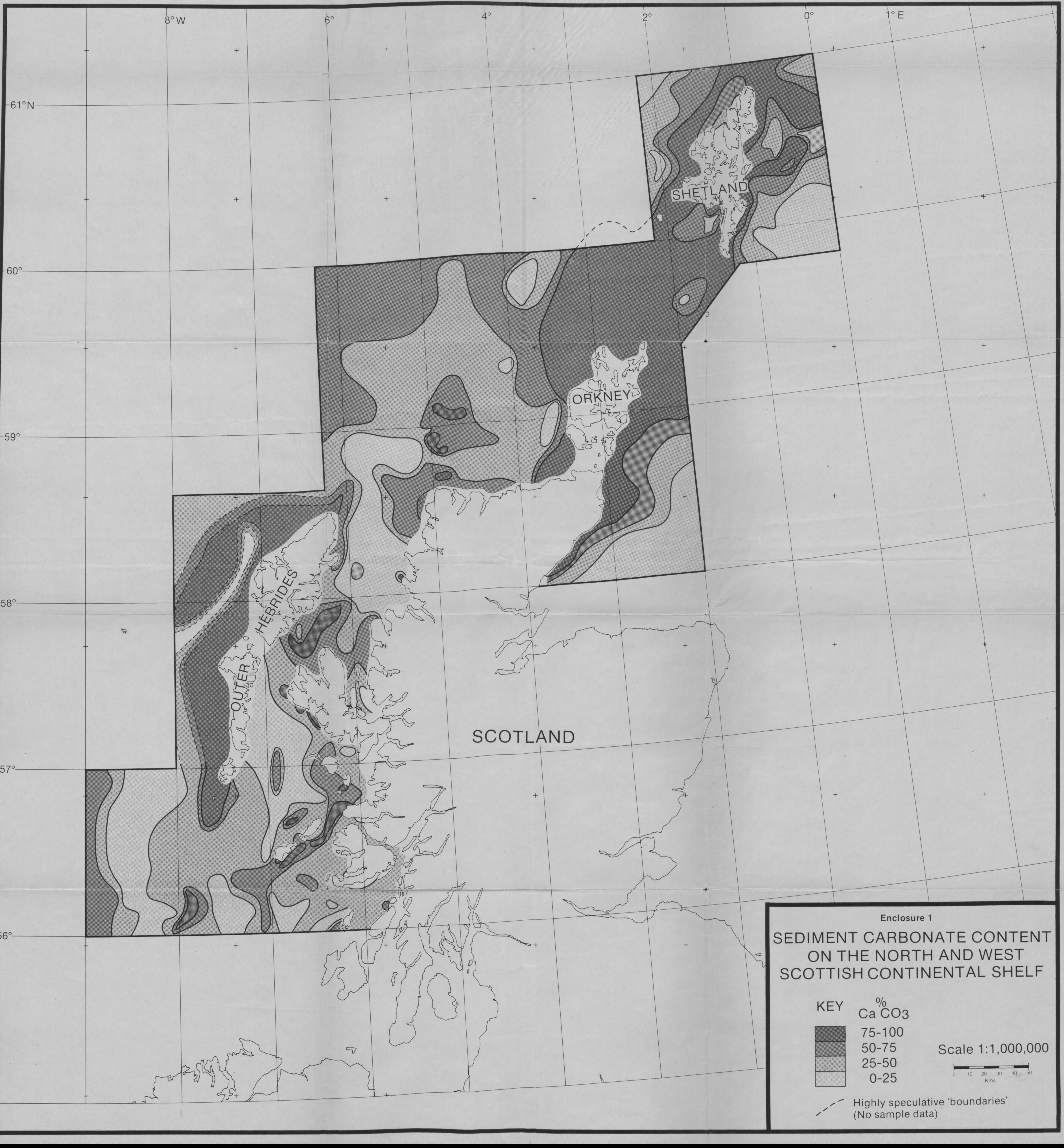
No.	Ba	Bi	E	G	S	Br	C	F	Uk	NC	gs	so	rd	pl	st	bo
60-02/22	19	36	3	2	31	7	0	3	12	8	4	1	2½	1	3	2
" /23	8	51	7	1	7	18	0	7	76	30	2½	2	31	3	1	0
" /24	3	57	9	1	12	10	0	8	8	29	3½	1	3	3	2	0
" /25	7	55	5	6	14	9	0	4	10	14	2½	1	3	3	2	2
" /26	20	43	3	1	23	4	0	3	6	15	4	1	4	3	0	2
" /27	10	65	2	3	10	9	0	2	3	5	3	1	4	1	2	4
" /28	9	41	6	6	14	22	0	1	7	1	4	1	4½	3	0	0
" /29	6	42	10	6	18	10	0	5	6	8	4	1	3	3	3	4
" /30	7	42	4	2	21	13	0	11	11	37	3½	1	3	3	2	2
" /31	10	36	8	4	27	11	0	3	4	11	4	1	3½	3	1	3
" /32	13	37	1	4	36	6	0	0	2	14	4	1	5	3	0	3
" /36	6	49	9	1	8	13	0	13	4	56	2½	1	2½	3	3	1
" /41	9	49	7	3	17	10	0	4	2	70	3½	1	2	1	3	3
" /43	13	57	3	4	13	8	0	2	4	26	4	1	2	1	3	4
" /44	6	20	2	2	66	3	0	1	3	8	4½	3	5½	1	3	3
" /46V	5	48	8	0	16	9	0	15	4	23	3½	2	2½	3	4	2
" /47	2	58	9	1	13	9	0	7	3	19	3½	1	4	1	2	2
" /50	2	33	26	1	17	13	0	8	3	15	4	2	3½	1	2	3
" /53	7	52	18	1	2	2	0	17	3	19	3	2	3½	1	3	4
" /54	10	45	5	3	30	4	0	3	5	16	4	1	2½	3	4	2
" /56	6	39	16	5	9	8	0	17	0	10	3½	1	2½	1	4	3
" /57	5	37	14	4	11	14	0	15	1	38	4	1	4	1	2	4
" /59	2	34	19	6	9	4	0	20	6	42	2½	2	2	3	2	2
" /60	2	35	26	2	6	6	0	21	3	62	3	1	2½	1	1	2
" /62	8	45	14	2	10	5	0	11	3	14	4	2	3	3	1	2
" /64	4	52	9	2	6	14	0	12	2	46	3½	1	3	1	2	2
" /68	3	64	5	2	8	2	0	11	1	38	3½	1	5	1	3	3
" /75	0	29	16	2	14	4	0	30	2	50	3½	1	2	1	3	4
" /119	4	48	19	1	2	4	0	23	1	54	2	3	2	3	0	0
" /120	8	62	8	3	7	2	0	10	1	18	4½	2	4	1	4	4
" /121	24	50	2	3	19	1	0	2	0	0	4½	1	3½	1	3	3

Shetland - Out Skerries district

60-02/100	6	42	16	8	12	11	0	4	1	8	4	1	4	3	3	2
" /101	12	50	18	3	5	8	0	4	2	12	4	1	3	3	2	2
" /105	3	43	19	1	1	7	0	25	2	23	3½	2	2½	1	3	3
" /106	18	65	3	3	10	0	0	0	0	9	4	2	3	1	1	0
" /109	7	57	7	3	1	3	0	21	1	24	3	1	2	1	1	3
" /110	8	49	3	3	33	1	0	2	0	11	4	1	5½	3	4	2
" /111	8	57	8	3	1	3	0	20	1	31	3	1	2½	1	0	4
" /113	30	44	1	11	14	0	0	0	0	25	4	1	4½	3	3	1
" /116	13	44	23	4	2	6	0	9	2	8	3½	1	3	1	1	3
" /117	5	60	11	3	1	4	0	16	2	31	2	2	2½	4	2	0
" /118	14	39	8	4	25	6	0	5	1	1	3½	1	3	3	3	3

Yell Sound district

60-02/76	4	57	11	1	22	2	0	3	1	19	3½	1	2½	3	2	2
" /78	7	48	16	5	8	8	0	9	1	36	3	1	2½	1	2	4
" /79	2	49	16	4	3	17	0	9	1	42	3½	1	2	3	2	1
" /80	4	49	16	2	4	12	0	12	1	58	3	2	2	3	2	0
" /81	5	57	11	2	5	6	0	13	1	27	3	1	2½	1	2	3
" /82	4	50	13	1	24	4	0	4	2	18	3½	1	2½	1	3	4
" /85	5	60	16	0	4	7	0	7	2	36	3½	1	2	1	0	4
" /86	2	74	10	0	4	6	0	4	2	14	3½	1	3	1	0	4
" /94	9	54	18	3	4	4	0	7	5	7	4	1	3½	1	2	3
" /96	7	61	14	2	2	7	0	7	1	3	3½	1	2	1	1	4



Enclosure 1

SEDIMENT CARBONATE CONTENT ON THE NORTH AND WEST SCOTTISH CONTINENTAL SHELF

KEY % Ca CO3

▨ 75-100
▨ 50-75
▨ 25-50
▨ 0-25

Scale 1:1,000,000

Highly speculative 'boundaries' (No sample data)