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SCOTTISH MARINE BIOLOGICAL ASSOCIATION

GARROCH HEAD SLUDGE DUMPING GROUND SURVEY

Preliminary report on the monitoring survey carried out
on 12th - 19th May 1983.

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September, 1983.

INTRODUCTION

Sampling was carried out between the 12th and 19th May 1983 from R.V. 'Calanus'. A total of fifty-eight sampling stations were occupied where various samples were taken as detailed below. A list of all sampling stations and samples taken is given in Table 1. The station positions were based on the Decca Navigator grid as shown in Figure 1, and are listed in Table 1(a). In addition trawl samples were taken over the dumping ground and over a control area some seven kilometres to the east of the dumping ground. Trawl sample areas are marked on Figure 1.

Sediment Redox Potential Survey

Core samples were taken at the fifty-eight sampling stations occupied throughout the area and the redox potential (Eh) profile down the core was recorded using standard redox electrodes. The redox levels at 40 mm depth in the sediment have been used for interstation comparisons. Low redox values are indicative of highly reducing conditions in the sediment brought about by the degradation of large amounts of carbonaceous material. Figure 2 shows those areas found to have low redox values.

Very highly reducing conditions (redox values below - 100 mV) were found immediately around the dumping grounds in an area some 5 Km² in extent. Relatively low redox values were found extending a little beyond this area to the west and south, but for a further 1 Km to the north and about 2.5 Km to the east. A further area of low potentials was found to the north of the designated grounds and some two kilometres south of Garroch Head. This northerly area of low potentials was more extensive

than that observed in May 1982. The area of low redox values in the centre of the grounds was similar in extent to that seen in 1982 except for the extension of lower values for \neq 1.5 Km to the east.

Oxygen content of overlying water

The oxygen content of the water immediately above the sediment surface was measured at station P1 situated seven kilometres from the centre of the dumping ground and at four stations situated from the edge to the centre of the grounds. The values obtained are given in Table 2 and vary about 8 mg O₂/L i.e. the bottom water over the dumping ground was fully oxygenated.

Transect Survey

The two lines of transect stations sampled during the previous surveys were again occupied. Two grab samples were obtained from each station one of which was sieved on a 1 mm mesh and the residue retained for examination of the macrobenthic fauna. Samples for the analysis of the organochlorine content were obtained from the second grab sample and the residue was retained as a back-up faunal sample. Samples for the analysis of the heavy metal content of the sediments were obtained from replicate core samples taken at the transect stations. Populations of macrofauna were present in all the samples taken, but much lower numbers were found in the centre of the grounds than in previous years. Preliminary visual examination of the samples for the presence or absence of particular large dominant macrofaunal species showed that sedimentary conditions and faunal communities varied in essentially the same manner along both transects. In the centre of the dumping grounds

the sediments contained large quantities of organic material, were black in colour and showed very negative redox potential. The fauna in these areas consisted of a few small nematodes and Capitellid worms. Total abundance appeared to be lower than those seen in the centre of the grounds in previous years. As distances from the centre of the dumping area increased these small worms were replaced by a more varied fauna of larger polychaetes and molluscs until at the edges of the affected area, some 3.5 Km² from the centre, where the sediments were brown/grey in colour, contained little visible organic material and showed positive redox potentials, a diverse community of polychaetes, molluscs, echinoderms and crustacea, similar to that found on soft silt sediments elsewhere in the Firth of Clyde, was found.

Diagrammatic summaries of these various changes along the transects are given in Figures 3 and 4.

Conditions along the northern arm of the N/S transect are slightly more varied than in other areas. In that area redox potentials are more variable and faunal distributions suggest a fluctuating but generally higher input of organic material to the sediments.

Depth of Sludge Deposit

Long core samples were taken by gravity cores from the centre of the dumping ground (station P7), from station P5 at 2 Km west of the centre and from station P1 situated 7 Km west of the centre of the ground. At P7 the upper 16 cm of the sample consisted of a black deposit of sludge. Below 80 cm normal grey/brown clay sediment was present. No sludge was obvious in the samples from P1 and P5 (Figure 5).

Trawl Survey

Two ten minute otter trawl hauls were taken, the first across the centre of the dumping ground, the second from station E11 to D12 some 7 Km east of the centre of the dumping grounds. Large numbers of fish were taken in the trawl from the dumping ground with Saithe, Cod and Long Rough Dab numerous and six other species present. Six species were found in the E11/D12 trawl with Norway Pout and Poor Cod the most numerous species present. A summary of the species taken in the various hauls is given in Table 3. Specimens of live fish from the centre of the dumping ground and the area to the NE were taken for bacteriological examination.

Conclusions

Areas of reduced sediment were present in the vicinity of the designated dumping grounds and in an area to the north of the grounds. The reduced area to the north of the grounds was more extensive than that found in previous surveys. Macrofaunal populations in the centre of the dumping grounds appeared to be less numerous than those noted in previous surveys. High populations of commercial fish species were again taken over the dumping grounds.

Table 1. List of stations occupied, sediment type and samples taken.

<u>Station</u>	<u>Depth (m)</u>	<u>Sample Taken*</u>	<u>Sediment Type</u>	<u>Gear</u>
A8	93	Eh,pH	0-10 cm light brown silt, darker below	Corer
C7	76	Eh,pH	0-7 cm light brown silt, black below	Corer
C8	110	Eh,pH	0-10 cm light brown silt, black below	Corer
D7	102	Eh,pH F, HM, OC.	0-4 cm light brown silt, black below	Corer Van-Veen Grab
D9	87	Eh,pH	0-18 cm light brown silt brown-grey below	Corer
E6	88	Eh,pH	0-7 cm light brown silt, grey-brown below	Corer
E7	92	Eh,pH	0-4 cm light brown silt, black below	Corer
E8	102	Eh,pH	0-7 cm light brown silt brown-black below	Corer
G5	70	Eh,pH	0-4 cm dark brown silt grey-brown below	Corer
G6	85	Eh,pH	0-3.5 cm brown, dark brown below	Corer
G7	83	Eh,pH F, HM, OC	0-12 cm light brown silt, black below	Corer Van-Veen Grab
G8	92	Eh,pH	0-10 cm light brown silt, black below	Corer
G9	85	Eh,pH	0-5 cm light brown silt, dark brown below	Corer
I7	84	Eh,pH F, HM, OC	0-6 cm brown silt, black below	Corer Van-Veen Grab
I8	90	Eh,pH	0-5 cm light brown silt, brown-black below	Corer

Table 1 (continued)

<u>Station</u>	<u>Depth (m)</u>	<u>Sample Taken*</u>	<u>Sediment Type</u>	<u>Gear</u>
J5	100	Eh,pH	0-10 cm grey brown silt, grey-black below	Corer
J7	82	Eh,pH	Dark brown silt throughout	Corer
J9	76	Eh,pH	Grey brown silt throughout	Corer
K7	86	Eh,pH F, HM, OC	0-5 cm brown silt, grey-brown below	Corer Van-Veen Grab
L7	85	Eh,pH F, HM, OC.	0-4 cm brown silt grey brown below	Corer Van-Veen Grab
M5	98	Eh,pH	0-9.5 cm light brown silt, brown-grey below	Corer
M7	82	Eh,pH F, HM, OC.	Brown silt with grey streaks	Corer Van-Veen Grab
M9	80	Eh,pH	0-4 cm light-brown silt, grey-brown below	Corer
M11	77	Eh,pH	0-1.5 cm light-brown silt, dark-brown below	Corer
N7	80	Eh,pH F, HM, OC.	Black surface, dark-brown silt below	Corer Van-Veen Grab
O7	83	Eh,pH	Black throughout	Corer
P1	144	Eh,pH, O ₂ F, HM, OC.	0-12 cm light brown silt, grey-brown below	Corer Van-Veen Grab
P2	150	Eh,pH F, HM, OC.	0-1 cm light brown silt, grey-brown below	Corer
P3	159	Eh,pH F, HM, OC.	0-2 cm light brown silt, grey-brown below	Corer
P4	151	Eh,pH F, HM, OC.	0-7 cm light brown silt, dark-brown below	Corer Van-Veen Grab
P5	124	Eh,pH, O ₂ F, HM, OC.	0-7 cm light brown silt, dark-brown with black streaks below	Corer Van-Veen Grab

Table 1 (continued)

<u>Station</u>	<u>Depth (m)</u>	<u>Sample Taken</u>	<u>Sediment Type</u>	<u>Gear</u>
P5.5	109	Eh,pH F,HM,OC.	0-5 cm brown silt, dark-brown with black streaks below	Corer Van-Veen Grab
P6	104	Eh,pH, O ₂ F,HM,OC.	0-3.5 cm dark-brown silt, grey-black below	Corer Van-Veen Grab
P6.5	92	Eh,pH	Sludge at surface black below	Corer
P7	85	Eh,pH, O ₂ F,HM,OC.	Sludge at surface (0-2 cm) Black sludge silt below	Corer Van-Veen Grab
P7.5	76 m	Eh,pH F,HM,OC.	Black silt throughout	Corer
P8	74 m	Eh,pH, O ₂ F,HM,OC	Black-grey at surface, grey-black below	Corer Van-Veen Grab
P8.5	67 m	Eh,pH, O ₂ F,HM,OC.	0-3 cm light-brown silt, grey-black below	Corer Van-Veen Grab
P9	64 m	Eh,pH F,HM,OC.	0-4 cm light-brown, dark grey below	Corer Van-Veen Grab
P9.5	76 m	Eh,pH	0-4 cm light-brown silt, brown-grey below	Corer
P10	78 m	Eh,pH F,HM,OC.	Dark brown silt throughout	Corer Van-Veen Grab
P10.5	83 m	Eh,pH	Dark-brown silt throughout	Corer
P11	91 m	Eh,pH F,HM,OC.	Light-brown silt throughout	Corer Van-Veen Grab
P12	83 m	Eh,pH F,HM,OC.	Light-brown silt throughout	Corer Van-Veen Grab
Q7	86 m	Eh,pH	Sludge at surface, black throughout	Corer
R7	104 m	Eh,pH F,HM,OC.	Sludge at surface, black throughout	Corer Van-Veen Grab
S7	113 m	Eh,pH F,HM,OC.	Brown/black at surface, black throughout	Corer Van-Veen Grab

Table 1 (continued)

<u>Station</u>	<u>Depth (m)</u>	<u>Sample Taken</u>	<u>Sediment Type</u>	<u>Gear</u>
S3	120 m	Eh,pH	0-10 cm brown silt, grey-brown below	Corer
S5	166 m	Eh,pH	0-10 cm light brown silt, brown below	Corer
S9	78 m	Eh,pH	0-10 cm Grey, black-grey below	Corer
S11	88 m	Eh,pH	Brown silt throughout, grey-brown below	Corer
T7	129 m	Eh,pH F, HM, OC.	Dark brown/black at surface, black below	Corer Van-Veen Grab
U7	152 m	Eh,pH	Brown silt to 4 cm black below	Corer
V5	144 m	Eh,pH	0-7 cm light brown silt, dark-brown below	Corer
V7	180 m	Eh,pH F, HM, OC.	0-12 cm dark-brown black below	Corer Van-Veen Grab
V9	116 m	Eh,pH	Brown silt throughout	Corer
W7	163 m	Eh,pH	Brown silt throughout	Corer
X7	144 m	Eh,pH F, HM, OC.	Brown silt throughout	Corer Van-Veen Grab
*	Eh,	Redox potential measurements taken at 1 cm intervals down core samples.		
	pH,	Acidity measurements taken at 1 cm intervals down core samples.		
	O ₂ ,	Oxygen content of water immediately above the sediment surface measured.		
	F,	Grab sample for faunal analysis taken.		
	HM,	Sediment sample for Heavy Metal Analysis taken.		
	OC,	Sediment sample for Organochlorine Analysis taken.		

Table 2. Oxygen content of the water immediately above the sediment surface (mean values from two samples).

Station	Oxygen Content mg O ₂ /L
P1	8.2
P5	8.4
P6	8.4
P7	8.4
P8	8.4

(Taken at 0800 hrs 18.5.83; i.e. prior to daily sludge dumping).

Table 3. Species taken in otter trawl hauls.

1. Trawl across dumping ground (P7-08) 12 minutes on bottom.

Cod,	<u>Gadus morhua</u>	52
Saithe,	<u>Pollachius virens</u>	154
Norway Pout,	<u>Trisopterus esmarki</u>	10
Long Rough Dab,	<u>Hippoglossoides platessoides</u>	176
Whiting,	<u>Merlangius merlangus</u>	3
Poor Cod,	<u>Trisopterus minutus</u>	1
Haddock	<u>Merlanogrammus aeglefinus</u>	6
Herring,	<u>Clupea harengus</u>	1
Plaice,	<u>Pleuronectes platessa</u>	3

2. Trawl 7 Km north-east of dumping ground (D11-E12) 15 minutes on bottom.

Norway Pout,		165
Poor Cod,		12
Rockling,	<u>Rhinonemus cimbricus</u>	2
Whiting,		12
Long Rough Dab,		7
Hake,	<u>Merluccius merluccius</u>	1

Table 4. Species taken in Agassiz Trawl hauls.

1. M7-K7 10 minutes on bottom.

Specimens of Apphorais pes-pelecani and Buccinum numerous.

Pandalus, Crangon, Eupagurus and Portunid crabs common.

Nephrops, Ophiura and Asterias occasional.

2. I7-G7 10 minutes on bottom.

Specimens of Apphorais pes-pelecani, Abra alba, Buccinum,

Ophiura, Pandalus, Crangon, Eupagurus and Portunid crabs common and collected.

Nephrops, Aphrodite, Asterias occasional.

3. P6-S7. 10 minutes on bottom.

Specimens of Buccinum, Crangon allmani, Pandalus sp. and

Nereid sp. taken.

Captions to Figures.

Figure 1. Map showing sampling grid and station positions with trawl positions marked.

Figure 2. Redox potential (Eh) values at 4 cm depth in the sediment.

Figure 3. Variation in redox potential at 4 cm depth in the sediment along the East-West transect compared with the distribution of large macrofaunal species observed in the grab samples.

Key Cm, Calocaris macandreae; Bl, Brissopsis lyrifera;
Ns, Nucula sp.; Ac, Amphiura chiajei;
Aa, Abra alba; Sk, Spiophanes kroyeri;
Lj, Lipobranchus jeffrysi; Ga, Glycera alba;
Cg, Corbula gibba; Tf, Thyasira flexuosa;
Cc, Capitella capitata; Nl, Notomastus latericeus;
Ct, Cirriformia tentaculata.

Figure 4. Variation in redox potential at 4 cm depth in the sediment along the North-South transect compared with the distribution of large macrofaunal species observed in the grab samples.

Key as for Fig. 3 with the addition of:

Sf, Scolelepis fuliginosa.

Figure 5. Comparison of sediment colour profiles at various points along the East-West transect with estimates of sludge depth.

FIG. 1

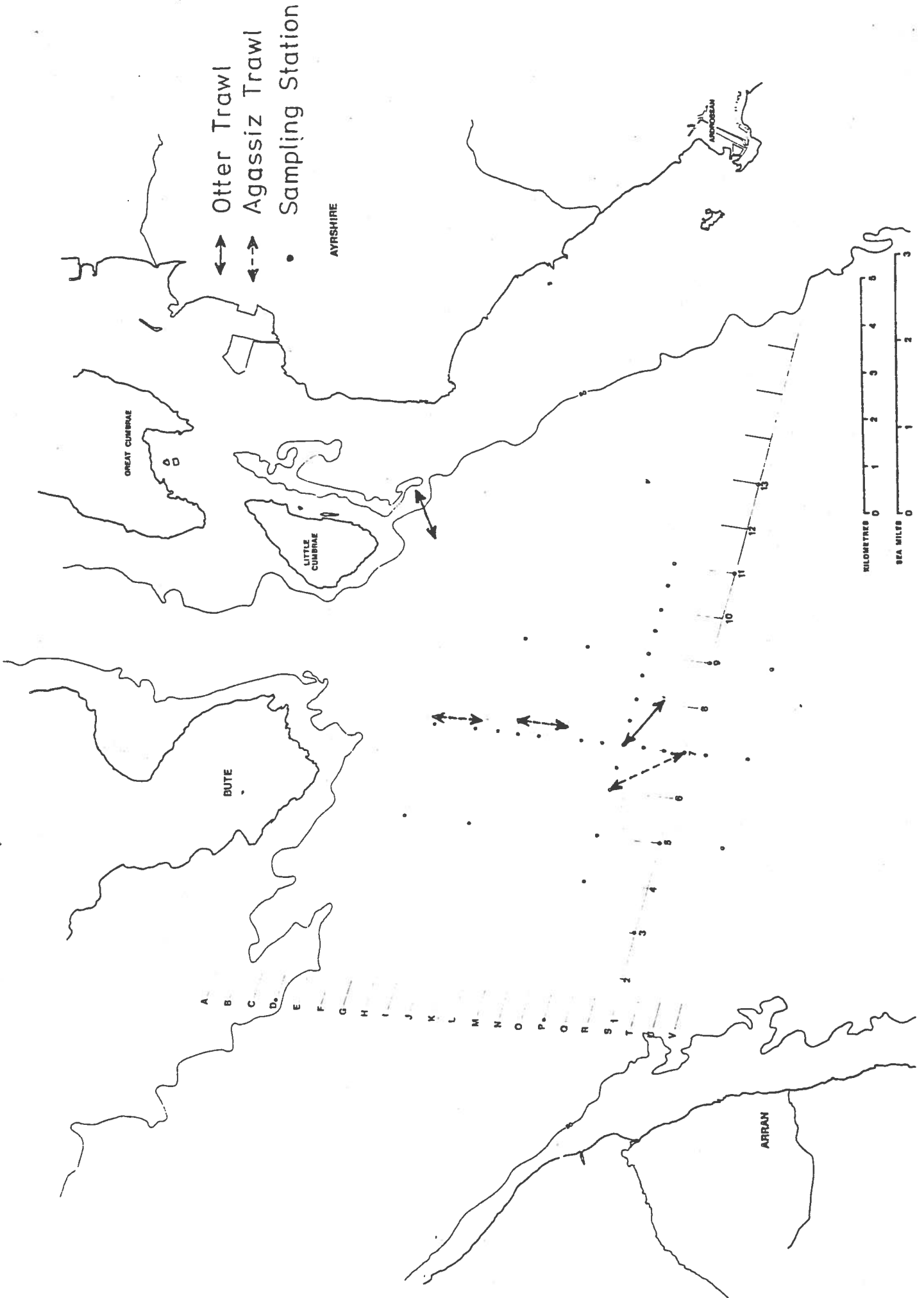
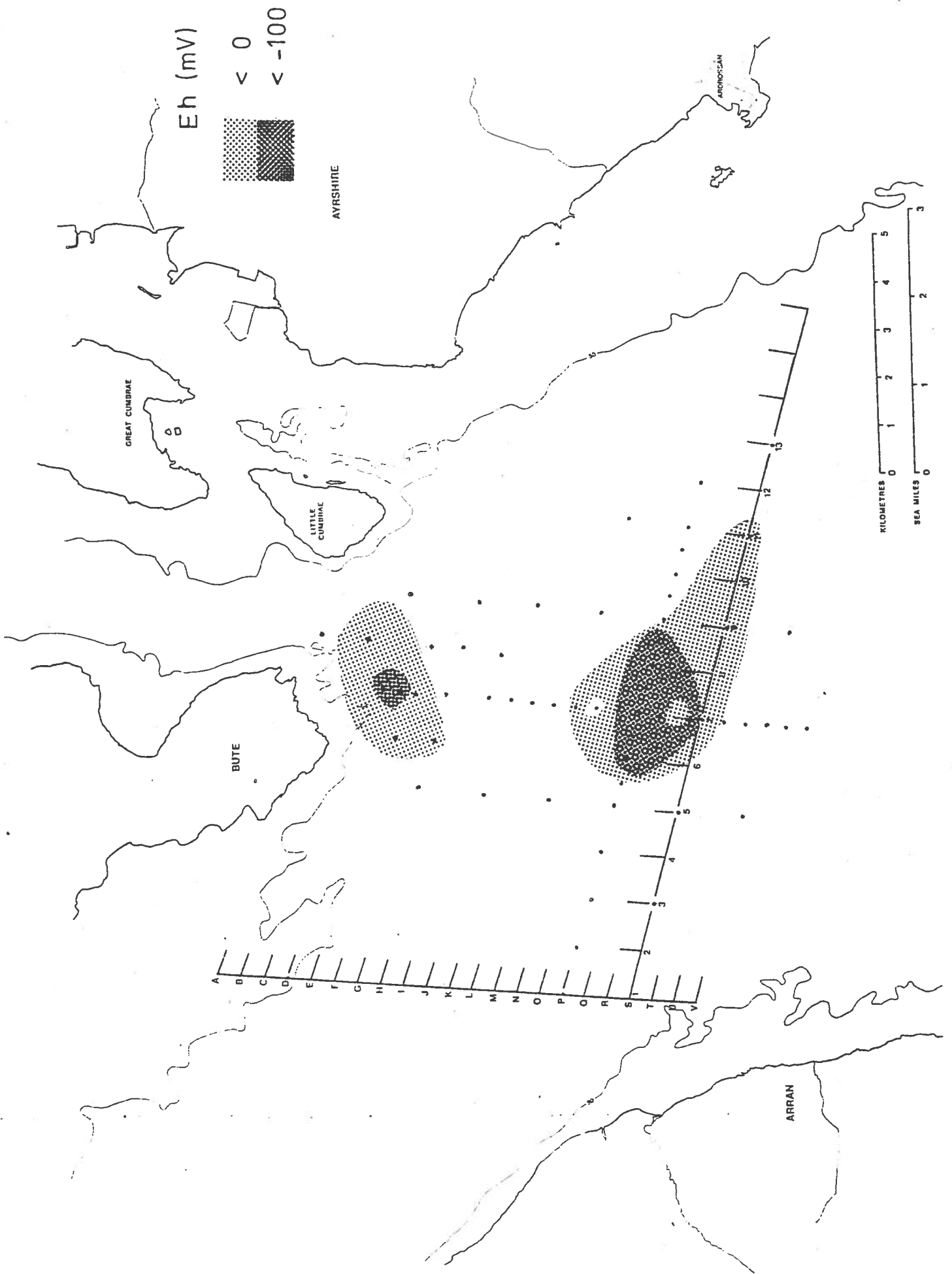
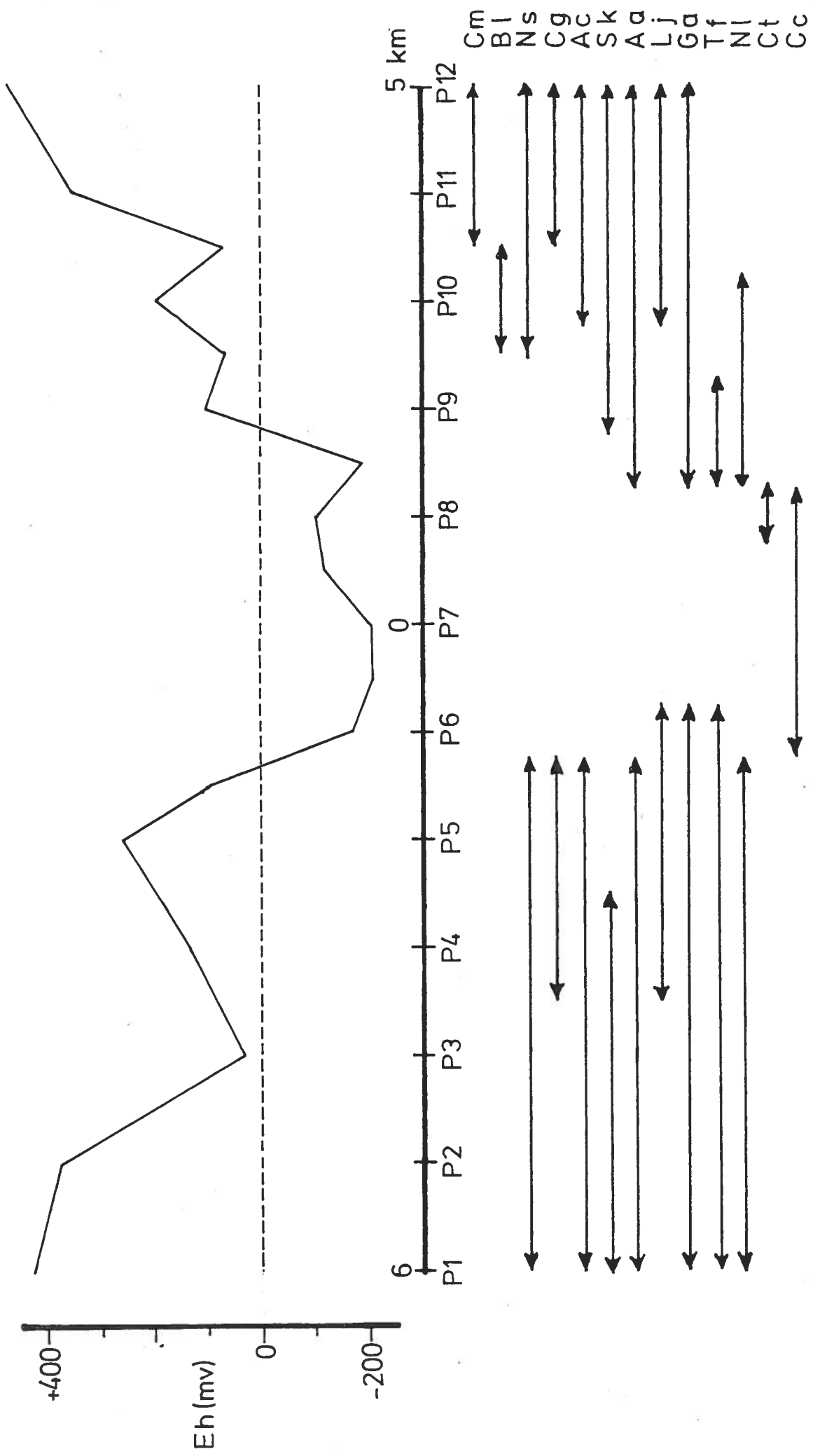
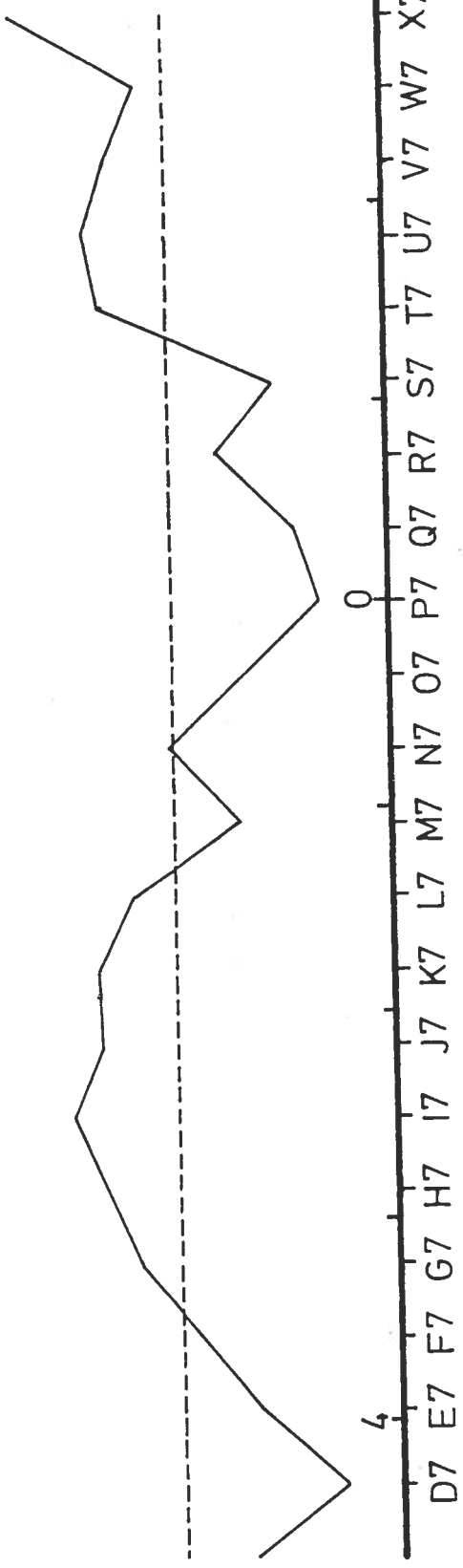


FIG. 2





+400
Eh (mv)
0
-200



Cm
Ns
Ac
Sk
Lj
Ad
Gg
Gd
Nl
Tf
Ct
Cc
Sf

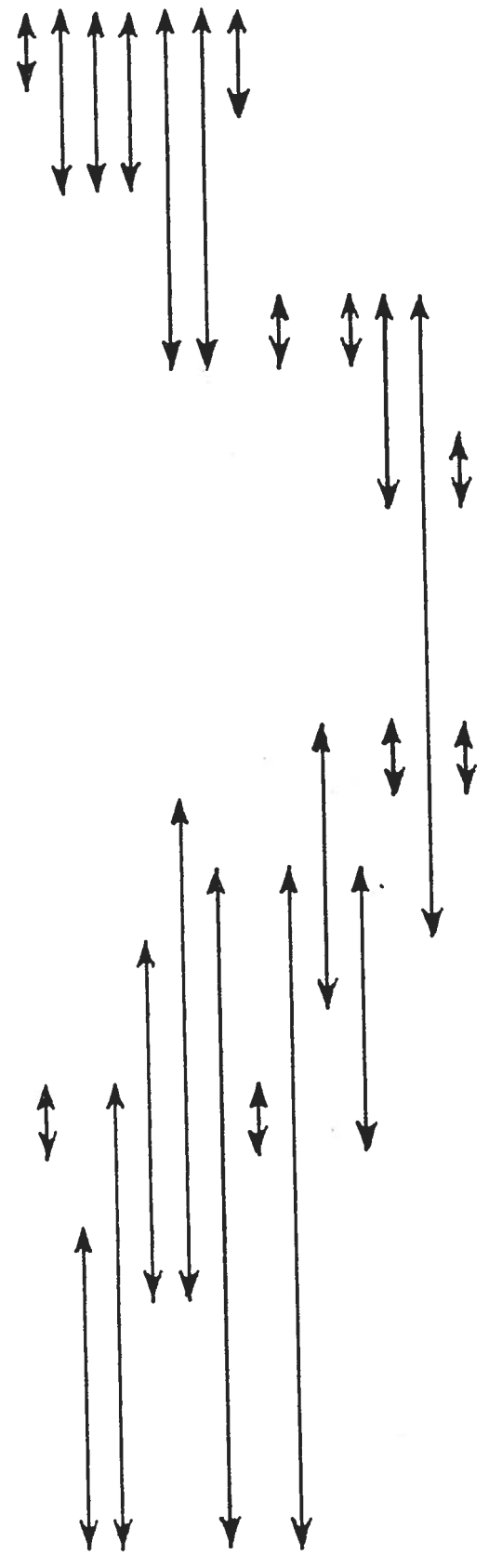


FIG. 5

