DURHAM

CRUISE REPORT

R.R.S. SHACKLETON

Leg 6/82

Barry to Liverpool

30th June to 22nd July 1982

Department of Geological Sciences

University of Durham

M. C. Sinha.

C. I. Uruski.

1. Objectives

Durham University's cruise SHACKLETON 6/82 set out with two scientific objectives. The first was to participate in the Caledonian Suture Seismic Project, an international seismic deep sounding experiment organised by Durham University in collaboration with the Dublin Institute for Advanced Studies and Karlsrühe University. The second objective was to carry out a detailed geophysical survey in North Rockall Trough, to the south of the Wyville-Thompson Ridge.

The Caledonian Suture Seismic Project was planned to investigate the crustal structure along strike of a belt of relatively uniform structure, along the Northumberland Trough and Solway Basin (Figure 1). For the project, Durham field parties ran a total of 60 Geostore Stations at 2 km spacings along a line from the Solway Firth to the Northumberland coast (Figure 2), as well as a number of mobile stations in Southern Scotland and the Isle of Man. This 120 km-long line of stations was to be extended by 120-km long shot lines at either end, in the Irish Sea and the North Sea (Figures 4 & 5). SHACKLETON's role was to operate Pull-Up Shallow-Water Seismometer (PUSS) stations in both the Irish Sea and the North Sea, to fire explosive shots of 150 and 450 kg at spacings of 4 km along both lines, and to fire closely-spaced shots from a large airgun array into PUSS and coastal land stations to determine the shallow structure along the shooting lines. Two small land shots on the Northern England line were to provide similar shallow information beneath the line of Geostore stations.

The scope of the project was greatly increased by the collaboration of the Dublin Institute for Advanced Studies and Karlsrühe University, who extended the line across Ireland by installing an additional 28 stations along a line from Dundalk Bay to the mouth of the Shannon, and by firing two additional shots off the West coast of Ireland (Figure 3). To connect the Irish line to the Durham line, SHACKLETON was to fire an additional

five shots of 150 kg each in the Western Irish Sea (I1 to I5, Figure 4) which were to be repeated the following day after some of the Irish stations had been moved up half a station spacing overnight.

The secondary objective of the cruise, to carry out a detailed seismic reflection, gravity and magnetics survey in North Rockall Trough, was planned to investigate in detail a group of suspected major igneous centres immediately to the South of Wyville-Thompson Ridge, whose presence had been indicated by results from previous surveys by Durham University (JOHN MURRAY, 1973; SHACKLETON, 1976).

2. Narrative, Leg 6/82

2.1 Preliminaries

The Durham University personnel for leg 6/82 (M. Sinha, C. Uruski, D. Asbery, R. Hobbs, E. Murphy and C. Powell) joined SHACKLETON in Barry on Tuesday 29th June, 1982. Loading and installation of scientific equipment was completed by 11.00/30th, and explosives were then loaded from 12.00 to 15.00. We sailed from Barry at 17.00 on Wednesday 30th June (All times GMT).

On Thursday 1st July, while on passage to the Irish Sea work area, the gyro-compass repeater in the main lab. ceased working. This was serious mainly because it meant that heading data was not reaching the data-logger. The fault proved to be extremely elusive, and it was not until the evening of Friday 2nd July that the system was working correctly again. Fortunately, during this period, the lab repeater was not essential to scientific operations, and the lack of it was a nuisance rather than a major problem.

2.2. C.S.S.P. Irish Sea

We arrived at the Irish Sea work area early a.m. on Friday 2nd July; from 0600 to 0800 we laid the first three PUSS's (1-3), followed by the next three (PUSS's 4-6) between 1230 and 1430 (Figure 6). The ship then

hove to for three hours while explosives for the first day's shooting were transported to the after-deck. Overnight we steamed to the Solway Firth end of the Irish Sea shooting line.

Shot firing on the main Irish Sea line (shots M1 to M25) took place between 0830 and 1530 on Saturday 3rd July. Shot M25 was repeated with a 450 kg charge at 1600, and shots I1 to I5 were then fired between 1650 and 2030/3rd. Overnight the ship steamed back along the line, and between 0630 and 0930 on Sunday 4th, PUSS's 4, 5 & 6 were recovered and replaced by PUSS's 10, 11 & 12. Between 1230 and 1500/4th, PUSS's 1-3 were recovered and replaced by PUSS's 7-9; and between 1550 and 1930, the five shots I1 to I5 were repeated for the Irish stations, which had moved up since the previous day. All the Irish Sea shots were fired successfully, on time and in their correct positions. While shot-firing in Northern Ireland territorial waters, we were escorted on both days by a Royal Navy patrol vessel.

Overnight, the ship steamed back to the Solway Firth end of the line; and at 0500 on Monday 5th we started deploying an array of 2 x 1000 cu.in + 2 x 300 cu.in. air-guns. This was completed by 0930, and at 1000/5th we began the Irish Sea airgun line. Airgunning continued until 0300/6th, when the airgun array was recovered. PUSS's 7, 8 & 9 were then recovered between 0330 and 0500; followed by PUSS's 10, 11 & 12 between 0700 and 0940. At 0945, having successfully completed the geophysical program in the Irish Sea, we commenced the passage around Northern Scotland to the North Sea area.

2.3 C.S.S.P. North Sea

From 2300/6th to 0100/7th we stopped off Dunstaffnage to collect spare parts for the gyrocompass repeater; passage to the North Sea was then resumed, and we arrived in the North Sea work area p.m. on Thursday 8th July.

PUSS's 7, 8 & 9 were deployed between 1800 and 2000/8th followed at first light on Friday 9th by PUSS's 10, 11 & 12. The afternoon was taken

up with streaming the linear airgun array (2 x 1000 cu.in. + 2 x 300 cu.in.), and shooting of the airgun line commenced at 1800/9th. Unfortunately, one of the 1000 cu. in. guns failed to fire at all, and the other 1000 cu. in. gun failed soon after the start of the line, due to a fractured air supply pipe. Consequently most of the line was shot using only 2 x 300 cu. in. airguns. We completed the airgun line at Druridge Bay at 0740/10th.

After recovering the airguns, PUSS's 7, 8 & 9 were recovered and exchanged for PUSS's 1, 2 & 3 during the afternoon of the 10th. The PUSS 9 ground line had become wrapped around the instrument, but both PUSS and mooring were recovered without damage. The ship then hove to for 2½ hours while the remaining explosives were transferred to the after-deck for the following day's shooting. Between 1800 and 2000/10th, we exchanged PUSS's 4, 5 & 6 for PUSS's 10, 11 and 12, before streaming the magnetometer fish and running a gravity and magnetics profile back along the length of the North Sea line, to Druridge Bay overnight.

On Sunday 11th, shots N1 to N29 were fired successfully between 0830 and 1615, followed at 1745 by a repeat of shot N23 with a 450 kg charge. Again all shots were fired on time and in their correct positions. On completion of shot-firing PUSS's 4, 5 & 6 were recovered, followed at 0600/12th by PUSS's 1, 2 & 3.

Since the airgun shooting in the North Sea had been only partially successful, it was decided to repeat the airgun lines, using 2 x 1000 cu.in. guns, towed side by side on a beam at a depth of 10 m. PUSS's 1 to 6 were therefore fitted with fresh tapes and batteries, reprogrammed, and re-deployed (starting at 1230/12th), in a single group located between shot-points N11 and N12. A burst hydraulic hose on the main A-frame caused some anxious moments and some delay during this operation, but all six PUSS's were deployed safely by 1530/12th. We then steamed back to Druridge Bay, deployed the array of 2 x 1,000 cu.in. airguns, and reshot the airgun line between 0800/12th and 0200/13th.

After recovering the airguns, we recovered PUSS's 1 to 6 from 0415 to

0615/13th, thus completing the North Sea part of the CSSP. We then steamed to South Shields and put D. Asbery ashore by Zodiac dinghy, before heading back up the North Sea to the Rockall Trough survey area.

2.4 North Rockall Trough Survey

After passing through the Pentland Firth on the afternoon of Wednesday 14th July, we commenced streaming reflection profiling equipment at 1930/14th and started profiling on line A (Figure 7) at 2200. Profiling continued throughout Thursday 15th, although the Geomechanique hydrophone streamer failed for several hours, due to a leak in the pre-amplifier pressure case. It failed again several times on Friday 16th, for the same reason, and each time profiling continued using an EG+G streamer while the Geomechanique was repaired. Finally the pressure case on the Geomechanique was filled with oil, which cured it, and thereafter it provided extremely good records for the remainder of the cruise.

An airgun compressor failure in the early hours of Saturday 17th was caused by a lamprey being inducted into the compressor cooling system. After removal of the (dead) lamprey, profiling continued throughout the rest of the Saturday and Sunday 18th. A.M. on Monday 19th we completed the North Rockall Trough survey successfully, then carried out a small survey over another suspected igneous centre on the continental margin off St. Kilda (lines p, Q, R & S Figure 7).

On Tuesday 20th we profiled south along the margin (line T) before starting a single long profile across the Hebridean margin (line U). We ended line U close to Colonsay at 0500 on Wednesday 21st, and recovered our profiling equipment before proceeding on passage to Liverpool. The cruise ended at the Princes Dock, Liverpool at 1100 on Thursday 22nd July.

3. Equipment Performance

Generally speaking, all equipment - Durham, RVS and ships-functioned

well as evidenced by the very small amount of time lost (2.9 hours). There were, however, one or two breakdowns, as follows:-

(i) Gyro-compasses

The Arma-Brown gyro was U/S throughout the cruise, leaving only the Microtechnica Sirius gyro. The gyrorepeater in the lab failed soon after sailing, which was a potentially serious problem since it prevented heading data from being received by the data logger. After much effort by both RVS and ship's personnel the fault was tracked down and fixed on the evening of Friday 2nd July - 48 hours after sailing, and after scientific work had commenced.

(ii) DECCA Navigator Mk 21.

This was installed in Barry by DECCA engineers. A few hours before sailing, it was found not to be working. A DECCA engineer was called post-haste from Cardiff, and finally got it working a few minutes before sailing. To obtain a signal, he found it necessary to disconnect the aerial cable from the ship's Earth.

Subsequently the DECCA proved unreliable throughout the cruise. It frequently (every 2-3 hours) slipped lanes on one or more channels, and occasionally lost lock. As a result it required constant vigilance on the part of the watch-keeper, and even so some of the values recorded by the data-logger are suspect. Even more seriously, the DECCA failed to operate at all during the North Rockall Trough survey, even though the bridge DECCA worked correctly throughout. The poor performance of the Lab. DECCA was almost certainly due to poor installation in the first place, by DECCA engineers.

(iii) Starboard Side A-frame

On two separate occasions while launching or recovering PUSS moorings, work was delayed for several minutes by failures of seals on the hydraulic system of the main A-frame. Although not serious on this cruise, such failures could be dangerous, and the occurrence of two separate failure in such a short time suggests that the A-frame hydraulics may

have been due for a complete overhaul.

(iv) Airguns

For the refraction work, we had hoped to have an array of 4 x 1000 cu.in. airguns; however, when we sailed, the largest available was 2 x 1000 + 2 x 300 cu.in. The guns were deployed in a linear array, with the four airguns (minus tailfins) suspended below a chain which in turn was suspended below four A4 floats. This arrangement proved very difficult to deploy, taking four hours or so to stream and 2½-3 hours to recover. A major problem with it was that, due to the large drag of the array, it was not possible to tow it at speeds above 4 to 4½ knots; and even at this speed, the gun guns towed at a depth of only 5-6 metres, which is much too shallow for their full effectiveness. On the North Sea airgun line, both 1000 cu.in. guns failed, so we repeated the line using 2 x 1000 in. guns towed on a beam at a depth of 10 m. This proved to be at least as good a seismic source as the four-gun array at 5-6 metres.

In spite of the difficulties we were able to fire some 450 airgun shots in the Irish Sea, which were recorded by four PUSS's, as well as coastal stations in England, Ireland, the Isle of Man and Southern Scotland; while a total of 570 airgun shots fired in the North Sea were also recorded by land stations and PUSS's.

It is clear that large airgun arrays can play an important role in future seismic experiments. What is needed is a means of towing at least four large airguns, separated laterally by far enough to prevent bubble coalescence or interaction (say 5-6 m apart); and at a depth of at least 10-12 m, to obtain maximum seismic signal output.

4. Summary

All major scientific objectives of the cruise were achieved, including firing 66 explosive shots and over 1000 airgun shots on the C.S.S.P., and obtaining some 1020 n.m. of seismic reflection, gravity and magnetics profiles. We were extremely fortunate with the weather, which was

fine throughout the cruise. Our success was also to a very large extent due to the generally high standard of reliability and performance of all the scientific equipment on board - ships, R.V.S., Durham and the PUSS's which were borrowed from Cambridge.

CIRCULATION

Dr. L.M. Skinner, Research Vessel Base, Barry.

Dr. J. Cleverley, N.E.R.C., Swindon.

Durham University (5).

M.I.A.S. I.O.S. Wormley.

Admiral D. Haslam, Hydrographer of the Navy.

Dr. B. Kelk, N.E.R.C., Swindon.

The Master, R.R.S. SHACKLETON (M. Harding).

3 Spare Copies.

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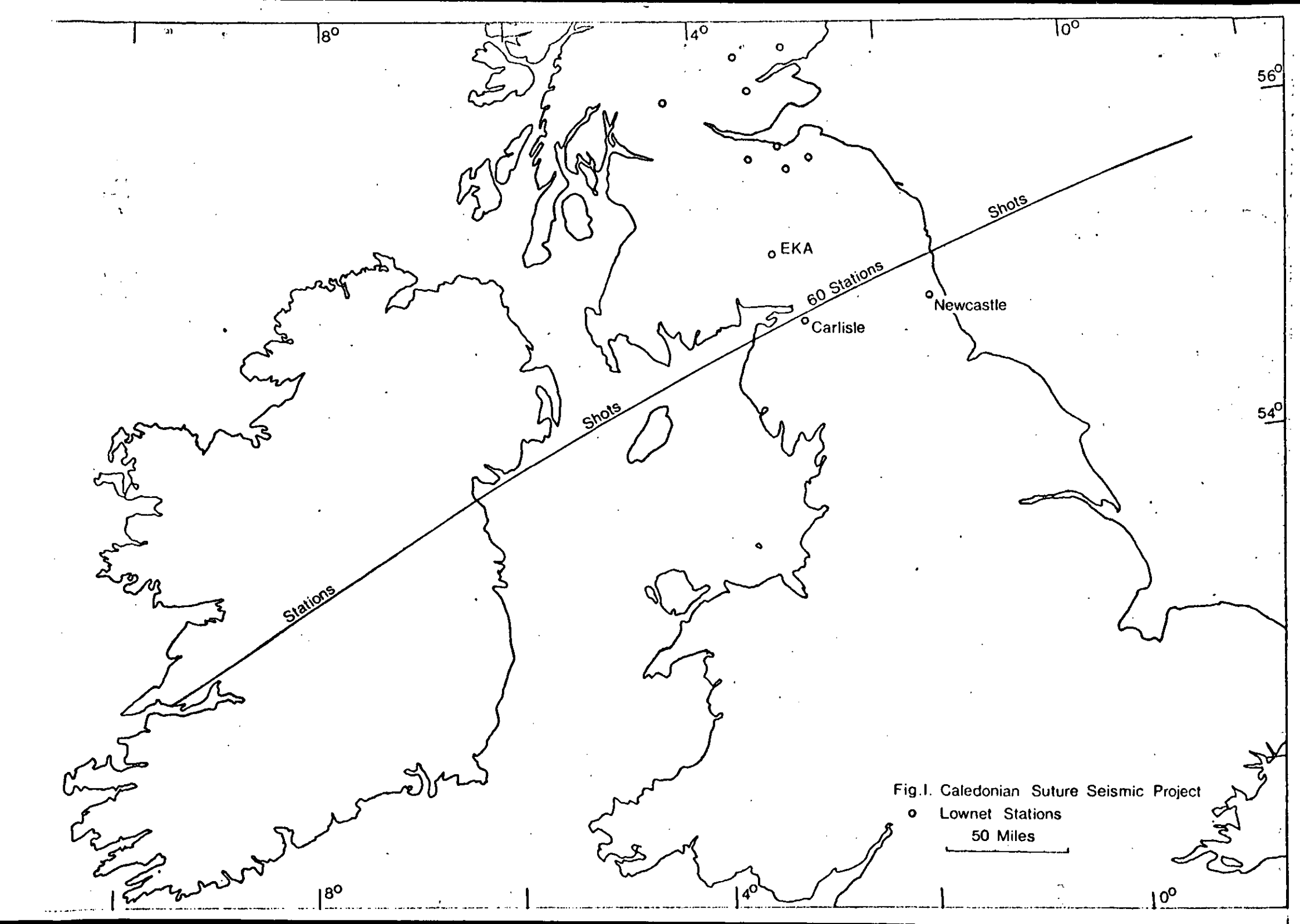
8°
4°
0°
56°
54°
EKA
Shots
60 Stations
Newcastle
Carlisle
Shots
Stations
Fig.I. Caledonian Suture Seismic Project
Lownet Stations
50 Miles

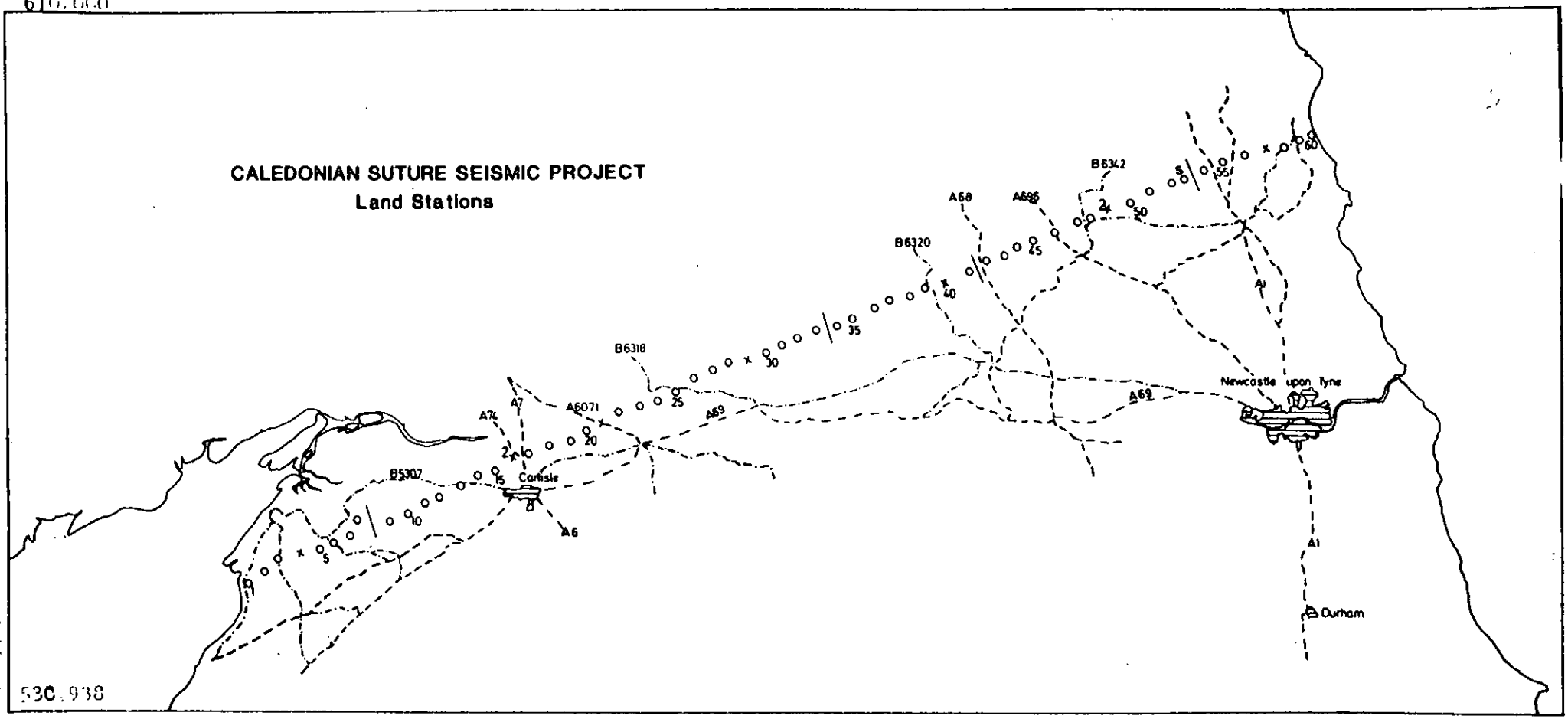

Figure 2: Key - open circles - radio linked vertical seismic stations
crosses - Geostore recording points. The 2 against a station indicates two geostores at that recording point.
S - Durham long playing recording sites.

The lines section the stations into blocks recording into geostore sites.

Reference is with respect to the National Grid.

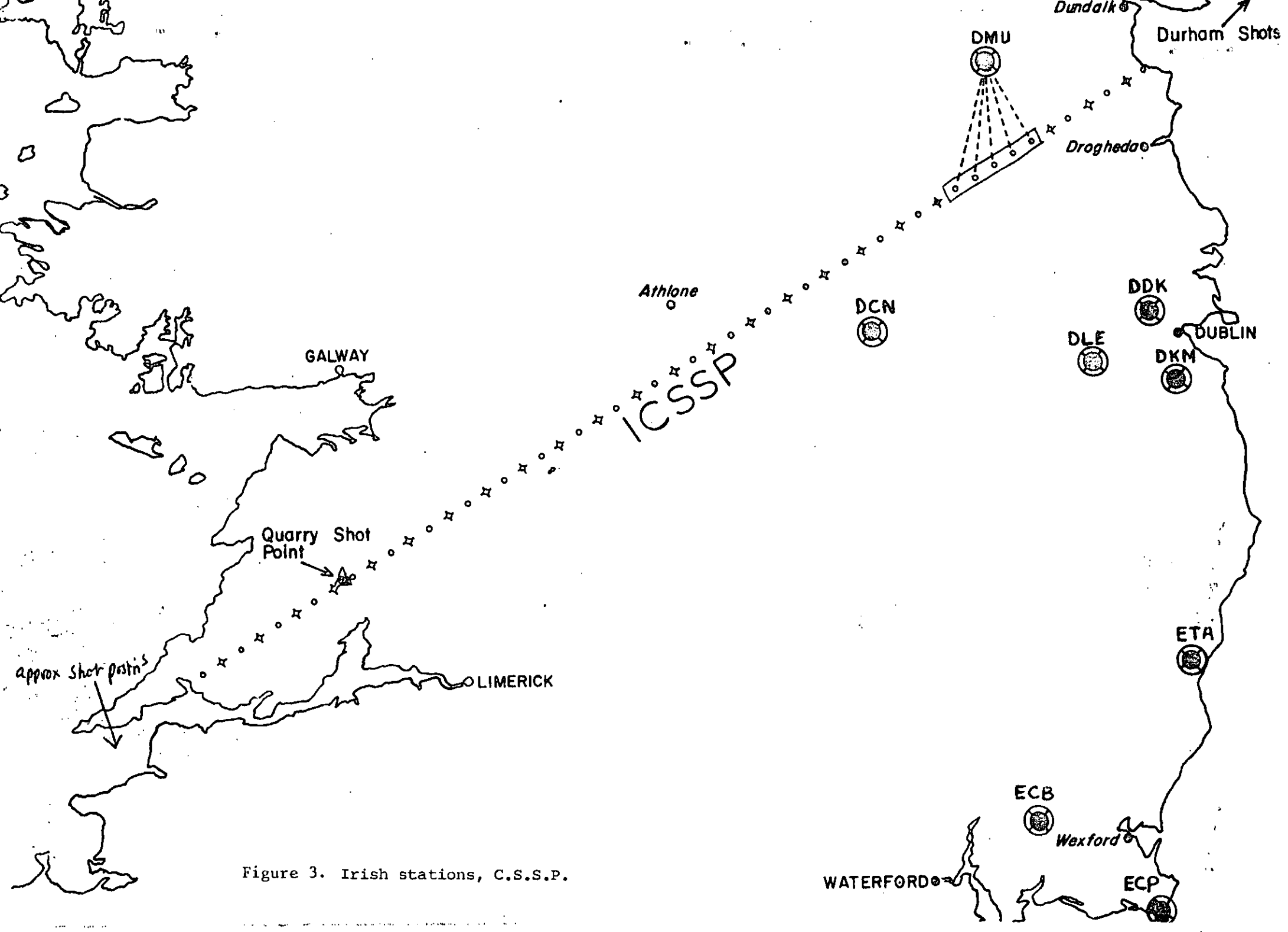

Figure 3. Irish stations, C.S.S.P.

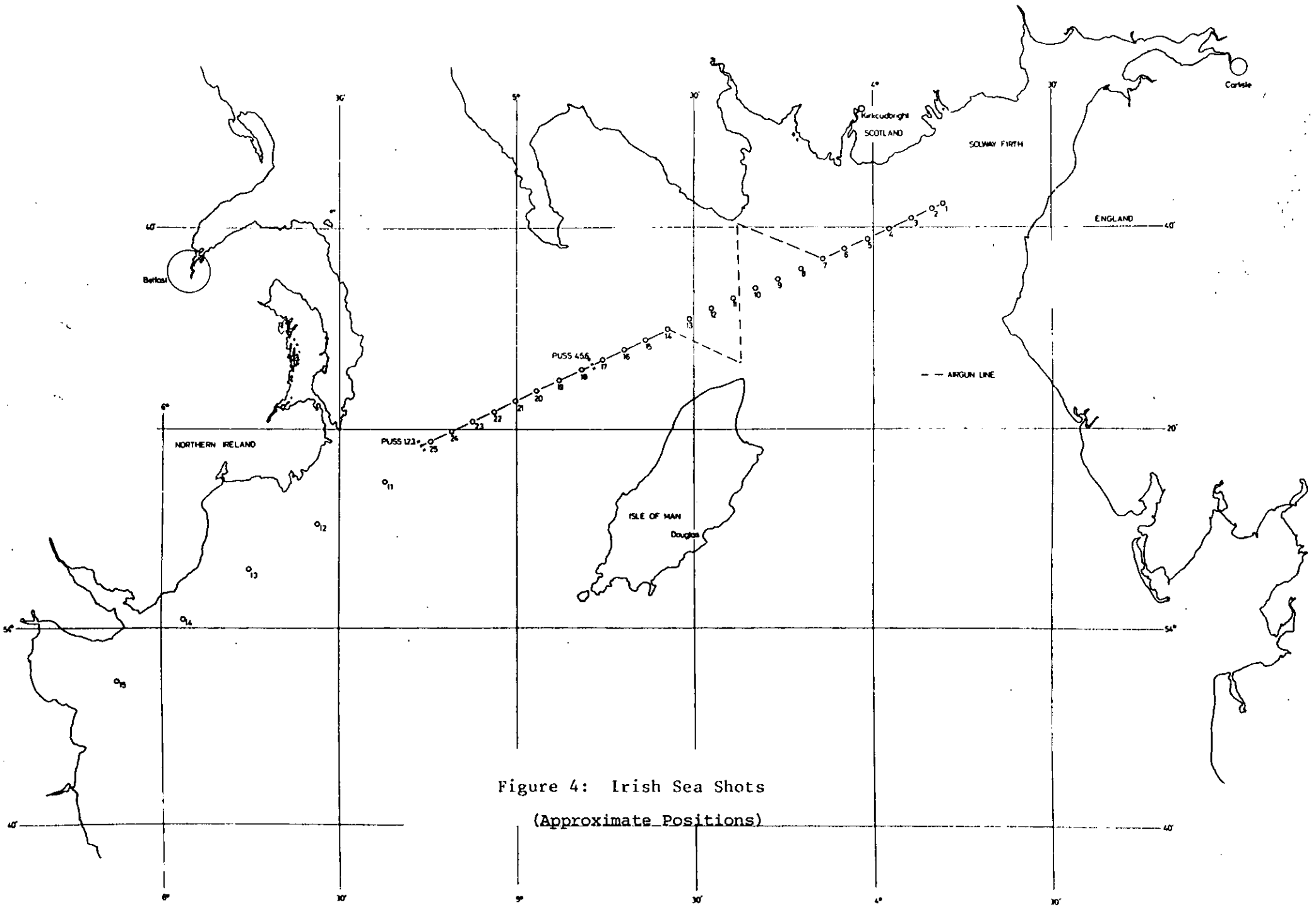

Figure 4: Irish Sea Shots

(Approximate Positions)

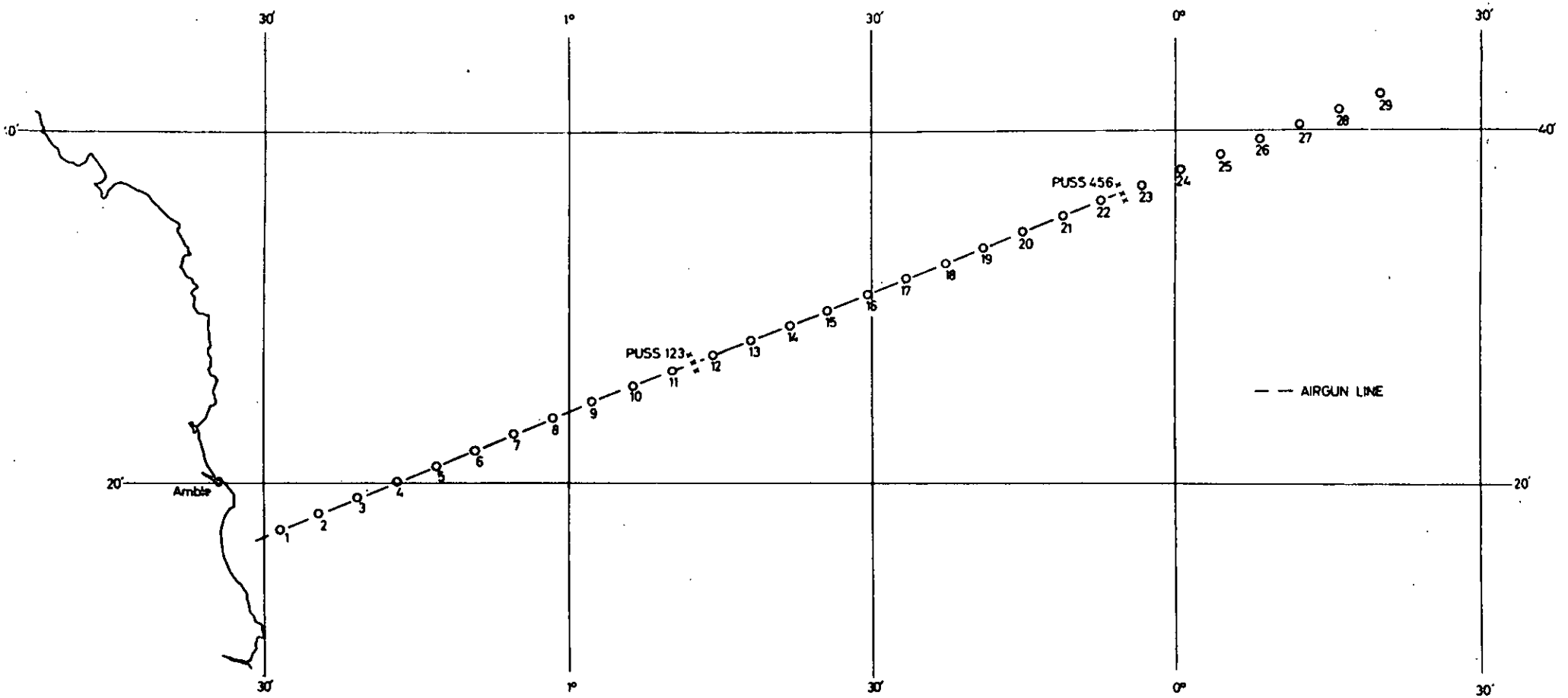

Figure 5: North Sea Shots.
Note: Latitude is 55°
(Approximate Positions)

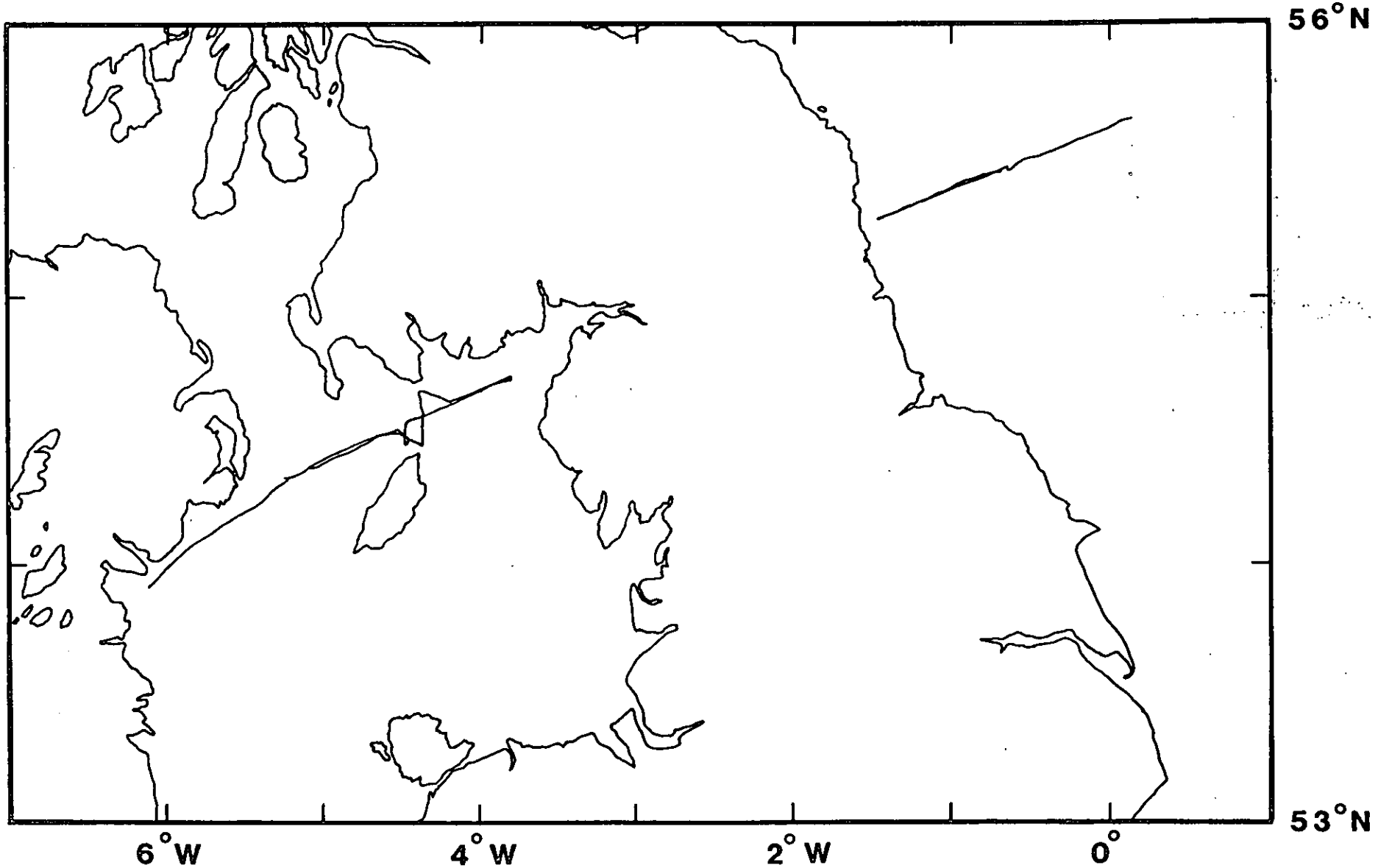

Figure 6: Representative ship's tracks,
SHACKLETON 6/82, C.S.S.P.

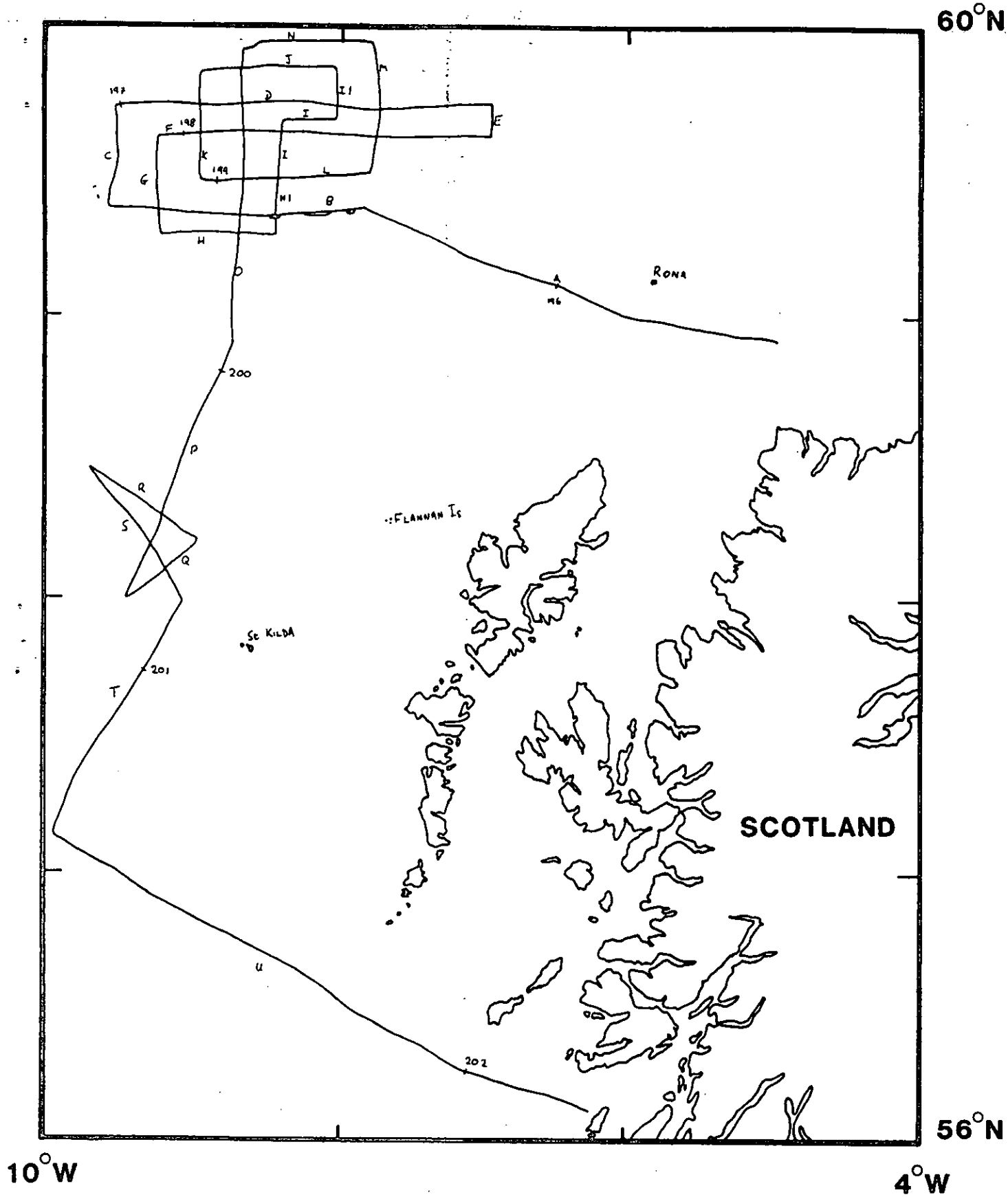

Figure 7: Summary of ship's tracks, SHACKLETON 6/82, seismic reflection profiling.

Appendix 1

Scientific Personnel, Leg 6/82

M. Sinha	Durham University	P.S.O.
C. Uruski	" "	
D. Asbery	" "	
R. Hobbs	" "	
E. Murphy	" "	
C. Powell	" "	
D. Spurlock	N.E.R.C.	Shot-Firer
K. Robertson	R.V.S.	Shot-Firer
J. Taylor	R.V.S.	
G. Knight	R.V.S.	
D. Ashworth	Galway University	Eire Government Observer

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Appendix 2

P.U.S.S. Deployments C.S.S.P.

(Shackleton 6/82)

a) Irish Sea

P.U.S.S.	Latitude	Longitude	Date/Time Laid (GMT)	Recovered (GMT)	Data Recorded
1	54°18.77'N	5°16.61'W	183/0629	185/1252	Explosive Shots
2	18.36'N	16.24'W	183/0704	185/1349	" "
3	17.98'N	15.90'W	183/0738	185/1427	" "
4	27.14'N	4°48.13'W	183/1337	185/0700	" "
5	26.52'N	47.45'W	183/1421	185/0834	" "
6	26.07'N	46.79'W	183/1455	185/0924	" "
7	54°19.09'N	5°16.83'W	185/1310	187/0530	Airgun Shots
8	18.46'N	16.22'W	185/1357	187/0552	" "
9	17.98'N	15.80'W	185/1436	187/0624	" "
10	26.97'N	4°47,98'W	185/0716	187/0938	" "
11	26.47'N	47.20'W	185/0846	187/0912	No Data
12	26.13'N	46.83'W	185/0930	187/0845	No Data

b) North Sea

1	55°27.35'N	0°47.92'W	191/1226	193/0704	Explosive Shots
2	26.93'N	47.74'W	191/1314	193/0645	" "
3	26.45'N	47.31'W	191/1425	193/0616	" "
4	37.11'N	05.19'W	191/1824	192/1917	" "
5	36.58'N	04.97'W	191/1905	192/1944	" "
6	36.17'N	04.72'W	191/1946	192/2008	" "
7	55°27.35'N	0°47.90'W	189/1804	191/1219	Airgun Shots
8	26.99'N	47.46'W	189/1831	191/1301	" "
9	26.53'N	47.23'W	189/1858	191/1348	" "
10	37.27'N	05.14'W	190/0829	191/1815	" "
11	36.72'N	05.01'W	190/0908	191/1856	" "
12	36.17'N	04.81'W	190/0937	191/1933	" "
1	55°27.17'N	0°47.41'W	193/1309	194/0443	Airgun Shots
2	27.18'N	46.57'W	193/1329	194/0425	" "
3	26.94'N	47.41'W	193/1352	194/0507	" "
4	26.83'N	47.97'W	193/1444	194/0526	" "
5	26.55'N	48.80'W	193/1509	194/0545	" "
6	26.50'N	49.23'W	193/1530	194/0606	" "

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Appendix 3

Shot Locations, C.S.S.P.

(SHACKLETON 6/82)

a) Irish Sea, 3rd July, 1982 (Day 184)

Shot	Lat.	Long.	Time (GMT)	Water Depth (m)
MO1	54°42.35'N	3°48.56'W	08:34:35.33	33
MO2	41.68'N	50.18'W	09:03:36.07	36
MO3	40.64'N	53.80'W	09:17:32.84	42
MO4	39.64'N	57.69'W	09:32:17.13	47
MO5	38.74'N	4° 1.35'W	09:45:55.25	55
MO6	37.74'N	5.42'W	10: 1:14.91	60
MO7	36.81'N	9.16'W	10:16: 6.05	64
MO8	35.83'N	12.55'W	10:32: 8.60	65
MO9	34.97'N	15.90'W	10:45:41.01	63
M10	34.02'N	19.69'W	11: 1: 8.97	56
M11	33.01'N	23.68'W	11:16: 3.59	67
M12	32.01'N	27.59'W	11:31:13.66	47
M13	30.95'N	31.35'W	12:31:29.68	55
M14	29.70'N	35.40'W	12:46:24.29	55
M15	28.93'N	38.97'W	13: 0:46.52	63
M16	27.84'N	42.83'W	13:17:15.01	59
M17	26.88'N	45.86'W	13:32:18.98	53
M18	26.06'N	48.85'W	13:47: 7.80	70
M19	25.09'N	52.15'W	14: 2:43.28	61
M20	23.89'N	55.96'W	14:17: 1.08	95
M21	22.93'N	5° 0.02'W	14:31:43.82	139
M22	21.95'N	3.97'W	14:46: 1.22	134
M23	20.91'N	7.57'W	15: 0:35.64	134
M24	19.77'N	11.09'W	15:15:32.79	133
M25a	18.83'N	14.44'W	15:30:39.68	97
M25b	18.78'N	14.67'W	16: 1:15.27	96
I1a	14.59'N	22.22'W	16:51:17.42	57
I2a	10.25'N	34.02'W	17:41:52.75	37
I3a	5.84'N	45.55'W	18:31:28.26	34
I4a	0.80'N	56.48'W	19:32:21.13	36
I5a	53°54.51'N	6° 7.90'W	20:32: 3.40	31

b) Irish Sea, 4th July, 1982 (Day 185)

I1b	54°14.76'N	5°22.43'W	15:51:10.17	57
I2b	10.30'N	33.83'W	16:41:16.46	38
I3b	5.90'N	45.51'W	17:32:32.15	33
I4b	0.77'N	56.31'W	18:31:35.17	35
I5b	53°54.68'N	6° 7.68'W	19:32: 1.42	30

c) North Sea, 11th July, 1982 (Day 192)

N1	55°17.39'N	1°27.87'W	8:32:25.35	51
N2	18.29'N	24.13'W	8:47:30.34	61
N3	19.26'N	20.18'W	9: 2: 7.91	64
N4	20.11'N	16.80'W	9:16: 2.31	74
N5	21.11'N	12.62'W	9:30:59.39	81

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Shot	Lat.	Long.	Time (GMT)	Water Depth (M)
N6	55° 21.92'N	1° 8.99'W	9:46: 5.91	97
N7	22.84'N	5.48'W	10: 0:53.64	100
N8	23.85'N	1.72'W	10:16:17.21	100
N9	55° 24.92'N	0° 57.73'W	10:30:54.63	105
N10	26.02'N	53.60'W	10:45:57.28	105
N11	26.78'N	50.11'W	11: 0:54.93	100
N12	27.43'N	46.12'W	11:16:12.57	100
N13	28.01'N	42.22'W	11:31: 6.46	98
N14	28.97'N	38.60'W	11:45:56.40	93
N15	29.64'N	34.78'W	12:46:41.44	75
N16	30.48'N	30.96'W	13: 1:31.56	73
N17	31.29'N	27.00'W	13:17: 7.11	68
N18	32.11'N	22.96'W	13:32: 6.64	69
N19	33.03'N	19.25'W	13:46: 4.78	74
N20	33.98'N	15.33'W	14: 1: 8.57	76
N21	34.92'N	11.39'W	14:16: 9.63	84
N22	35.88'N	7.54'W	14:30:55.60	82
N23a	55° 36.81'N	0° 3.52'W	14:46: 3.17	82
N24	55° 37.71'N	0° 0.49'E	15: 1: 6.22	79
N25	38.69'N	4.66'E	15:16:25.28	72
N26	39.57'N	8.44'E	15:31: 4.21	72
N27	40.40'N	12.15'E	15:46: 6.03	74
N28	41.27'N	16.00'E	16: 1: 5.90	81
N29	42.06'N	19.71'E	16:16: 5.13	85
N23b	55° 36.90'N	0° 3.25'W	17:46: 7.56	85

NOTE - All shots exploded on the sea-floor.

Shot Sizes:- M25(b) & N23(b) 450 Kg

All others 150 Kg

Appendix 4

Seismic Reflection Survey

North Rockall Trough

to Inner Hebrides

SHACKLETON 6/82, DURHAM UNIVERSITY: NORTH ROCKALL TROUGH to the INNER HEBRIDES. 20.00/ Day 195 to 04.00/ Day 202 (14 to 21 July, 1982).

Seismic Reflection.

i) Survey Considerations.

The greatest possible cowrage was required during this surwey with no loss of data quality. R.R.S. Shackleton is fitted with two Reavell Compair VHP 36 compressors. When powering a Bolt PAR 1500 c air gun with a 160 cubic inch chamber, they can together maintain a six second firing rate at apressure of 2000 p.s.i. The maximum expected two-way seismic travel time for the 1000 to 2000 m water depths encountered in the major part of the survey is also six seconds. Therefore this firing rate is optimum. Survey speed is critical for both coverage and data quality. There is a trade-off between the two factors. Horizontal resolution depends on shot spacing and noise increases with speed. A survey speed of six knots was chosen. This gives a shot interval of around 26 m which is ample for the major part of the survey. The extra noise incured by towing the hydrophone at six knots rather than the usual five knots was found to be negligible and the larger speed gave 20 % extra coverage. When poor weather increased noise levels, the hydrophone was streamed further out. The increased length of the negatively buoyant towing cable caused the hydrophone streamer to sink below the noisy layer. It was not possible to do the same with the stand-by hydrophone as its tow cable was too short. Initially, the tow cable was weighted with lead to sink

the streamer, but this was found to be unnecessary due to the great length of tow cable available.

Survey lines were planned to be as long as possible as the gravimeter takes some time to stabilise after a turn. The pattern adopted resulted in few short base lines.

ii) Seismic Source.

Two Bolt PAR 1500 c air guns were carried. A single air gun was streamed leaving one as stand-by. It was only considered neccessary to change the guns over once during the seven days of the survey. This was a precautionary measure and not a result of a break-down.

Firing rate was generally once every six seconds. It was sometimes reduced to once every eight seconds when one of the compressors was shut down for routine maintainance. Shooting was stopped only once due to break-down when a lamprey was ingested into the compressor cooling water intake causing a valve to overheat. It was then that the air guns were swapped.

iii) Hydrophones.

Two hydrophones were carried on this cruise. The main streamer was the Géomechanique, 30 m I.G.S. array. During the early part of the survey, the pre-amplifier section was prone to flooding. This shorted out the pre-amplifier intermittently and caused a steady deterioration in data quality. When the deterioration was recognised, the stand-by streamer, an E.G. & G. 263 c array was substituted while

repeatedly

unsuccsessful attempts were made to repair the Géomechanique array. The substitute hydrophone had poorer noise cancelling qualities and therefore, data collected using this streamer is of a correspondingly poorer quality. The pre-amplifier section of the main array was eventually adequately sealed and the larger part of the survey was completed using the Géomechanique array.

iv) Signal Acquisition and Processing.

The following acquisition and processing equipment was available on board;

1 x E.P.C. two-channel crystal delay unit

1 x E.P.C. key/gate T.V.G. unit

1 x T.S.S. 303 stacking unit

1 x T.S.S. 305 swell filter

1 x T.S.S. 306 tape replay system

1 x T.S.S. 307 T.V.G. amplifier

2 x Krohn-Hite band-pass filters.

The E.P.C. crystal delay unit was used as a clock sending a signal once every second to the E.P.C. keying unit. The second channel of the crystal delay unit was used to control the keying pulse delay to the first E.P.C. recorder. The keying unit was used to trigger the air gun and the E.P.C. recoreders thus controlling the firing rate which could be adjusted by whole seconds. The unfiltered hydrophone signal was recorded on magnetic tape and was also passed through two band-pass filters. One signal was amplified using the T.S.S. 307 T.V.G. amplifier and was then played out on the

first E.P.C. recorder. Output from the second band-pass filter was played out directly on the second E.P.C. recorder. The freqüency response of the other T.S.S. units is such that they were largely unsuitable for use during collection of the relatively low-frequency air gun signals.

v) Signal Recording.

The raw hydrophone signal was recorded on magnetic tape using a Racal Store Four DS tape recorder. The tapes used with this machine were AGFA PE 49, 18 cm (7") diameter reels containing 2400' (730 m) of tape. With the possible exception of tape 6 which may accidentally have been recorded at a speed of 15/16" per second, all tapes were recorded at a speed of $1\frac{7}{8}$" per second. This gives a total recording time of approximately four and a half hours per tape. Twenty-three tapes were available and all were used. Data were recorded in analogue form and all four tracks were used synchronously. Channel one was used to record the keying pulse, tape flutter was recorded on channel two, the hydrophone signal on channel three and channel four was reserved for the M.S.F. Rugby time signal which was backed up by verbal time-keeping by the watch-keeper. Part of tape 14 and tapes 15 to 23 do not contain M.S.F. as it was switched off at 00.0 day 199 (Sunday 19 July) for its annual service.

vi) Tape Details.

Tape No;	Start;	End;	Line No;
1	04.00/196	08.00/196	82/A

Tape No;	Start;	End;	Line No(s);
2	11.40/196	16.07/196	82/B
3	16.11/196	20.40/196	B
4	20.44/196	01.04/197	C
5	01.30/197	06.00/197	D
6	06.00/197	13.00/197	D,E
7	13.18/197	17.30/197	F
8	17.30/197	21.50/197	F
9	21.50/197	04.30/198	F,G
10	04.30/198	08.50/198	H
11	08.50/198	13.10/198	H1,I
12	13.15/198	17.49/198	I,I1,J
13	17.50/198	22.10/198	J,K
14	22.10/198	02.30/199	K,L
15	02.30/199	06.50/199	L,M
16	06.50/199	11.22/199	M,N
17	11.22/199	15.53/199	N,O
18	15.53/199	20.10/199	O
19	20.10/199	00.35/200	O,P
20	00.35/200	04.55/200	P
21	04.55/200	09.20/200	P
22	09.24/200	13.50/200	P,Q
23	13.56/200	18.30/200	Q

viii) Survey Line Details.

North Rockall Trough Survey

Line no;	Starts;	Ends;
82/A	20.00/195	07.00/196
B	07.00/196	20.50/196
C	20.50/196	00.0 /197
D	00.0 /197	12.10/197
E	12.10/197	13.07/197
F	13.07/197	01.00/198
G	01.00/198	04.20/198
H	04.30/198	08.10/198
H1	08.10/198	12.10/198
I	12.10/198	13.55/198
I1	13.55/198	15.30/198
J	15.30/198	20.10/198
K	20.10/198	23.30/198
L	23.30/198	04.50/199
M	04.50/199	08.55/199
N	08.55/199	13.57/199
O	13.57/199	23.00/199

Igneous centre North-west of St Kilda

Line no;	Starts;	Ends;
82/P	23.00/199	08.40/200
Q	08.40/200	11.52/200
R	12.00/200	16.20/200
S	16.20/200	21.26/200

Hebridean Shelf Traverses

T	21.30/200	06.30/201
U	06.30/201	

SHACKLETON CRUISE 6/82; NORTH ROCKALL TROUGH TO INNER HEBRIDES.

Seismic Reflection Data Tapes.

Total No of Tapes: 23

Recording Speed, all tapes: 1 7/8" per second

Source: 160 cubic inch, Bolt PAR 1500c airgun.

Firing rate: Generally 6 seconds, it was sometimes neccessary to reduce this to 8 seconds when one compressor was off for servicing.

Channel One: Keying pulse.

Channel Two: ~~Hydrophonexxsignal~~. Flutter

Channel Three: ~~Flutter~~. Hydrophone signal.

Channel Four: Voice and M.S.F. Rugby signal

Appendix 5

Table of Julian Day Numbers

30 June	181	11 July	192
		12 "	193
1 July	182	13 "	194
2 "	183	14 "	195
3 "	184	15 "	196
4 "	185	16 "	197
5 "	186	17 "	198
6 "	187	18 "	199
7 "	188	19 "	200
8 "	189	20 "	201
9 "	190	21 "	202
10 "	191	22 "	203

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Appendix 6

Summary of Performance & Results Achieved

(i) Use of Ship Time:

		Hours
Scientific Time:-	Station Work	110.7
	Under Way	304.2
	TOTAL	374.9
Passage Time:-		135.8
Port Stop:-		3.7
Breakdown Delay:-		2.8
	TOTAL AVAILABLE	517.2

(ii) Distances Steamed:

Scientific:-	C.S.S.P.	874 n.m.
	Reflection Profiling	1020 n.m.
	TOTAL	1894 n.m.
On Passage:-		1355 n.m.
Total Distance Steamed:-		3249 n.m.

(iii) P.U.S.S. Deployments:-

	Irish Sea	North Sea
Successful	10	18
Unsuccessful	2	-
TOTAL	12	18

(iv) Explosive Shots:-

	Irish Sea	North Sea
150 Kg Shots	35	29
450 Kg Shots	1	1
Misfires	-	-
TOTAL	36	30

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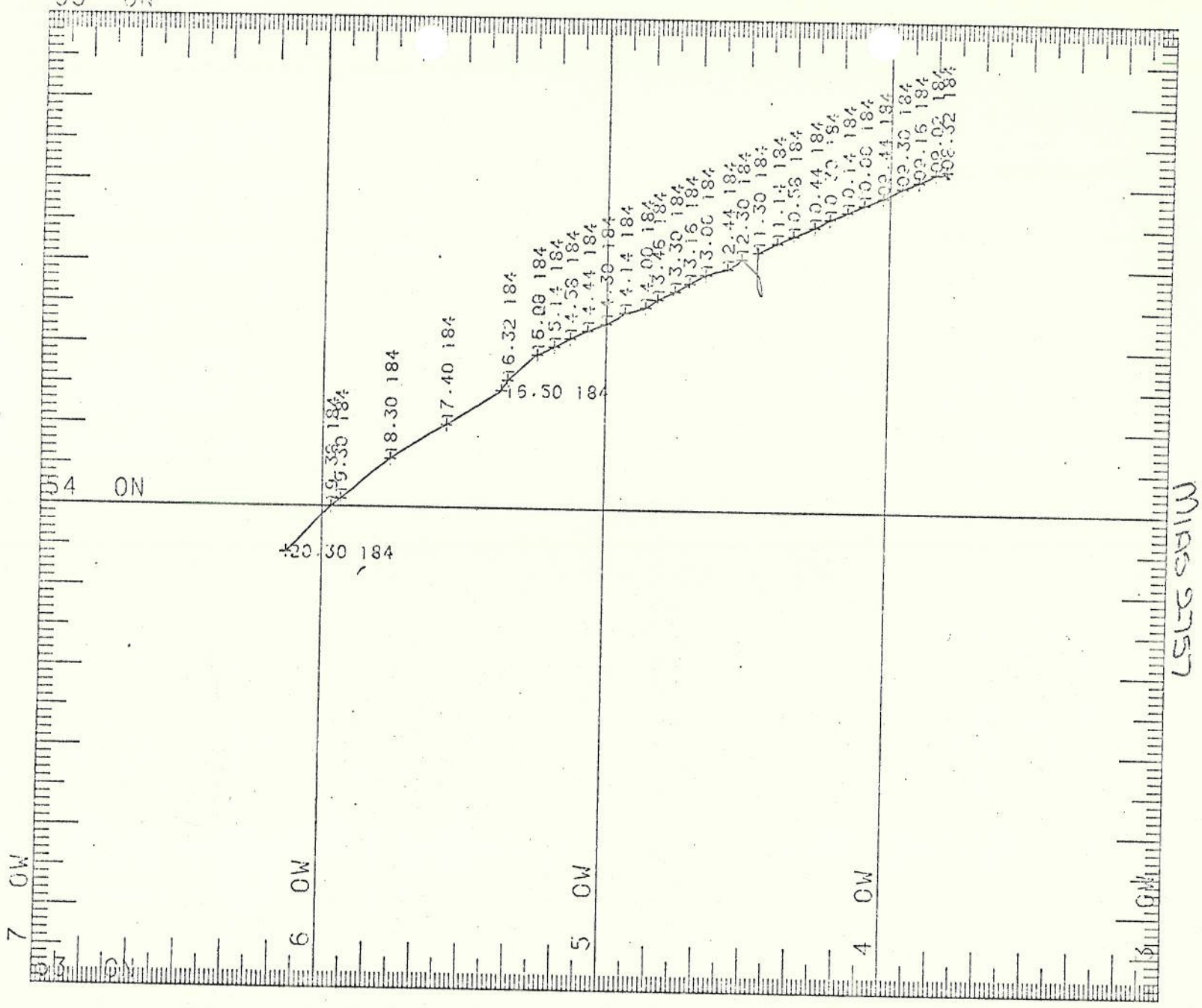


MERCATOR PROJECTION

SCALE 1 TO 1250000 (NATURAL SCALE AT LAT. 57.0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0.0N

Fig. 1 Track Chart, CSSP, Explosive Shots, Irish Sea

SHACKLETON CRUISE 6/82

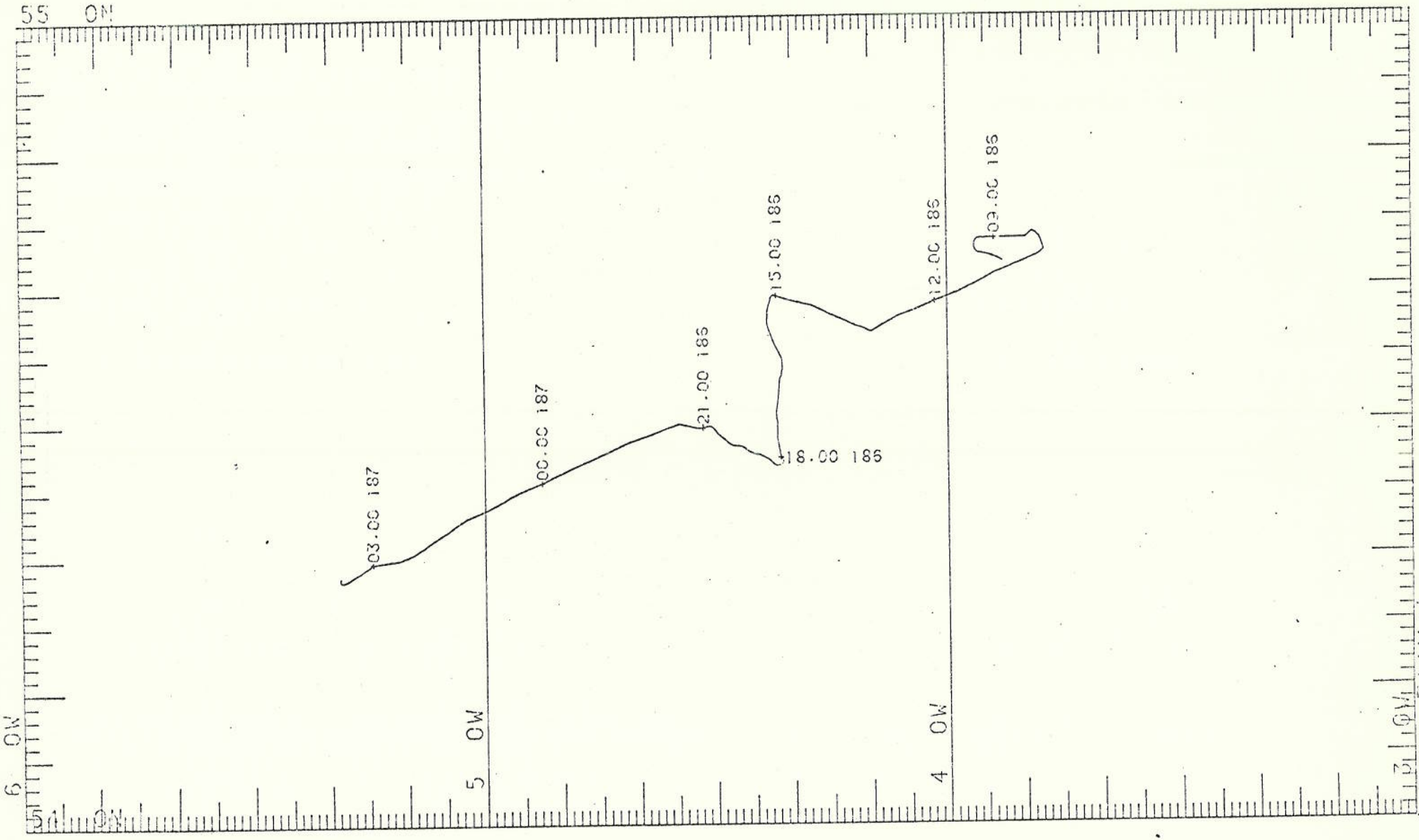


Fig. 2 Track Chart, CSSP,
Airgun Shots, Irish Sea

MERCATOR PROJECTION

SCALE : TO 750000. (NATURAL SCALE AT LAT. 55 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0.0N

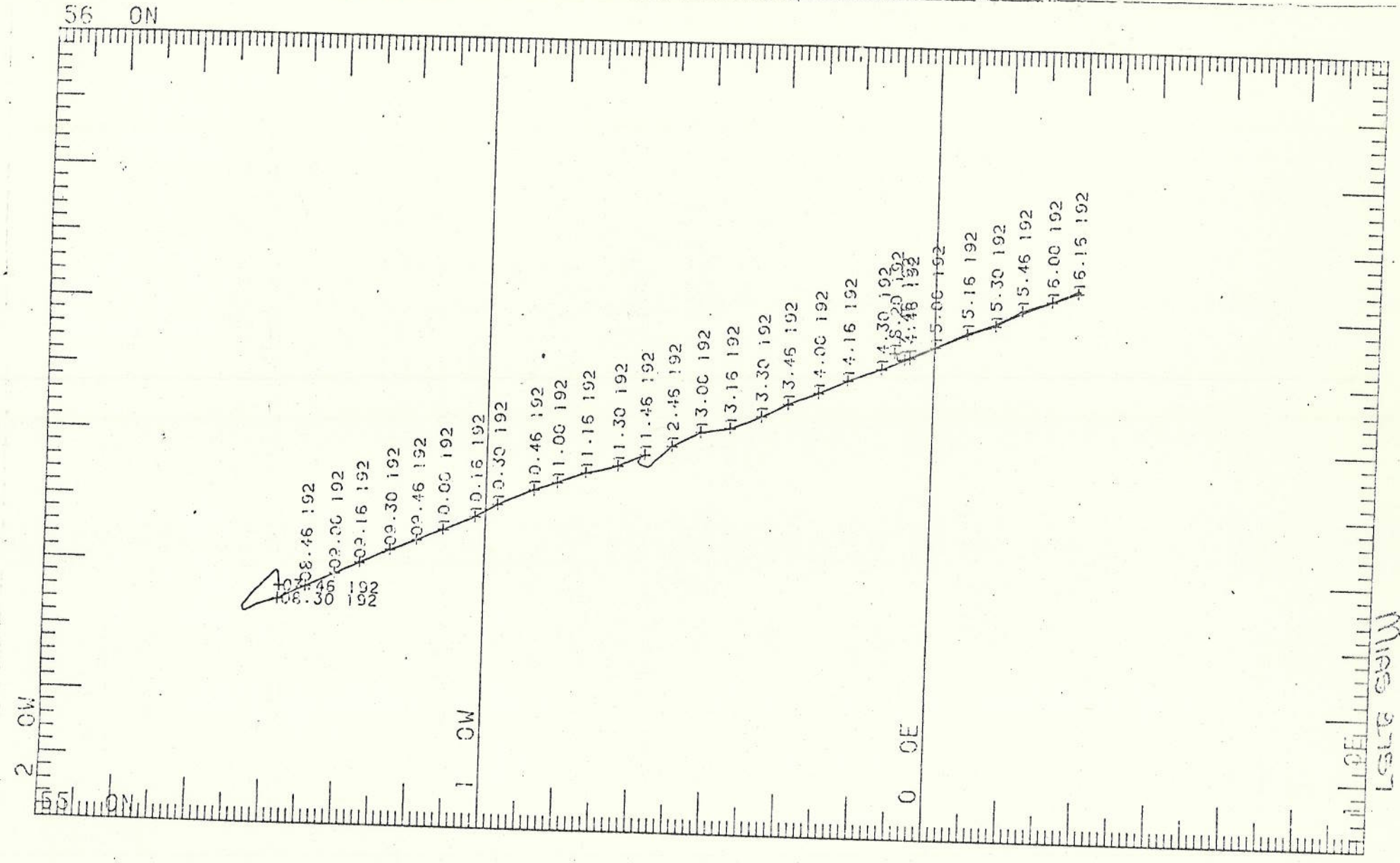


Fig. 3 Track Chart, CSSP, Explosive Shots, North Sea

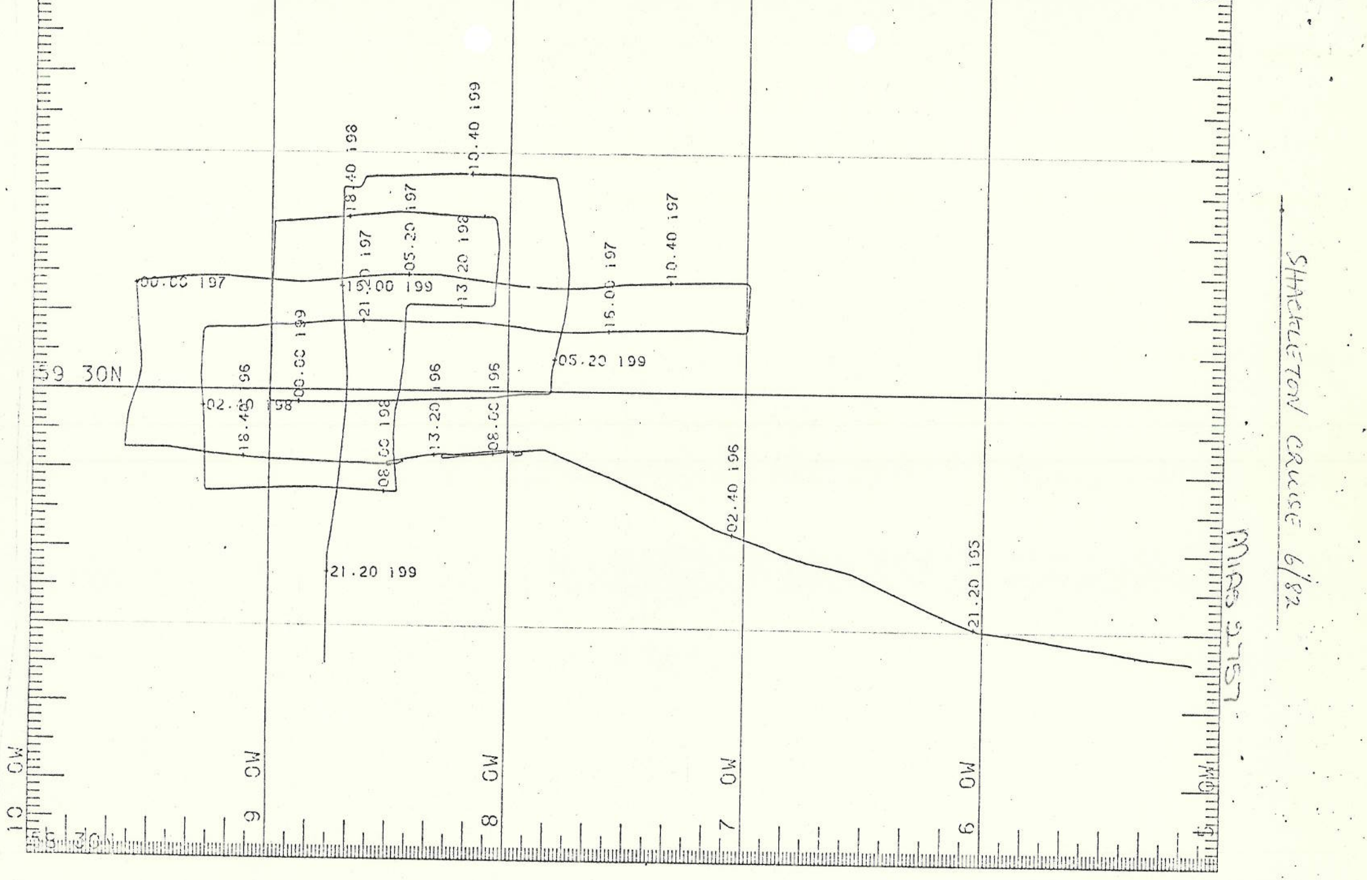
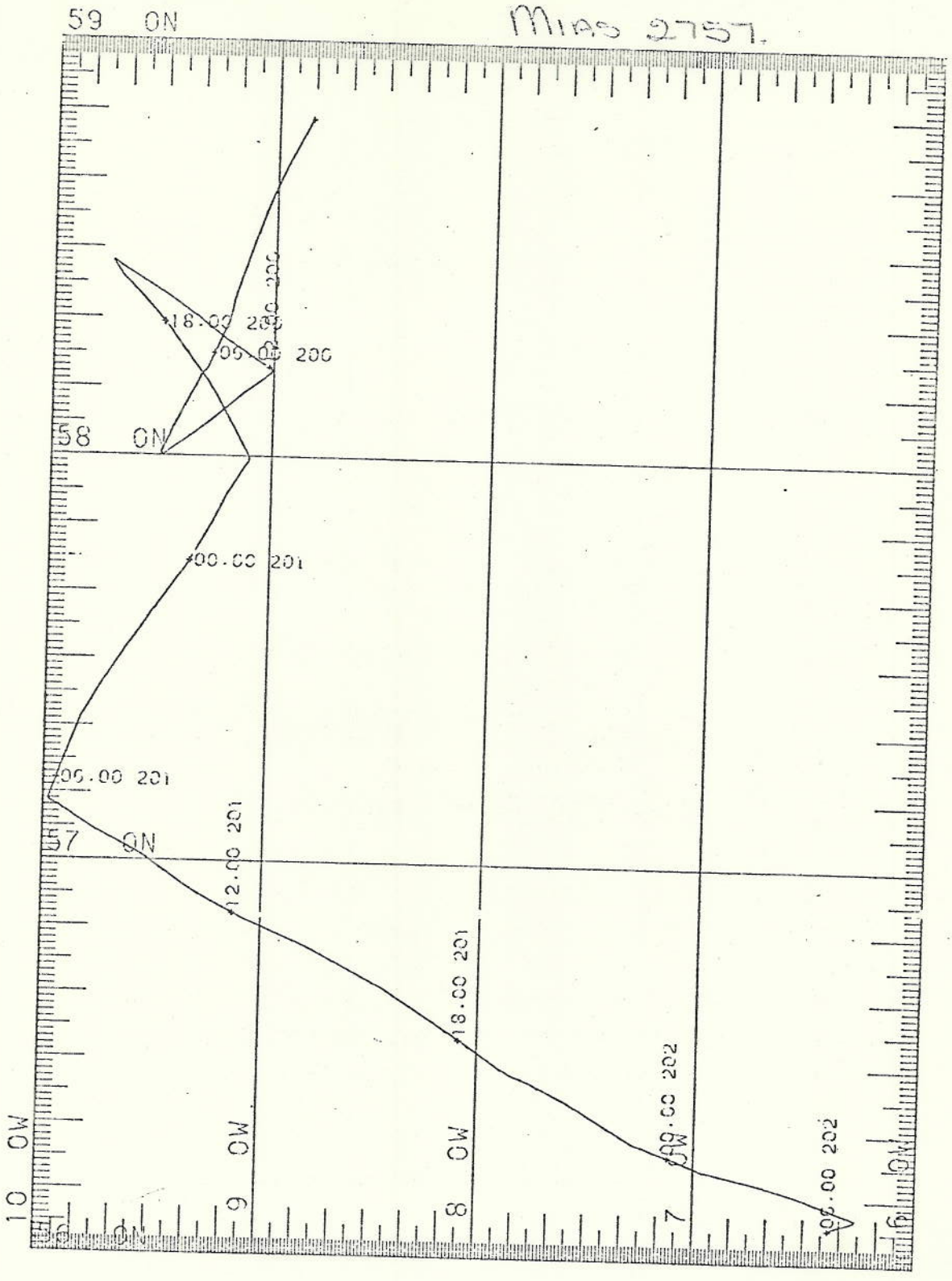


Fig. 4 Track Chart, Detailed Survey, North Rockall Trough (Grav/Mag/SRP)

SHACKLETON CRUISE 6/82.



MERCATOR PROJECTION

SCALE 1 TO 1750000. (NATURAL SCALE AT LAT. 57.0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0.0N

Fig. 5 Track Chart, Cont. Margin & Sea of Hebrides (Grav/Mag/SRP)