

BEACH DEVELOPMENT ALONG THE
HOLDERNESS COAST, NORTH HUMBERSIDE,
WITH SPECIAL REFERENCE TO ORDS.

by

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VOLUME II



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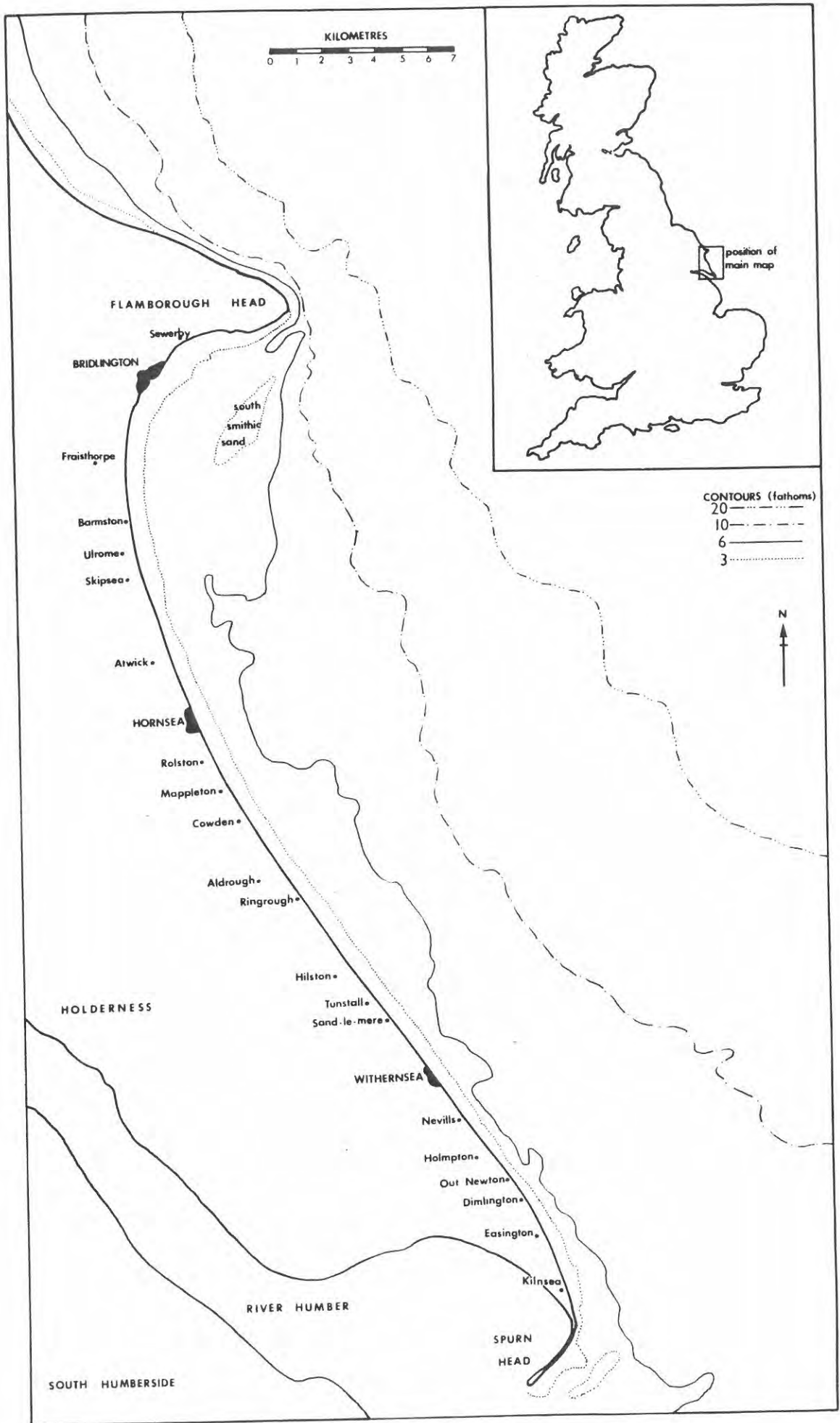


FIGURE 1.1 Location Map with Offshore Contours

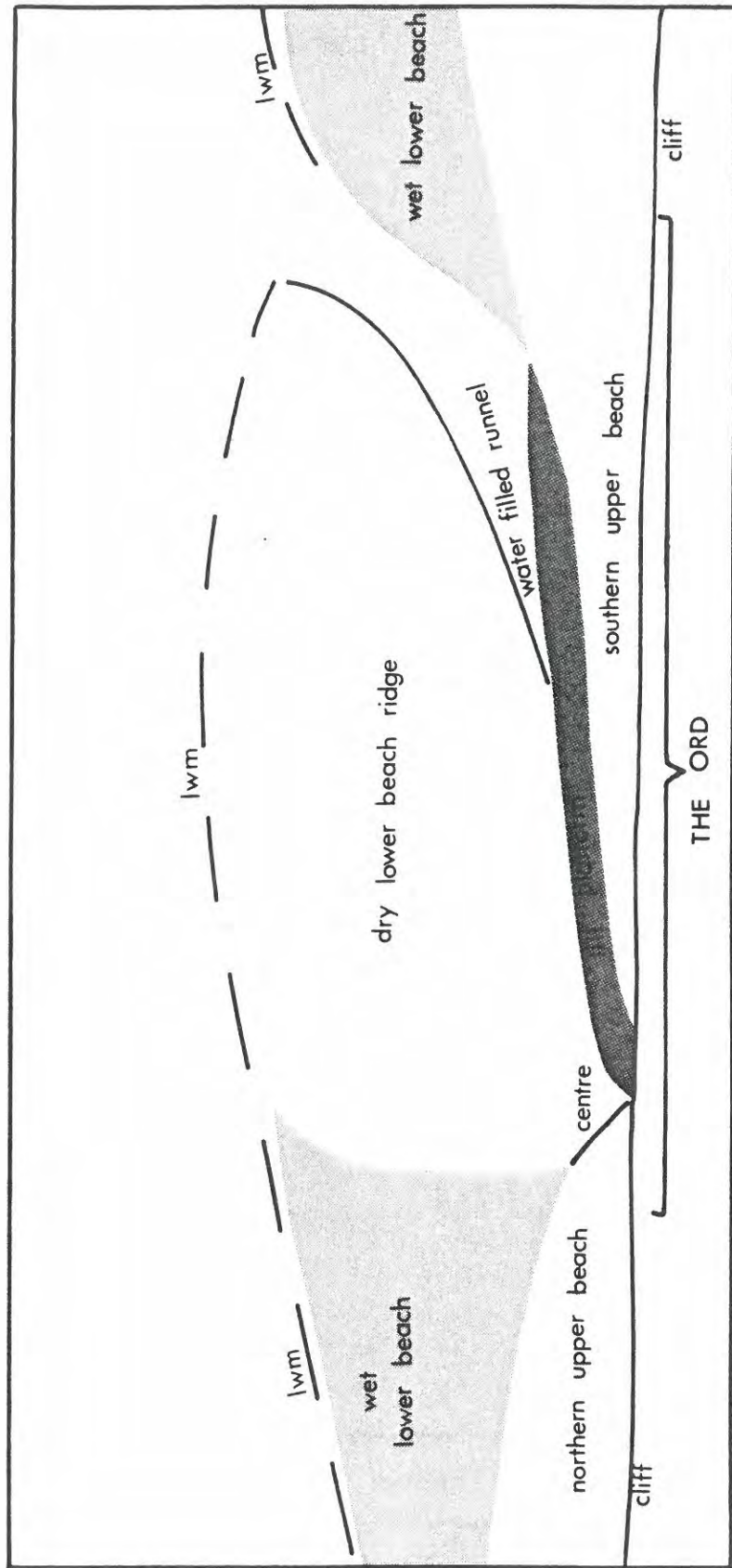


FIGURE 1.2 A GENERALIZED PLAN OF AN ORD

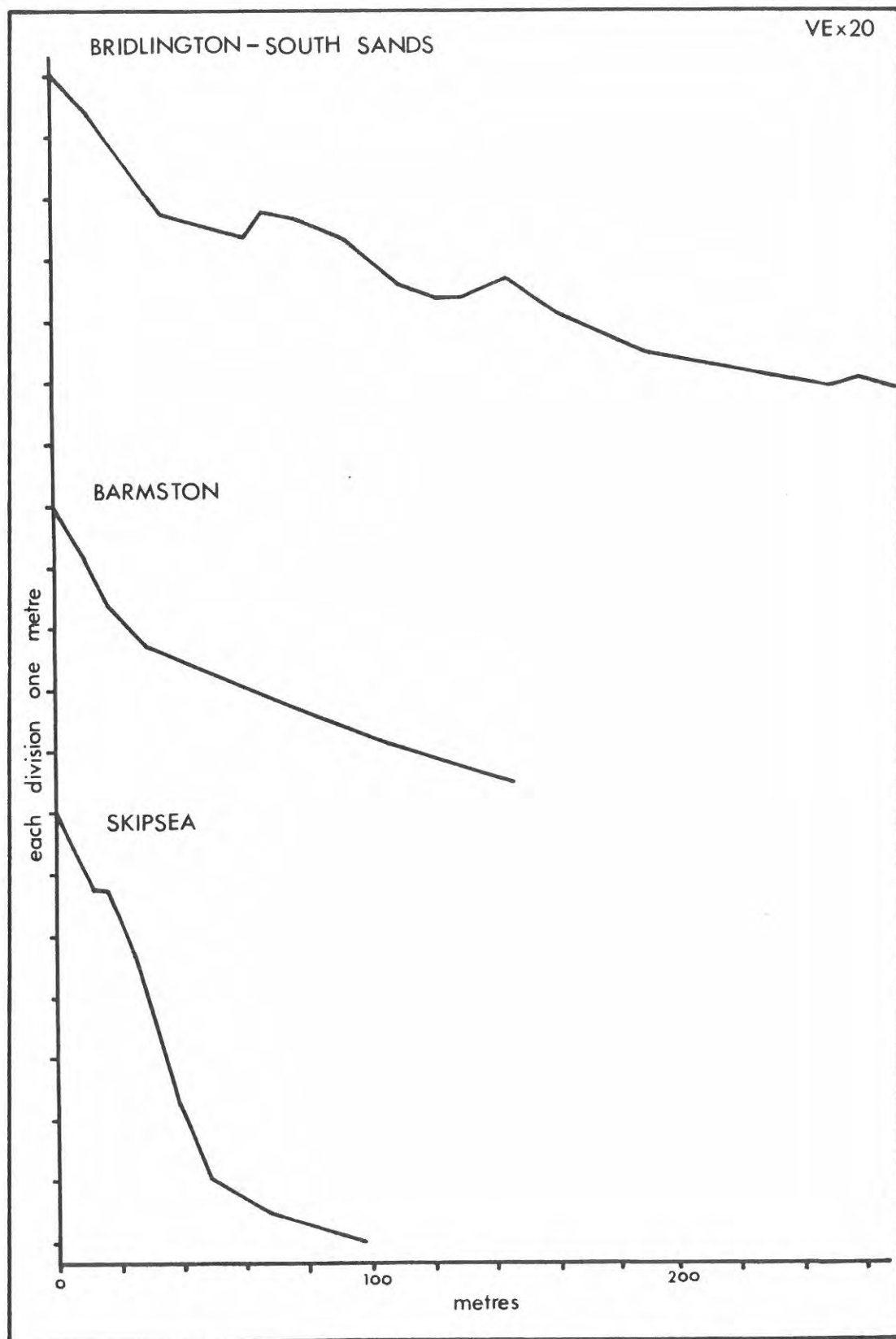
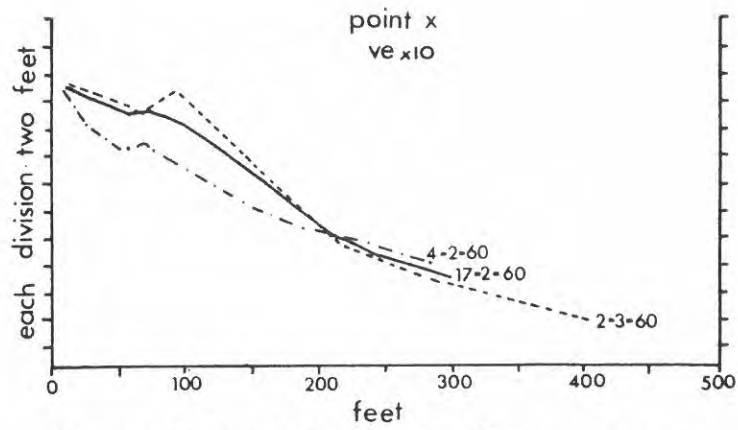
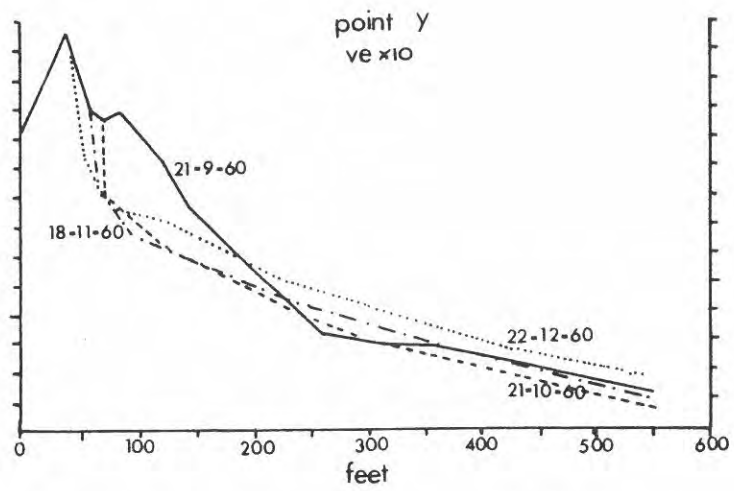


FIGURE 2.1 TRANSVERSE PROFILES OF THE NORTHERN HOLDERNESS BEACH

after Phillips 1964



The rebuilding of the beach after an ord has moved south.



The effect of the presence of an ord

FIGURE 2.2 An ord on Spurn Head

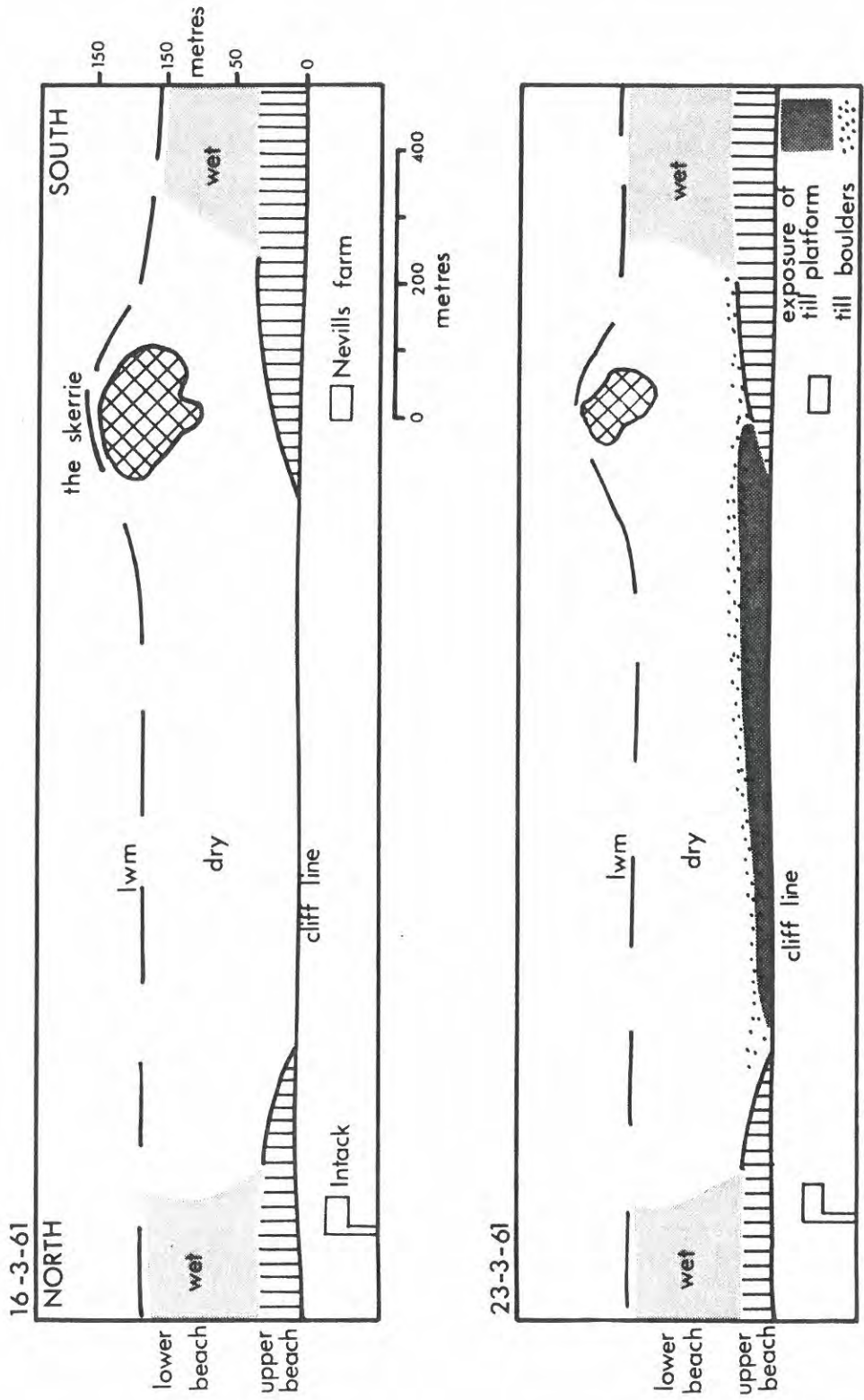


FIGURE 2.3 THE ORD AT INTACK, NORTH OF HOLMPTON 1961, BEFORE AND AFTER A STORM.

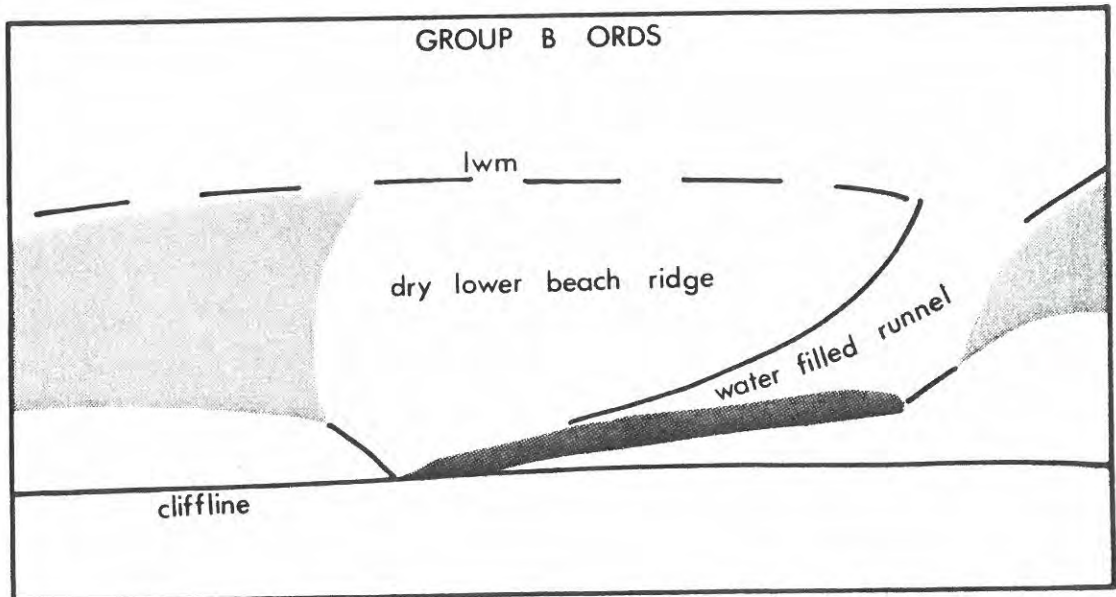
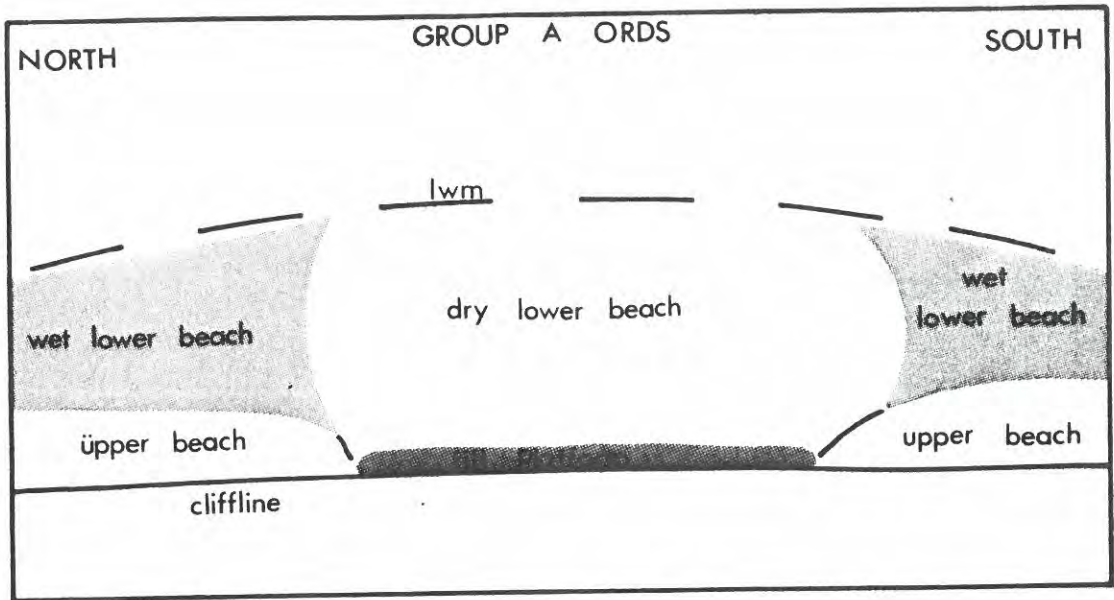


FIGURE 2.4 GENERALIZED PLANS OF GROUP A AND B ORDS

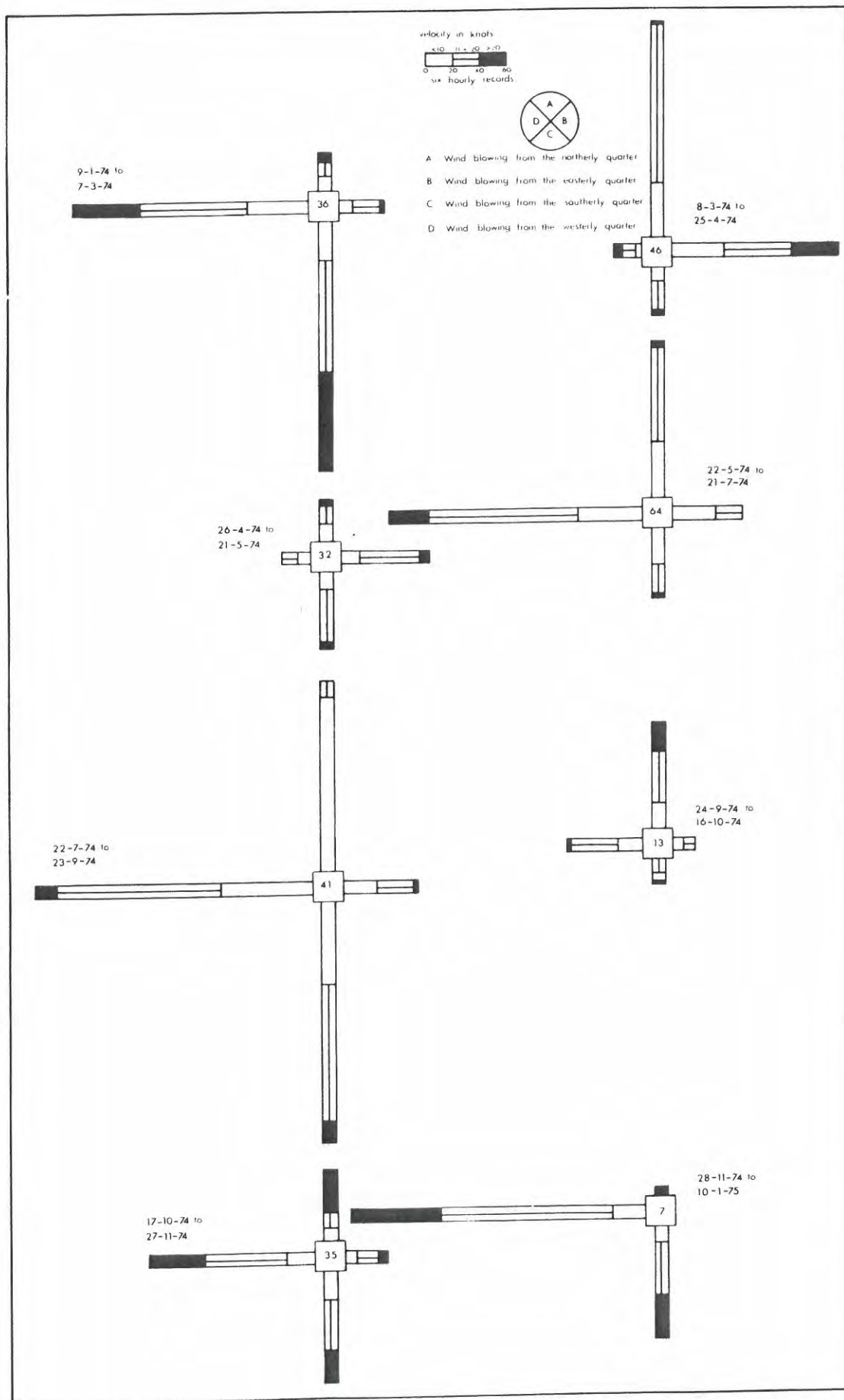


FIGURE 2.5 Wind direction and velocity, Holderness, January 1974 to February 1976

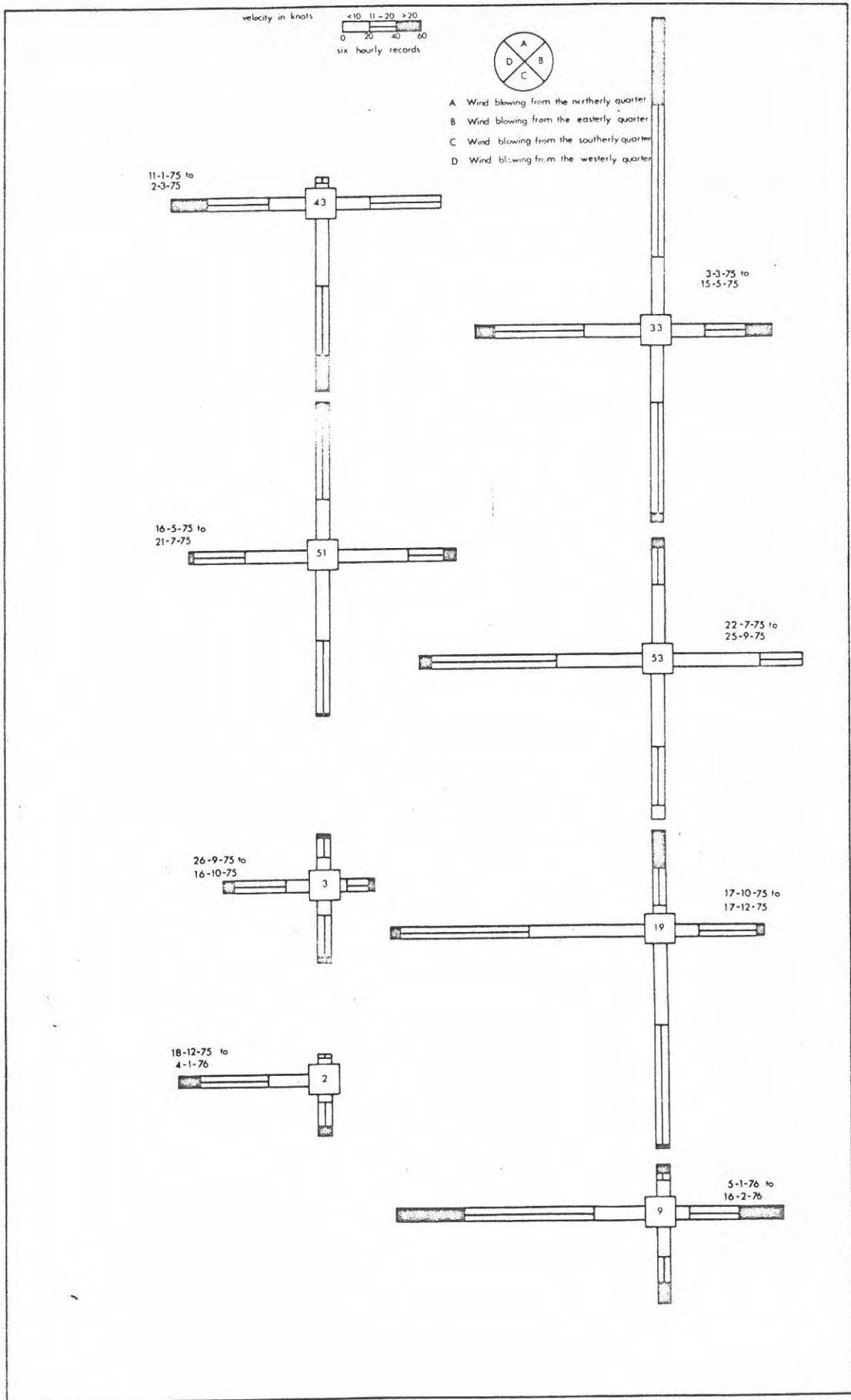


FIGURE 2.5 (cont) Wind direction and velocity

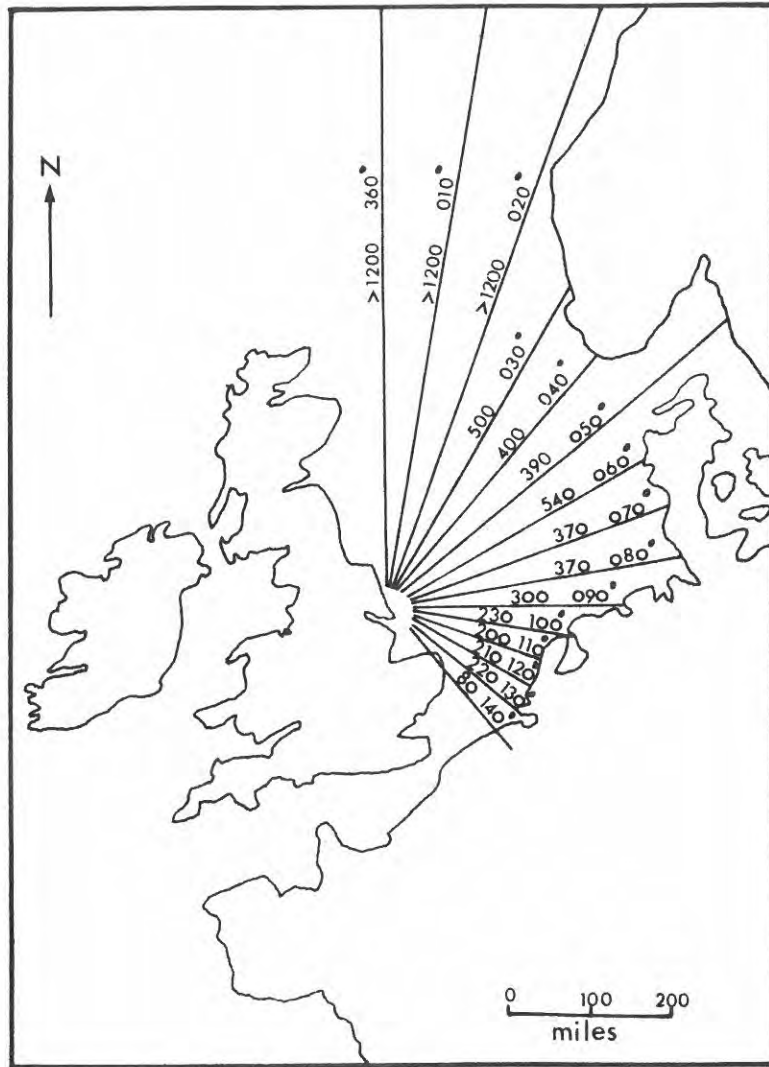


FIGURE 2.6 The exposure of the Holderness coast, showing fetch in miles.

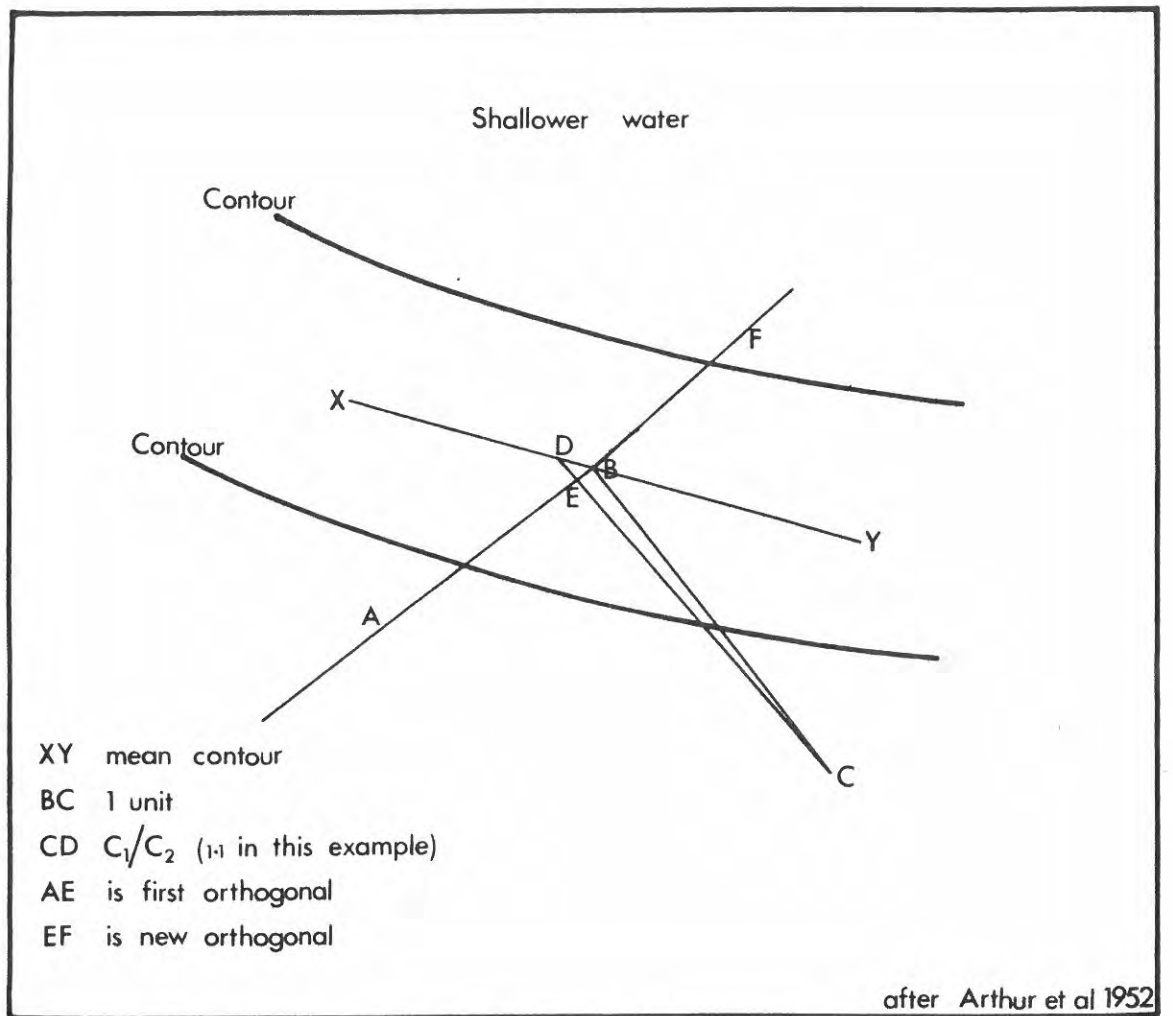


FIGURE 3.1 The construction of wave orthogonals

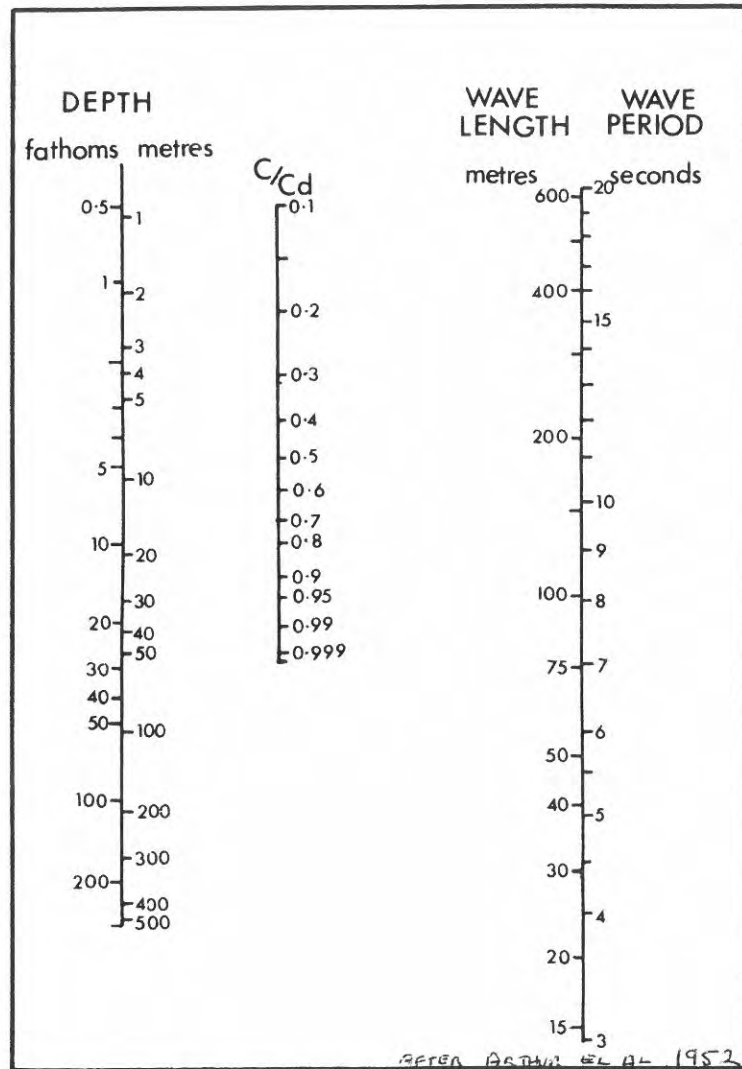


FIGURE 3.2 Diagram to relate wave period, length and velocity for varying depth

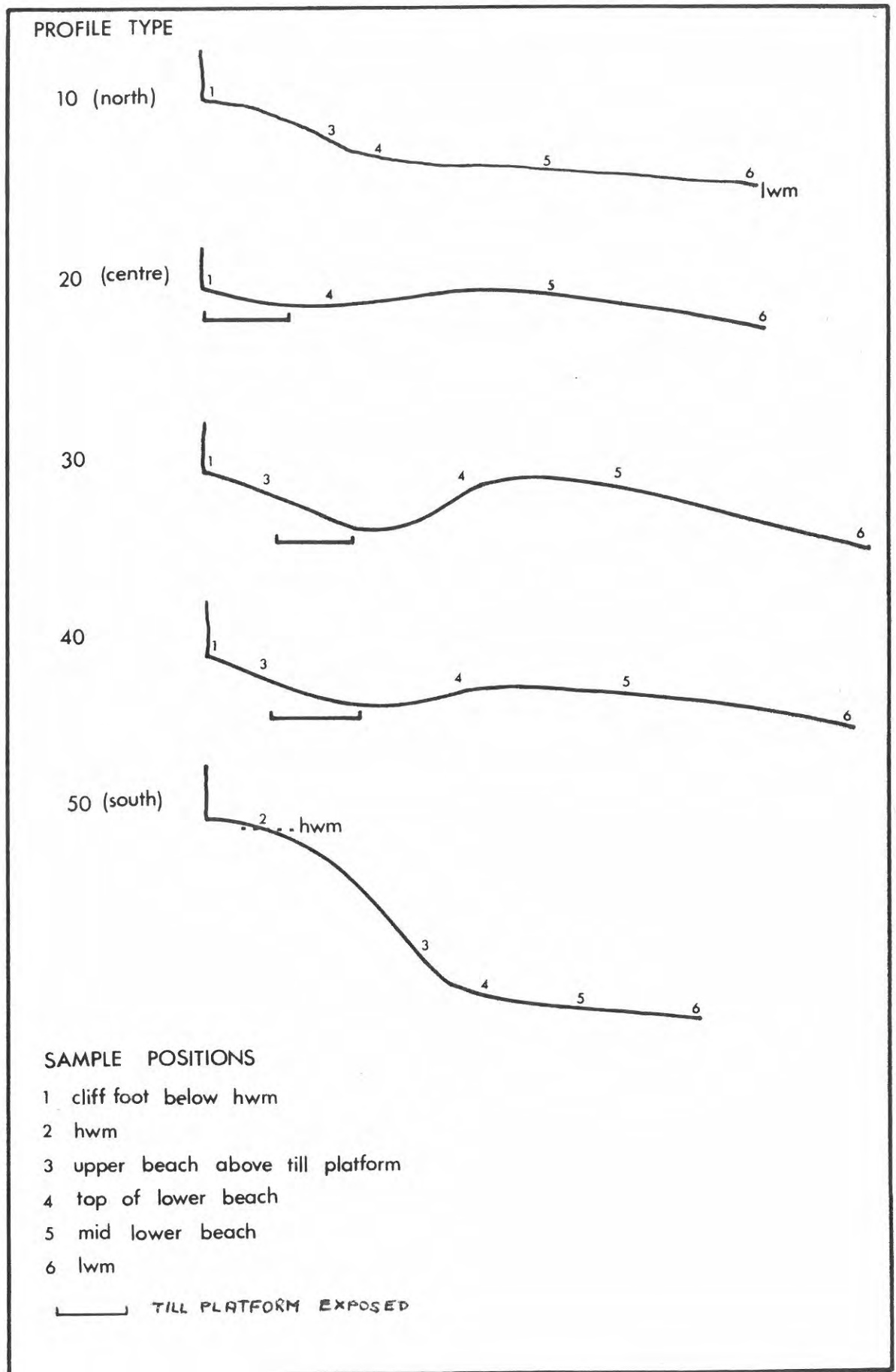


FIGURE 3.3 TRANSVERSE PROFILE AND SEDIMENT SAMPLE CLASSIFICATION

FIGURE 3· 4

AN EXAMPLE OF A SIEVE ANALYSIS DATA FORM

Sample No. EA1 - CF Analysed by PAS
 Sample Date 26-4-74 Analysis Date 23-10-74
 Description Coarse sand
 Weight of Sample 100 gms. Sieve Time 20 m

SCREEN MM.	GRADE PHI	WEIGHT RETAINED (GM.)	CUMULATIVE %
2·4	-1·25	0·2	0·2
2·0	-1·0	0·2	0·4
1·7	-0·75	0·15	0·55
1·4	-0·5	0·65	1·2
1·2	-0·25	0·6	1·8
1·0	0	1·1	2·9
0·85	0·25	2·5	5·4
0·71	0·5	3·6	9·0
0·60	0·75	8	17·0
0·50	1·0	14·6	31·6
0·42	1·25	27·4	59·0
0·35	1·5	22·5	81·5
0·30	1·75	11·1	92·6
0·25	2·0	5·6	98·2
0·21	2·25	1·2	99·4
0·18	2·5	0·5	99·9
0·15	2·75	0·1	100·0
0·125	3·0	None	
0·105	3·25	None	
0·090	3·5	None	
0·075	3·75	None	

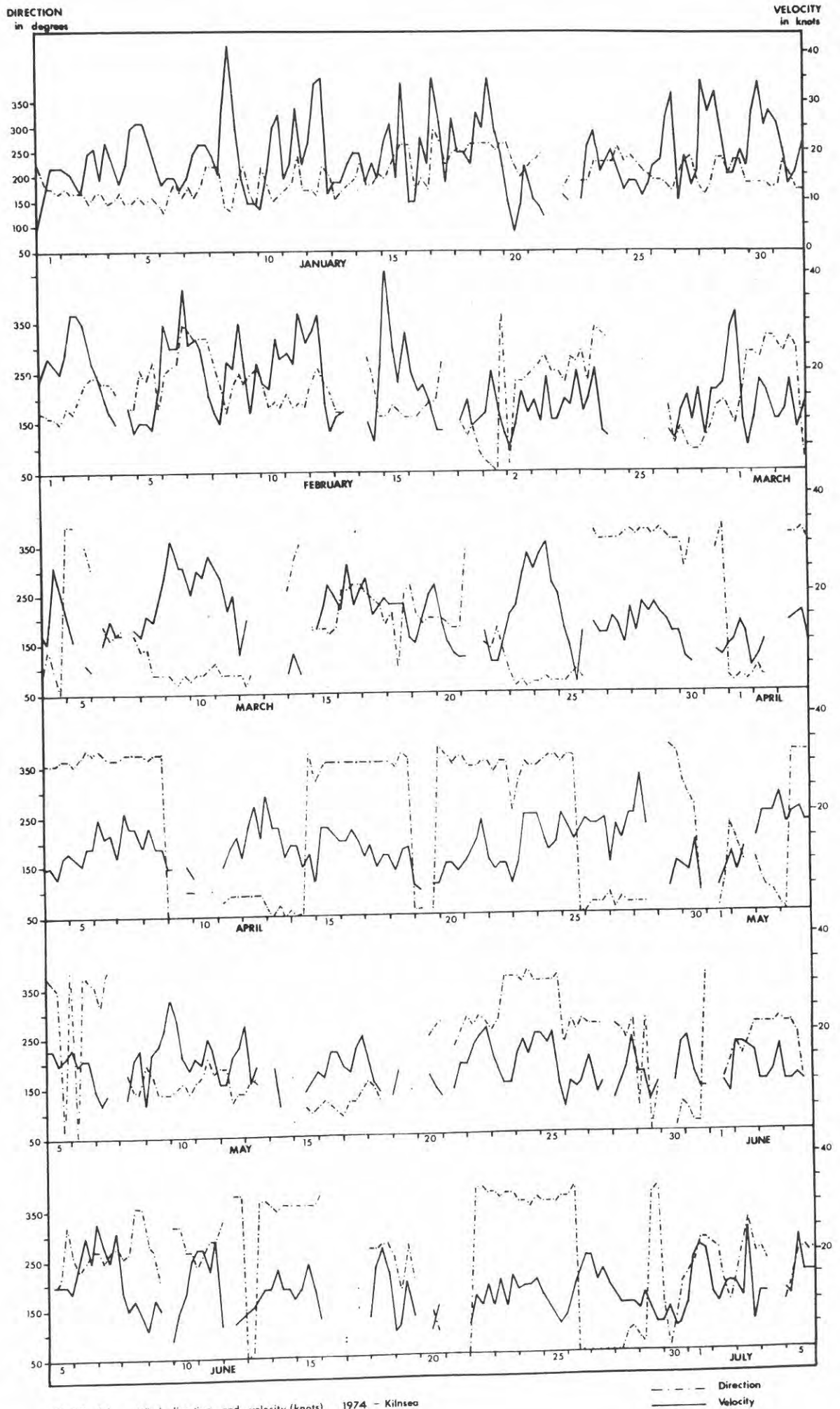


FIGURE 4.1 Wind direction and velocity (knots) 1974 - Kilnsea

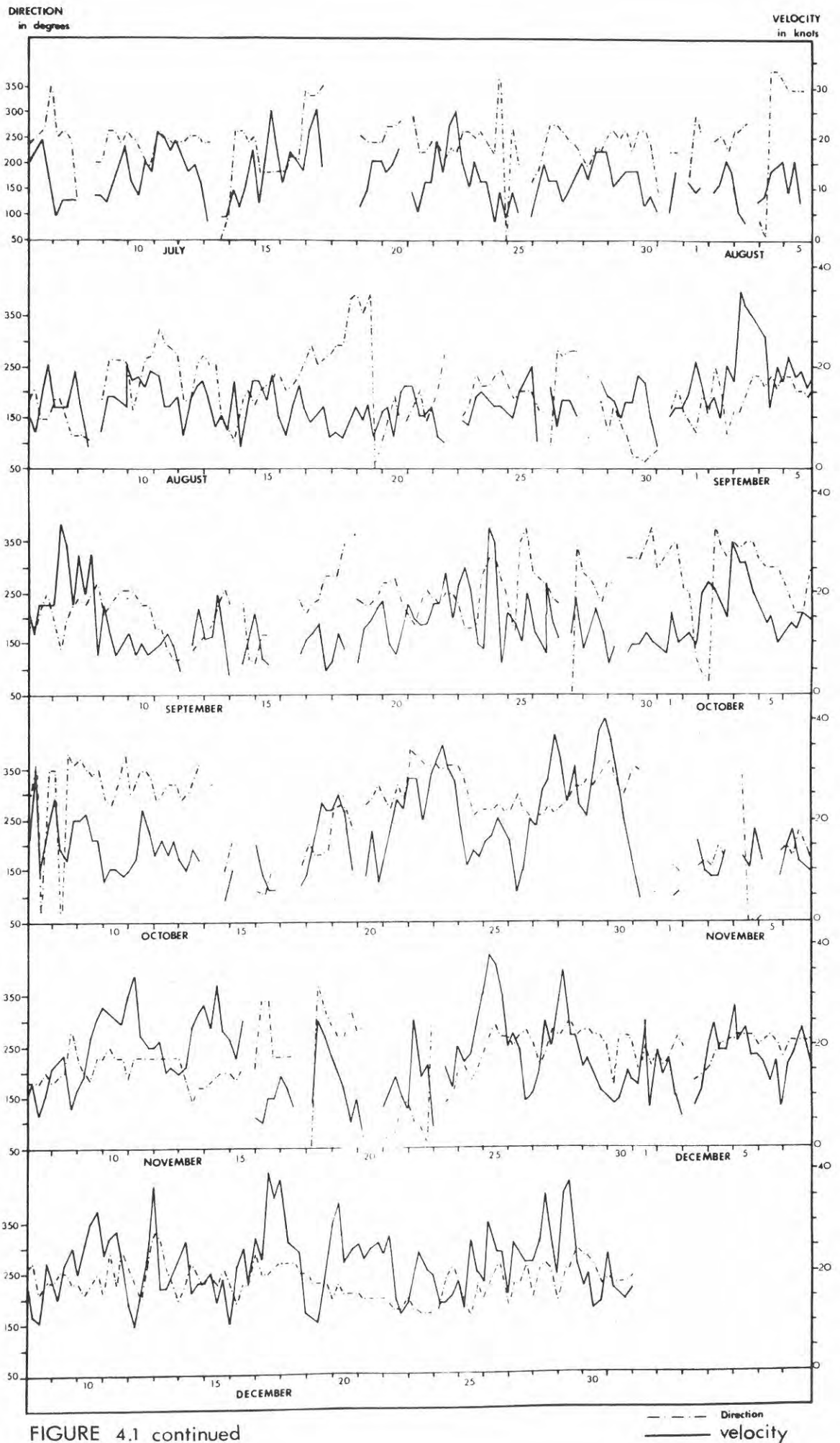


FIGURE 4.1 continued

--- Direction
 — velocity

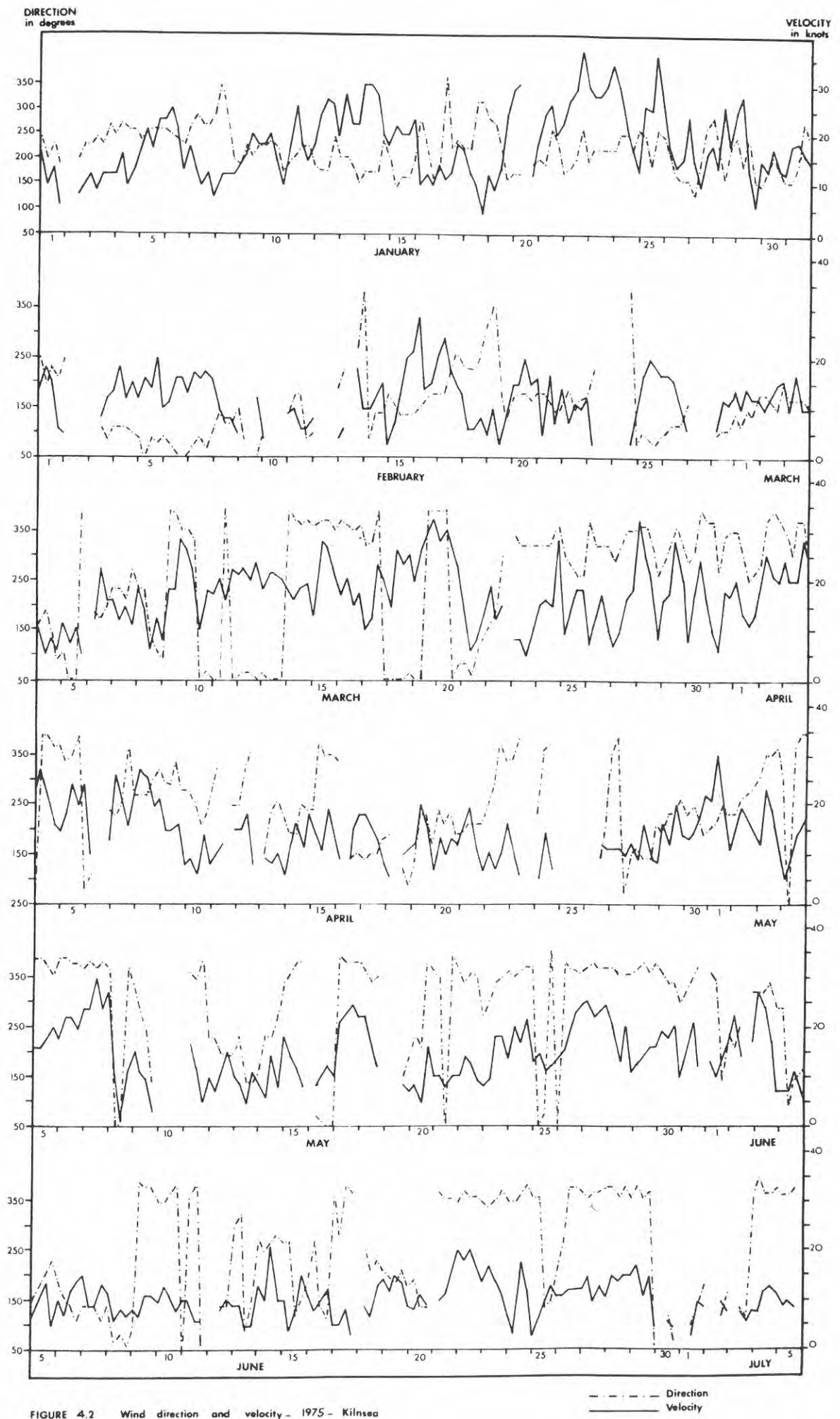


FIGURE 4.2 Wind direction and velocity - 1975 - Kilnsea

--- Direction
 — Velocity

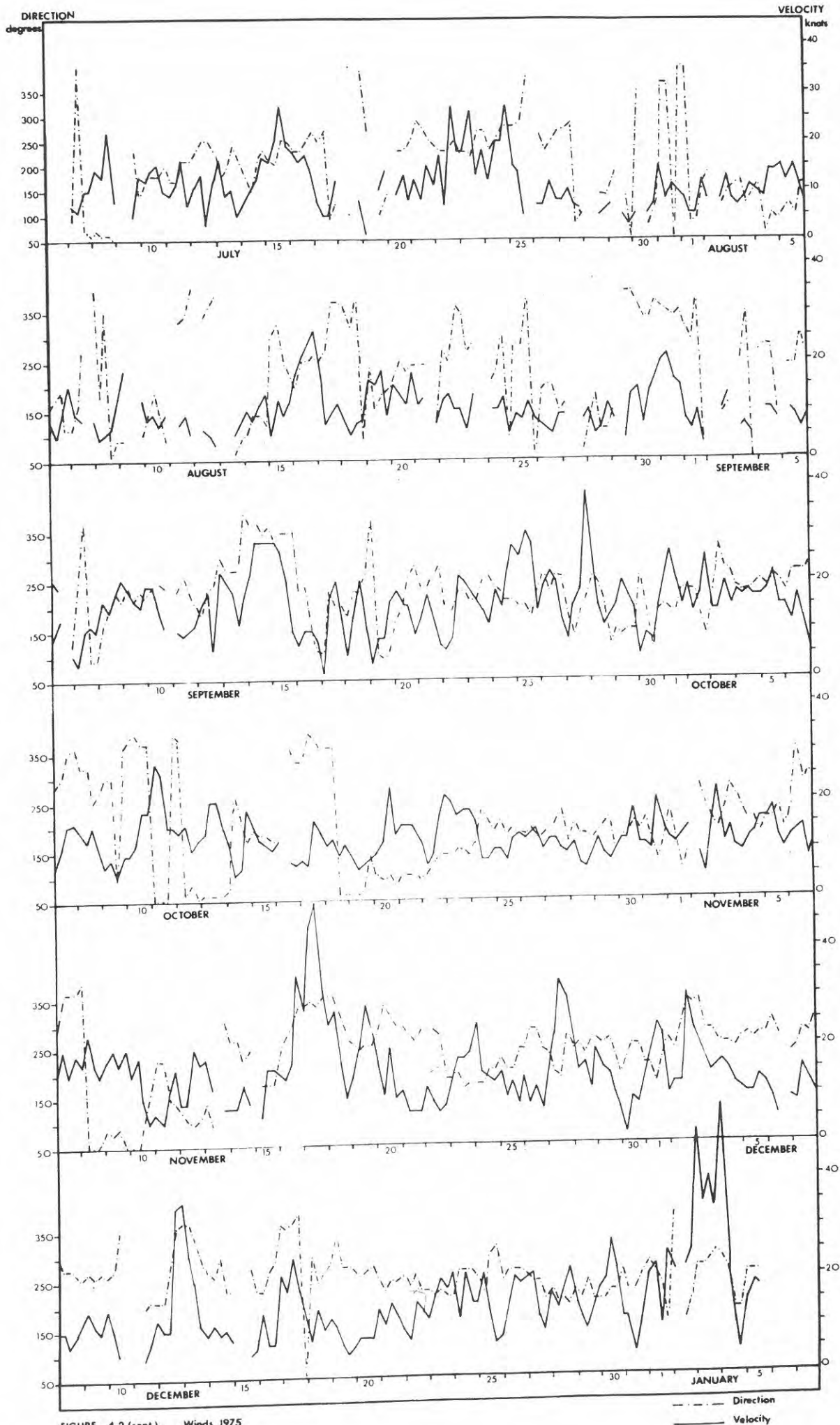


FIGURE 4.2 (cont.) Winds 1975

--- Direction
 — Velocity

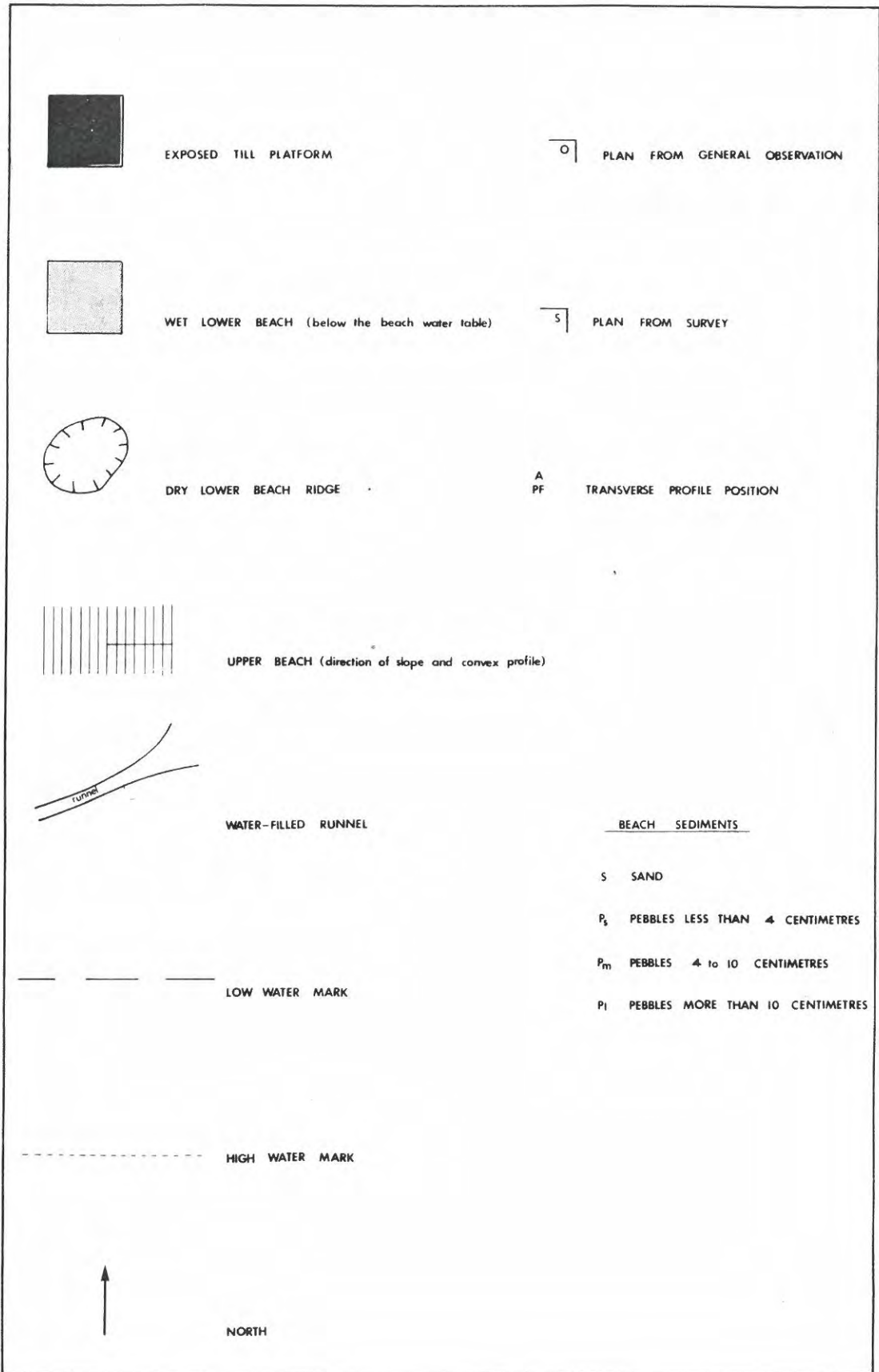


FIGURE 4.3 KEY TO THE ATWICK, HOLMPTON AND EASINGTON BEACH PLANS

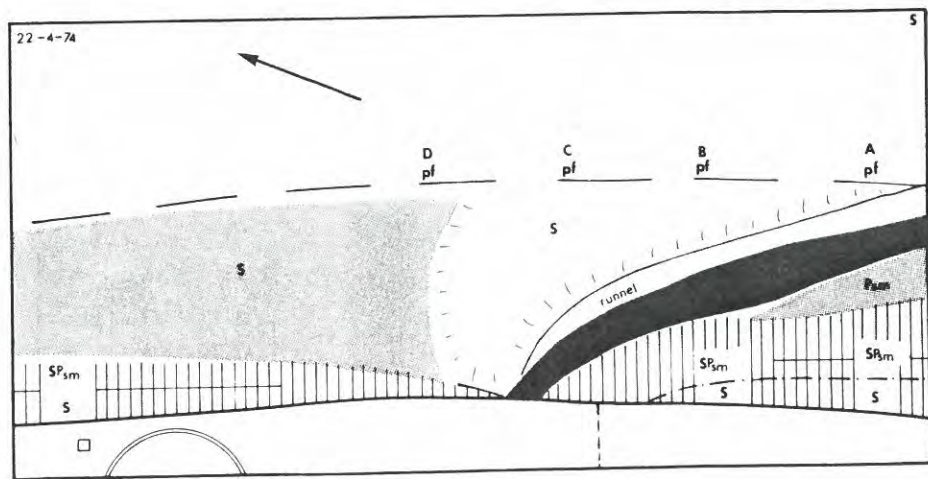
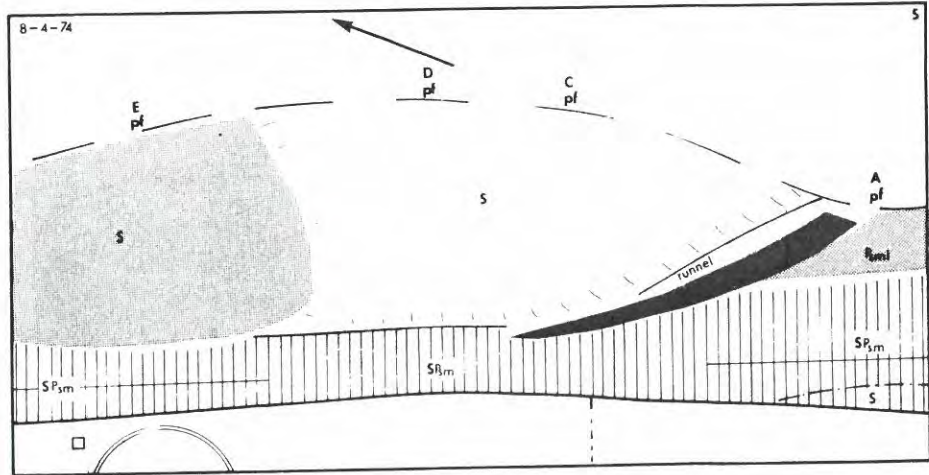
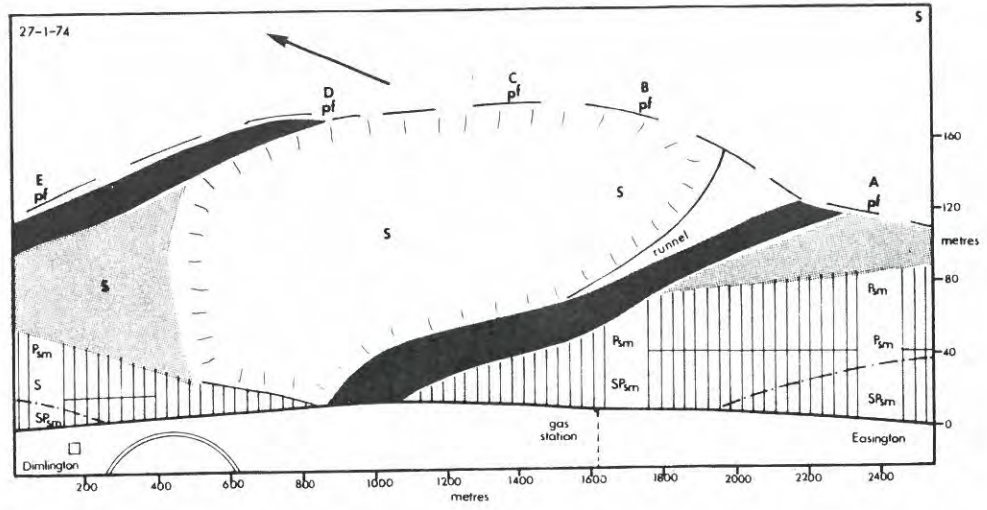


FIGURE 4.4 Easington Ord Plans

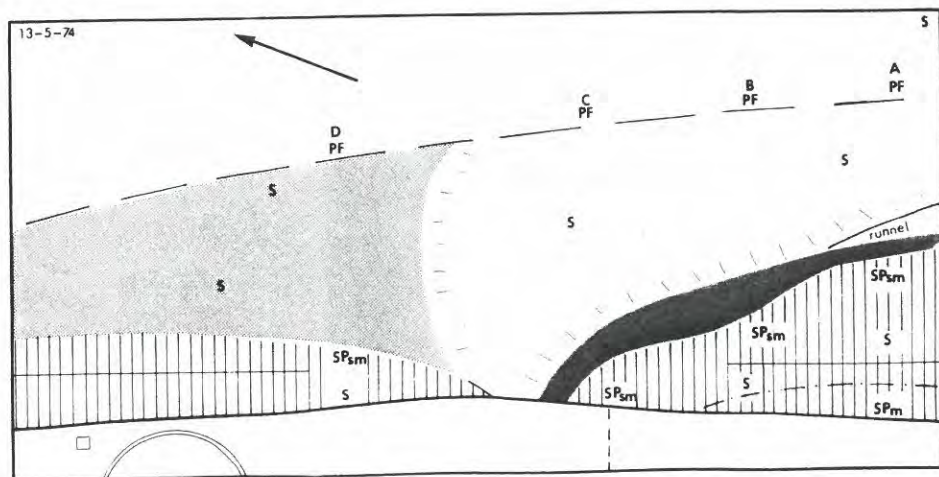
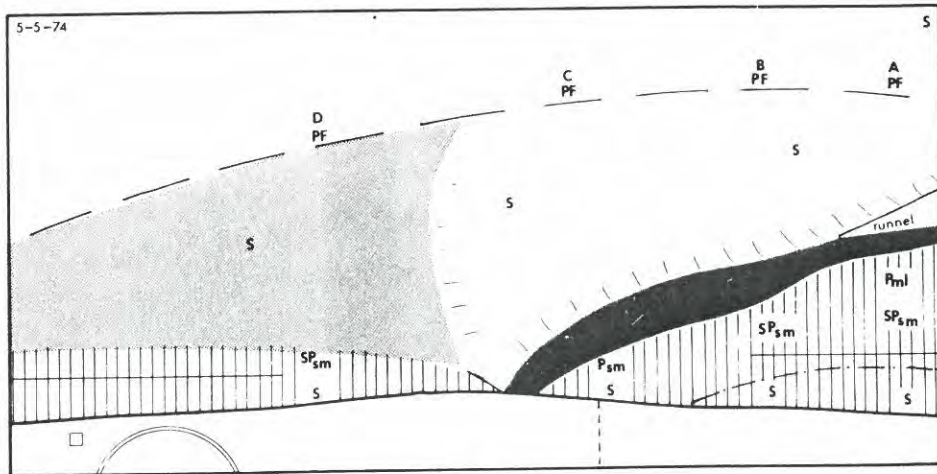
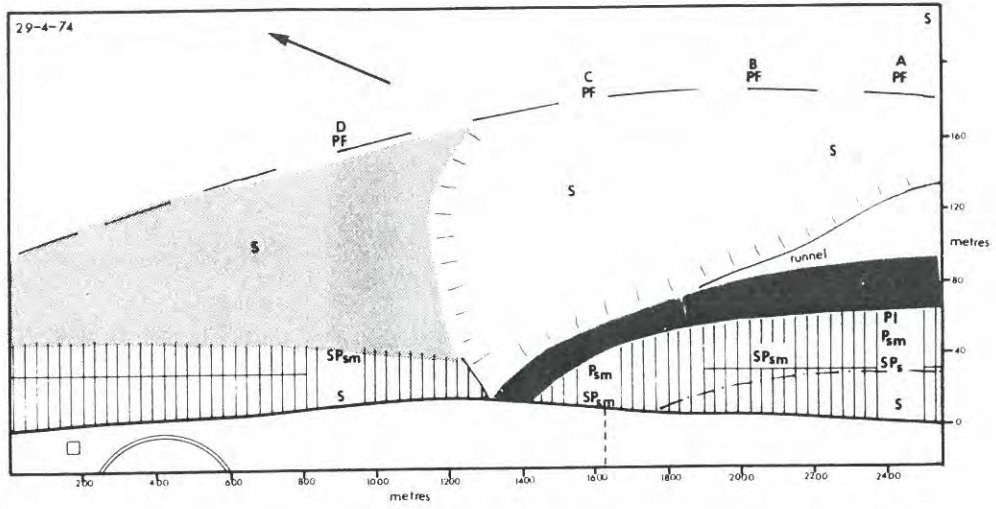


FIGURE 4-5 Easington Ord Plans

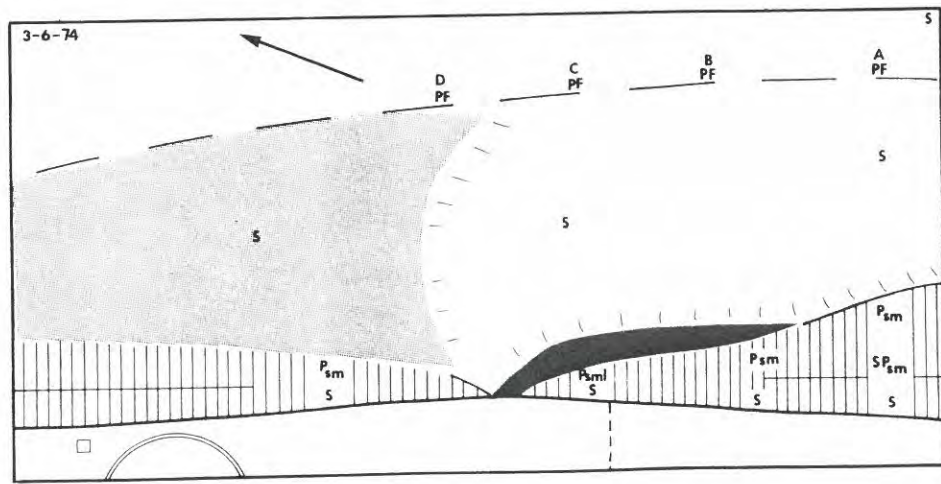
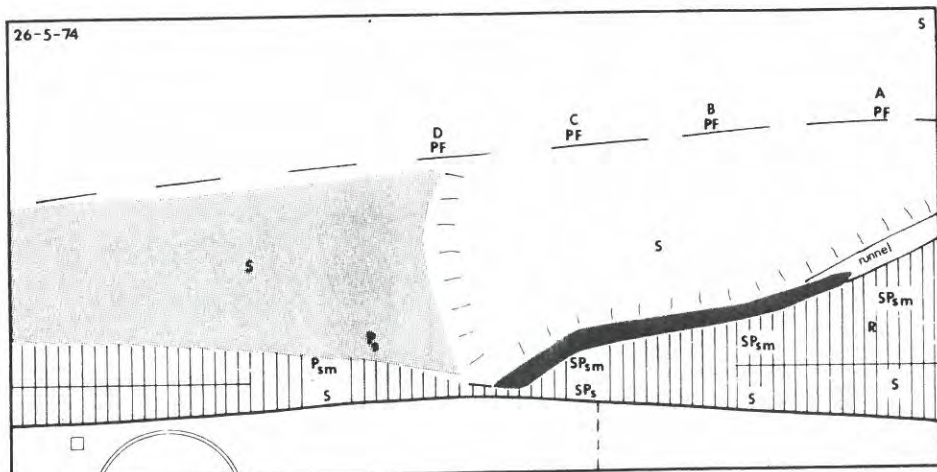
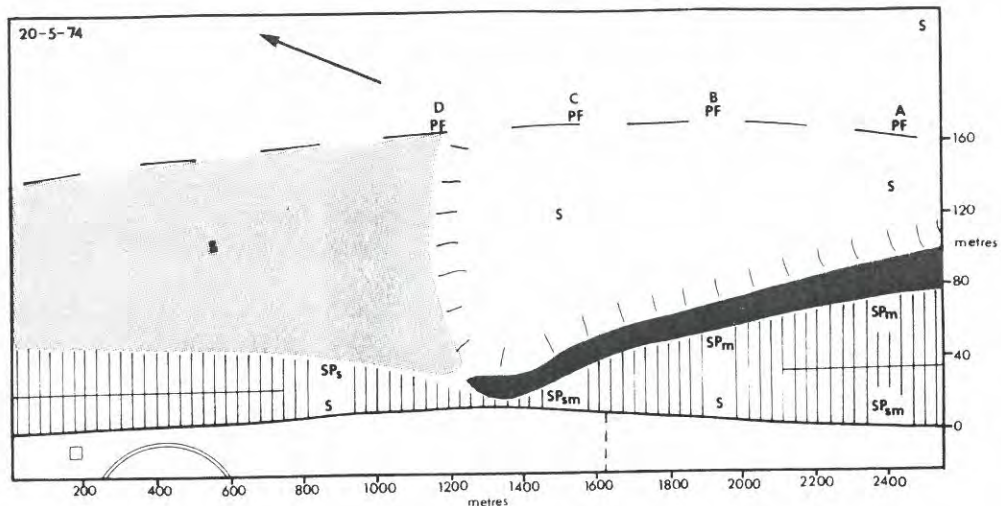


FIGURE 4-6 Easington Ord Plans

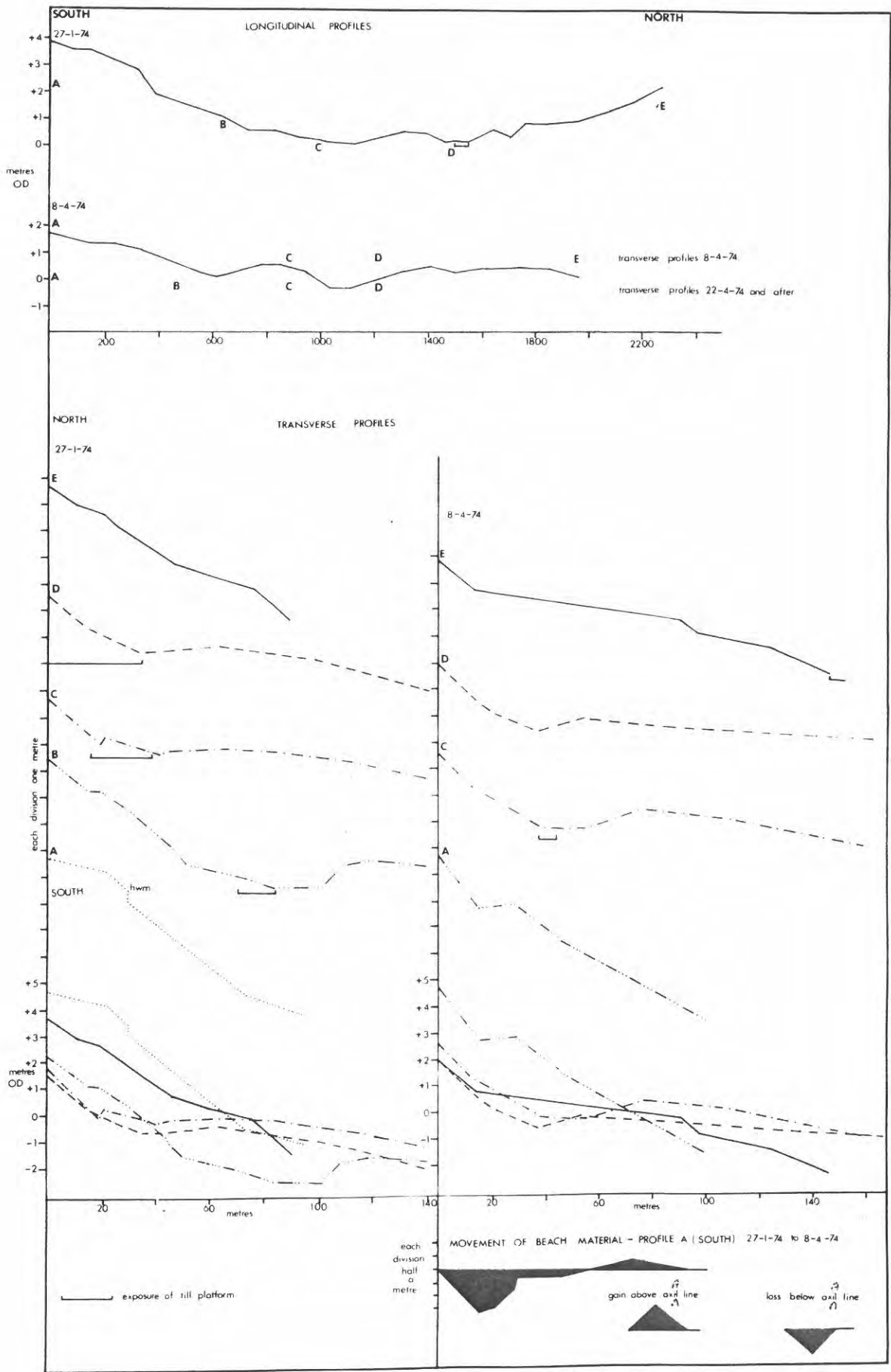


FIGURE 4.7 EASINGTON - LONGITUDINAL AND TRANSVERSE PROFILES

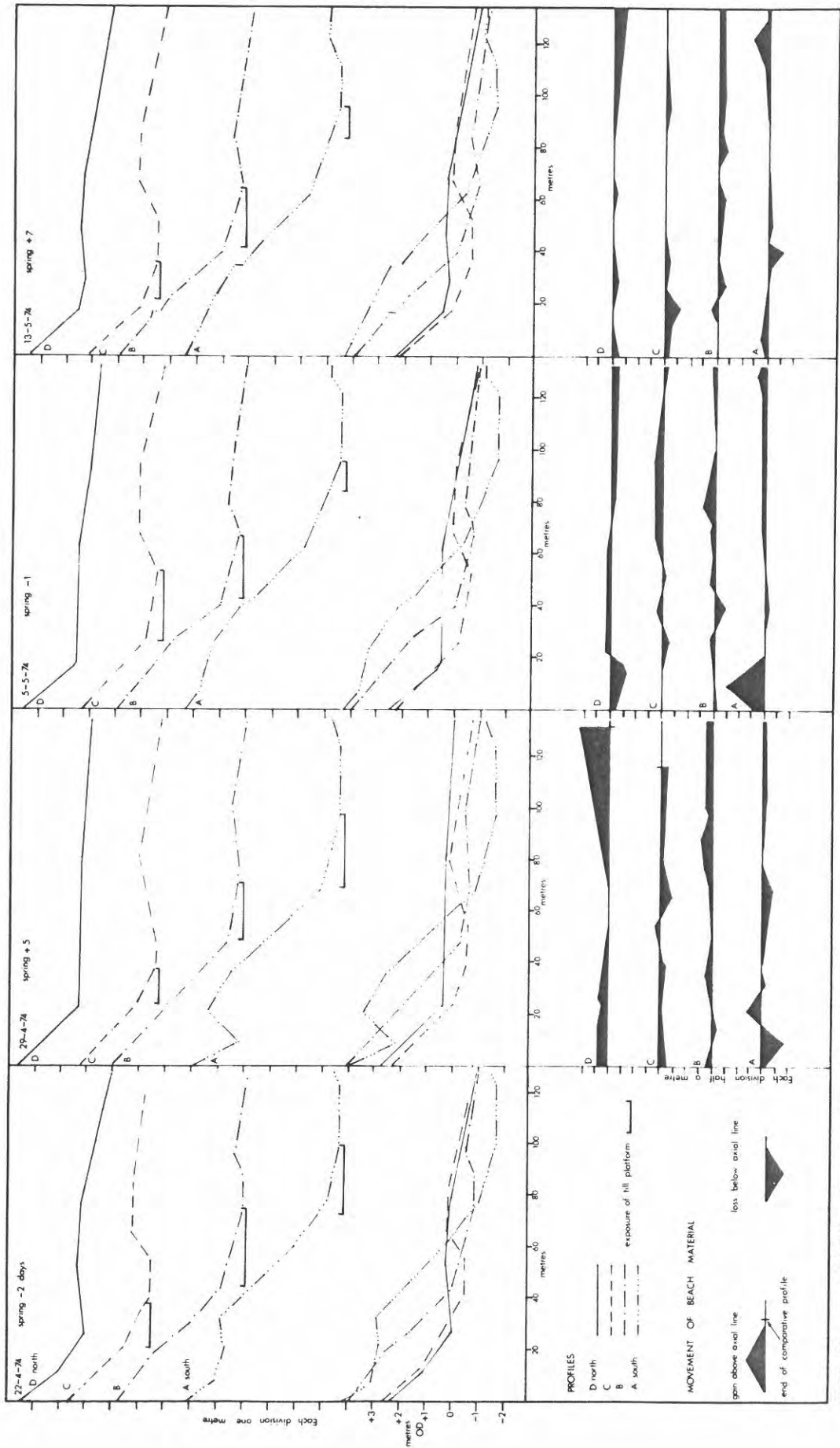


FIGURE 4-8 EASINGTON - Transverse profiles and beach changes 1974

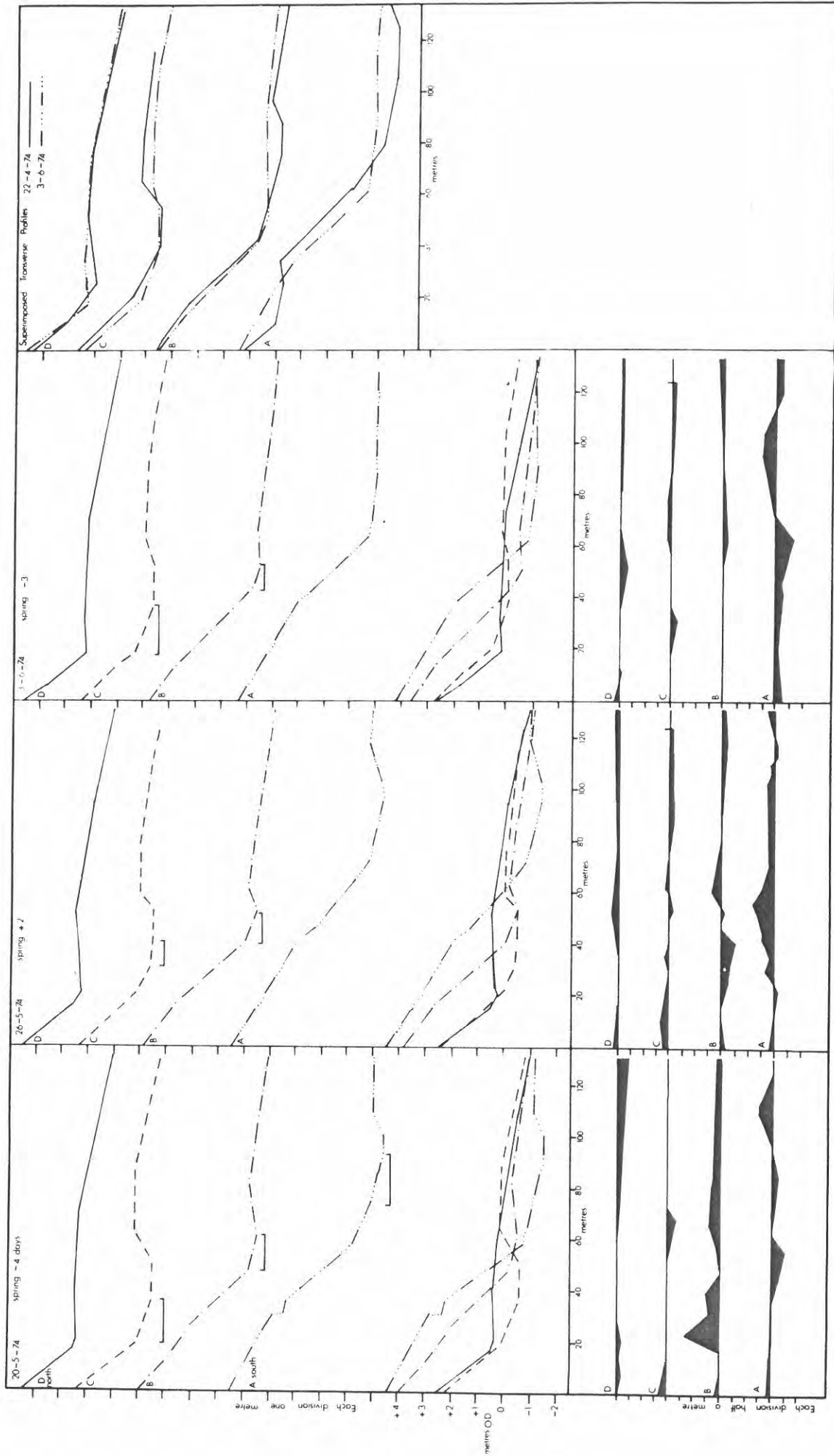


FIGURE 4.9 EASINGTON - Transverse profiles and beach changes 1974

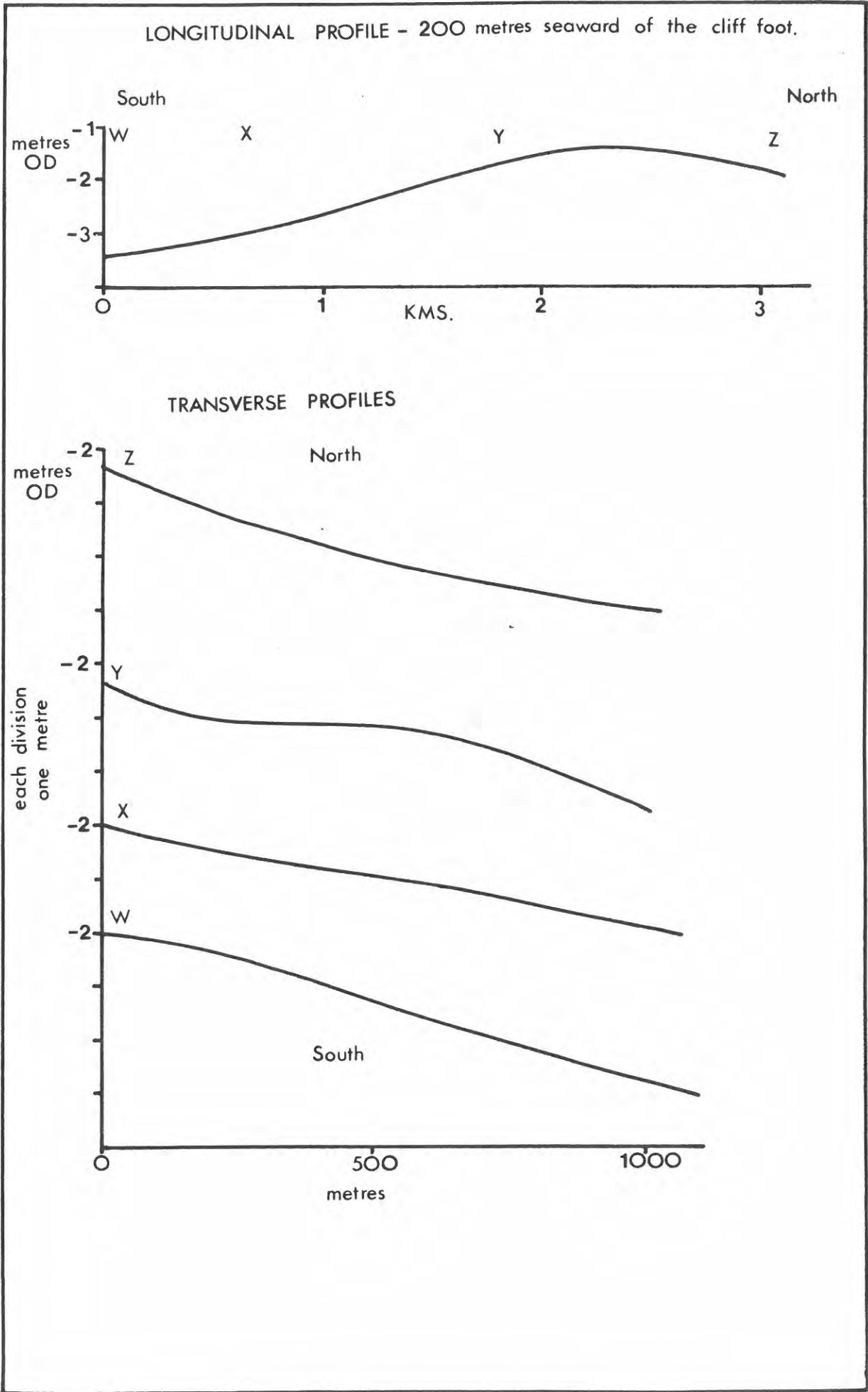


FIGURE 4.10 Easington echo-sounding traces 21-8-74

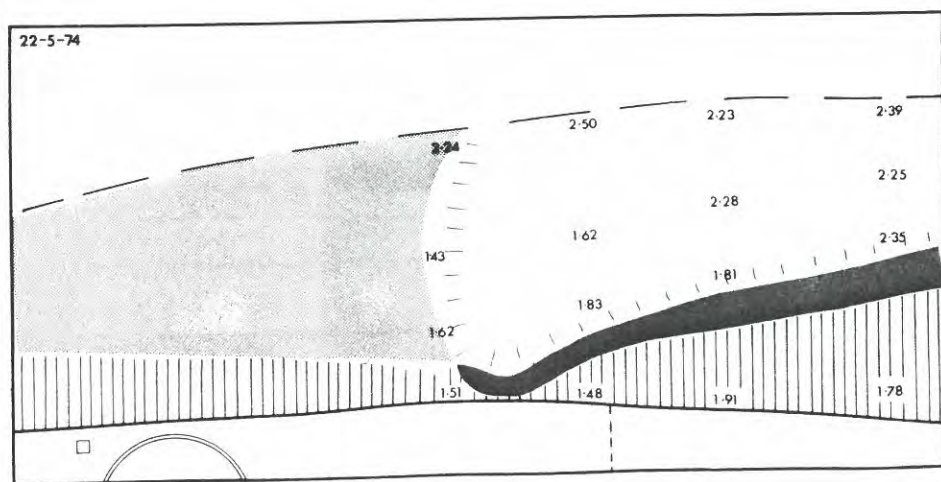
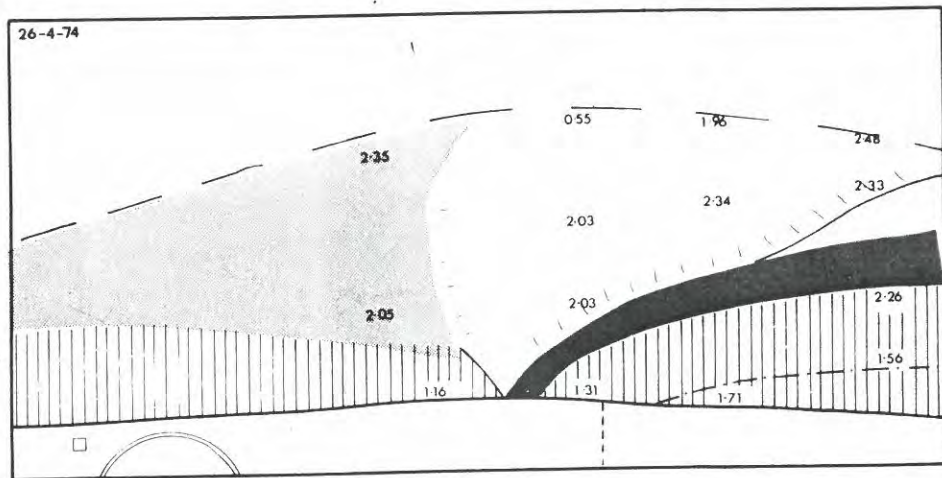
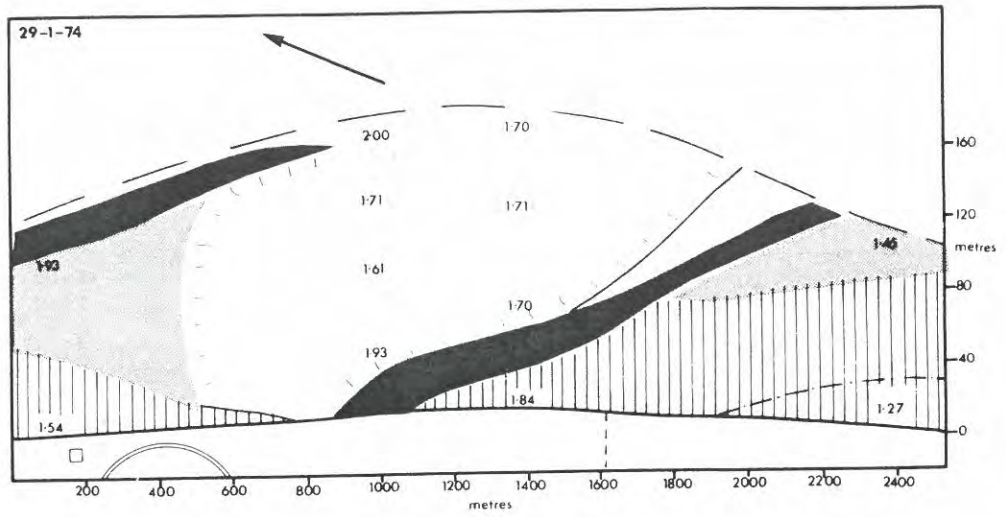


FIGURE 4-11 Easington Sample Means (phi units)

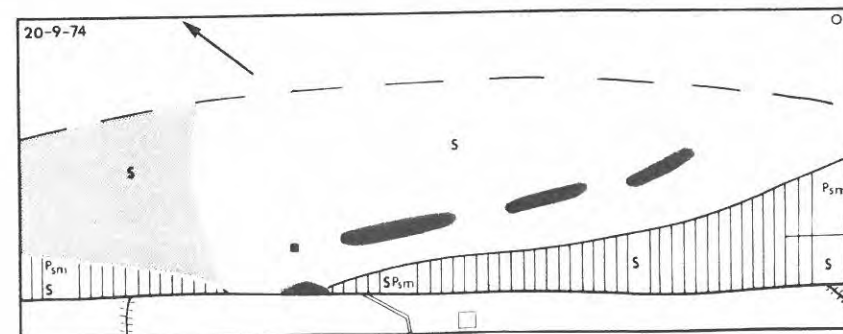
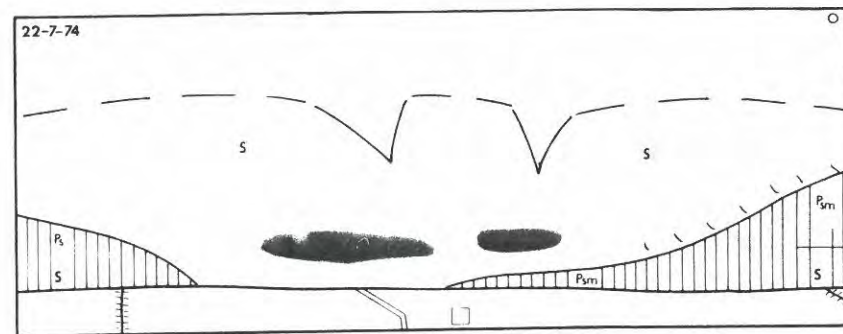
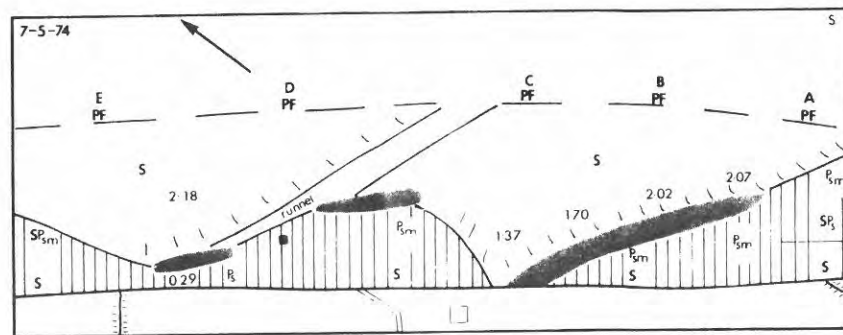
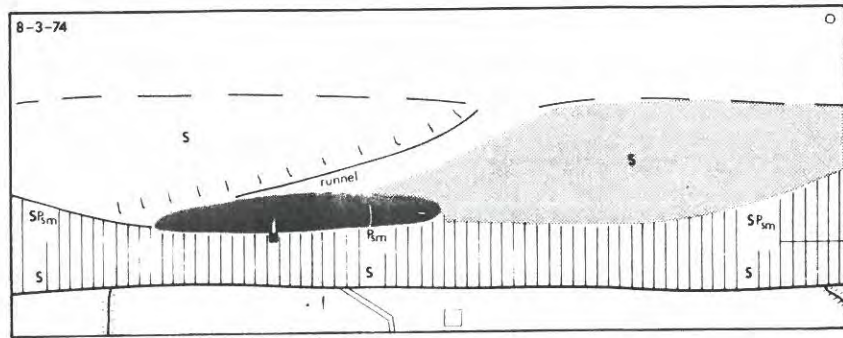
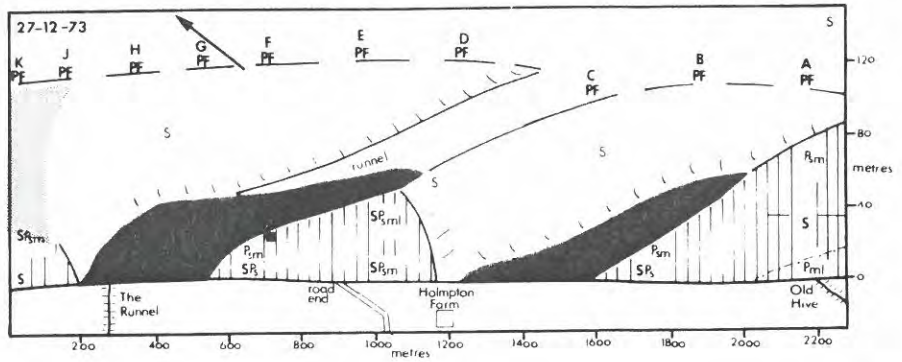


FIGURE 4.12 Halampton Ord Plans, with sample means (phi units)

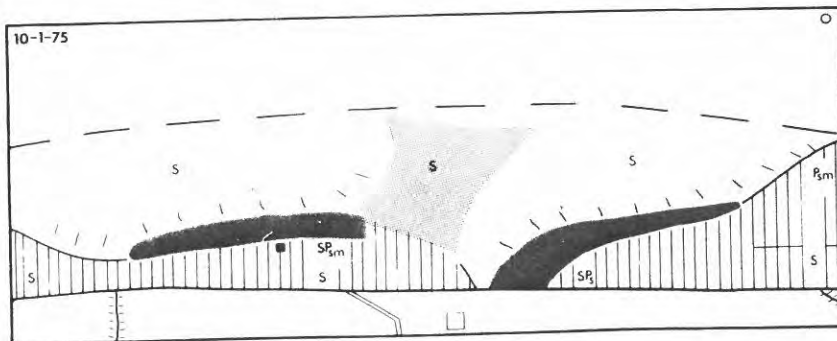
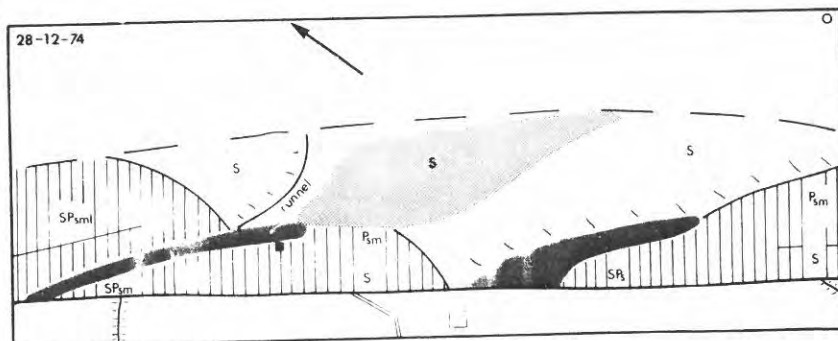
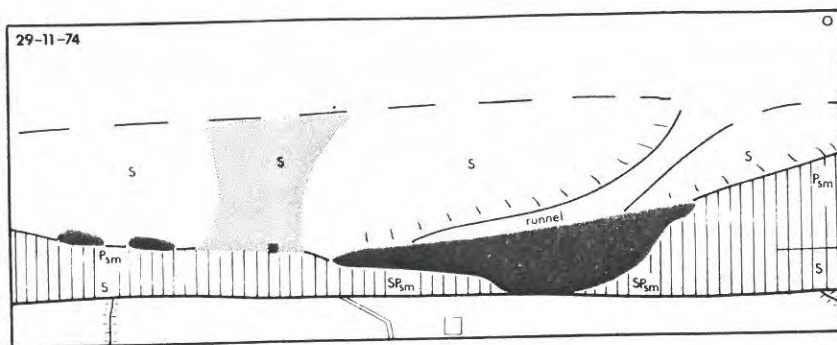
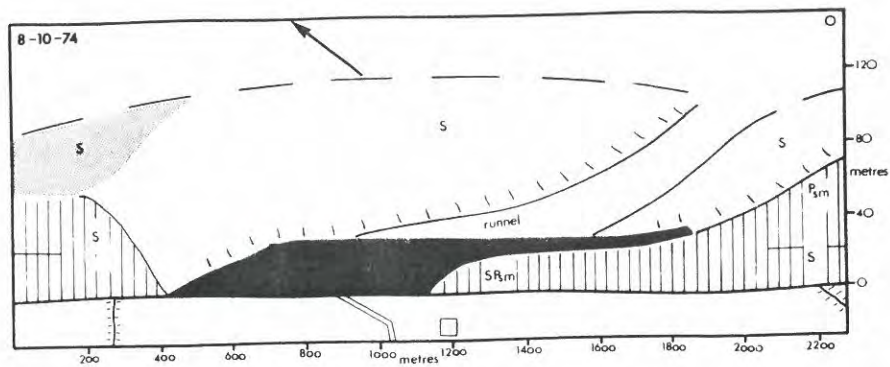


FIGURE 4-13 Helmlpton Ord Plans

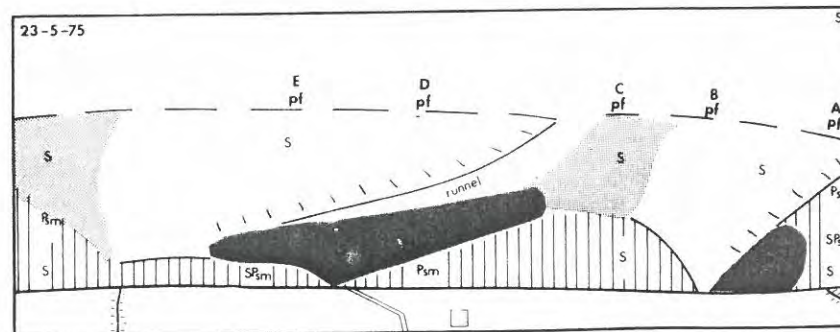
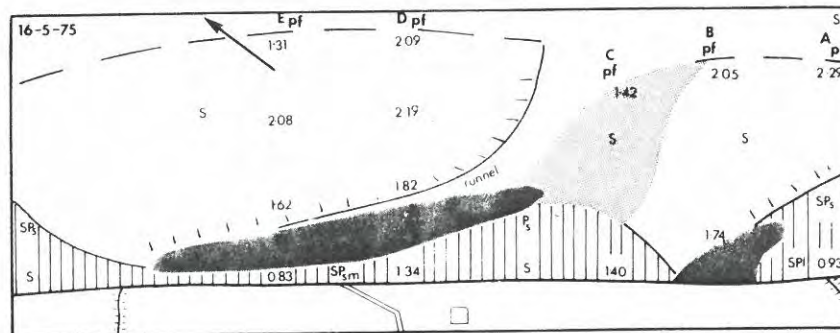
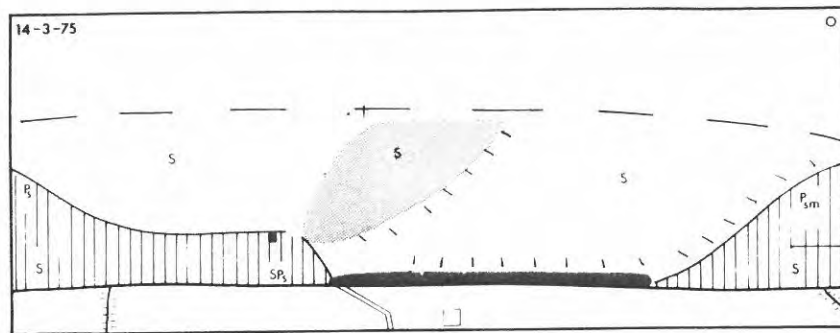
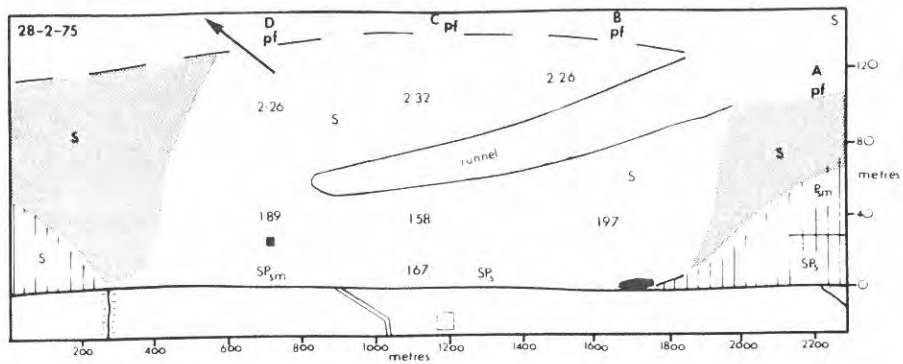


FIGURE 4-14 Holmpton Ord Plans, with sample means (phi units)

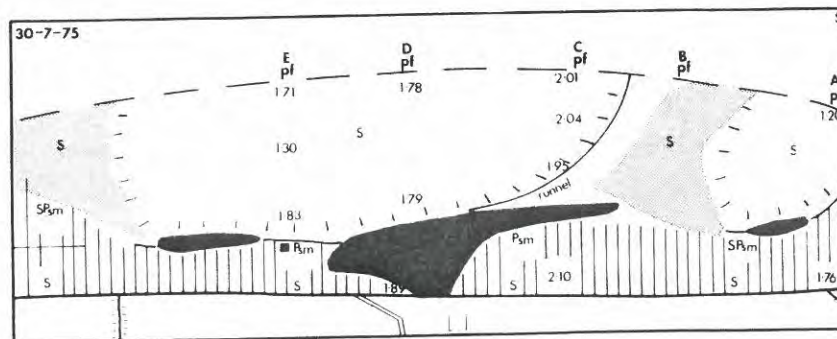
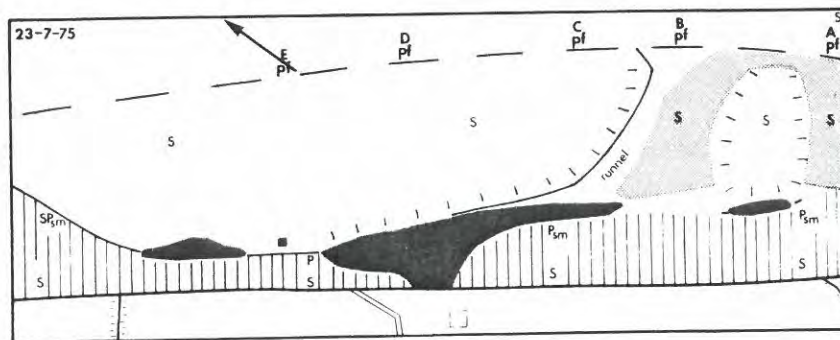
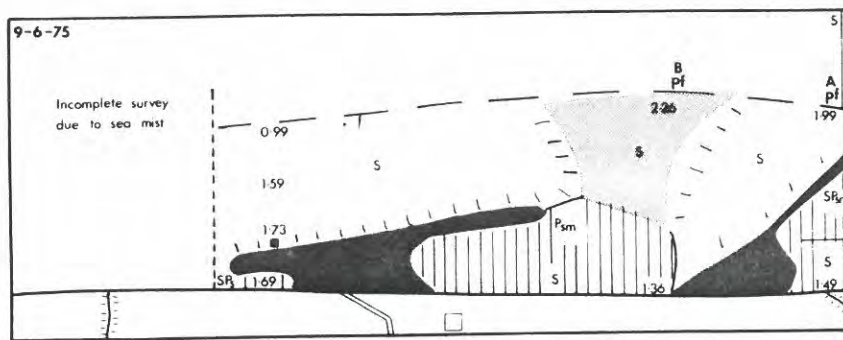
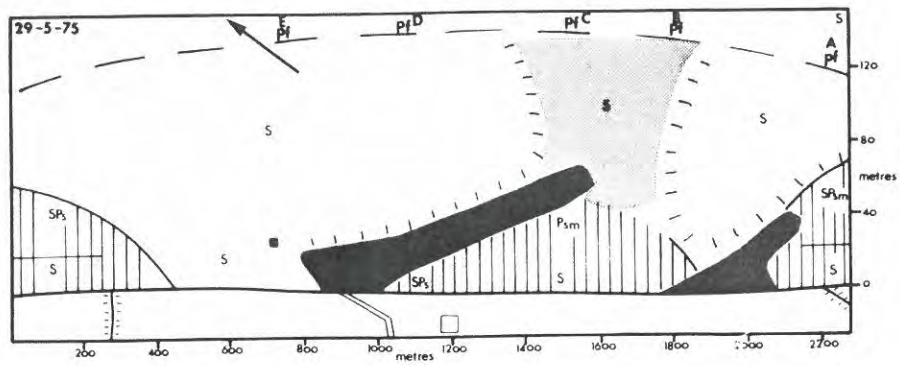


FIGURE 4 15 Holmpton Ord Plans, with sample means (phi units)

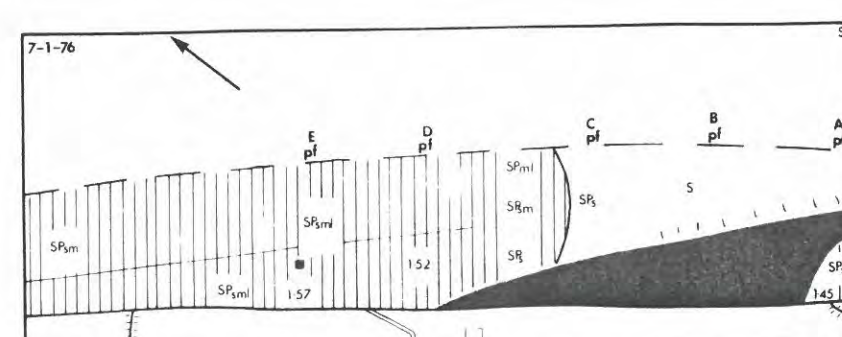
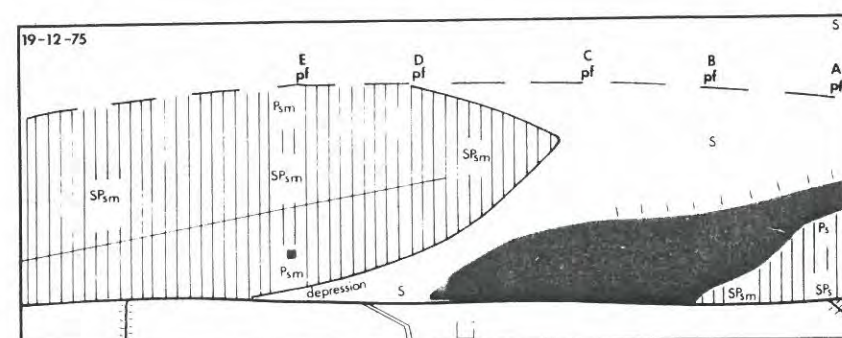
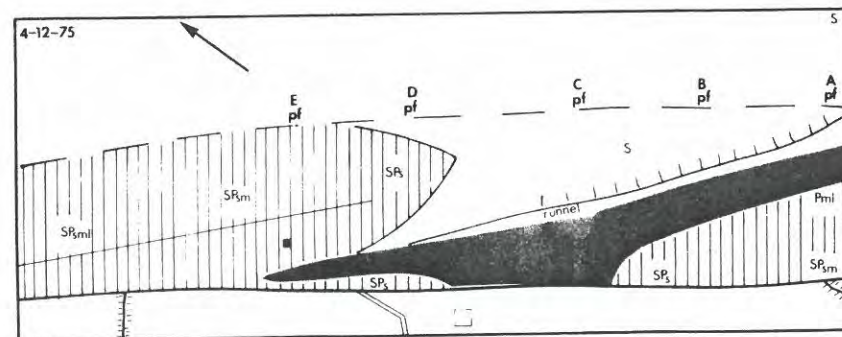
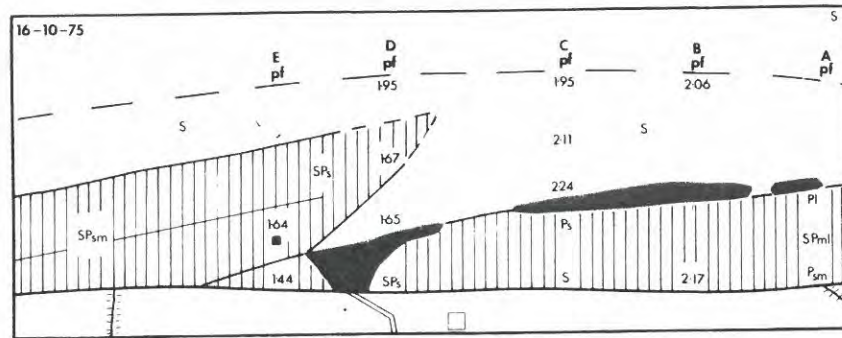
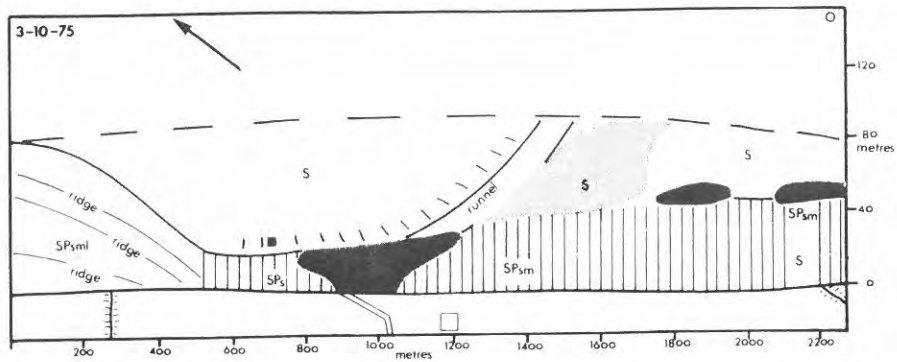


FIGURE 4-16 Holmpton Ord Plans, with sample means (phi units)

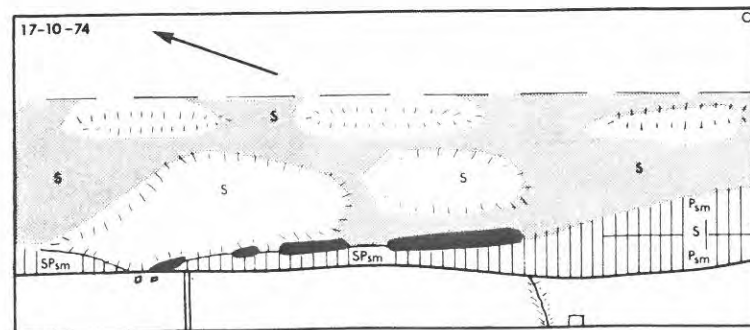
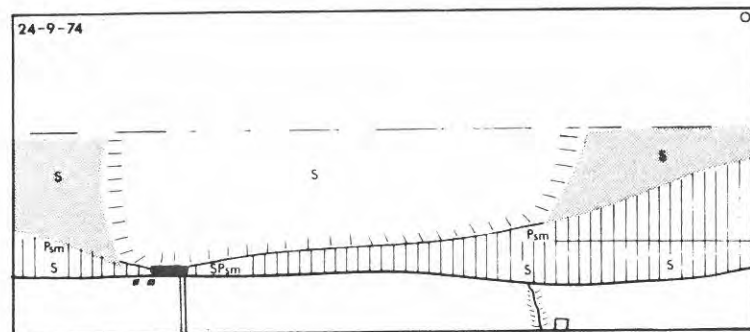
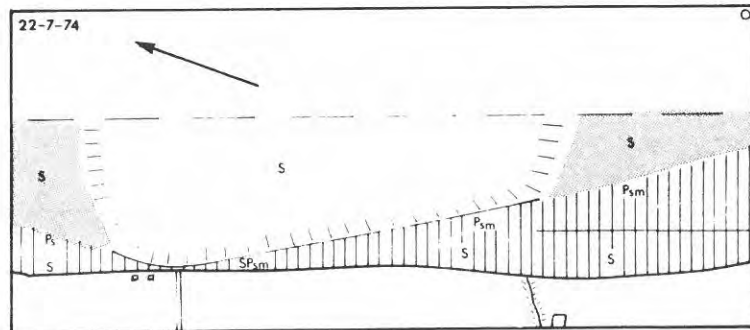
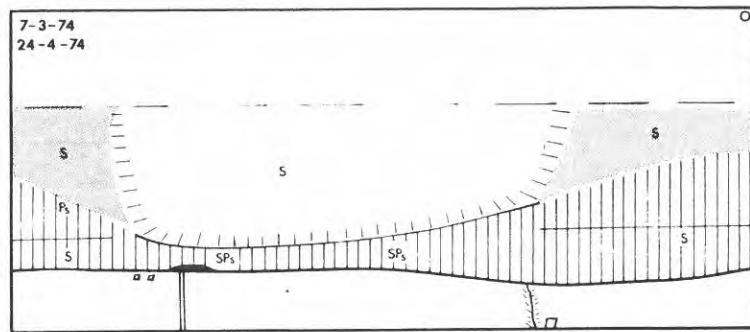
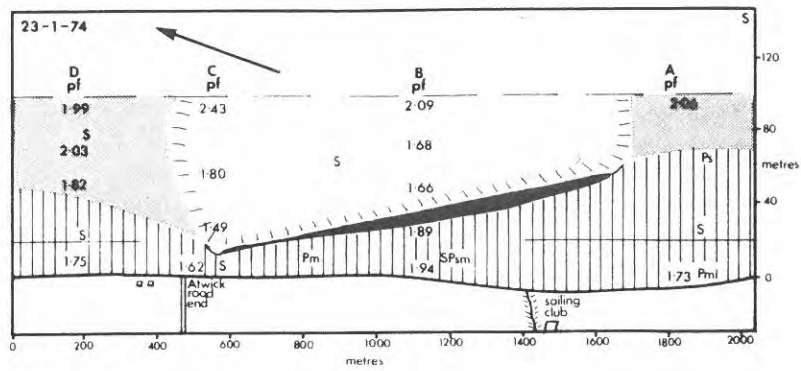


FIGURE 4.17 Atwick Ord Plans, with sample means (phi units)

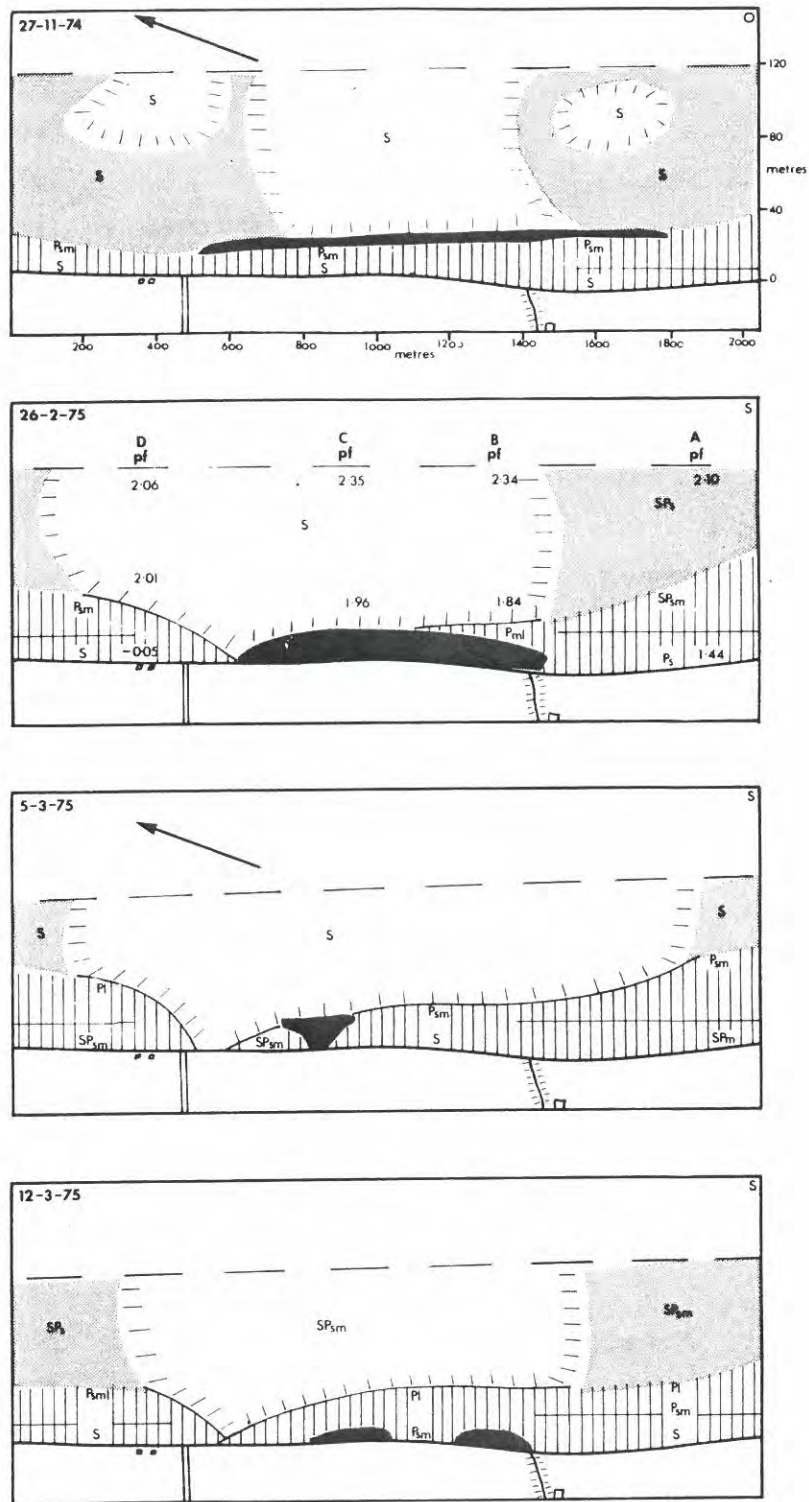


FIGURE 4.18 Atwick Ord Plans, with sample means (phi units)

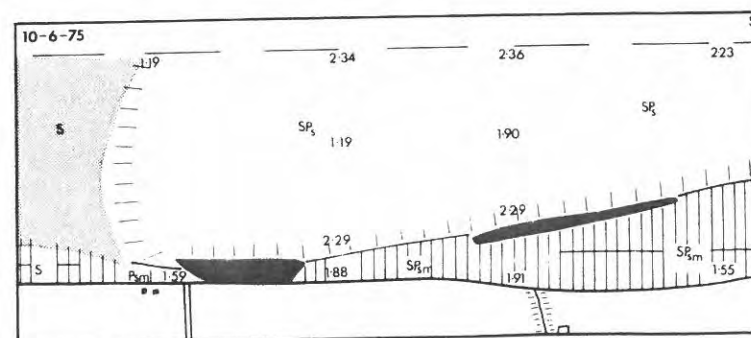
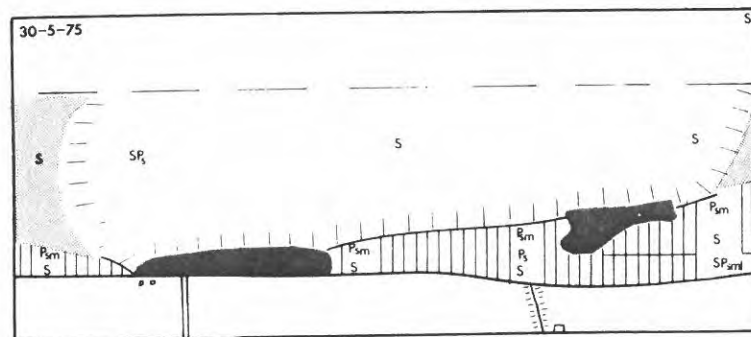
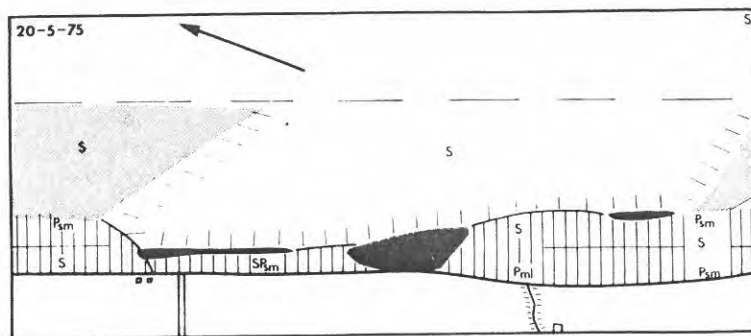
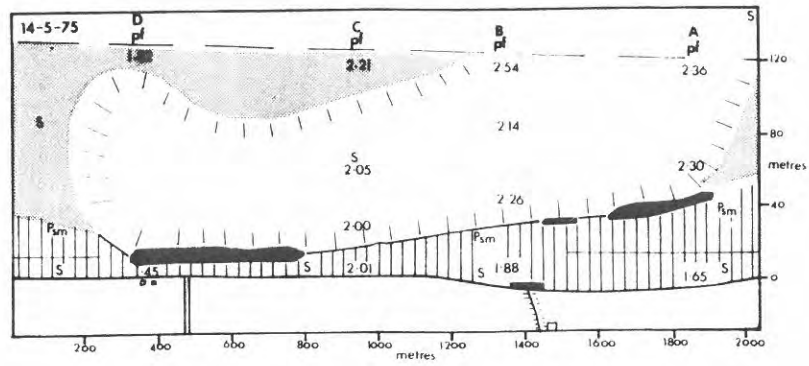


FIGURE 4.19 Atwick Ord Plans, with sample means (phi units)

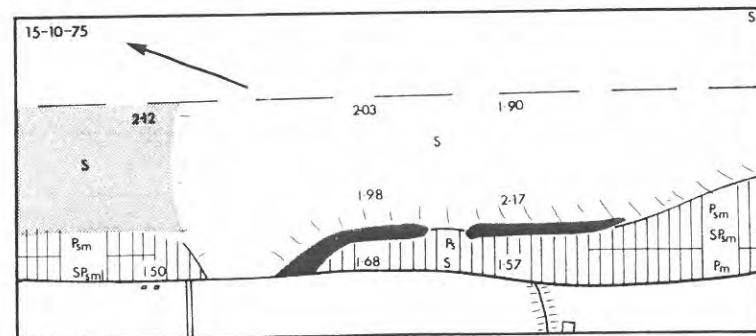
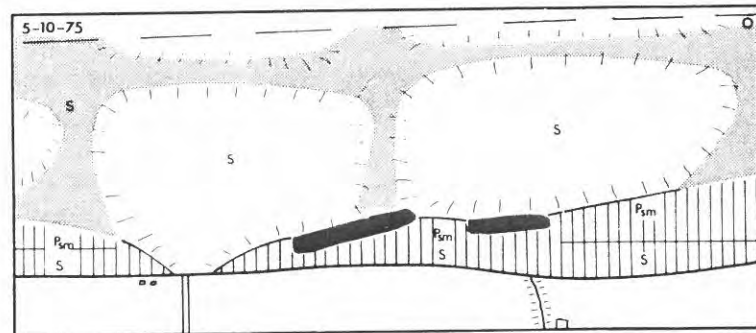
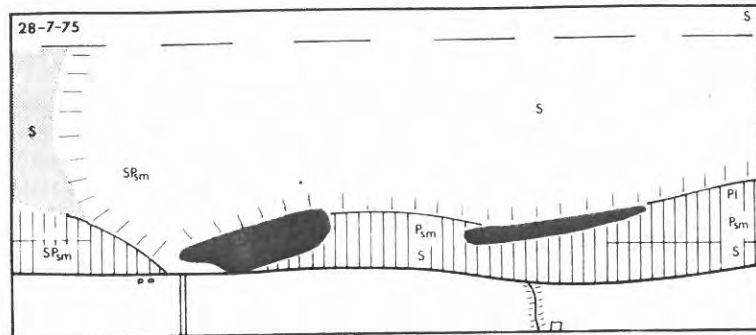
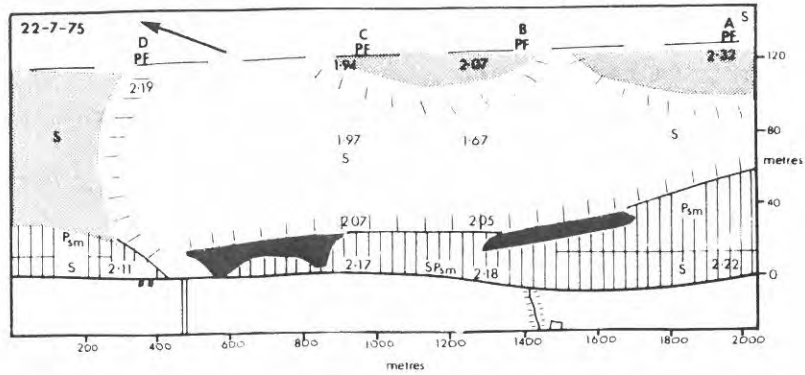


FIGURE 4 20 Atwick Ord Plans, with sample means (phi units)

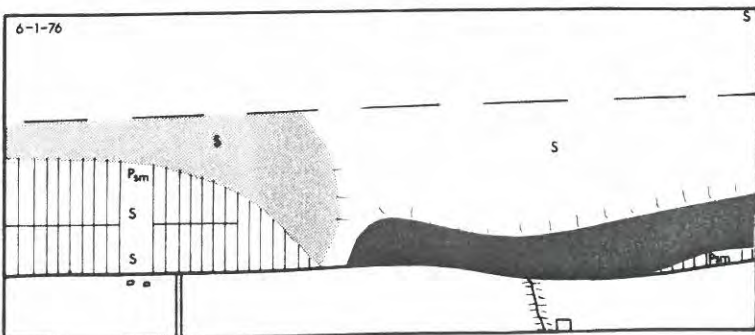
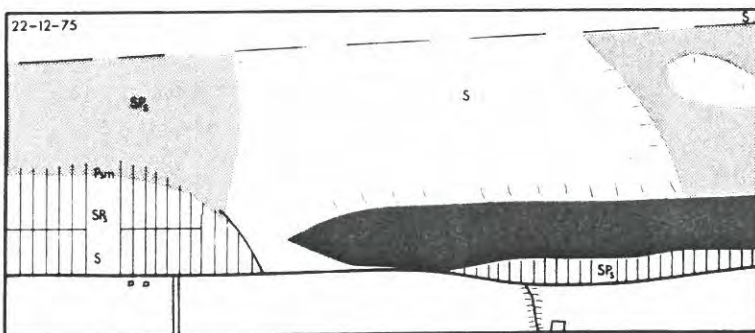
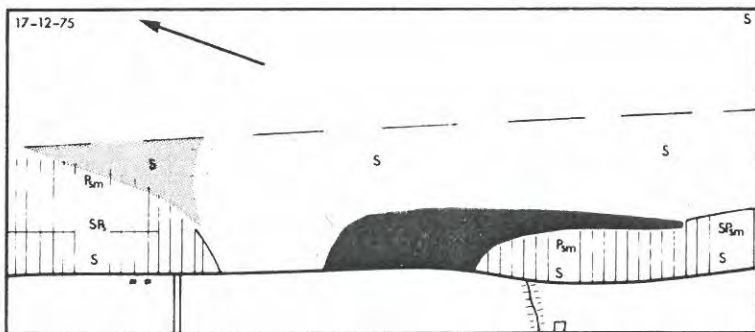
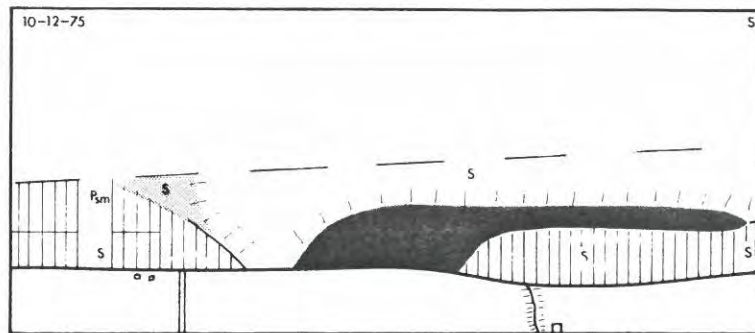
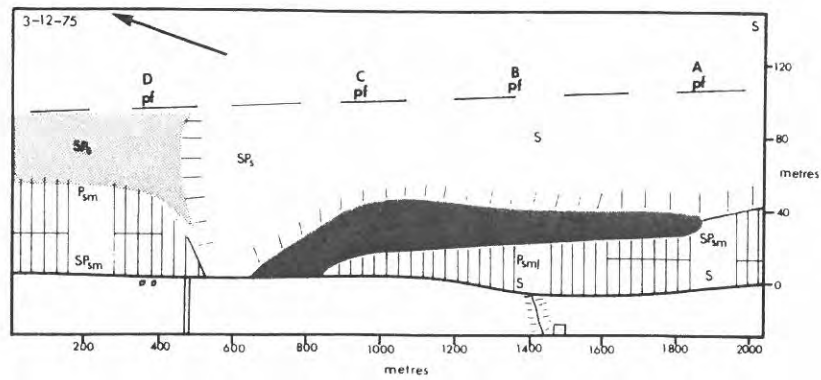


FIGURE 4-21 Atwick Ord Plans

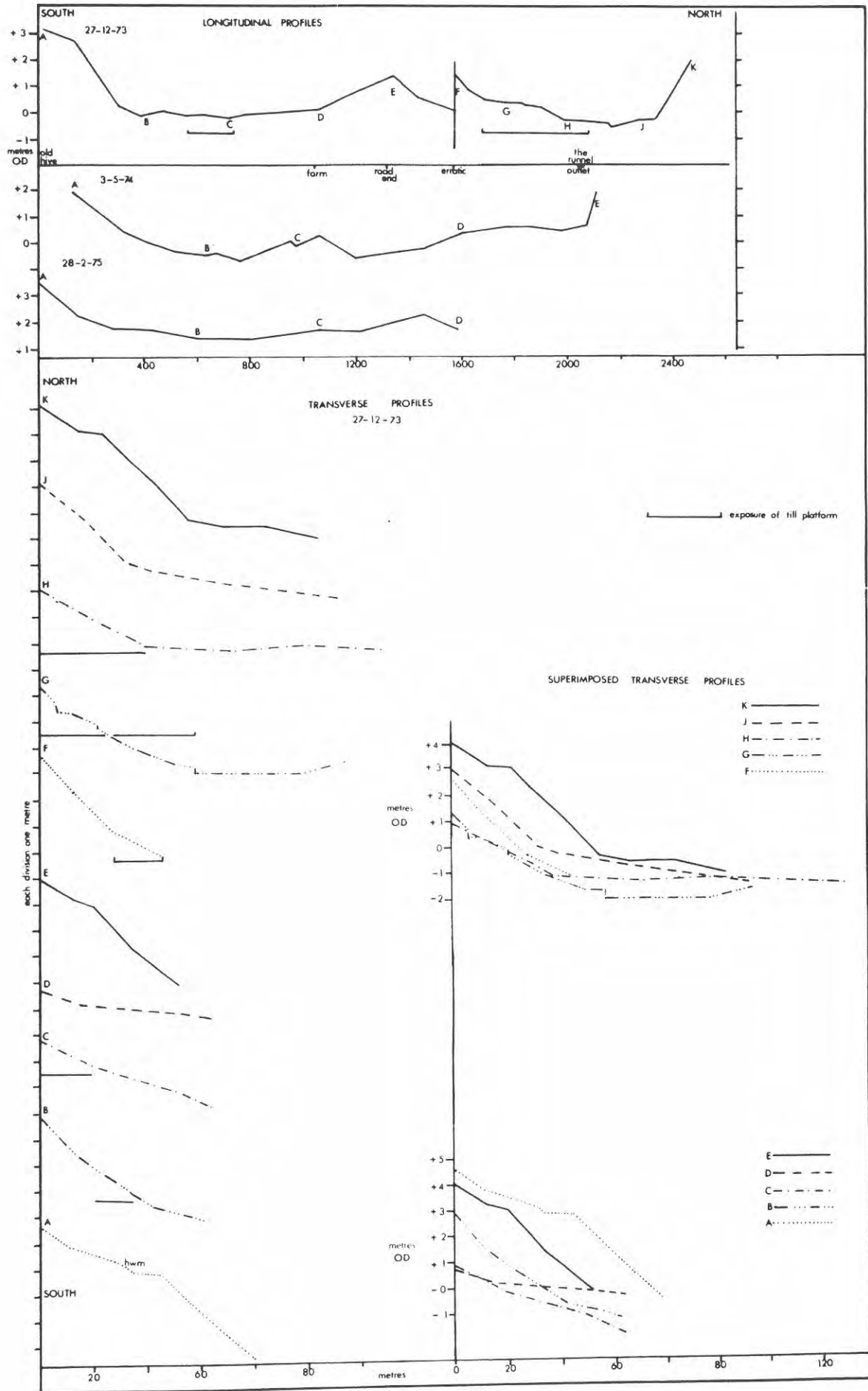


FIGURE 4.22 HOLMPTON - Longitudinal and transverse profiles

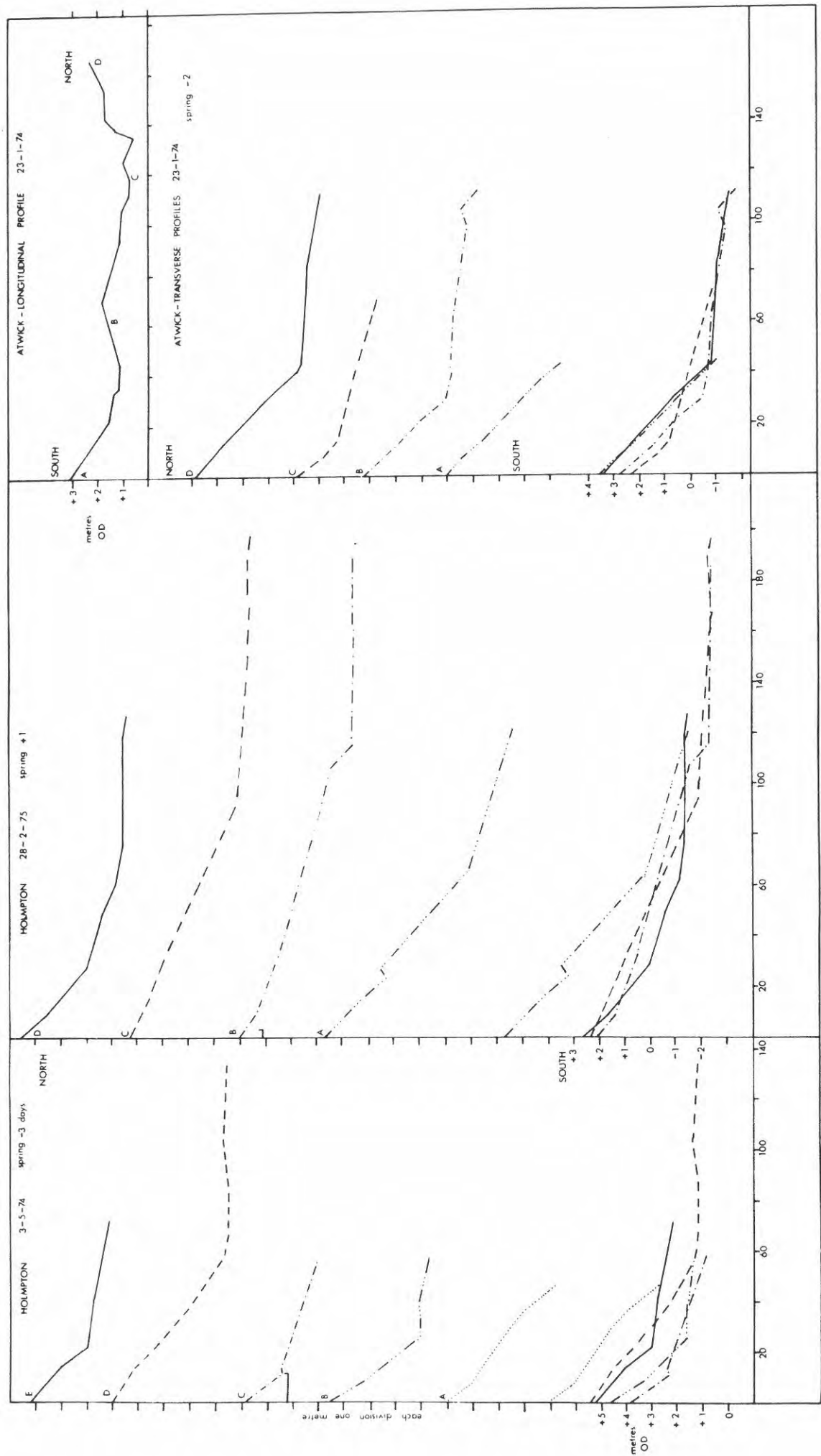


FIGURE 4.23 Holmpton transverse profiles - Atwick longitudinal and transverse profiles 1974

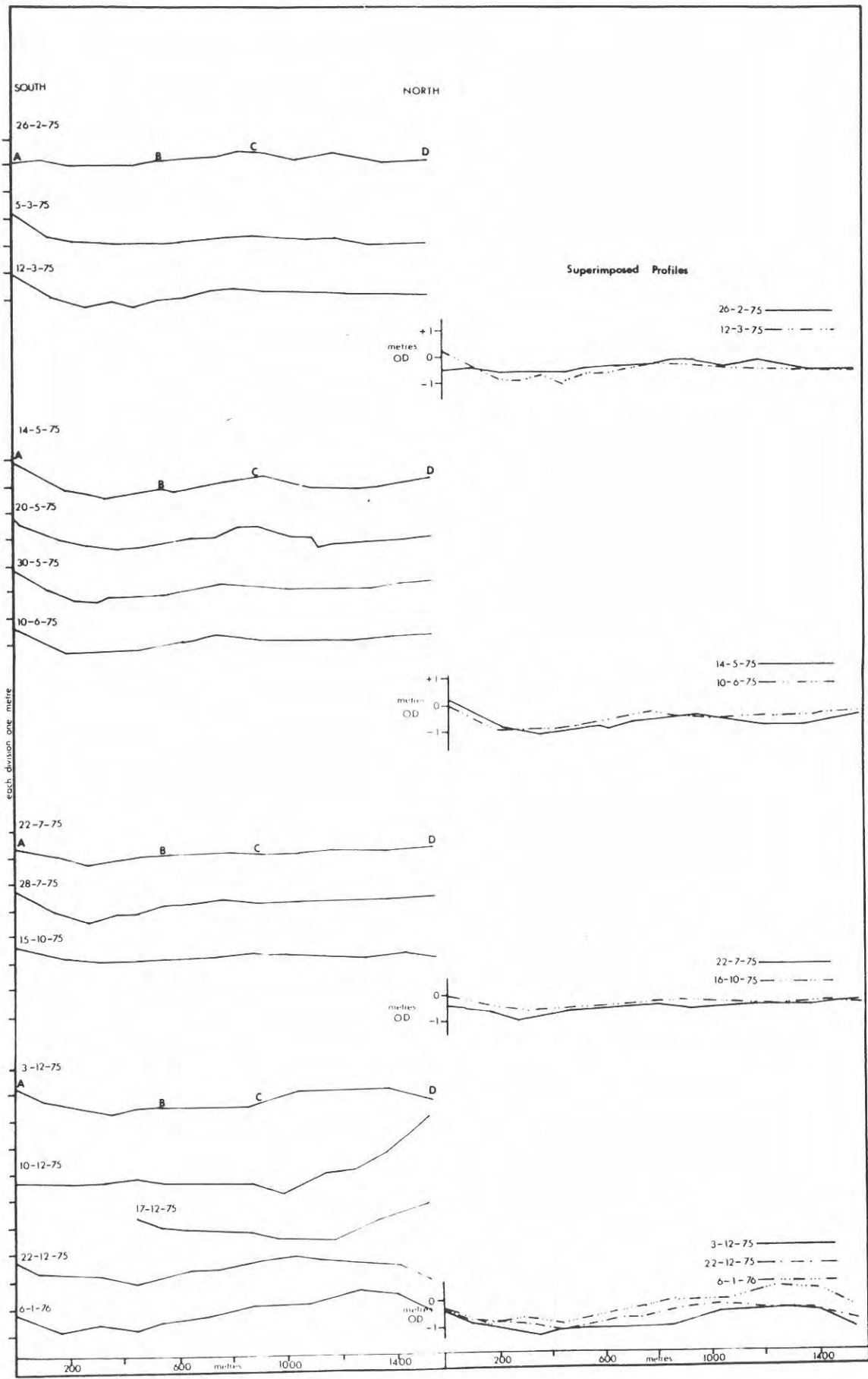


FIGURE 4 24 ATWICK - Longitudinal profiles 1975 - 1976

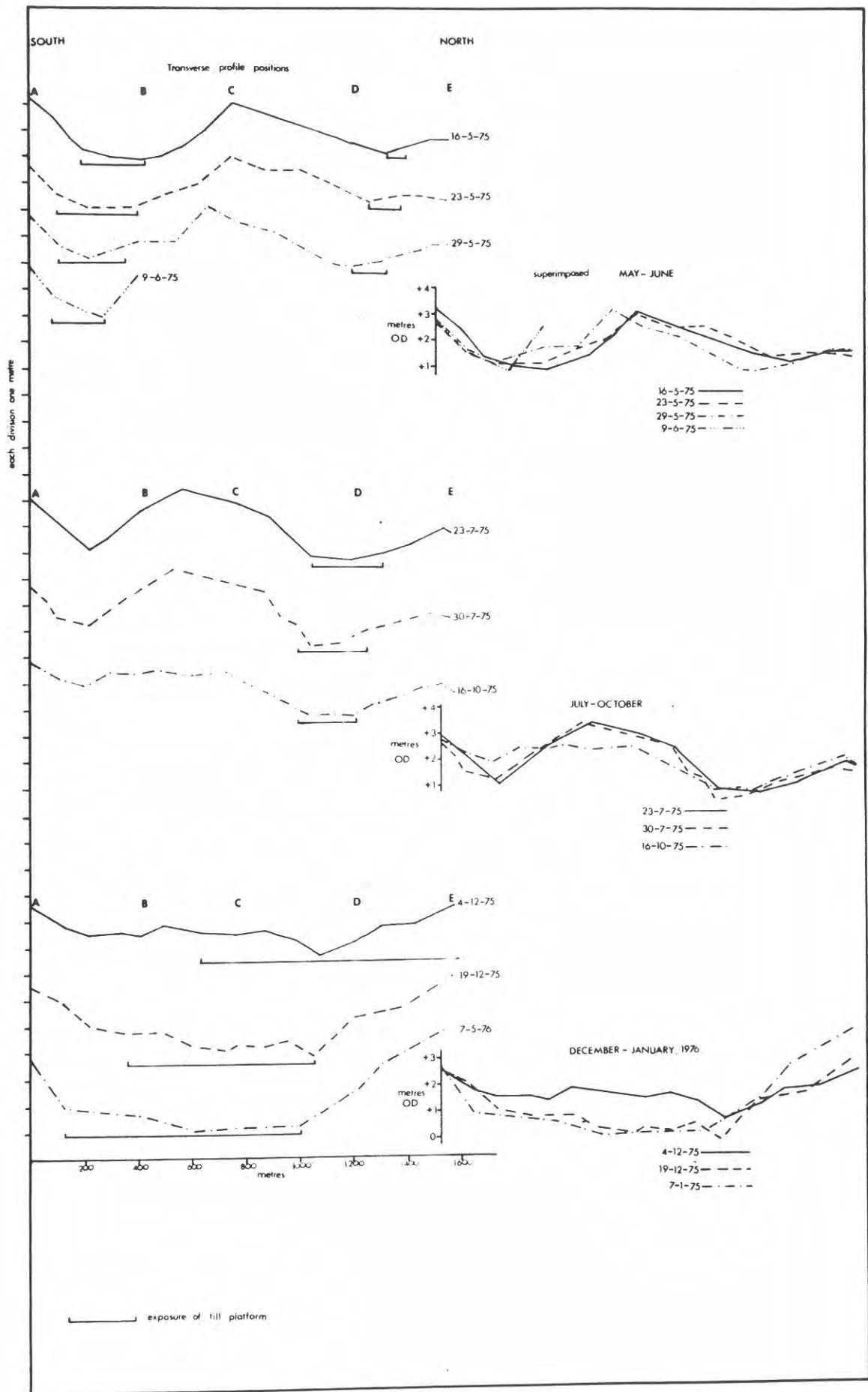


FIGURE 4.25 HOLMPTON - LONGITUDINAL PROFILES 1975 - 1976

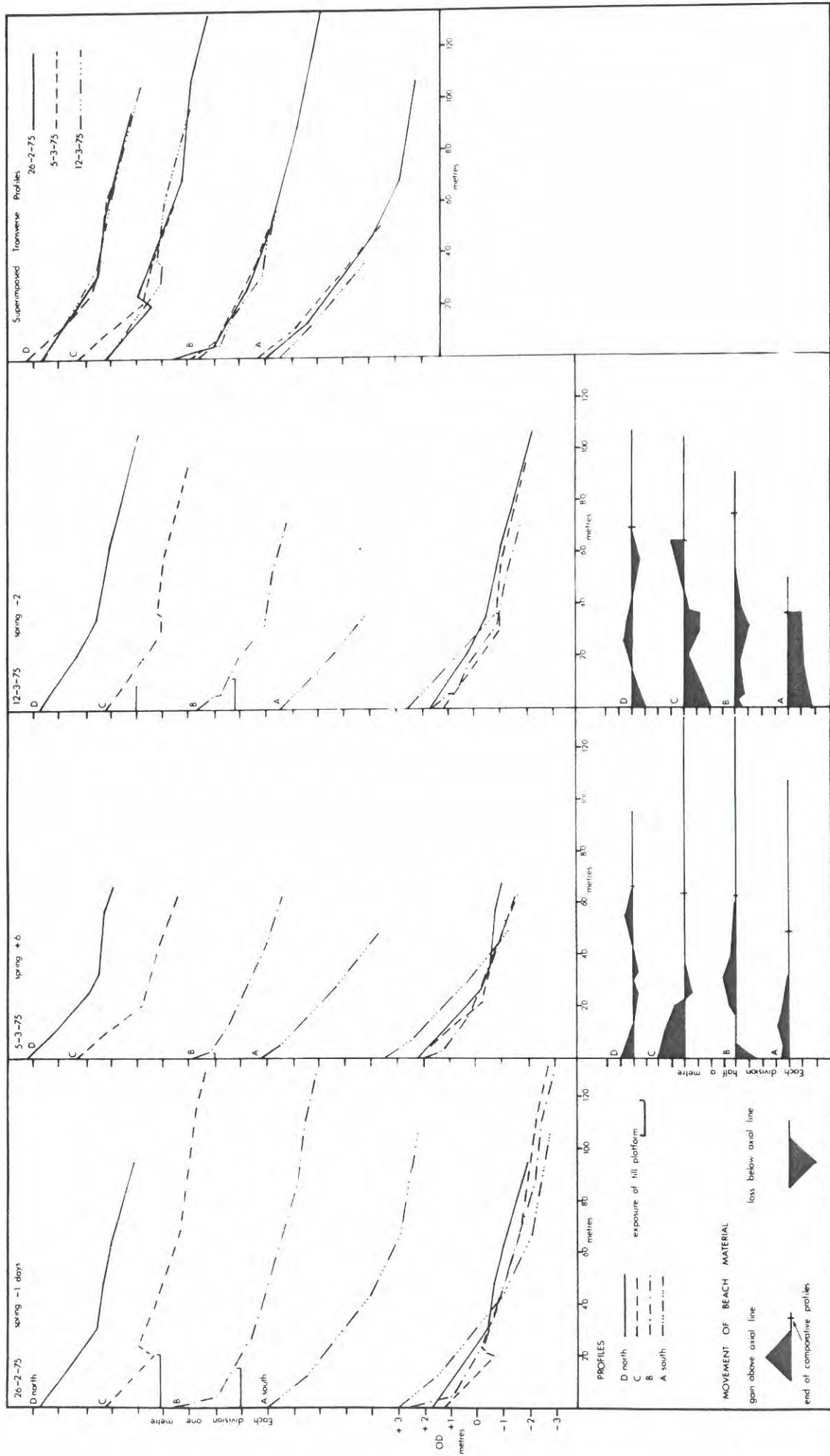


FIGURE 4.26 ATWICK - Transverse profiles and beach changes - FEBRUARY AND MARCH 1975

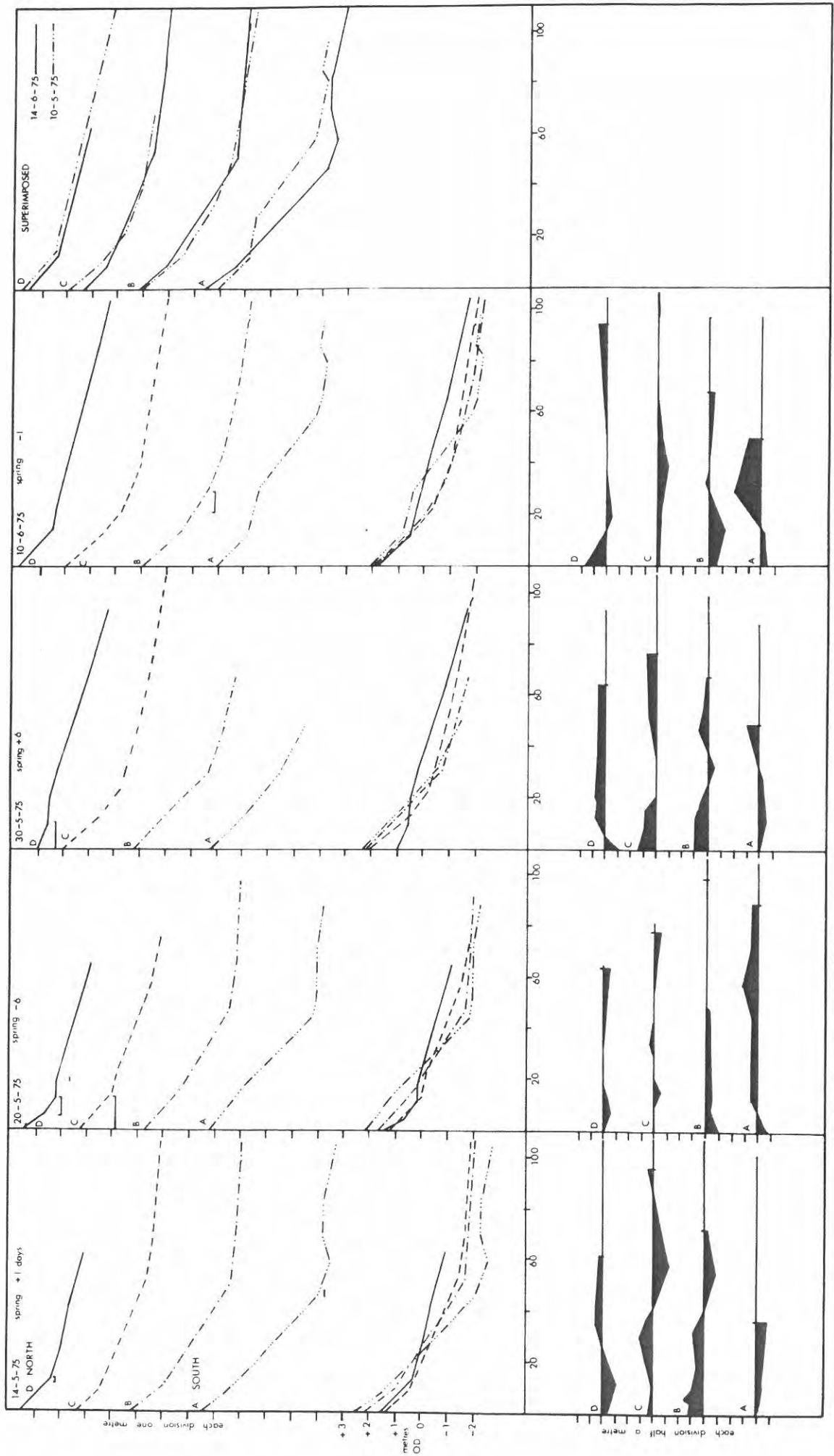


FIGURE 4.27 ATWICK - Transverse profiles and beach changes MAY - JUNE 1975.

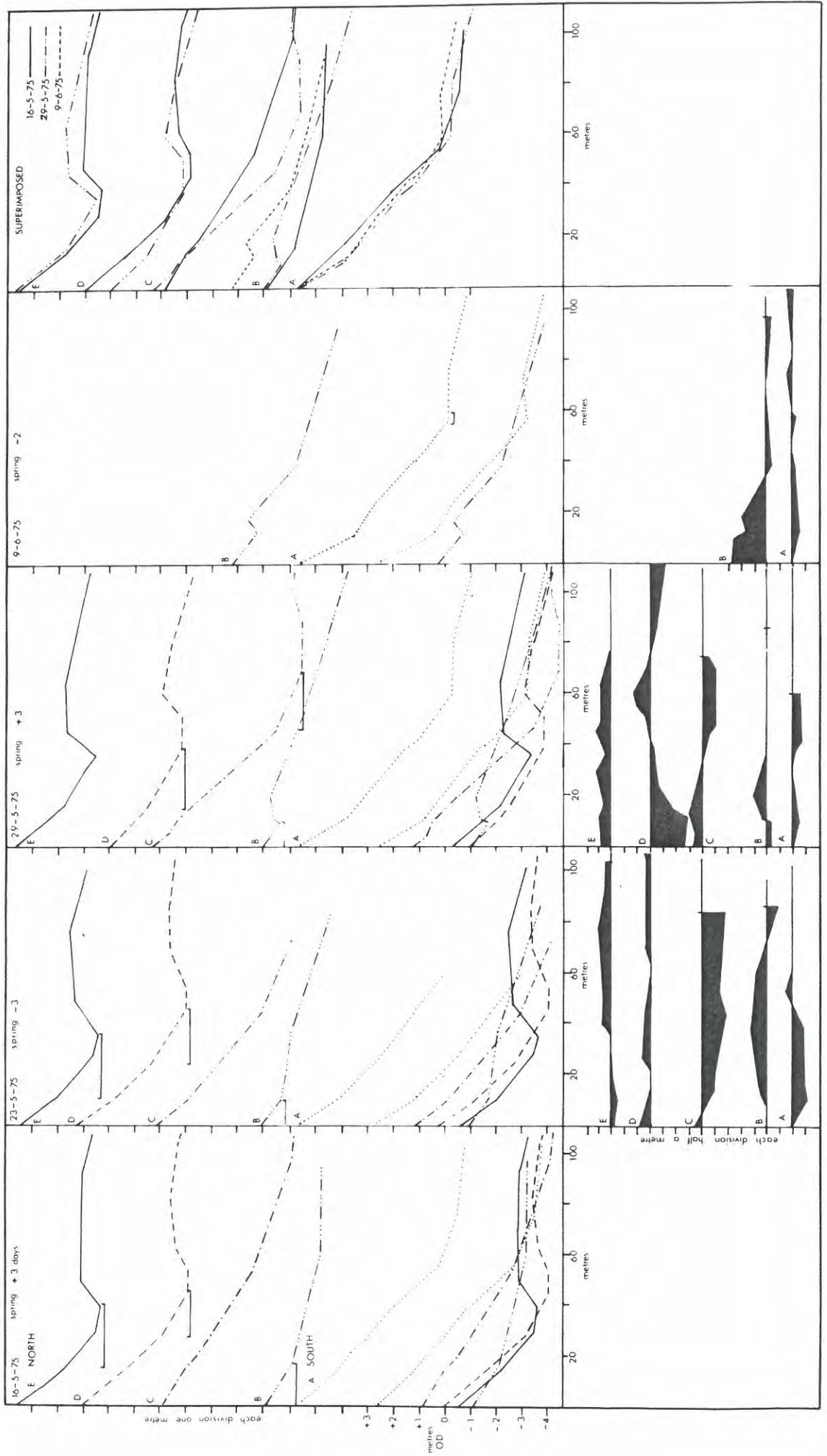


FIGURE 4-28 HOLMPTON - Transverse profiles and beach changes MAY - JUNE 1975

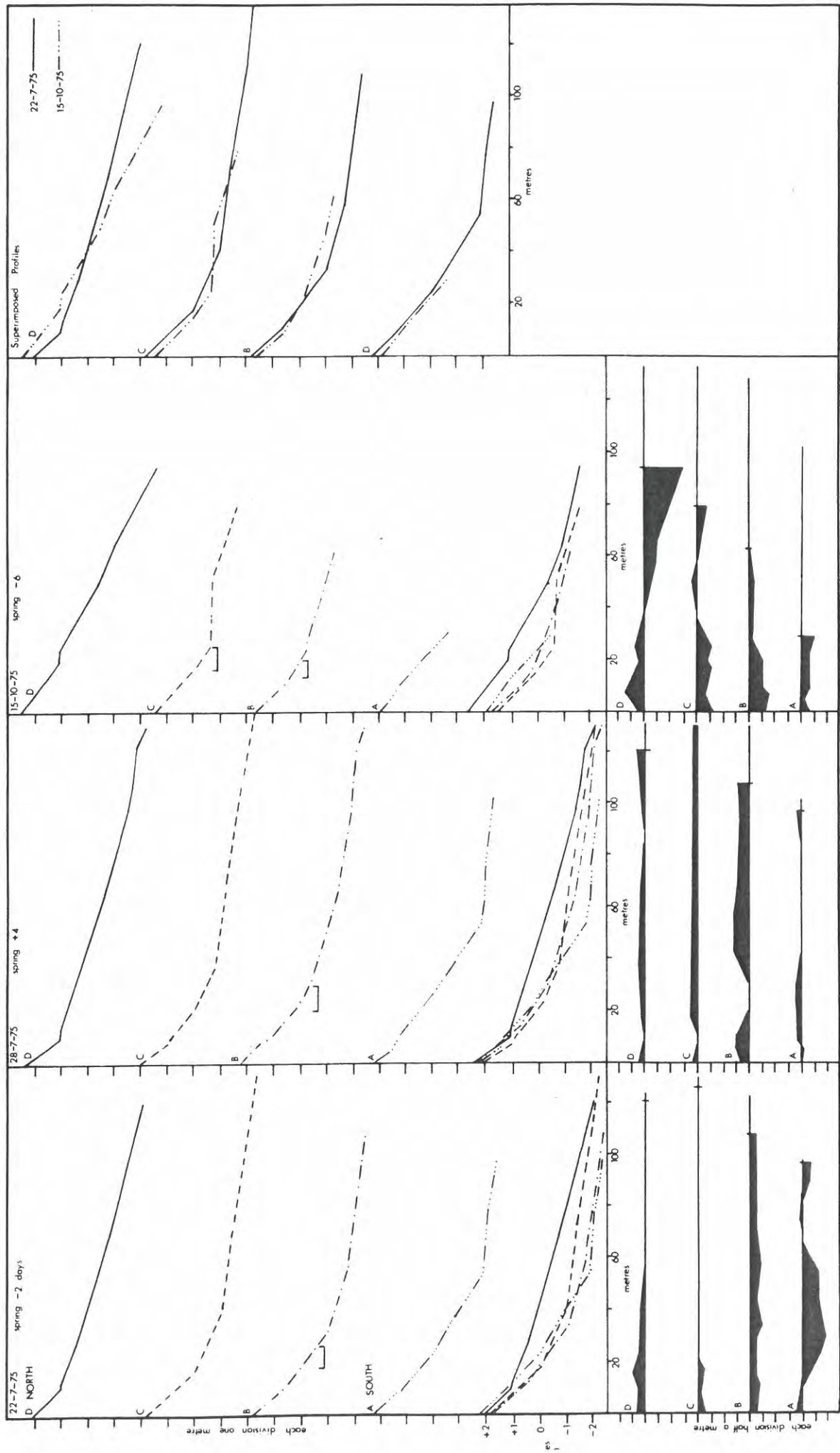


FIGURE 4.29 ATWICK - Transverse profiles and beach changes JULY - OCTOBER 1975

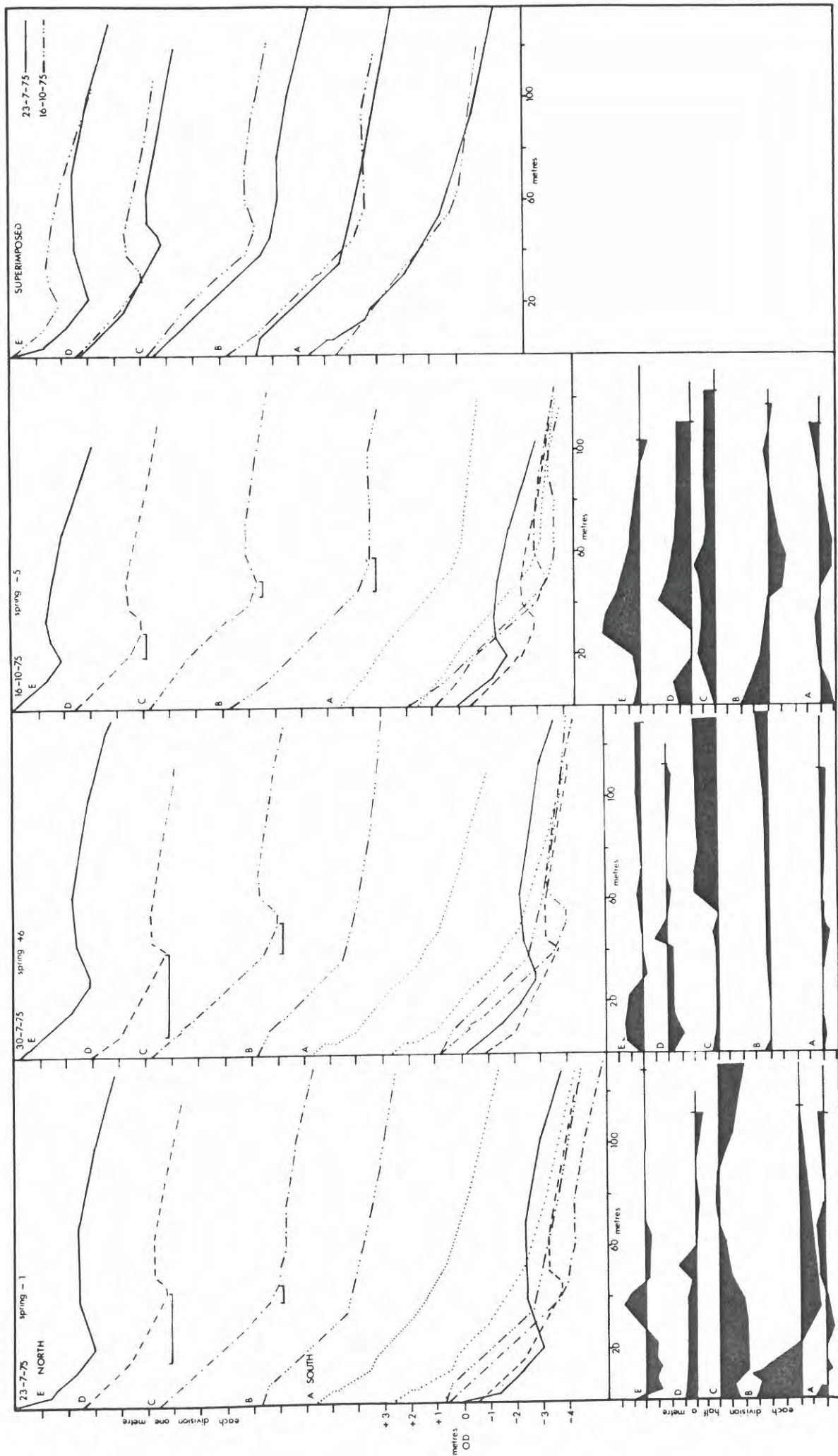


FIGURE 4.30 HOLMPTON - Transverse profiles and beach changes JULY - OCTOBER 1975

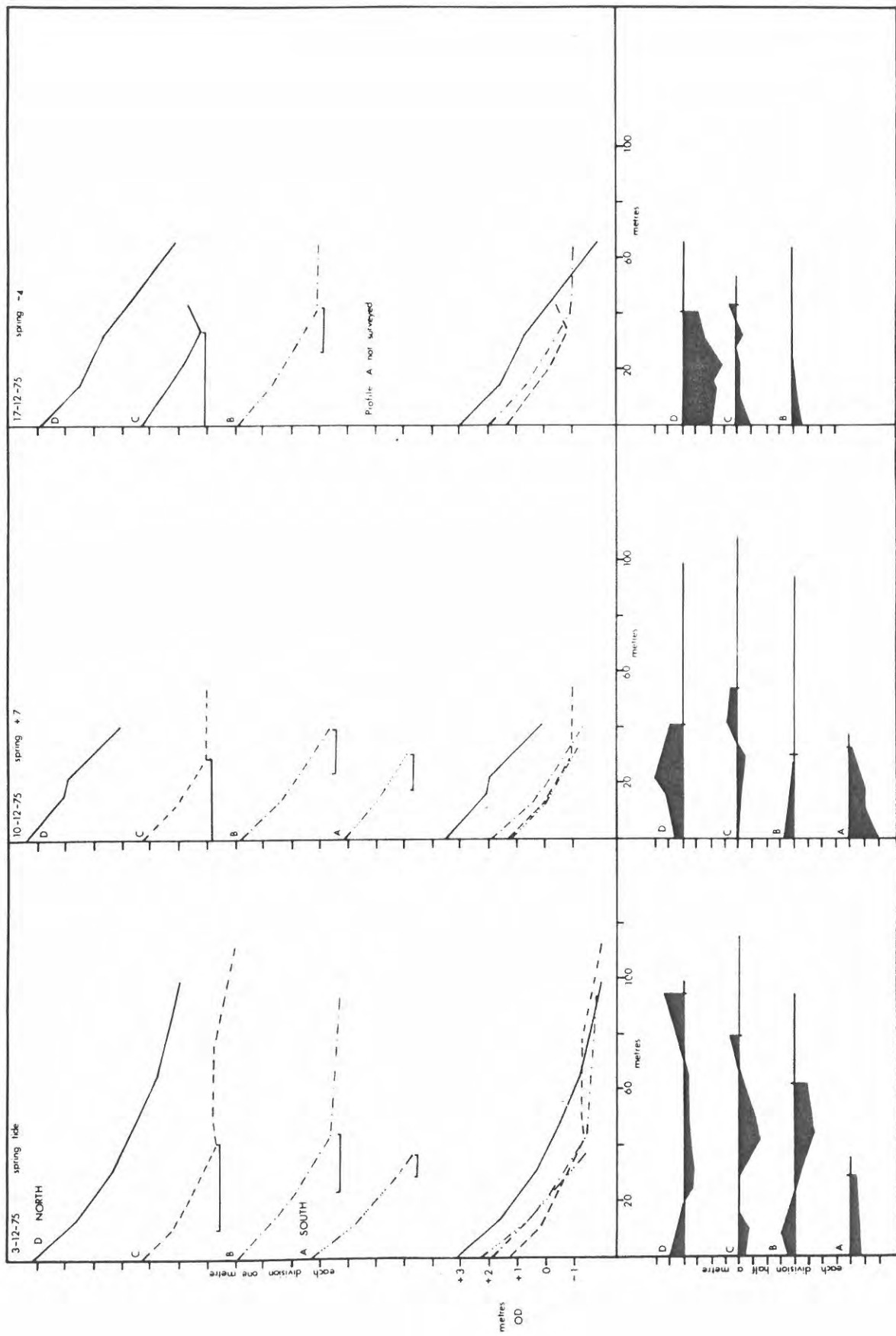


FIGURE 4.31 ATWICK - Transverse profiles and beach changes DECEMBER 1975

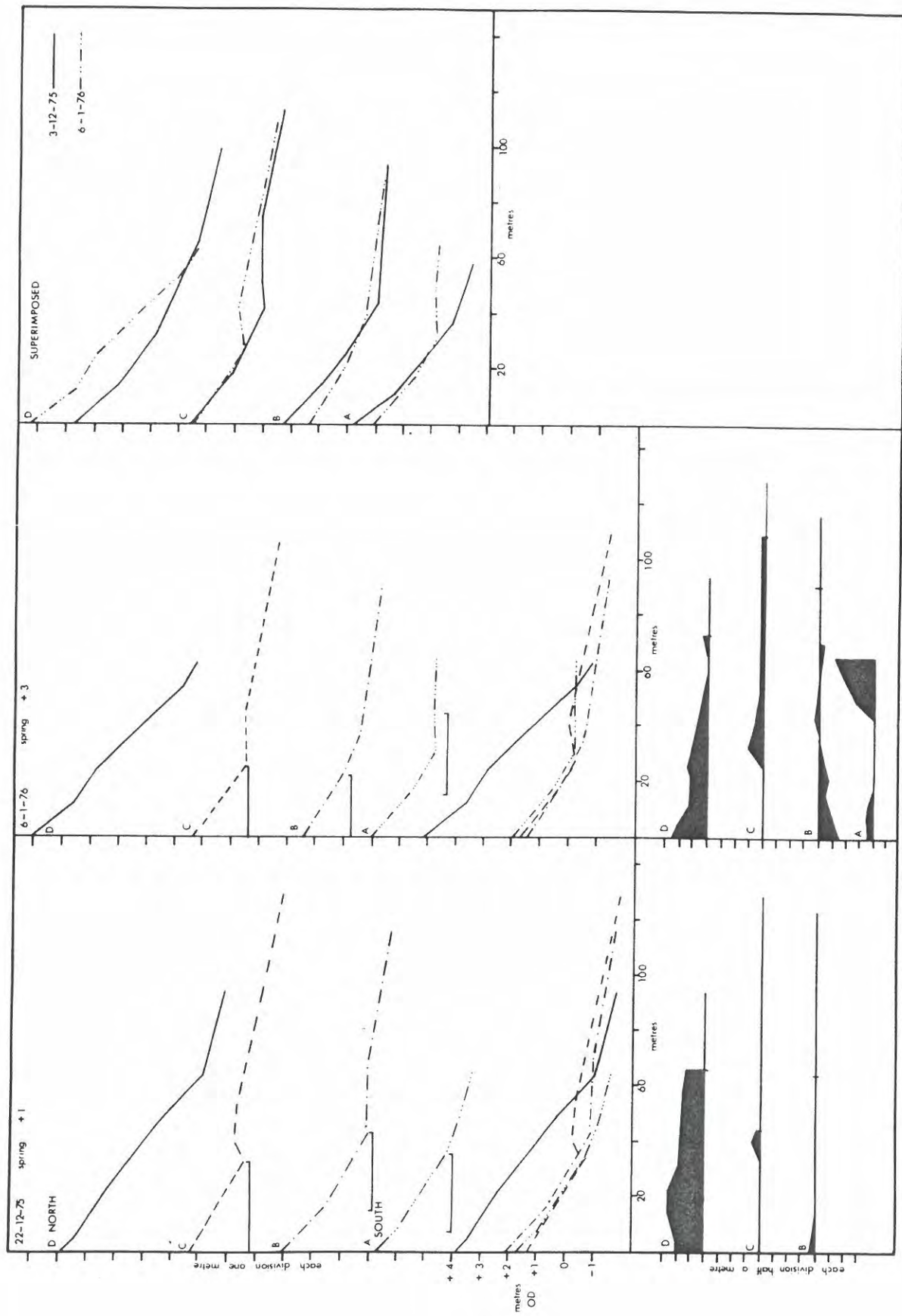


FIGURE 4.32. ATWICK - Transverse profiles and beach changes DECEMBER 1975 - JANUARY 1976

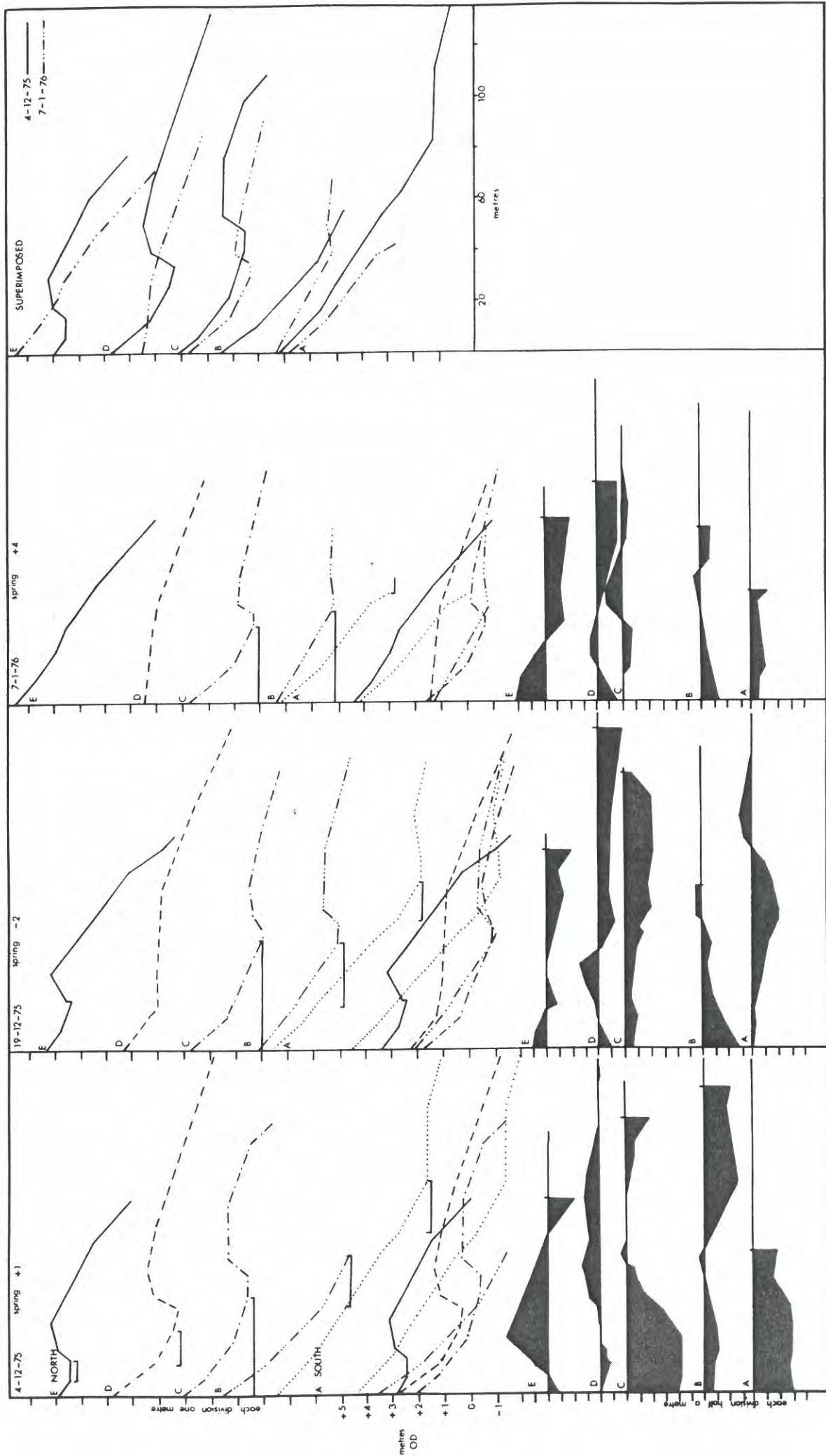


FIGURE 4.33 HOLMPTON - Transverse profiles and beach changes DECEMBER 1975 - JANUARY 1976

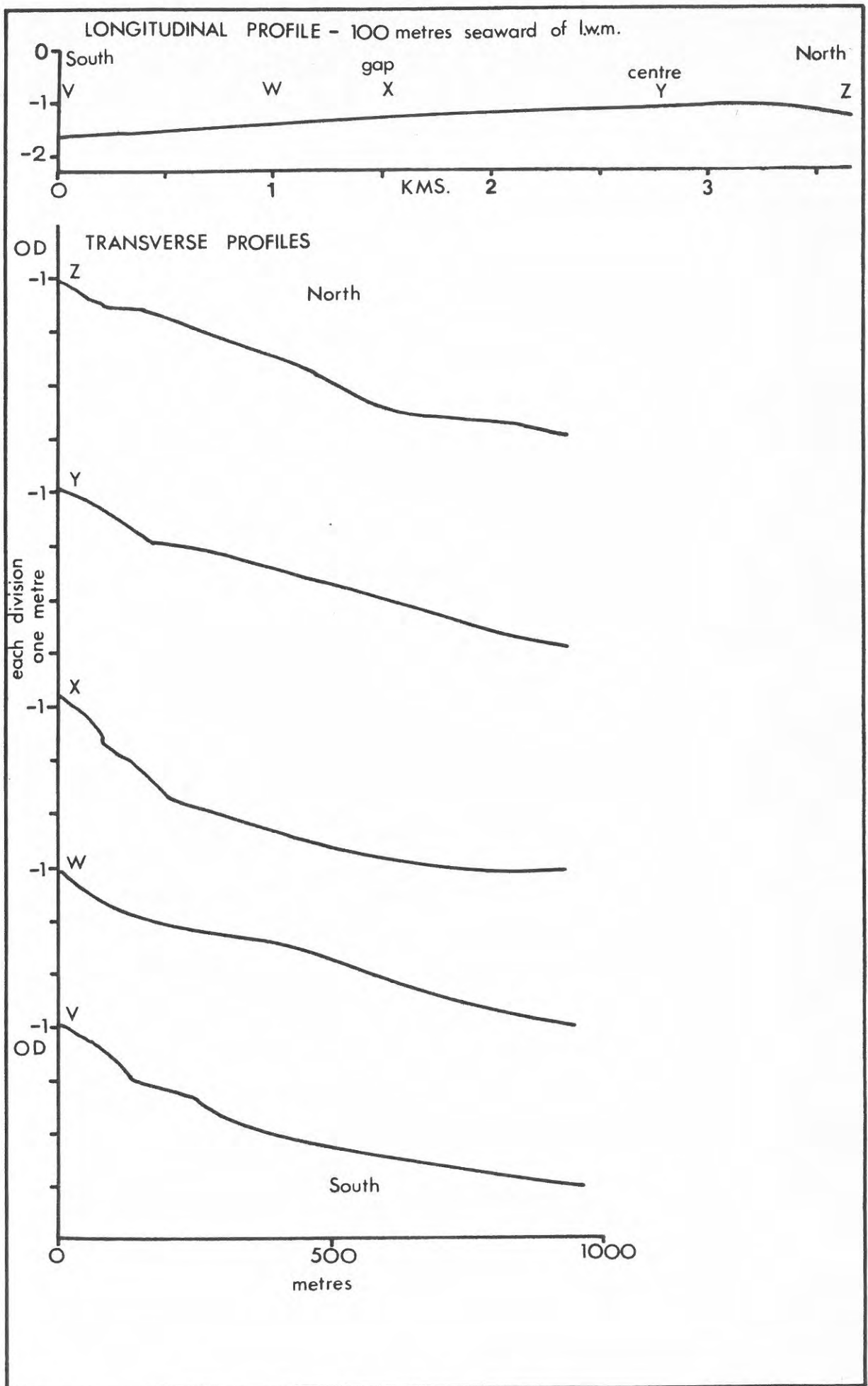


FIGURE 4.34 Atwick echo-sounding traces 4-8-75.

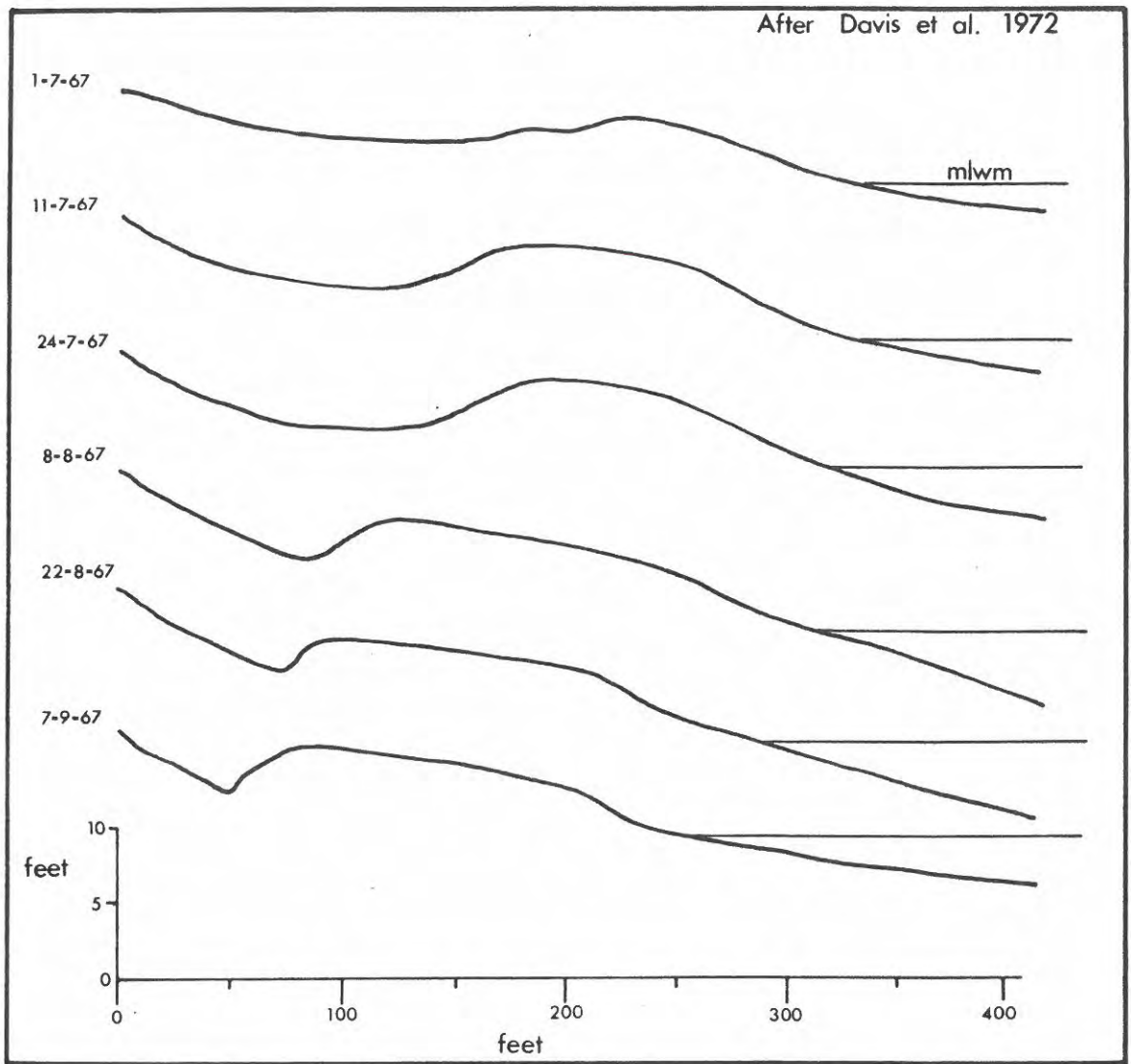


FIGURE 5.1 Ridge migration - Crane Beach, Ipswich, Massachusetts

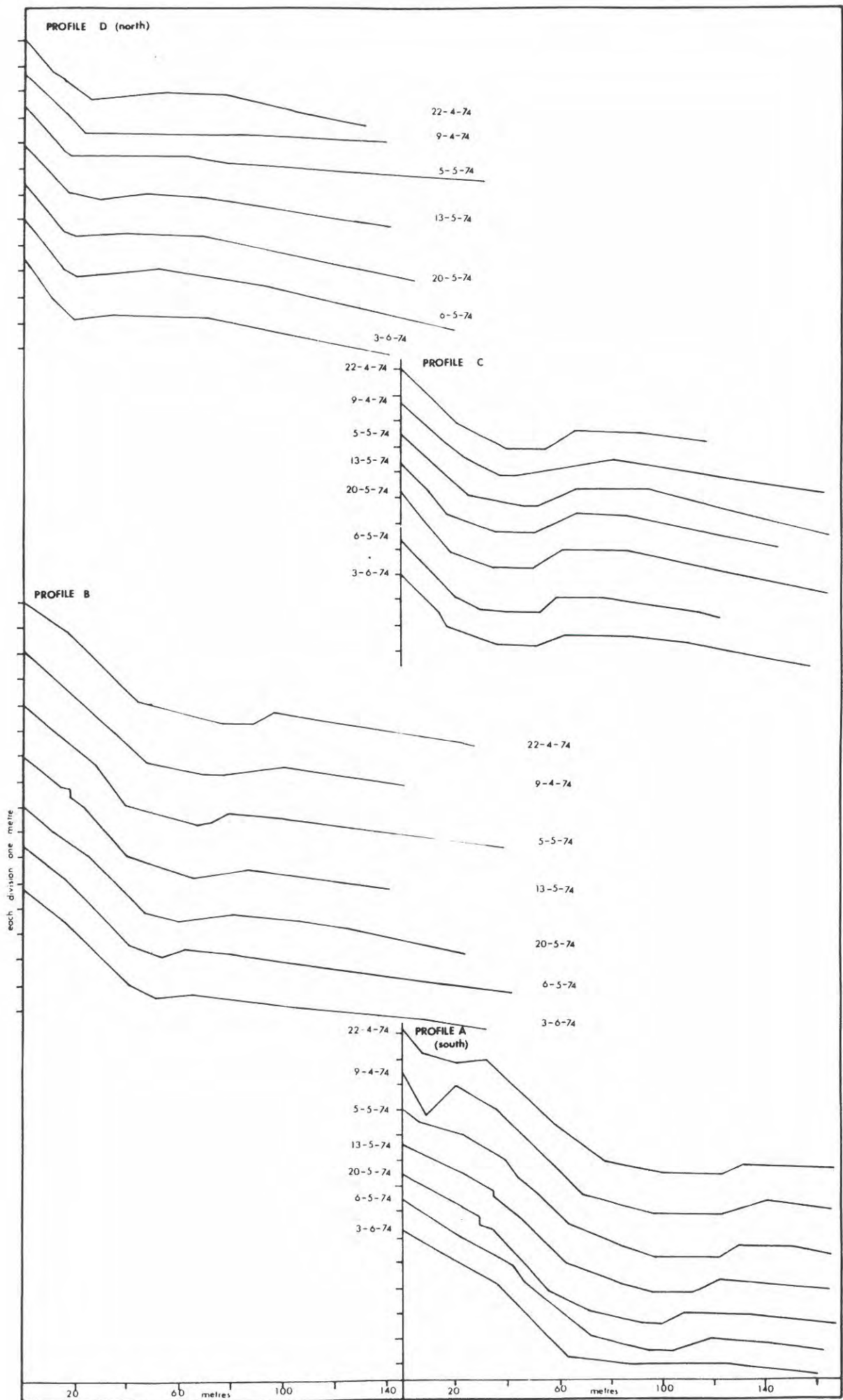


FIGURE 5.2 EASINGTON - Movement of the lower beach APRIL to JUNE 1974.

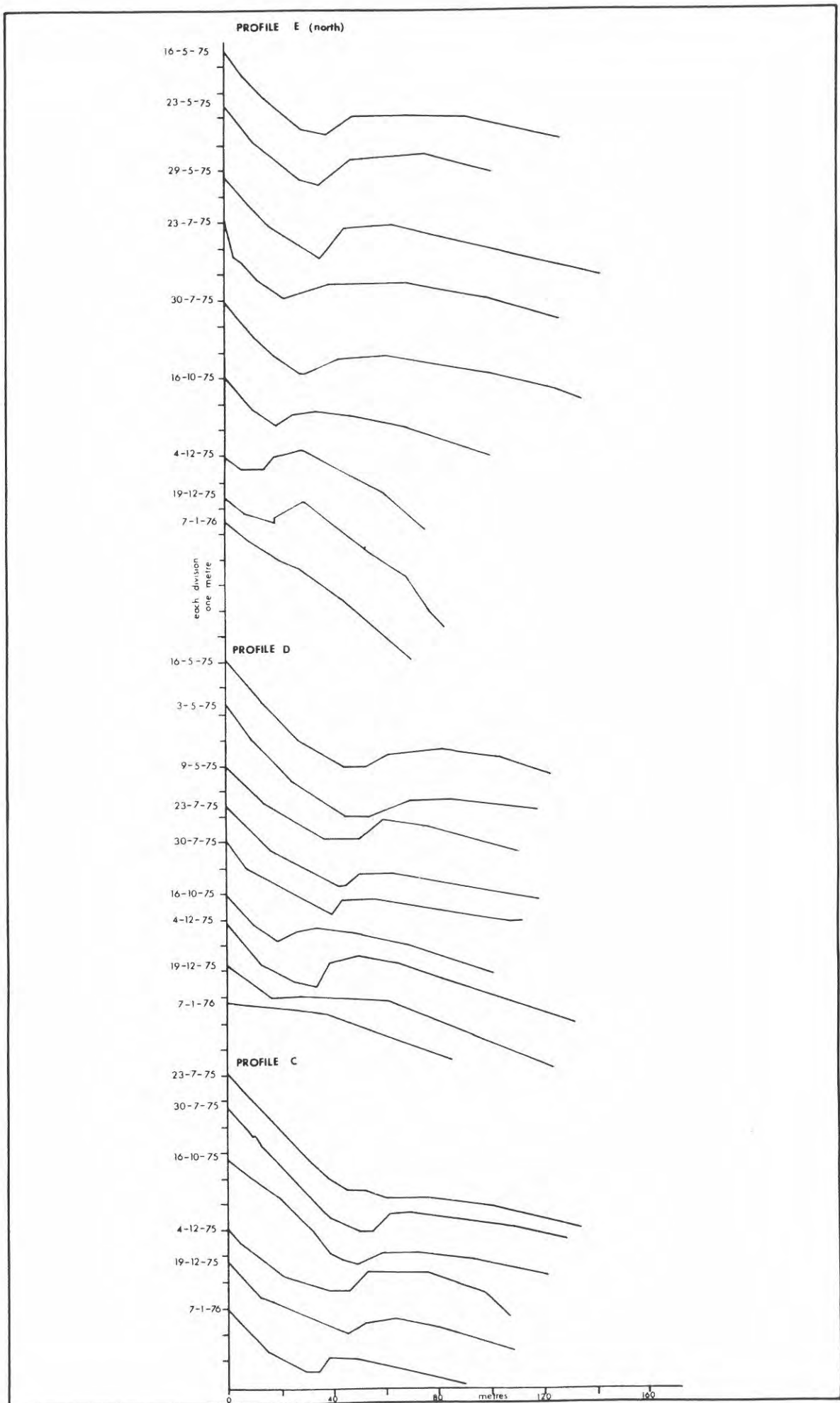


FIGURE 5.3 HOLMPTON - Movement of the lower beach 1975

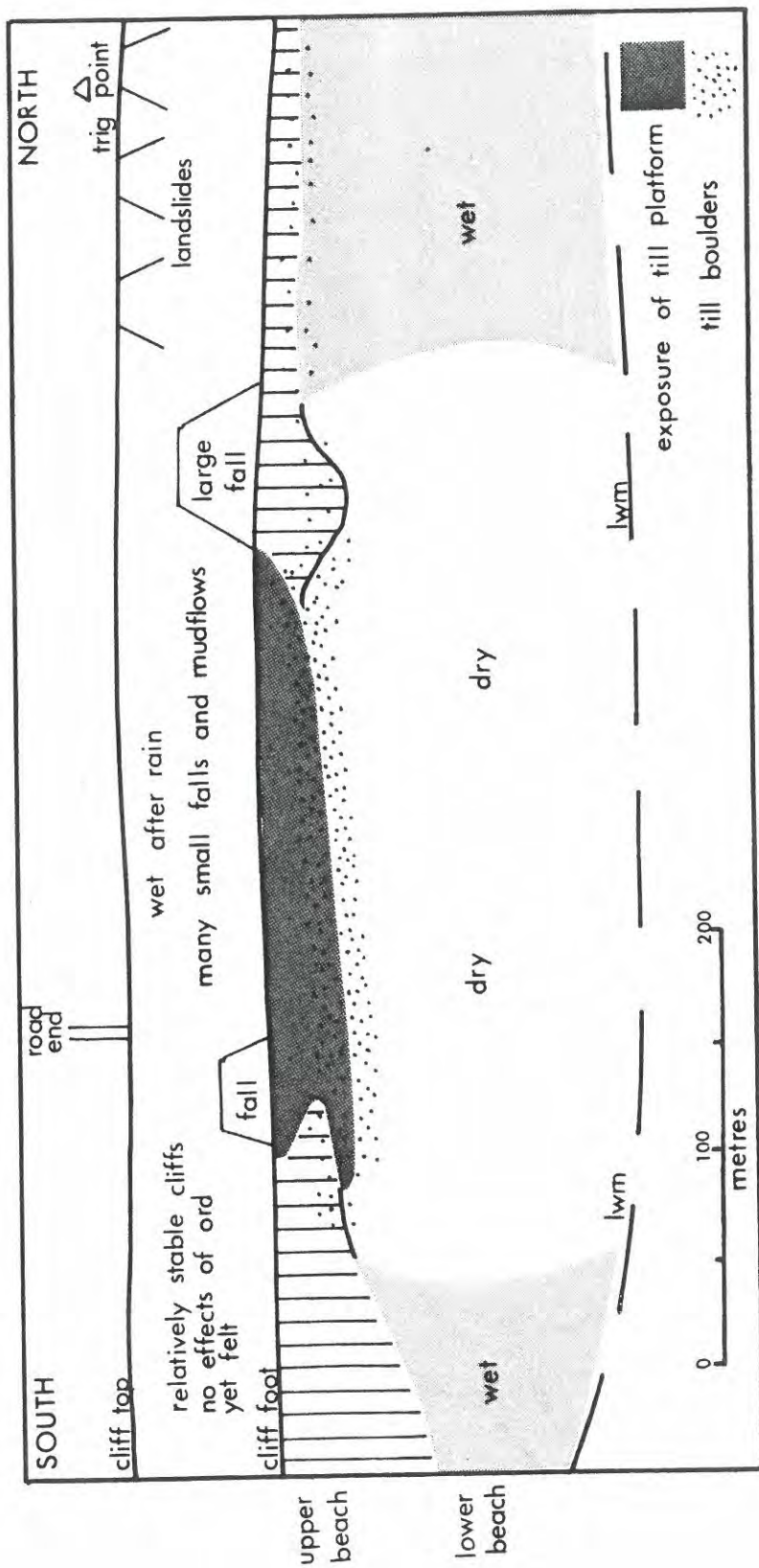


FIGURE 5.4 PLAN OF THE HILSTON ORD 2-10-74 SHOWING THE CONDITION OF THE CLIFFS AND BEACH AFTER A STORM.

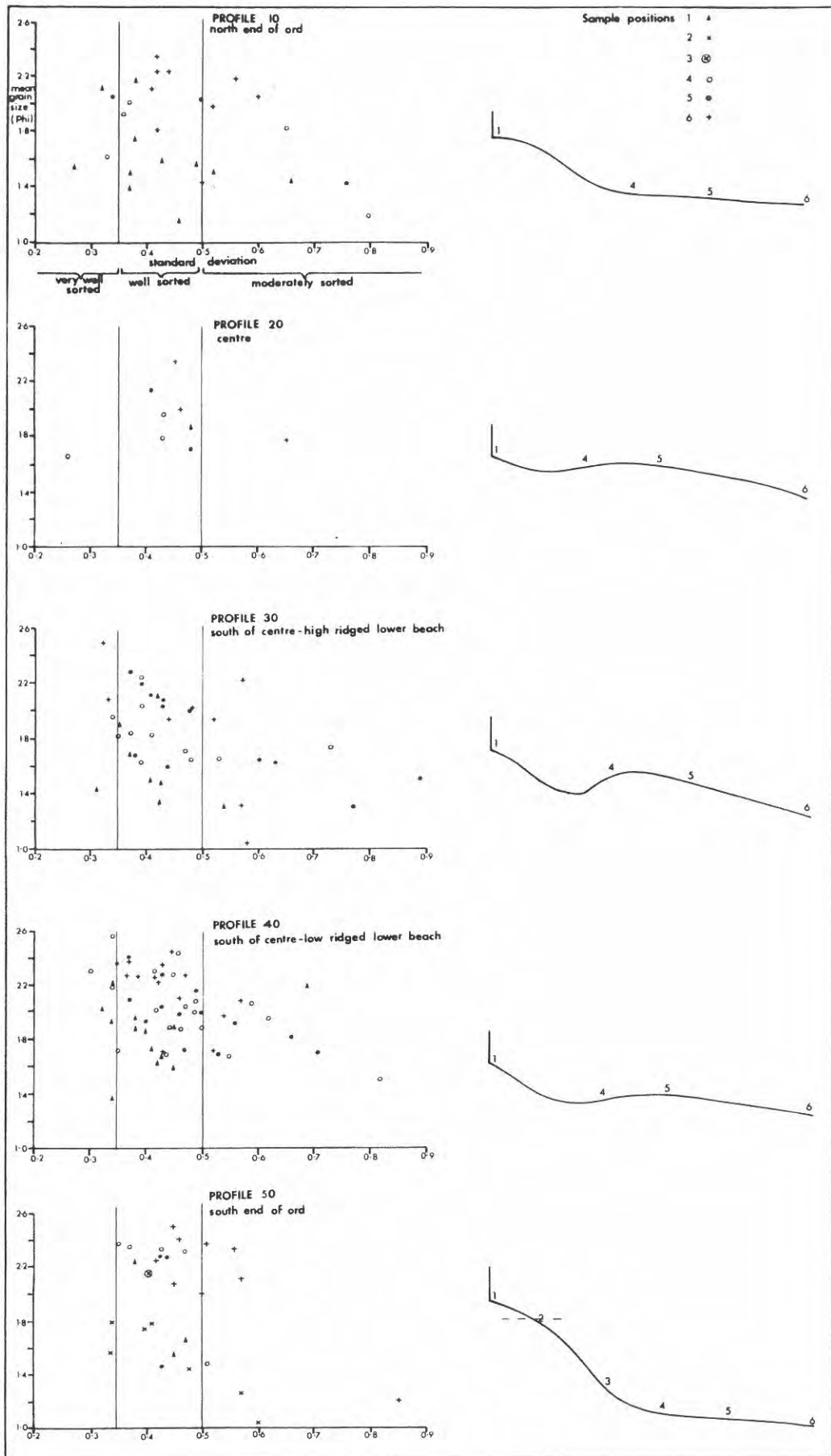


FIGURE 5.5 Sample means/standard deviation for the five profile types

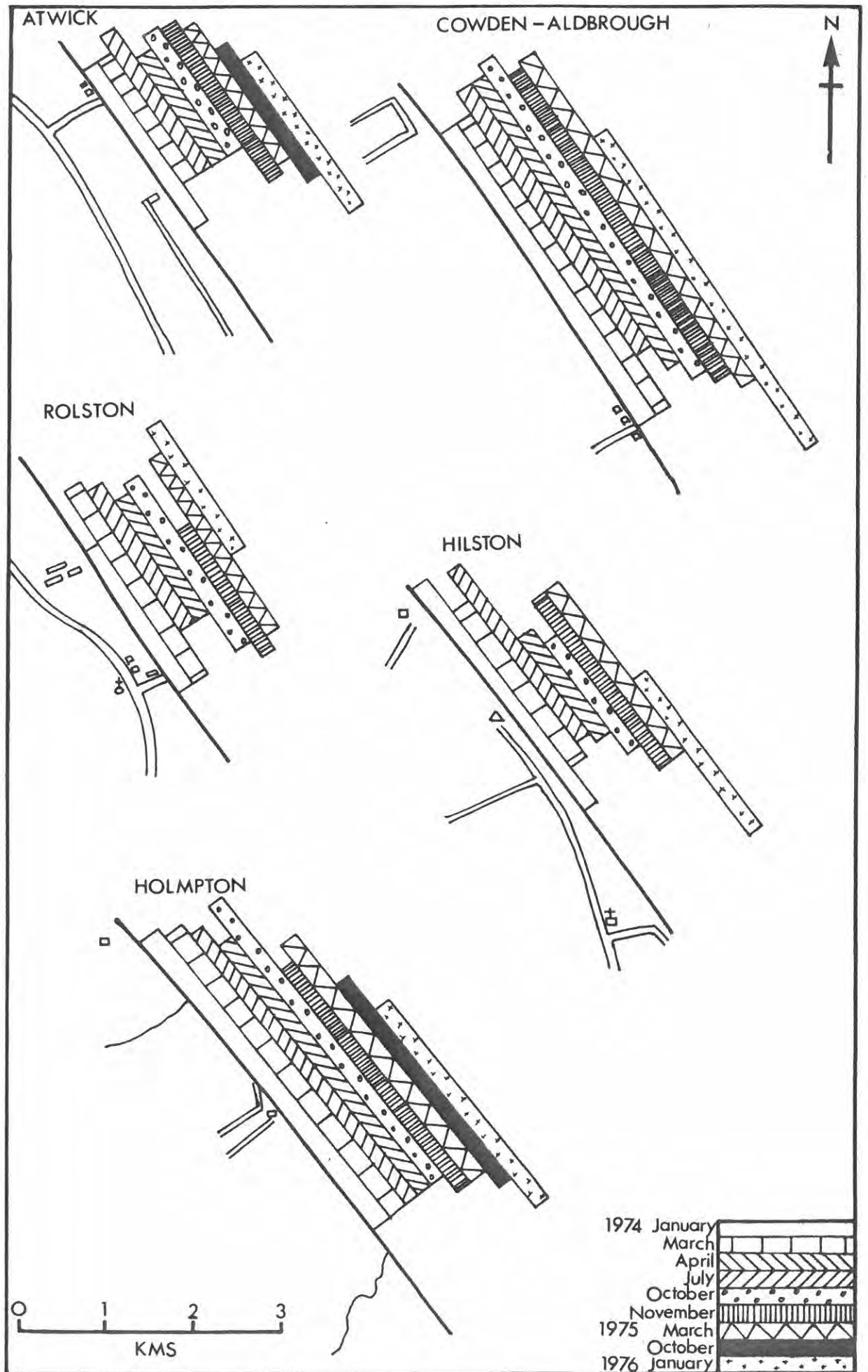


FIGURE 6.1 The position of five of the ords on nine occasions during 1974-1975 (length only)

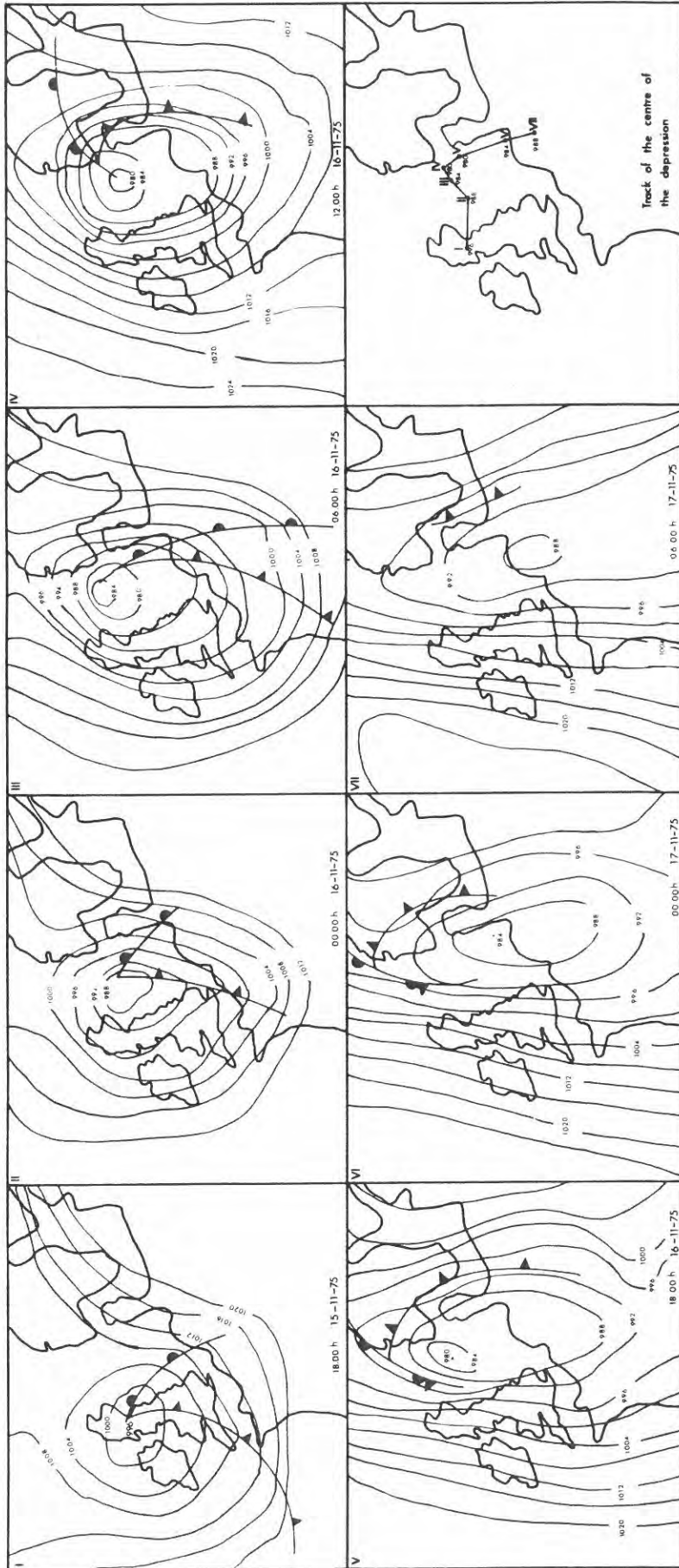
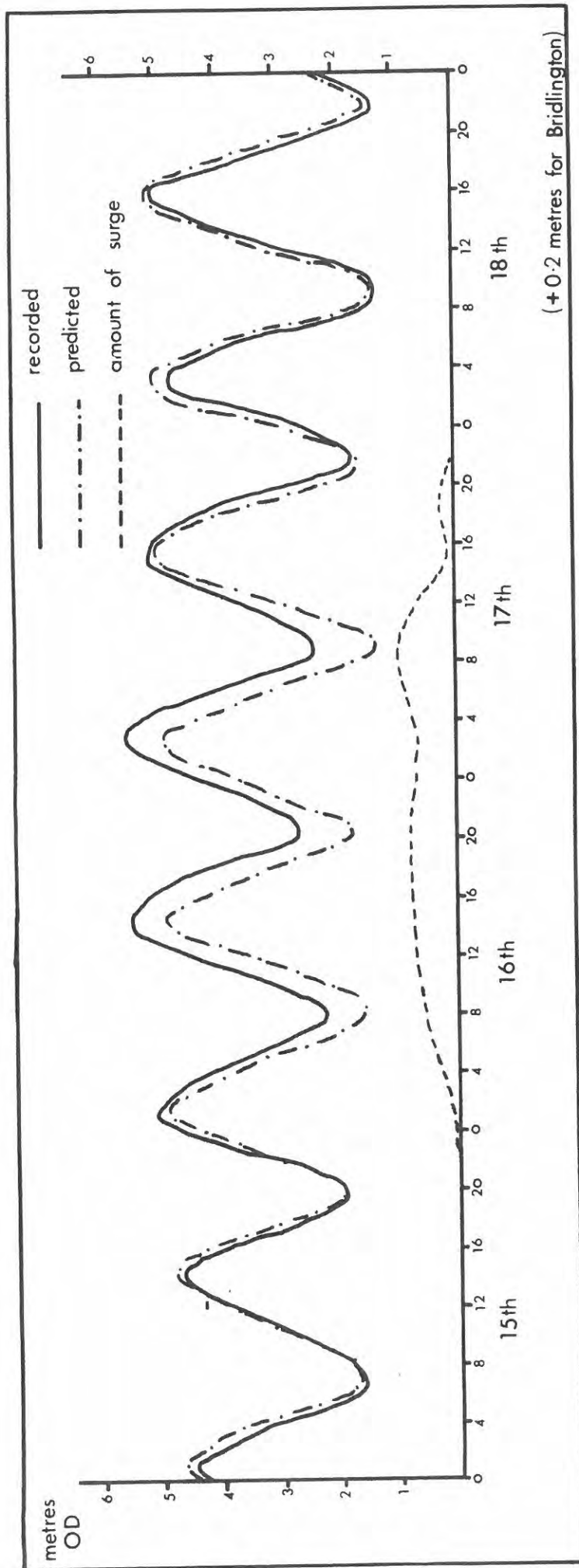


FIGURE 6.2 Synoptic charts for every six hours - 15th, 16th, 17th November, 1975



(+ 0.2 metres for Bridlington)

FIGURE 6.3 Recorded and predicted tidal curves, November 1975 - RIVER TEES ENTRANCE

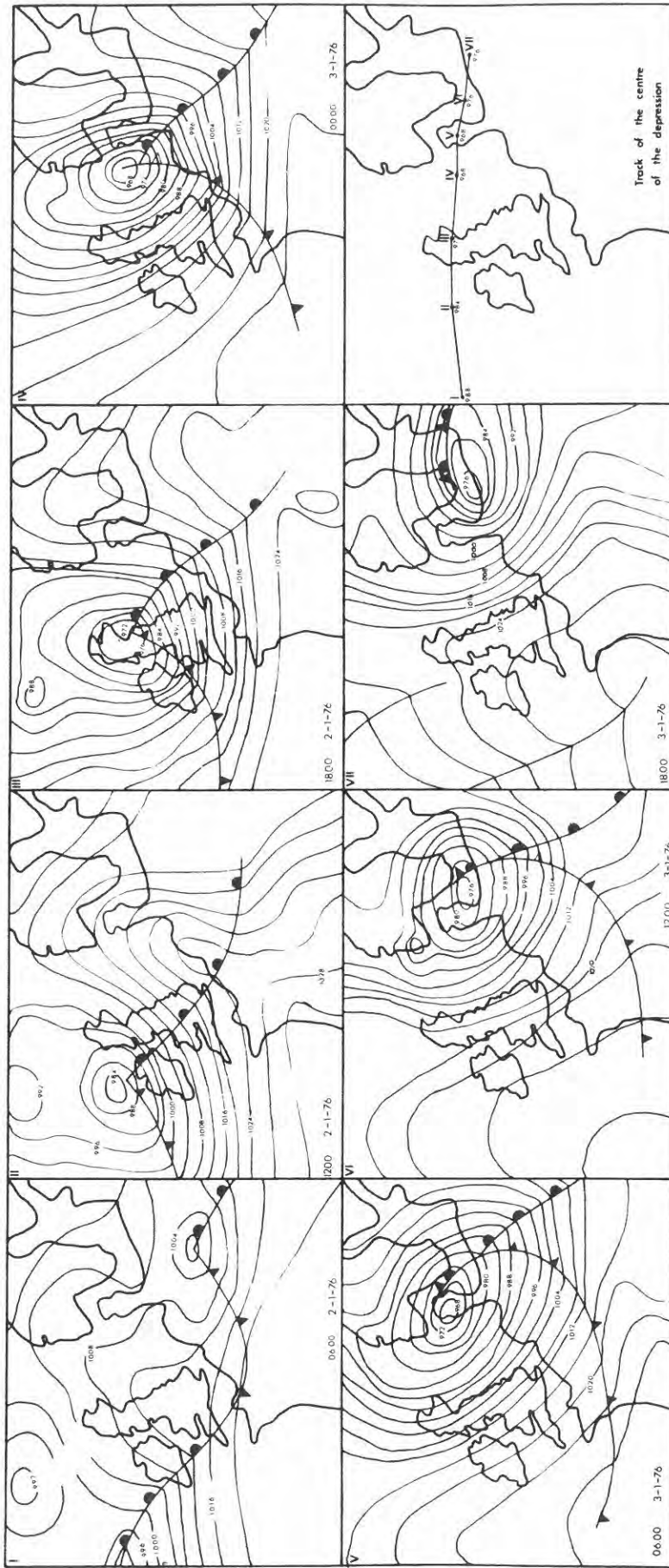


FIGURE 6.4 Synoptic charts for every six hours - 2nd & 3rd January, 1976

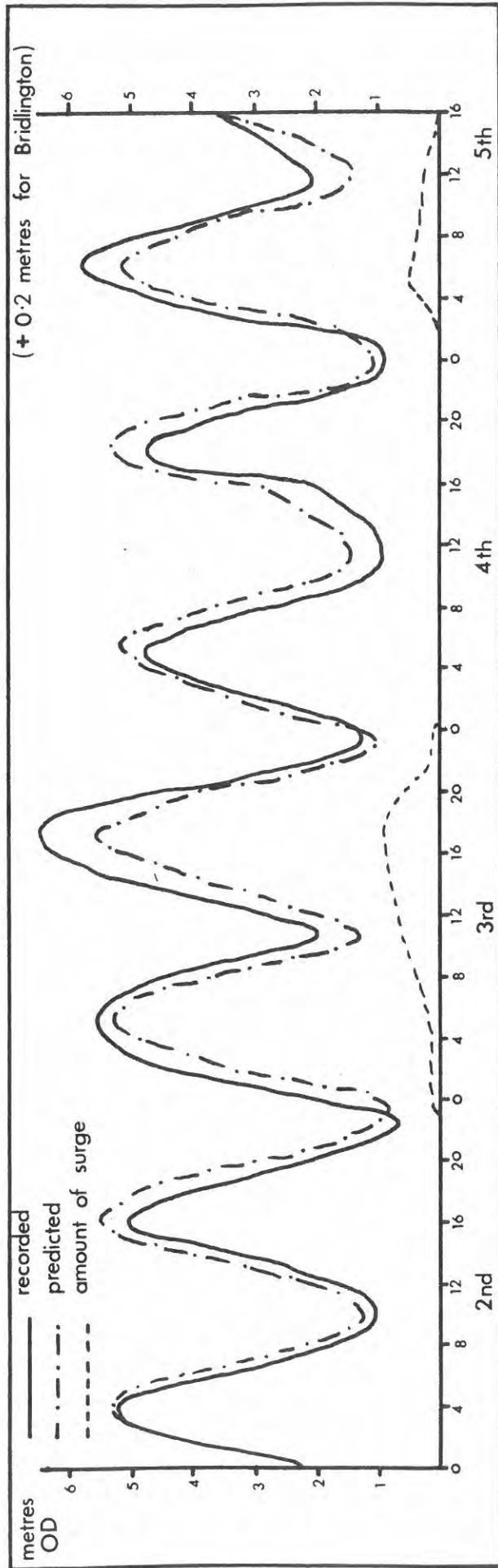


FIGURE 6.5 Recorded and predicted tidal curves, January 1976— RIVER TEES ENTRANCE

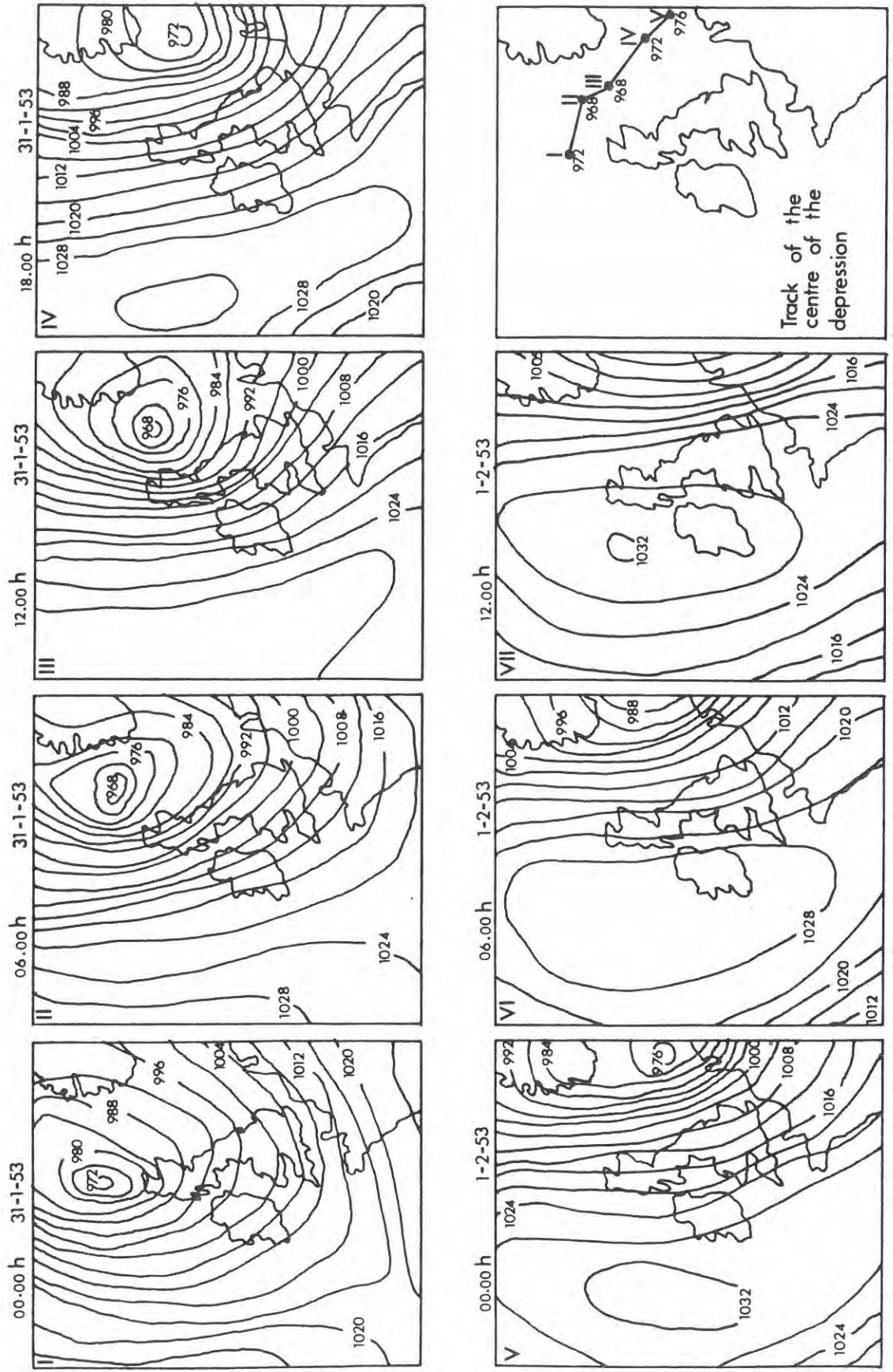


FIGURE 6.6 Synoptic charts for every six hours 31st January and 1st February 1953

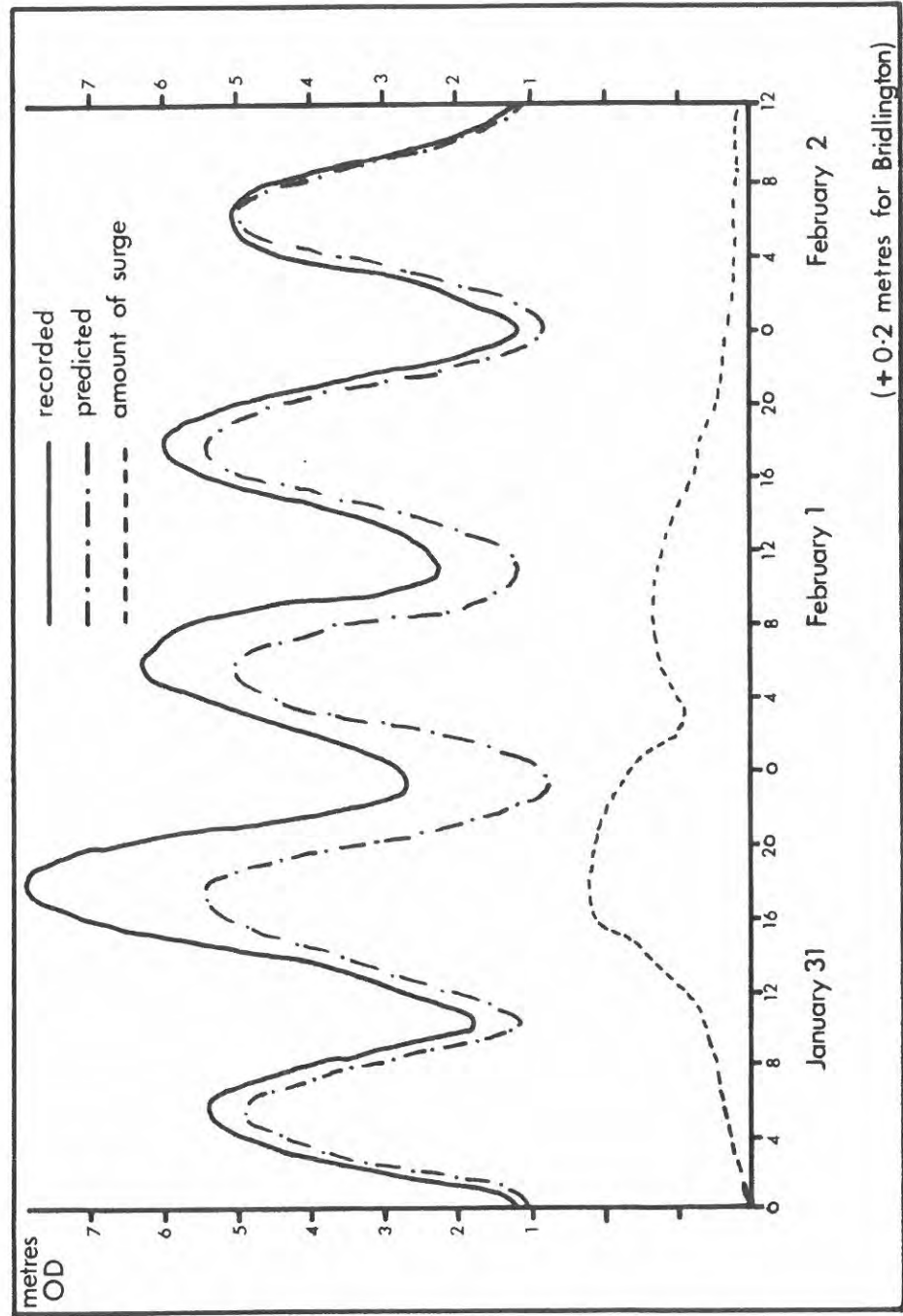


FIGURE 6.7 Recorded and predicted tides 1953 - RIVER TEES ENTRANCE (+ 0.2 metres for Bridlington)

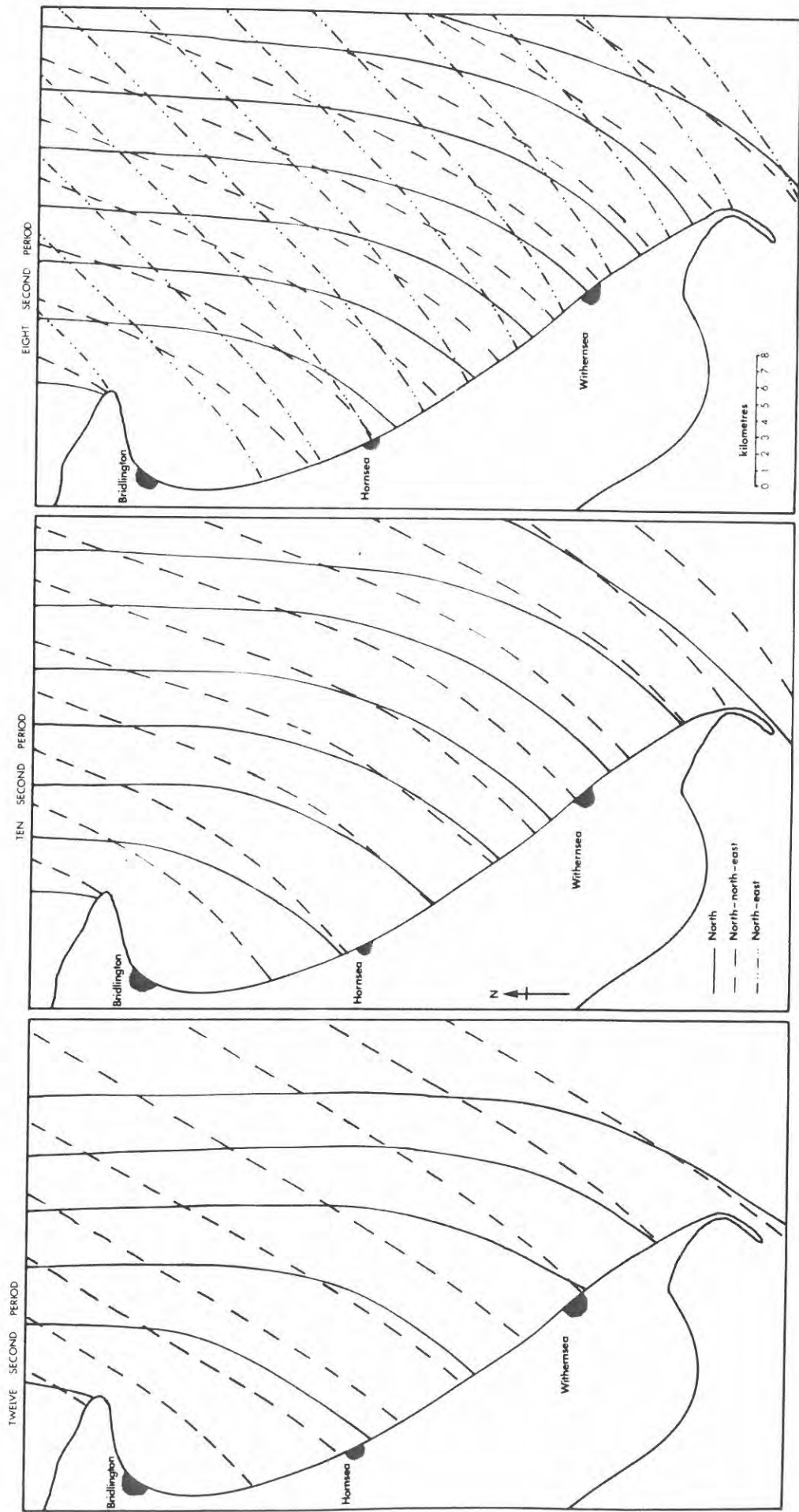


FIGURE 6.8 Wave orthogonals, Holderness - 12, 10, & 8 second periods

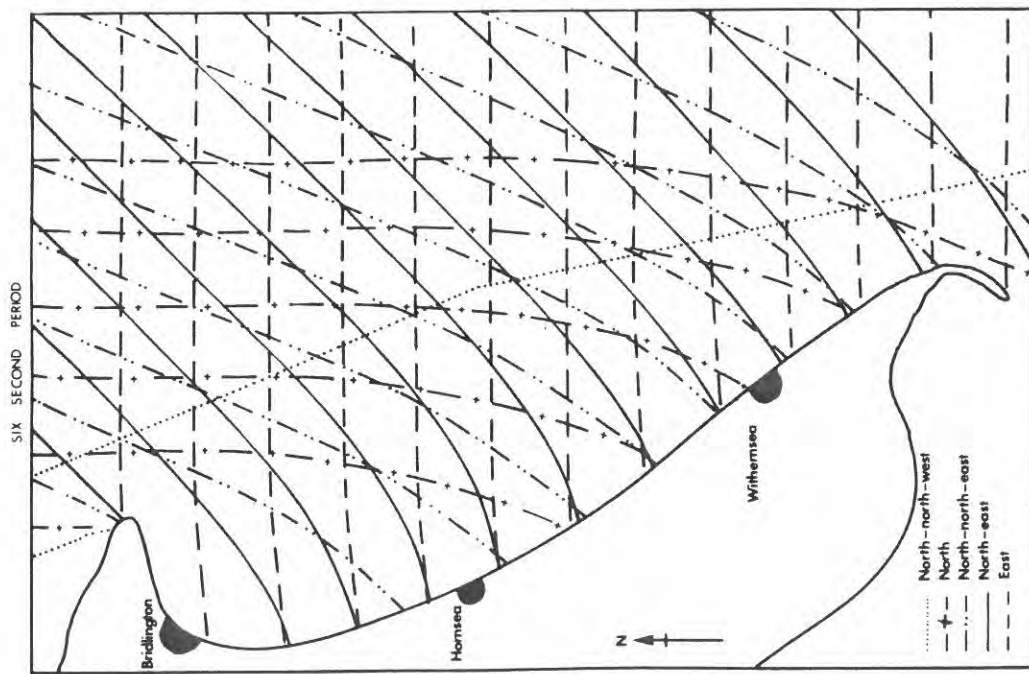
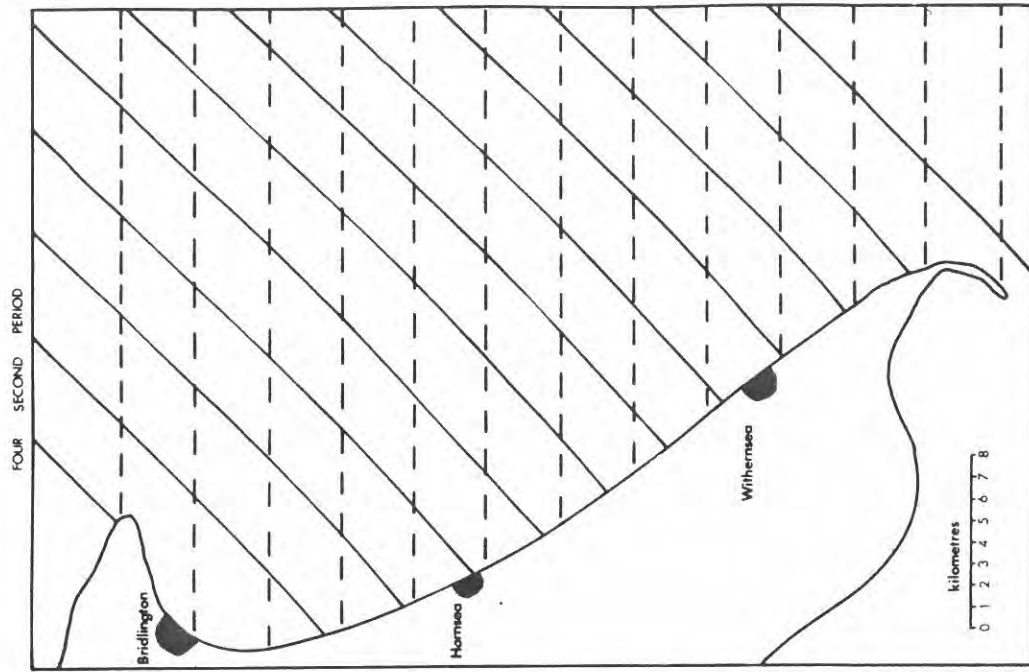


FIGURE 6.8 (cont.) Wave orthogonals - 6 & 4 second periods

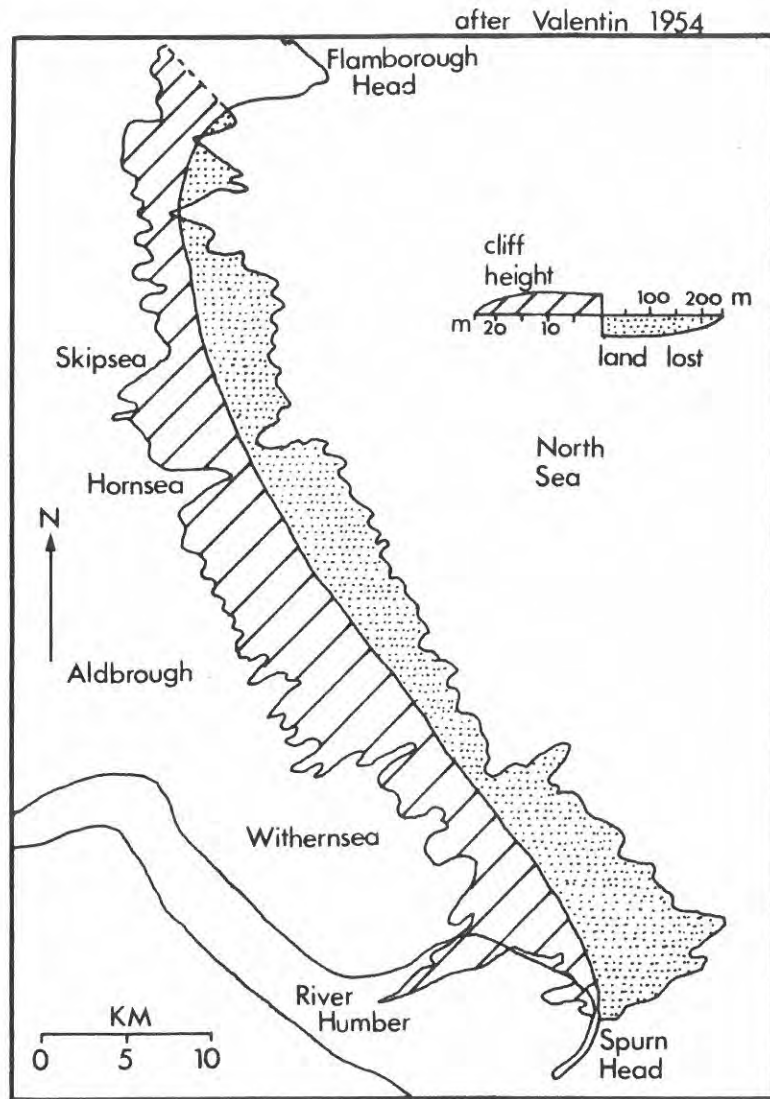


FIGURE 6.9 Relations between cliff height and erosion, Holderness, 1852–1952

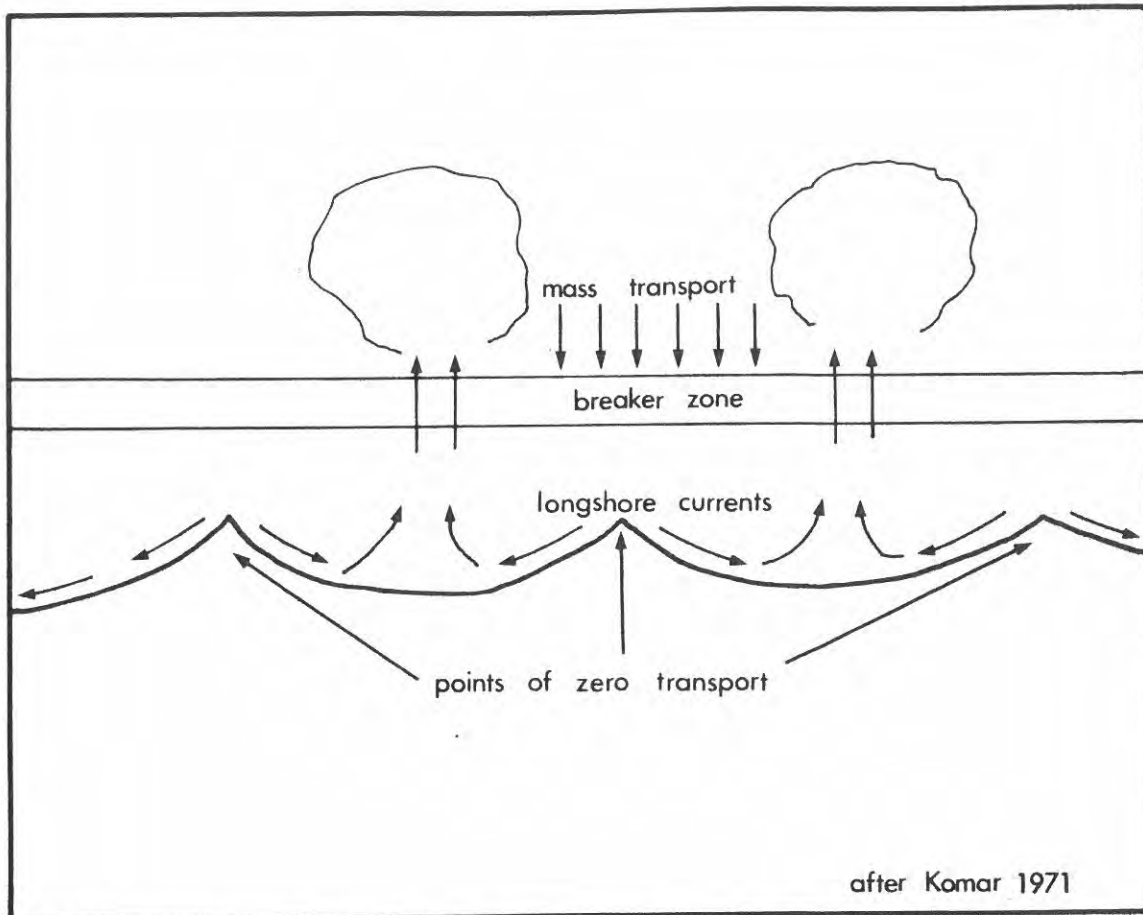


FIGURE 6.10a Nearshore cell circulation and the formation of giant cusps

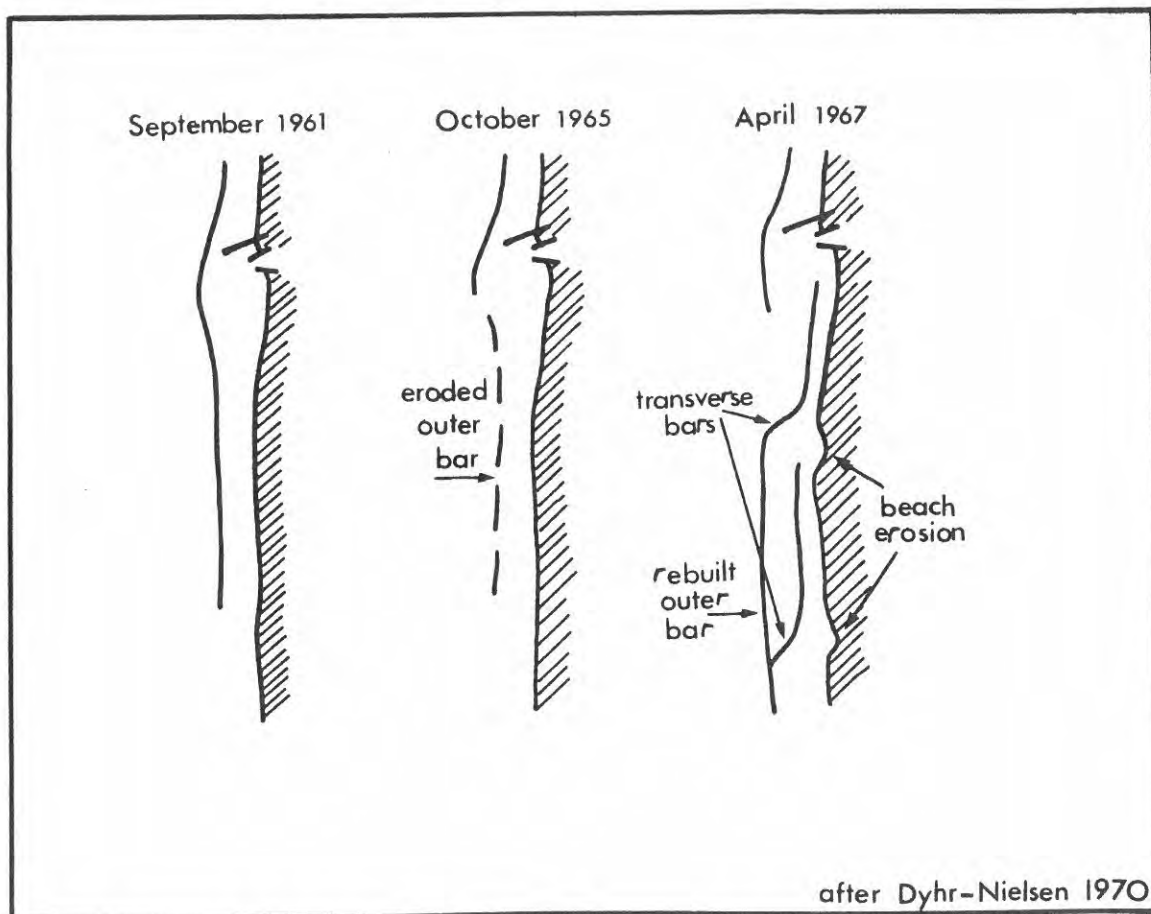


FIGURE 6.10b Beach erosion related to transverse offshore bars, west Denmark.

TABLE 1.1 GRID REFERENCES OF PLACES MENTIONED IN THE TEXT

ALDBROUGH - ROAD END	TA 257 396
ATWICK - ROAD END	TA 197 512
BARMSTON - ROAD END	TA 172 594
BRIDLINGTON - HARBOUR	TA 185 665
COWDEN - ROAD END	TA 237 424
DIMLINGTON HIGH LAND	TA 391 298
EASINGTON - ROAD END	TA 408 187
FRAISTHORPE	TA 154 617
HILSTON - ROAD END	TA 303 334
HOLMPTON - CLIFF FARM	TA 374 239
HORNSEA - MARINE HOTEL	TA 208 483
INTACK	TA 358 259
KILNSEA	TA 418 158
MAPPLETON	TA 228 438
NEVILLS FARM	TA 363 251
NORTH CLIFF SAILING CLUB - HORNSEA	TA 201 502
OLD HIVE	TA 381 231
OUT NEWTON - CLIFF FARM	TA 385 224
RINGBROUGH	TA 273 373
ROLSTON CHILDREN'S CAMP	TA 222 453
THE RUNNEL	TA 367 247
SAND-LE-MERE	TA 316 315
SEWERBY	TA 202 687
SKIPSEA	TA 182 553
TUNSTALL	TA 305 320
ULROME - ROAD END	TA 176 572
WAXHOLME	TA 327 300
WITHERNSEA - PIER TOWERS	TA 344 279

TABLE 2.1 POSITIONS AND LENGTHS OF THE ORDS (IN KILOMETRES)
ON THE SIX SETS OF AERIAL PHOTOGRAPHS

APPROX. POSITION	1959	1961A	1961B	1962	1966	1972	MEAN LENGTH
ATWICK		1.4			1.6	1.0	1.3
ROLSTON	3.8	4.0	4.8	4.6		2.2	3.9
COWDEN/ ALDBROUGH	3.2	2.2	1.6	1.6	3.2	3.2	2.5
RINGBROUGH	2.0	2.0	2.6	1.8	3.8	1.2	2.3
HILSTON	0.8	0.6	1.2	1.2	2.0	4.0	1.6
WAXHOLME	1.0	0.8	3.4	2.6	1.0	0.8	1.6
THE RUNNEL	0.8	1.0	1.2	2.4	1.2	1.8	1.4
OUT NEWTON	3.8	1.6		1.8	3.2	2.0	2.5
EASINGTON GAS STATION	1.8	2.8	2.0	1.1		1.0	1.7
KILNSEA		0.4	0.4	2.0	0.8		0.9
NUMBER OF ORDS	8	10	8	9	8	9	
MEAN LENGTH	2.2	1.7	2.2	2.1	2.1	1.9	2.0

TABLE 3.1 WAVE OBSERVATIONS MADE ON THE HOLDERNESS COAST
DECEMBER 1973 TO JANUARY 1976

<u>DATE</u>	<u>DIRECTION (IN DEGREES)</u>	<u>HEIGHT*</u>	<u>PERIOD (IN SECONDS)</u>
27.12.73	52	Moderate	10
28.12.73	45	Moderate	12
11. 3.74	100	Large	7
20. 9.74	40	Small	10
24. 9.74	46	Large	10
8.10.74	32	Moderate	6
17.10.74	110	Small	6
27.11.74	98	Small	4
28.11.74	30	Large	10
29.11.74	360	Moderate	10
25. 2.75	90	Small	5
26. 2.75	100	Moderate	6
28. 2.75	82	Small	4
3. 3.75	112	Small	4
5. 3.75	100	Small	5
" " "	42	Moderate	10
12. 3.75	60	Large	10
14. 5.75	54	Moderate	12
16. 5.75	65	Moderate	9
20. 5.75	50	Small	5
23. 5.75	25	Large	10
29. 5.75	35	Moderate	8
30. 5.75	42	Moderate	8
9. 6.75	F L A T	C A L M	
10. 6.75	45	Small	4
22. 7.75	F L A T	C A L M	
23. 7.75	45	Small	6
3.10.75	40	Moderate	6
5.10.75	90	Small	10
15.10.75	135	Moderate	5
3.12.75	50	Large	10
4.12.75	55	Small	10
5.1.76	45	Moderate	8

* WAVE HEIGHTS :-
 SMALL - less than 0.5 metre
 MODERATE - 0.5 to 1.5 metres
 LARGE - more than 1.5 metres

TABLE 3.2 WENTWORTH AND PHI UNIT (KRUMBEIN 1934) SEDIMENT CLASSIFICATION

<u>TYPES</u>	<u>PHI UNITS</u>	<u>WENTWORTH (MM)</u>
Boulder	more than -8.0	more than 256
Cobble	-8.0 to -6.0	256 to 64
Pebble	-6.0 to -2.0	64 to 4
Granule	-2.0 to -1.0	4 to 2
Very coarse sand	-1.0 to 0.0	2 to 1
Coarse sand	0.0 to 1.0	1 to 0.5
Medium sand	1.0 to 2.0	0.5 to 0.25
Fine sand	2.0 to 3.0	0.25 to 0.125
Very fine sand	3.0 to 4.0	0.125 to 0.0625
Coarse silt	4.0 to 5.0	0.0625 to 0.0312
Medium silt	5.0 to 6.0	0.0312 to 0.0156
Fine silt	6.0 to 7.0	0.0156 to 0.0078
Very fine silt	7.0 to 8.0	0.0078 to 0.0039
Coarse clay	8.0 to 9.0	0.0039 to 0.00195
Medium clay	9.0 to 10.0	0.00195 to 0.00098

TABLE 4.1 DATES OF THE ORD SURVEYS

<u>PERIOD</u>	<u>ATWICK</u>	<u>EASINGTON</u>	<u>HOLMPTON</u>
1974	23.1.74	27.1.74 8.4.74 22.4.74 29.4.74 5.5.74 13.5.74 20.5.74 26.5.74 3.6.74	27/28.12.73 3. 5.74
February - March 1975	26. 2.75 5. 3.75 12. 3.75		28. 2.75
MAY - June 1975	14. 5.75 20. 5.75 30. 5.75 10. 6.75		16. 5.75 23. 5.75 29. 5.75 9. 6.75
July 1975	22. 7.75 28. 7.75		23. 7.75 30. 7.75
October 1975	15.10.75		16.10.75
December 1975 January 1976	3.12.75 10.12.75 17.12.75 22.12.75 6. 1.76		4.12.75 19.12.75 7. 1.75

TABLE 4.2

EASINGTON BEACH SAMPLES

CF	-	CLIFF FOOT
HWM	-	HIGH WATER MARK
TOP LB	-	LOWER BEACH NEAREST CLIFF
MID LB	-	LOWER BEACH HALFWAY TO LWM
LWM	-	LOW WATER MARK
LOW UB	-	LOWER SLOPE OF THE UPPER BEACH

SAMPLE CLASS - SEE FIGURE 3.3

29.1.74

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	SKEWNESS	KURTO
E (NORTH)	HWM	12	1.51	1.54	0.27	+0.11	0.89
E	LWM	16	1.91	1.93	0.37	+0.08	1.03
D	LOW UB	23	1.89	1.93	0.66	+0.14	1.20
D	TOP LB	24	1.68	1.66	0.26	-0.07	1.03
D	MID LB	25	1.72	1.71	0.48	-0.14	1.12
D	LWM	26	2.02	2.00	0.43	-0.11	1.13
C	CF	41	1.84	1.84	0.40	-0.02	0.99
C	TOP LB	44	1.72	1.70	0.35	-0.06	1.13
C	MID LB	45	1.77	1.71	0.47	-0.19	1.04
C	LWM	46	1.77	1.70	0.52	-0.23	1.08
A (SOUTH)	HWM	52	1.29	1.27	0.57	-0.25	1.14
A	LOW UB	53	1.43	1.45	0.43	+0.04	0.97

26.4.74

D (NORTH)	CF	11	1.18	1.16	0.46	+0.06	1.00
D	MID LB	15	2.03	2.05	0.34	+0.05	1.11
D	LWM	16	2.39	2.35	0.42	-0.15	0.94
C	CF	31	1.30	1.31	0.54	+0.36	1.16
C	LOW UB	33	2.19	2.18	0.55	-0.03	1.07
C	TOP LB	34	2.02	2.03	0.39	+0.01	1.15
C	MID LB	35	2.05	2.00	0.48	-0.20	1.21
C	LWM	36	0.57	0.55	COARSE SAND		

TABLE 4.2 (Contd.)

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	KURT SKEWNESS	
B	CF	41	1.73	1.71	0.41	-0.04	1.0
B	LOW UB	43	-0.10	VERY COARSE SAND			
B	TOP LB	44	2.36	2.34	0.35	-0.07	1.1
B	LWM	46	2.17	1.95	0.54	-0.35	1.2
A (SOUTH)	HWM	52	1.54	1.56	0.34	+0.11	0.9
A	LOW UB	53	2.27	2.26	0.43	-0.05	1.1
A	TOP LB	54	2.37	2.33	0.37	-0.16	1.1
A	LWM	56	2.52	2.48	0.45	-0.17	1.3
<u>22.5.74</u>							
D(NORTH)	CF	11	1.50	1.51	0.52	-0.01	1.0
D	TOP LB	14	1.63	1.62	0.33	-0.05	1.0
D	MID LB	15	1.53	1.43	0.76	-0.31	1.2
D	LWM	16	2.30	2.24	0.44	-0.29	1.1
C	CF	31	1.58	1.48	COARSE SAND		
C	TOP LB	34	1.86	1.83	0.37	-0.14	0.9
C	MID LB	35	1.72	1.62	0.63	-0.32	1.3
C	LWM	36	2.52	2.50	0.32	-0.13	1.1
B	HWM	32	1.92	1.91	0.35	-0.05	1.0
B	TOP LB	34	1.99	1.81	0.35	-0.21	1.0
B	MID LB	35	2.33	2.28	0.37	-0.28	1.1
B	LWM	36	2.33	2.23	0.57	-0.34	1.2
A (SOUTH)	HWM	52	1.80	1.78	0.34	-0.07	1.0
A	TOP LB	54	2.40	2.35	0.36	-0.22	1.1
A	MID LB	55	2.30	2.25	0.44	-0.23	1.0
A	LWM	56	2.45	2.39	0.46	-0.25	1.0

TABLE 4.3

HOLMPTON BEACH SAMPLES

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	SKEWNESS	KURTOSIS
<u>28.2.75</u>							
D (NORTH)	TOP LB	44	1.92	1.89	0.50	-0.09	1.20
D	MID LB	45	2.30	2.26	0.43	-0.21	1.19
C	TOP LB	44	1.67	1.66	0.43	+0.01	0.94
C	MID LB	45	1.58	1.59	0.47	+0.05	0.88
C	LWM	46	2.32	2.27	0.42	-0.25	1.13
B	MID LB	45	1.97	1.97	0.46	-0.11	1.03
B	LWM	46	2.31	2.26	0.43	-0.24	1.15
<u>16.5.75</u>							
E (NORTH)	CF	31	0.85	0.83	0.45	-0.14	1.25
E	TOP LB	34	1.63	1.62	0.39	0.00	1.02
E	MID LB	35	2.10	2.08	0.43	-0.14	1.10
E	LWM	36	1.29	1.31	0.57	+0.05	0.84
D	CF	31	1.39	1.34	0.45	-0.19	1.16
D	TOP LB	34	1.85	1.82	0.41	-0.09	1.07
D	MID LB	35	2.20	2.19	0.39	-0.05	1.01
D	LWM	36	2.05	2.09	0.33	+0.11	0.97
C	CF	11	1.37	1.40	0.37	+0.12	0.39
C	LWM	16	1.33	1.42	0.50	+0.25	0.93
B	TOP LB	24	1.78	1.74	0.51	-0.14	1.08
B	LWM	26	2.07	2.05	0.58	-0.10	0.93
A	HWM	52	0.99	0.93	0.60	-0.19	1.21
A (SOUTH)	TOP LB	54	2.30	2.29	0.47	-0.04	1.03
<u>9.6.75</u>							
E (NORTH)	CF	31	1.72	1.69	0.37	-0.07	1.09
E	TOP LB	34	1.78	1.73	0.74	-0.17	0.78
E	MID LB	35	1.63	1.59	0.44	-0.15	1.06
E	LWM	36	0.93	0.99	0.58	+0.12	1.33

TABLE 4.3 contd.

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	SKWESS	KURTOSIS
<u>9.6.75</u>							
B	CF	41	1.33	1.36	0.34	+0.10	1.02
B	LWM	46	2.03	2.26	0.37	-0.20	1.0
A (SOUTH)	TOP LB	54	1.47	1.47	0.51	-0.09	1.13
A	LWM	56	2.02	1.99	0.50	-0.14	1.04
<u>30.7.75</u>							
E (NORTH)	TOP LB	34	1.81	1.83	0.47	+0.17	0.97
E	MID LB	35	1.07	1.30	0.77	+0.29	0.71
E	LWM	36	1.70	1.71	0.47	+0.01	0.97
D	CF	21	1.87	1.87	0.48	-0.03	1.07
D	TOP LB	24	1.83	1.79	0.43	-0.15	1.00
D	LWM	26	1.80	1.78	0.65	-0.01	0.92
C	HWM	32	2.18	2.10	0.42	-0.36	1.01
C	TOP LB	34	2.02	1.95	0.34	-0.29	1.31
C	MID LB	35	2.03	2.04	0.43	-0.07	1.14
C	LWM	36	2.04	2.01	0.48	-0.11	0.97
B	CF	11	2.21	2.17	0.38	-0.11	1.04
B	LWM	16	2.29	2.24	0.42	-0.23	1.12
A	CF	51	1.78	1.76	0.41	-0.05	1.02
A	LWM	56	1.30	1.20	0.85	-0.25	1.12
<u>16.10.75</u>							
E (NORTH)	CF	31	1.41	1.44	0.31	+0.11	0.91
E	TOP LB	34	1.69	1.64	0.48	-0.24	1.15
D	TOP LB	34	1.70	1.65	0.53	-0.19	1.15
D	MID LB	35	1.69	1.67	0.38	-0.01	0.93
D	LWM	36	1.93	1.95	0.44	+0.04	0.94
C	TOP LB	34	2.27	2.24	0.39	-0.20	1.10
C	MID LB	35	2.09	2.11	0.41	-0.02	1.13
C	LWM	36	1.98	1.95	0.52	-0.06	0.76

TABLE 4.3 contd.

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	SKEWNESS	KURTOSIS	
<u>16.10.75</u>								
B	CF	41	1.17	1.21	0.36	+0.10	0.8	
B	MID LB	45	2.06	2.06	0.36	-0.07	1.0	
<u>11.12.75</u>								
E (NORTH)	CF	11	1.59	1.57	0.49	-0.08	0.9	
D	TOP LB	14	1.67	1.52	0.82	-0.39	1.3	
D	MID LB	15	-0.04	V e r y C o a r s e S a				
B	CF	31	1.42	1.45	0.41	+0.08	1.1	

TABLE 4.4

ATWICK BEACH SAMPLES

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	SKEWNESS	KURTOSIS
<u>25.1.74</u>							
D (NORTH)	CF	11	1.73	1.75	0.38	+0.06	1.06
D	TOP LB	14	1.87	1.82	0.65	-0.27	1.26
D	MID LB	15	2.06	2.03	0.50	-0.04	1.67
D	LWM	16	2.01	1.99	0.52	-0.08	0.81
C	CF	41	1.61	1.62	0.47	+0.04	1.01
C	TOP LB	44	1.59	1.49	0.82	-0.29	1.40
C	MID LB	45	1.87	1.80	0.66	+0.17	1.09
C	LWM	46	2.50	2.43	0.45	-0.33	1.32
B	CF	41	1.94	1.94	0.38	-0.05	1.06
B	LOW UB	43	1.84	1.89	0.63	+0.10	0.70
B	TOP LB	44	1.68	1.66	0.55	+0.05	1.45
B	MID LB	45	1.74	1.68	0.71	-0.23	1.16
B	LWM	46	2.19	2.09	0.46	-0.30	0.98
A (SOUTH)	HWM	52	1.74	1.73	0.40	-0.02	0.97
A	LWM	54	2.10	2.06	0.45	-0.14	0.88
<u>26.2.75</u>							
D (NORTH)	CF	11	-0.05	-0.05	0.46	+0.03	1.07
D	TOP LB	14	1.96	2.01	0.37	+0.23	0.83
D	LWM	16	2.18	2.06	0.60	-0.28	0.92
C	TOP LB	24	1.97	1.96	0.43	-0.06	1.07
C	LWM	26	2.42	2.35	0.45	-0.30	1.15
B	TOP LB	44	1.87	1.86	0.46	-0.05	0.96
B	LWM	46	2.38	2.34	0.43	-0.23	1.12
A (SOUTH)	HWM	52	1.43	1.44	0.48	-0.06	1.03
A	LWM	56	2.17	2.10	0.57	-0.20	0.93
<u>14.5.75</u>							
D (NORTH)	CF	11	1.45	1.45	0.66	+0.10	1.10
D	LWM	16	1.80	1.82	0.42	+0.08	0.97

TABLE 4.4 contd.

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	KURTOSIS SKEWNESS	
<u>14.5.75</u>							
C	CF	41	1.98	2.01	0.32	+0.08	1.08
C	TOP LB	44	2.00	2.00	0.42	0.00	1.02
C	MID LB	45	2.15	2.05	0.47	-0.35	1.33
C	LWM	46	2.22	2.21	0.42	-0.09	0.92
B	CF	41	1.90	1.88	0.38	-0.10	1.02
B	TOP LB	44	2.28	2.26	0.45	-0.10	1.03
B	MID LB	45	2.18	2.14	0.49	-0.16	0.91
B	LWM	46	2.58	2.54	0.34	-0.25	1.25
A (SOUTH)	CF	51	1.68	1.65	0.47	-0.11	0.92
A	TOP LB	54	2.35	2.30	0.43	-0.21	0.98
A	LWM	56	2.47	2.36	0.51	-0.38	1.17
<u>10.6.75</u>							
D (NORTH)	CF	11	1.62	1.59	0.43	-0.10	1.06
D	LWM	16	1.22	1.19	0.80	-0.11	0.96
C	CF	41	1.91	1.88	0.45	+0.04	1.10
C	TOP LB	44	1.88	1.87	0.44	-0.16	1.30
C	MID LB	45	2.06	1.91	0.40	-0.18	0.91
C	LWM	46	2.41	2.34	0.43	-0.29	1.04
B	CF	41	1.93	1.91	0.34	-0.11	0.81
B	TOP LB	44	2.32	2.29	0.30	-0.12	0.90
B	MID LB	45	1.93	1.90	0.56	+0.02	0.92
B	LWM	46	2.41	2.36	0.37	-0.23	1.01
A (SOUTH)	CF	51	1.54	1.55	0.45	+0.01	1.00
A	LWM	56	2.25	2.23	0.42	+0.03	0.91
<u>28.7.75</u>							
D (NORTH)	CF	11	2.12	2.11	0.32	-0.08	1.04
D	LWM	16	2.31	2.19	0.56	-0.31	0.97
C	CF	41	2.17	2.17	0.69	+0.03	0.90
C	TOP LB	44	2.22	2.07	0.49	-0.43	0.98
C	MID LB	45	1.98	1.97	0.50	-0.06	0.99
C	LWM	46	1.94	1.94	0.62	+0.01	0.68

TABLE 4.4 contd.

PROFILE	SITE	CLASS	MEDIAN	MEAN	STANDARD DEVIATION	KURTOSI SKEWNESS	
<u>28.7.75</u>							
B	CF	41	2.20	2.18	0.34	-0.01	0.95
B	TOP LB	44	2.02	2.05	0.59	+0.07	1.0
B	MID LB	45	1.67	1.67	0.53	-0.05	1.0
B	LWM	46	2.09	2.07	0.57	-0.06	0.73
A (SOUTH)	CF	51	2.29	2.22	0.38	-0.29	0.96
A	LWM	56	2.48	2.32	0.56	-0.46	1.03
<u>15.10.75</u>							
D (NORTH)	CF	11	1.47	1.50	0.37	+0.19	1.05
D	LWM	16	2.19	2.12	0.41	-0.23	0.97
C	CF	41	1.71	1.68	0.43	-0.10	1.06
C	TOP LB	44	2.01	1.98	0.49	-0.15	1.08
C	MID LB	45	2.06	2.03	0.47	-0.12	1.00
B	CF	41	1.57	1.57	0.45	-0.03	0.98
B	TOP LB	44	2.16	2.17	0.34	-0.01	0.95
B	MID LB	45	1.89	1.90	0.43	+0.06	1.21

TABLE 6.1 HOLDERNESS LAND LOSS BY PARISH, 1852-1952
(after Valentin 1954)

No.	Parish	Annual cliff recession	Shore length (m.)	Annual land loss (sq.m.)	Average cliff height (m.)	Annual loss in volume (cu.m.)
1	Bridlington	0.36	4,875	1,755	13.5	23,693
2	Carnaby	0.49	1,350	662	9.9	6,549
3	Barmston	0.52	5,700	2,964	7.0	20,748
4	Ulrome	1.57	1,175	1,845	7.1	13,098
5	Skipsea	1.44	3,600	5,184	10.8	55,987
6	Atwick	1.13	3,075	3,475	16.6	57,681
7	Hornsea	0.84	4,175	3,507	12.6	44,188
8	Mappleton	1.45	6,600	9,570	17.4	166,518
9	Aldbrough	1.24	4,600	5,704	18.0	102,672
10	East Garton	1.14	1,925	2,195	22.6	49,596
11	Roos	0.85	5,275	4,484	17.0	76,224
12	Rimswell	0.85	1,950	1,658	13.4	22,211
13	Withernsea	1.08	3,600	3,888	10.6	41,213
14	Hollym	1.36	2,250	3,060	11.9	36,414
15	Holmpton	1.50	2,000	3,000	15.3	45,900
16	Easington	1.89	9,375	17,719	13.6	240,975

P L A T E S



1. Ridges and runnels on Bridlington South Sands.



2. The Holderness beach south of Barmston showing the formation of a narrow upper beach and the wide flat wet lower beach.

P L A T E S



3. The Holderness beach at Skipsea. A wide, high, upper beach with shingle at the high water mark and a very narrow lower beach.



4. The southern end of the Easington Ord, January 1974, showing the wide upper beach with till platform at its foot, a water-filled runnel and the dry ridged lower beach, submerged at the southern end of the ord.

P L A T E S



5. The centre of the Easington Ord, January 1974.
Eroding vertical till cliffs and the till shore platform loosely covered by till and rock boulders.



6. The northern end of the Easington Ord, January 1974.
Note the low upper beach north of the ord. Picture taken from the dry lower beach.



9. The Holderness beach looking north from Mappleton, November 1974. In the distance the dry lower beach marks the site of the Rolston Ord.



10. The Cowden/Aldbrough Ord, November 1974. Looking south from Cowden, this very long ord has a narrow upper beach at the cliff foot, seaward of this exposed till platform covered with many till boulders, and a dry lower beach to the low water mark.



11. The northern end of the Hilston Ord, Movember 1974. The upper beach becomes lower and narrower as the ord is approached, the lower beach becomes raised and dry.



12. The Hilston ord from the north, November 1975. Much recent erosion has covered the very narrow upper beach and the till platform with till boulders. Note the abrupt build up of the upper beach at the southern end of the ord, typical of the Group A ords.

P L A T E S



13. The northern section of the double ord at Holmpton, taken from the farm, January 1975. Note high ridged lower beach opposite the lowest parts of the ord at the cliff foot.



14. The southern section of the double ord at Holmpton, taken from the farm, January 1975. Note the ridged lower beach forming north of the ord centre.



15. The southern end of the Atwick Ord, 22nd December 1975.
Note line of concrete blocks opposite the Sailing Club
gap.



16. The southern end of the Atwick Ord, 5th January 1976.
Note more till boulders on the beach than in Plate 15,
after the storm on 2nd and 3rd January.

P L A T E S



17. The Holmpton Ord looking north from the farm, 4th December 1975. Note the centre of the ord and the asymmetrically ridged tongue of upper beach seaward of it.



18. The Holmpton Ord looking north from the farm, 11th December 1975. The tongue of upper beach material has now moved up to the cliff foot, covering the previous position of the centre of the ord in Plate 17.



19. The Holmpton Ord looking north from the farm, 5th January 1976. The movement south of the northern end is now complete. The upper beach is built up at the cliff foot and no sign of the ord remains.



20. The Holmpton Ord looking south from the farm, 4th December 1975. Note the wide exposure of till platform and the ridged lower beach.



21. The Holmpton Ord looking south from the farm, 11th December 1975. The landward movement of the tongue of upper beach material (see Plate 18) has shifted the centre of the ord southwards.



22. The Holmpton Ord looking south from the farm, 5th January 1976. The landward movement of the lower beach ridge continues and the width of till platform exposed is narrowed. Note the many till boulders on the beach after the storm on 2nd and 3rd January.



23. The landward slope of the asymmetrical lower beach ridge at Holmpton, December 1974.



24. A section of the Easington ord, January 1974, south of the centre, showing the upper beach building up at the cliff foot, and seaward, the uneven surface of the exposed till platform.

P L A T E S



25. A major slip about to occur at Hilston.



26. A cliff fall at Holmpton.

P L A T E S



27. Sub-aerial processes. A series of small mudflows at Skipsea; the high water mark is just below the cliff foot.



28. The cliffs at the centre of the ord at Holmpton, December 1974, showing the results of being washed by the waves at every high water.