

Continental Shelf Northern Unit

Internal Report No. 77/15

M.V. EMERALD CRUISE REPORT - LEG 5

27 September - 10 October

1977

77/EM/06

by

R. Holmes

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Personnel

R. Holmes	Continental Shelf Northern Unit	Senior Scientist
C. Himsworth	CSNU	
N.A. Ruckley	CSNU	
J. McGuigan	CSNU	
R. Sutherland	CSNU	
D. Long	Engineering Geology Unit, Edinburgh	
A. Forster	Engineering Geology Unit, London	
A. Davis	Analytical and Ceramics Unit, London	

Introduction

Leg 5 was the last leg of the 1977 "Emerald" shallow sampling cruises for IGS. The aim was to complete routine sample stations between 57°N and $57^{\circ}30'\text{N}$ before moving onto complete unsampled or inadequately sampled 1:100,000 Sheets between 56°N and 57°N and 00°W to 2°E . Vibrocore sample stations were planned in advance from a knowledge of geology interpreted from shallow seismic coverage and were occupied whenever weather and daylight hours permitted.

Equipment Report

No major problems were experienced with the grab, dredge or gravity corer. One grab suffered a broken spring and was replaced. The gravity core wire rope was spliced on three occasions when wire strands parted during rough weather. The following faults were found with the vibrocorer.

4.10.77 Cable snarled in main hoist wire was crushed and split, subsequently 4 buoys were taped to the electric cable just above the polythene sheathing to prevent this happening again, and the technique was successful.

5.10.77 Inboard male plug failure - hole blown in plug insulation.

6.10.77 Screening strands penetrated power cable insulation

on power cable join approximately 100m from pot - caused appearance of 1 phase down at pot end.

8.10.77 No recovery despite apparently perfect core run (with piston approximately 4m up liner) - reason for no recovery not apparent. After the first vibrocorer run (which showed a partially inverted double core catcher on recovery) a triple core catcher was used.

The method of vibrocore recovery over the stern of the ship was efficient until the vibrocorer was clean of the water and the winches were manipulated to bring the vibrocorer horizontally on to the deck. Although the ship was inherently very stable, a small ship movement tended to start the vibrocore swaying from side to side when poised above the deck, thus endangering the ship's officer in charge of recovery operations. It was thought that if the same method was used in future operations safer operations could be made in marginal weather by clipping running wires or ropes to the legs of the vibrocorer, these anchor wires being controlled by tension run through blocks on both sides of the vibrocorer.

Analytical Report

The samples were taken for the following analyses:

Vibrocore: geological description completed on board ship, and whenever possible engineering tests:

- a) Undrained sheer strength, peak and residual (lab. vane and hand vane) - on board ship.
- b) Undrained compressive strength (hand penetrometer) - on board ship.
- c) Moisture content and degree of saturation ('ring test')

- d) Bulk density, saturated density and dry density ('ring test').
 - e) Void ratio and porosity ('ring test')
 - f) Atteburg limits, specific gravity, particle size analysis.
- (Tests c, d, e, f were carried out at land lab.)

Gravity core: geological and engineering tests as above where possible.

Grab sample: geological description, particle size analysis, micropalaeontology.

Cone dredge: cone dredge, micropalaeontology (if not taken from grab), geochemical analysis (samples deep frozen on ship).

Geological Report (please note all figs are at back of this report.)

The following observations and speculations are made on the basis of results from leg 5 of Cruise 77/EM/06 only.

1:100,000 sheet 57°30'N 01°W

Superficial sediments are characteristically monotonous muddy very fine to medium sands which are siltier and finer with increase of water depth, which varied from approximately 90m to 120m. There is no similar gradual relationship between sorting index and depth and although sands clean of clay and silt were always found in less than 95m water depth, muddy sand was also found in this depth range. Most sands are moderately sorted.

These 3
types of
sampling
described
in
the
text.

The lowest carbonate values (1-5%) were found in the shallowest waters (<95m) whilst some of the highest carbonate values (>30%) were found in the deepest waters (up to approx. 120m). This relationship is thought to exist because small fragments of thin walled carbonate are hydraulically equivalent to fine grained quartz sand (rather than the deep waters being a source of such carbonate).

In gravity cores muddy sands and clean sand changed from surface olive grey or olive (5Y) downwards to a more brownish or darker olive grey below the first few centimeters, the colour change also corresponding to an increase in silt. The colour changes originate both from redox changes and matrix composition.

'Surface sand' isopach contours were constructed from gravity core data - Fig. 1. The thickness of 'surface sand' is defined as the thickness of sand of broadly the same size and composition as the superficial sand proper (sampled by cone dredge and grab) to its junction with clays below. From the descriptions of sand variations given above it is obvious that much of the 'surface sand' so defined is out of equilibrium with present day environments and is probably much older than superficial sands. In addition the deeper surface sand is probably contaminated by biological reworking from clays, which are usually less than 50cms below such sands (Fig. 1). Biological reworking agents will include Nephrops norvegicus which is fished extensively in this area and which may form burrows up to 100cms below the sea bed. There is no apparent correlation of the thickness of 'surface sand'

Fig 1a.

with water depth/or with the nature of the underlying clay.

The clays cored in this area are soft to very soft and from previous research it is probable that they are Late Glacial. The softest clays in the deepest waters are equivalent to the Witch Ground Beds (see Rep.Inst.Geol. Sci. No. 77/1⁴5). In the shallower waters it is possible that due to the small thicknesses of sand above the clays that the soft clays represent relatively recently reconstituted clays originating from older overconsolidated clays below.

1:100,000 sheets 56°30'N 01°E; 56° 00'N 01°E; 56°00'N 00°W

The area is characterised by a cover of monotonous olive or olive grey very fine to medium quartz sands. These sands usually contain a fine admixture of dark coloured lithic fragments of less than 2% of the total volume, and shell carbonate usually appears to constitute less than 5% of the total volume, although due to the fine nature of much of the sediment the carbonate could be badly underestimated.

'Surface sand' (as defined previously) is greater than 20cms thick over greater than 50% of the total area (Fig. 2). The thickness of this sand is apparently unrelated to present day topography. (Fig 3a) However, the geological picture is complicated by the widespread occurrence of fine to very fine, very well sorted silty sands which form widespread sub-surface Late Glacial deposits in this area and which merge almost imperceptibly with the true surface sands above (These sands are equivalent to the Marr Bank Beds, and lowest

series of Upper Channels, see Rep. Inst. Geol. Sci., No. 77/14). Indeed, these Late Glacial Sands, could be the source for most of the very well sorted 'surface sands' which dominate the southern part of the study area, and the sorting index may not therefore be reflecting fully stabilized modern conditions.

It is also noteworthy that the largest areas of poorly sorted sand correlate with the areas of the thinnest 'surface sand' (Figs. 2, 3). (The data for thin sand <20cm to <10cm in blocks 28/19, 20, 24, 25 (Fig. 2) is not good, only being controlled by 2 sample stations and several other stations where the core catcher had pulled through and where it was assumed stiff clays were sampled below thin sand cover.) The areas of thin sand in these cores appear to overlie subcrops of stiff clay very near to the sea bed. Such clays have been proved in the Auk Field nearby (Fig. 2) to consist of stiff to hard marine clays commonly containing a mud supported admixture of dropstones, including quartz, which were deposited from floating ice. It is tentatively suggested therefore that large areas of poorly sorted superficial sands could originate as dispersion haloes from such clays and reflect the locally derived origin of ^{some of} the sand.

Conclusions and recommendations

1) Sheet 57°30'N 1°W is inadequately sampled by vibrocore stations which could provide evidence for the origin and composition of the various ^kbands in the area. The routine sampling completed during this cruise was incapable of

providing such evidence and it is recommended that several more vibrocore stations are completed on this sheet.

2) Sheets $56^{\circ}30'N$ $01^{\circ}E$; $56^{\circ}00'N$ $01^{\circ}E$; $56^{\circ}00'N$ $00^{\circ}W$ have adequate routine samples within the area covered by this cruise, but problems of the type discussed above could be solved by completion of more vibrocore sites. It is recommended that many further vibrocore sites are completed on these sheets with a view to solving these problems.

3) The success of the cruise in difficult weather conditions was due in a large part to the good ship stability, the good food and clean conditions on the ship, and the wholehearted and cheerful cooperation of the ship's crew. The charter of this ship is strongly recommended for next year.

APPENDICES

a) Cruise summary

~~Two~~ ^{One} hundred and fifty-seven ^{routine} sample stations and 11 vibrocore stations were occupied.

Wednesday 28th September

0000-2400 Alongside Aberdeen harbour in storm. Forecast at 1755: Westerly force 9 decreasing to 7 or gale force 8 veering to SW7. Senior scientist returned from Edinburgh with new maps, lattices and sample plans.

Thursday, 29

0000-1500 Alongside Aberdeen harbour. 1355 forecast: Viking, Forties, Dogger force 8 SW, veering W force 10.
1500 Cast off Aberdeen harbour.
1540 Out of Aberdeen harbour.
1630 Westerly force 13 reported from Ekofisk ($56N02E$).
1930 On station, routine sampling 1:100,000 sheet $57^{\circ}30'N$ $1^{\circ}W$.
2145 Abandoned sampling in gale force 8 in dangerous conditions, headed slowly west.
2400 Day total: 2 sample stations sheet $57^{\circ}30'N$ $1^{\circ}W$ (routine samples include grab sample, cone dredge and gravity core).

Friday, 30

0000-1115 Running stern to weather towards sample stations.
63 knot winds reported from Forties Field 60
miles to east.
1115 Routine sampling 57°30'N 1°W.
2400 Day total: 15 stations on 57°30'N 1°W.

Saturday, 1st October

0100 Routine sampling stopped in heavy swell,
standing to west in westerly gale force 8.
0930 Started routine sampling in large swell.
1508 Stopped routine sampling to run to "Mayday"
distress 20 miles to SW of position from
downed helicopter.
1630 Helicopter passengers rescued by others, but
sampling plan abandoned in force 8 gale;
30 foot swell; standing to.
2400 Standing to in gale 8, 18 miles NE of Peterhead.
Day total: 8 stations on sheet 57°30'N 1°W.

Sunday 2

0000-0600 Standing to in gale 8 decreasing to force 7.
0945 Sampling sheet 57°30'N 1°W.
1910 Finished sheet 57°30'N 1°W, running to 56°30'N 1°E.
2400 Day total: 12 stations sheet 57°30'N 1°W.

Monday 3

0200 Start routine sampling sheet 56°30'N 01°E.
0750 Moving to vibrocore site.
0850 Laying anchors.
0920 Anchors down.
0935 Start vibrocoreing.
1015 Corer on deck, heaving anchors.
1045 Anchors in.
1130 Commence anchor next site.
1215 Anchors down.
1240 Start vibrocoreing.
1335 End vibrocoreing.
1345 Vibrocorer on deck.
1400 Lift anchors.
1550 Laying anchors.
1625 Finish anchor.
1630 Lower vibrocorer.
1635 Start vibrocorer.
1735 End vibrocoreing.
1745 Vibrocorer back on deck.
1748 Lifting anchors, electric cable on vibrocorer
being repaired.
1825 Start routine sample pattern.
2400 Day total: 18 stations (3 vibrocore) on sheet
56°30'N 01°E.

Tuesday, 4

0000-0830 Routine sampling.
0848 Lay anchors for vibrocorer site.
0920 Anchored up, vibrocorer inoperable due to wet
cable.
1040 Lift anchors.

Tuesday, 4

1115 Start routine sampling.
1510 Start anchor up for vibrocore site.
1540 Anchored up.
1545 Vibrocorer down.
1550 Vibrocoring.
1645 Vibrocorer off.
1700 Vibrocorer on deck.
1706 Lifting anchors.
1745 Commenced routine sampling.
2400 Day total: 22 stations (1 vibrocore) sheet
56°30'N 01°E.

Wednesday, 5

0000-0730 Routine sampling.
0855 Start anchoring up on vibrocorer site.
0920 Anchored up.
0935 Start vibrocorer.
1025 End vibrocoring.
1045 Lift anchors.
1112 Off site.
1315 Start anchoring up on vibrocorer site.
1355 Anchored up.
1405 Start vibrocorer.
1435 End vibrocorer.
1525 Off site.
1612 Start anchoring up on vibrocorer site.
1650 Anchored up.
1655-1755 Electric power cable inoperable - repaired on
deck.
1755 Start vibrocoring.
1825 End vibrocoring.
1835 Anchors up.
1905 Routine sampling.
2400 Day total: 15 stations (3 vibrocores) sheet
56°N 0°E.

Thursday, 6

0000-0640 Routine sampling.
0842 Start anchoring up on vibrocore site.
0923 Anchored up.
0936 Start vibrocorer.
1006 End vibrocoring.
1020 Vibrocorers on deck.
1022 Lift anchors.
1051 Off site.
1130 Start anchoring up on vibrocore site.
1212 Anchored up, but power to vibrocorer again
inoperable; screening penetrated insulation
on power leads.
1350 Lifting anchors.
1430 Off site; commence routine sampling in force 7.
2400 Day total: 22 stations on sheet 56°N 1°E.
(1 vibrocore)

Friday, 7

0000 Routine sampling.
1420-1430 Splicing wire on gravity core cable.
1430 ^{Continued} ~~Onward~~ routine sampling.
2400 Day total: 21 stations completed off sheet
56°N 01°E

Saturday, 8

0000 Routine sampling sheet 56°01°E.
0105 Start routine sampling sheet 56°00°W.
1454 End routine sampling, start anchoring up for
vibrocore site.
1533 On site.
1540 Vibrocorer over side.
1542 Start vibrating.
1615 End vibrating.
1625 Vibrocorer on deck, no sample despite using
piston, sand slipped through treble core
catcher?
1700 Vibrocorer over side for second attempt.
1700 Vibrocorer on.
1735 End vibrocoreing.
1745 Vibrocorer on deck with sample of dense sand.
1750 Lifting anchors.
1830 Off site started routine sampling sheet
56°N 00°W.
2000-2200 Started ship demobilisation procedure.
2400 Day total: 23 stations (1 vibrocore) sheet
56°N 00°W.

Sunday, 9

0000-0830 Routine sampling sheet 56°N 00°W.
0910 Start anchoring up for vibrocorer station.
0945 On site.
0955 Vibrocorer down.
1005 Start vibrocoreing.
1105 End vibrocoreing.
1112 Vibrocorer on deck.
1120 Lifting anchors.
1155 Anchors up.
1312 Commence anchoring for vibrocore site.
1355 On site.
1400 Vibrocorer over side.
1406 Start vibrocoreing.
1442 End vibrocoreing.
1455 Vibrocorer on deck.
1525 Lift anchors.
1545 Off site, flushing main prop shaft.
1630 Left for Leith.
2400 Day total: 10 stations (2 vibrocorer) sheet
56°N 00°W.

Monday, 10

0000 Steaming for Leith.
0405 Anchors down east of Inchkeith Island: Lock
gates at Leith inoperable, waiting for repair.
1710 Alongside Robb Caledon wharf, Leith Harbour.
Start to demobilise.

APC NS B

IGS CONTINENTAL SHELF DIVISION

SHIP TIME ANALYSIS

DAY MONTH YEAR

SHIP INELAD AREA ABERDEEN

TIME (HRS BST)⁴

21 6 49 77

TOTAL

(HOURS)

16

7

UNIT 55000

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SUBMERSIBLE																									
OTHER																									

NOTES

¹ INCLUDE ANCHORING/POSITIONING

² COMMENT OVERLEAF

³ SPECIFY OVERLEAF

⁴ COMPLETE TO NEAREST 0.1 HR.

SHIP TIME ANALYSIS

UNIT CS02

ICS CONTINENTAL SHELF DIVISION

DAY MNTH YEAR

SHIP EMERALD AREA 57°30'N 01W

12/9/09 1712

TIME (HRS BST)⁴

TOTAL (HRS)

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NOTES

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² COMMENT OVERLEAF

³ SPECIFY OVERLEAF

⁴ COMPLETE TO NEAREST 1 HR

UNIT CSUN

SHIP TIME ANALYSIS

IGS CONTINENTAL SHELF DIVISION

DAY MONTH YEAR

SHIP EMERALD AREA _____

13 06 97

TIME (HRS BST) ⁴

TOTAL
(HOURS)

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NOTES

¹ INCLUDE ANCHORING/POSITIONING

² COMMENT OVERLEAF

³ SPECIFY OVERLEAF

⁴ COMPLETE TO NEAREST 0.1 HR.

UNIT 80

SHIP NAME

IGS CONTINENTAL SHELF DIVISION

DAY MONTH YEAR

SHIP EMERALD AREA 157-0

01 11 77

TIME (HRS BST)

TOTAL (HOURS)

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¹ INCLUDE ANCHORING/POSITIONING ² COMMENT OVERLEAF ³ SPECIFY OVERLEAF ⁴ COMPLETE TO NEAREST 0.1 HR. NOTES

SHIP ME LYS:
DAY MNTN YEAR

SHIP 51503040 AREA 156701

TIME (HRS BST) ⁴

TOTAL
(HOUR)

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NOTES

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² COMMENT OVERLEAF

³ SPECIFY OVERLEAF

⁴ COMPLETE TO NEAREST 0.1 HR.

UNIT 322

35 CONTINENTAL SHELF DIVISION

DAY MNTH YEAR

HIP ENGALD AREA +56+01

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$$\text{TIME (HRS. BST)}^4$$

TOTALS
(HOURS)

[illegible]

UNIT: GSON.

SHIP TIME ANALYSIS

IGS CONTINENTAL SHELF DIVISION

DAY MNTN YEAR

SHIP EMERALD AREA 156+01

04 110 77

TIME (HRS BST)⁴

TOTAL (HRS)

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NOTES

¹ INCLUDE ANCHORING/POSITIONING

² COMMENT OVERLEAF

³ SPECIFY ADDRESS

⁴ CURRENT TIME AND DATE

UNIT 3000

SHIP TIME ANALYSIS

IGS CONTINENTAL SHELF DIVISION

DAY MNTH YEAR

SHIP EMERALD AREA FORNIES 456401

TIME (HRS EST) ⁴

TOTAL (HOURS)

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¹ INCLUDE ANCHORING/POSITIONING ² COMMENT OVERLEAF ³ SPECIFY OVERLEAF ⁴ COMPLETE TO NEAREST 0.1 HR.

NOTES

UN--CS

IGS CONTINENTAL SHELF DIVISION

SHI ME LYS

DAY MNTH YEAR

SHIP EMERALD AREA 'FORTIES' 156+01

06 10 77

TIME (HRS BST) ⁴

TOTAL
(HOURS)

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NOTES

¹ INCLUDE ANCHORING/POSITIONING

² COMMENT OVERLEAF

³ SPECIFY OVERLEAF

⁴ COMPLETE TO NEAREST 0.1 HR.

UNIT 332

SBL TIME LYS

IGS CONTINENTAL SHELF DIVISION

DAY MNTY YEAR

SHIP EMERALD AREA FORTIES 55401

06 10 77

TIME (HRS BST) ⁴

TOTAL (HOURS)

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
IN PORT																									
ON PASSAGE																									
TRAVERSING BETWEEN STATIONS ¹																									
ON STATION ¹																									
WEATHER EQUIPMENT																									
SHIP																									
OTHER																									
GRAVIMETER																									
MAGNETOMETER																									
ECHO SOUNDER																									
PINGER																									
BOOMER																									
SPARKER																									
AIRGUN																									
SSC (TOWED)																									
SSC (TRANSIT)																									
OTHER ³																									
DREDGE																									
GRAB/CAMERA																									
GRAVITY CORE																									
VIBROCORE																									
ROCK DRILL																									
SUBMERSIBLE																									
OTHER																									

NOTES

¹ INCLUDE ANCHORING/POSITIONING

² COMMENT OVERLEAF

³ SPECIFY OVERLEAF

⁴ COMPLETE TO NEAREST 0.1 HR.

APPENDIX C

Updated data on sample station registration

								61 -03	61 -02	61 -01	61 +00	61 +01	61 +02	
								1	1	1	1	2	1	
71°N								60 -04	60 -03	60 -02	60 -01	60 +00	60 +01	60 +02
								1	1	9	278	19	19	1
70°N			59 -08	59 -07	59 -06	59 -05	59 -04	59 -03	59 -02	59 -01	59 +00	59 +01	59 +02	
						1	1	1	1	38	3	1	1	
69°N		58 -10	58 -09	58 -08	58 -07	58 -06	58 -05	58 -04	58 -03	58 -02	58 -01	58 +00	58 +01	58 +02
							1	1	10	3	4	1	1	1
68°N		57 -10	57 -09	57 -08	57 -07	57 -06	57 -05	57 -04	57 -03	57 -02	57 -01	57 +00	57 +01	57 +02
							1	1	1	73	80	181	1	
67°N		56 -10	56 -09	56 -08	56 -07	56 -06	56 -05	56 -04	56 -03	56 -02	56 -01	56 +00	56 +01	56 +02
							1	1	1	1	35	97	2	
66°N			55 -09	55 -08	55 -07	55 -06	55 -05	55 -04	55 -03	55 -02	55 -01	55 +00	55 +01	55 +02
										1	1	1	1	1
65°N														
64°N														

NEXT SAMPLE N°

Situation by end of cruise 77/EM/06 leg 5.

R. Adre

SAMPLE STATION REGISTRATION

The area is divided into blocks 1°lat. x 1°long.

Sample stations are sequentially numbered within each location block.

The diagram above indicates the next number to be used in each block.

FIG.1. SURFACE SAND ISOPACHS

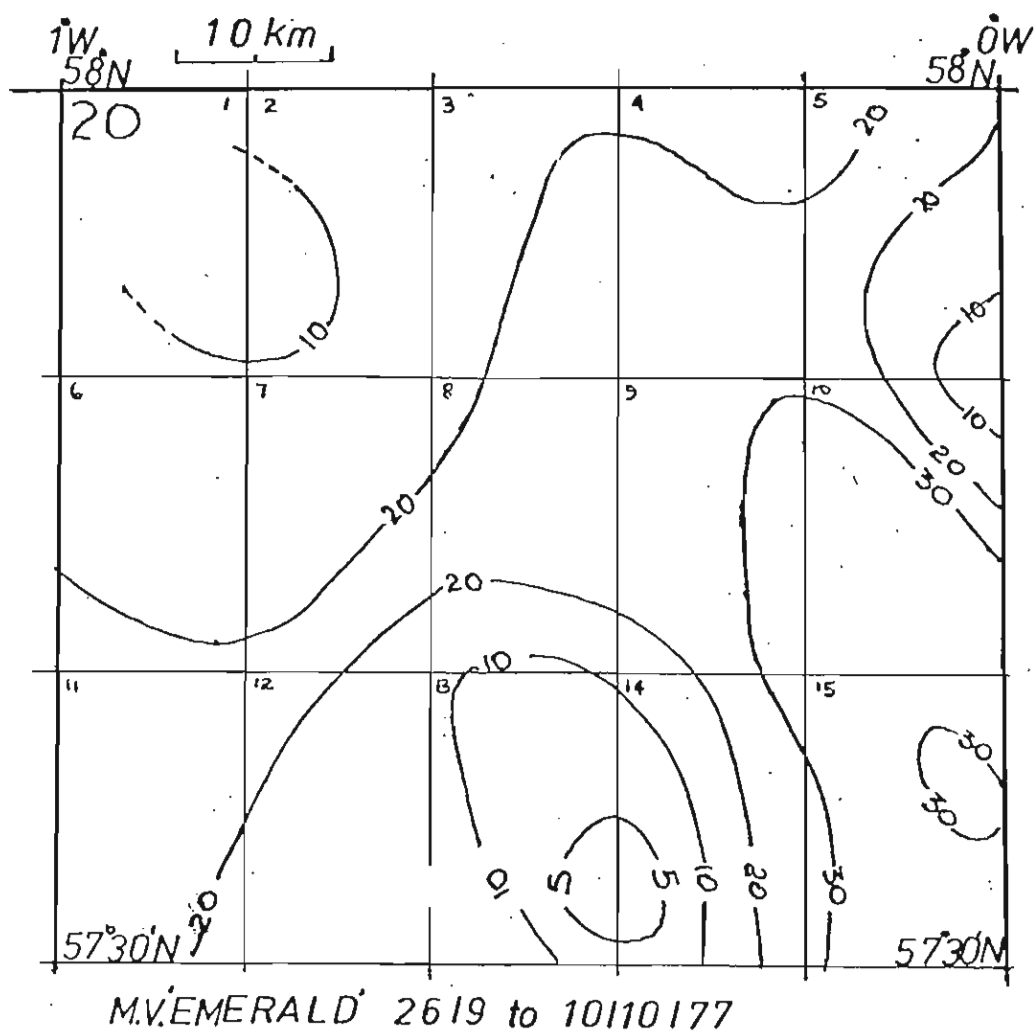


FIG 1a. BATHYMETRY (m.)

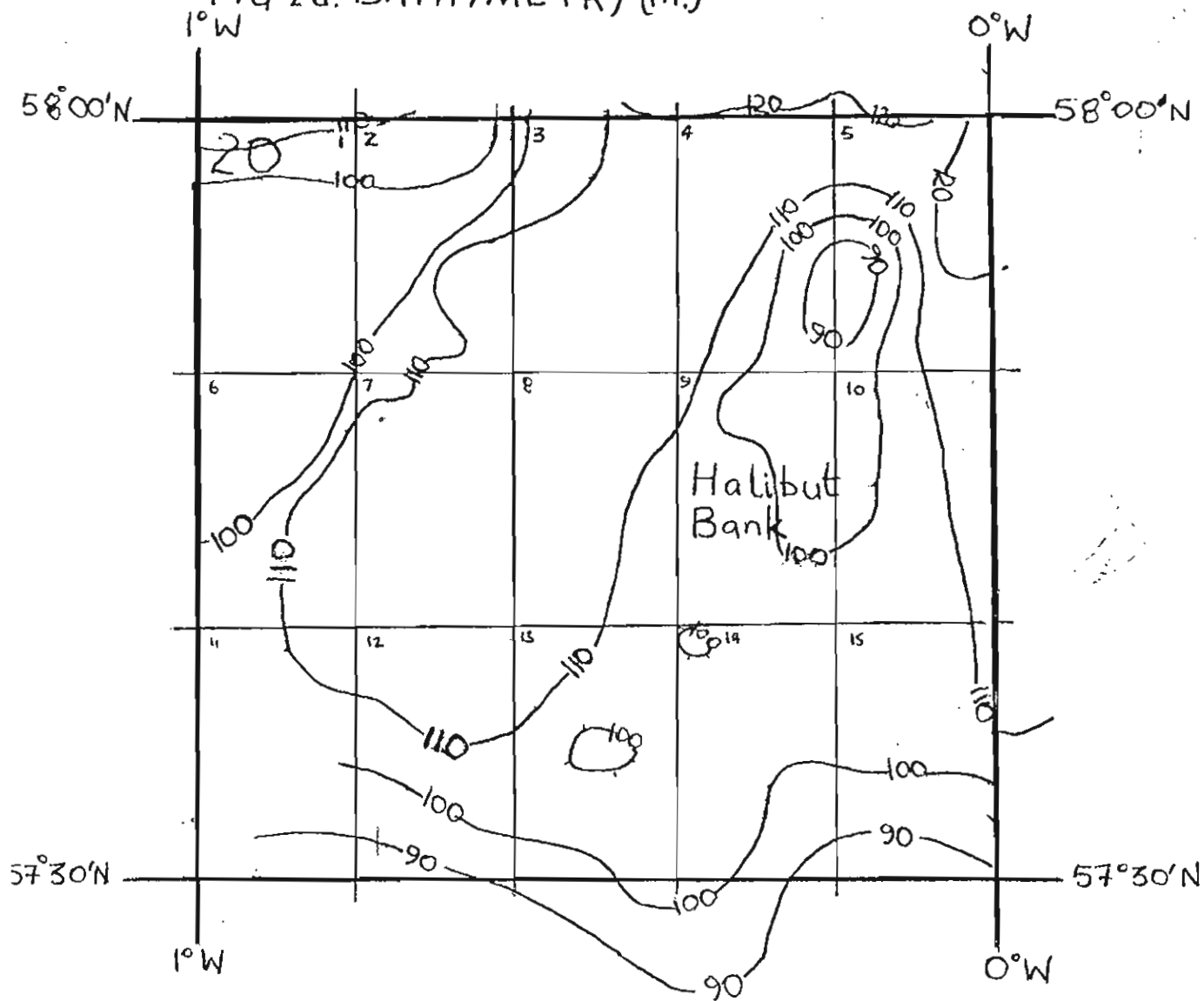


FIG.2. SURFACE SAND ISOPACHS (cm)

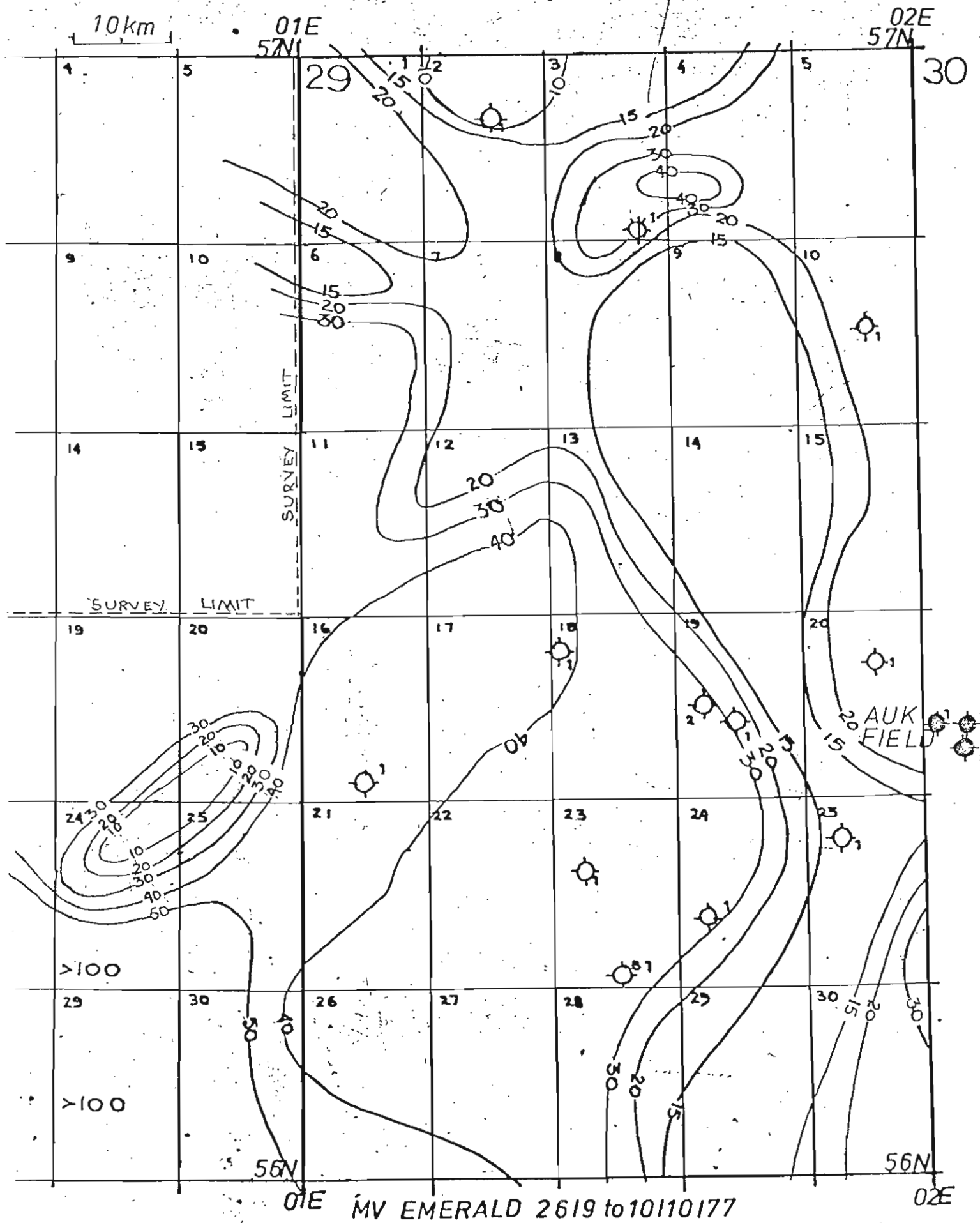
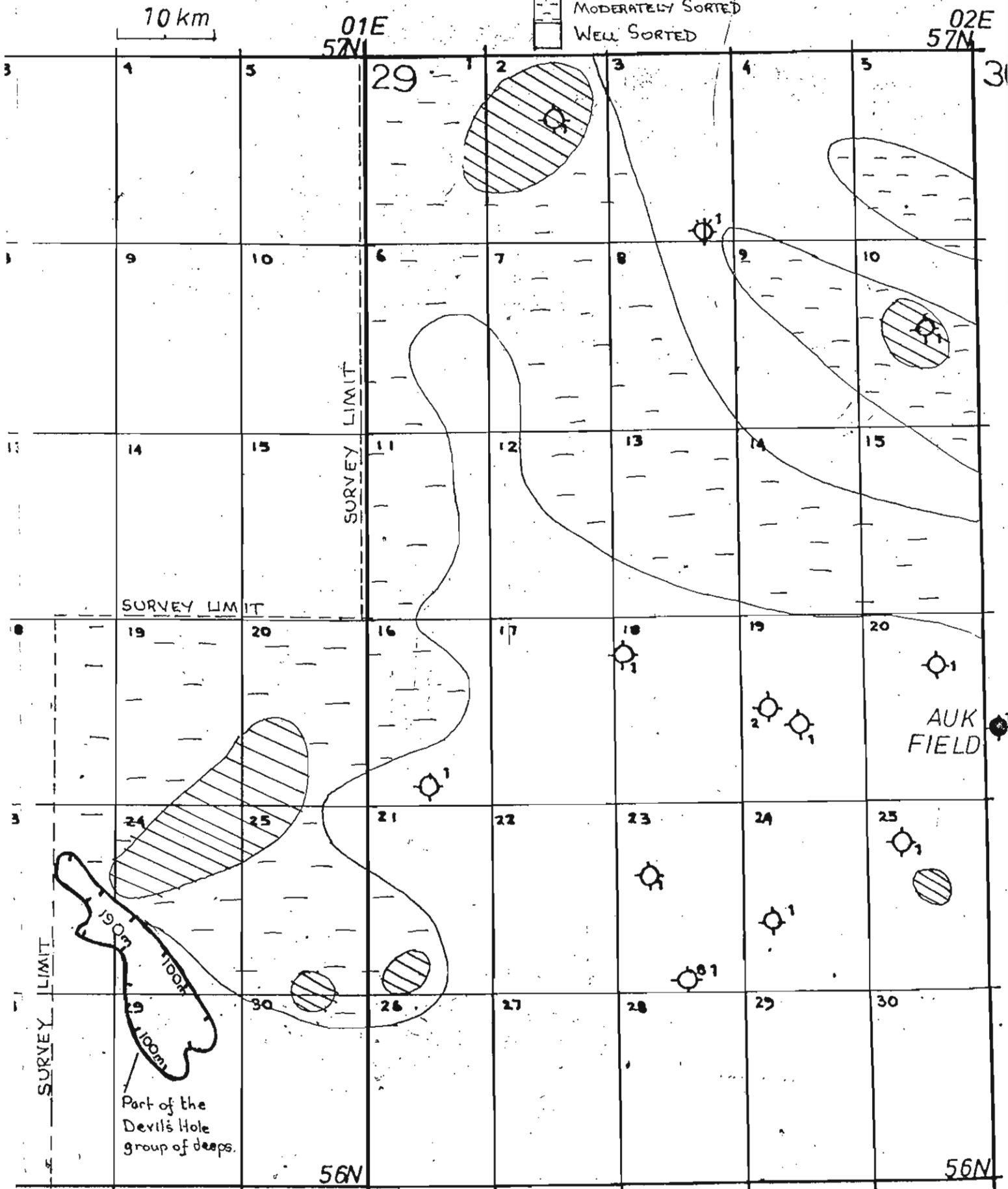
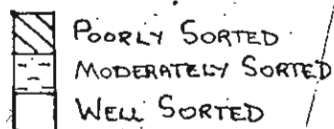


FIG 3 SORTING INDEX

10 km



01E MV EMERALD 2619 to 10110177

02E

FIG 3A. BATHYMETRY (m)

