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RRS JOHN MURRAY CRUISE 9/80 : 27 AUGUST -
9 SEPTEMBER 1980
RRS CHALLENGER CRUISE 16/80 : 17-30 OCTOBER 1980

CELTIC SEA

CRUISE REPORT NO 114

1981

NATURAL ENVIRONMENT
INSTITUTE OF OCEANOGRAPHIC SCIENCES
RESEARCH COUNCIL

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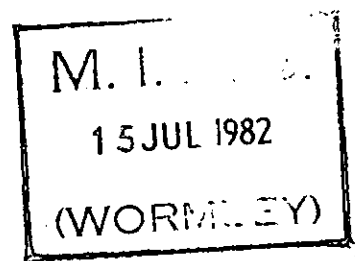
RRS CHALLENGER CRUISE 16/80: 17-30 OCTOBER 1980

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Institute of Oceanographic Sciences
Bidston Observatory
Birkenhead
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All times are quoted in GMT; all Decca positions are in order red, green, purple.

Abbreviations

CM	Current meter
PR	Pressure recorder
TC	Thermistor chain
CM/PR	Bottom mounted current meter and pressure recorder combined.
CTD	Conductivity, temperature and depth.
UCM-2	Acoustic current meter

DURATION

RRS JOHN MURRAY 9/80 - Deployment:

Leg 1	Sailed from Barry at 1700	27 August 1980
	Docked at Pembroke Dock at 0750	1 September 1980
Leg 2	Sailed from Pembroke Dock at 2000	1 September 1980
	Docked at Barry at 1745	9 September 1980

RRS CHALLENGER 16/80 - Recovery:

	Sailed from Liverpool at 1800	17 October 1980
	Docked at Barry at 2100	30 October 1980

SCIENTIFIC STAFF

Deployment leg	G. Ballard	
	A.D. Banaszek	
	D. Flatt	
	N.S. Heaps	(Principal Scientist)
	A.G. Kerr	
	D.L. Leighton	
	R.I.R. Palin	
	T. Ryan	(Observer)

Recovery leg	G. Ballard	
	A.D. Banaszek	
	D. Flatt	
	M.J. Howarth	(Principal Scientist)
	A.G. Kerr	
	D.L. Leighton	
	J. O'Dea	(Observer)
	R. Proctor	
	R. Smith	
	M. Taylor	
	J. Wolf	

SHIP'S OFFICERS

Deployment leg

RRS JOHN MURRAY

M.A. Harding	Master
J.J. Moran	First Officer
J.S. Jones	Second Officer
G. Harries	Third Officer
R.M. Morris	Purser
R.E. Crook	Chief Engineer
N.E. Wilson-Devoze	Second Engineer
D. Hornsby	Third Engineer

Recovery leg

RRS CHALLENGER

G. Selby-Smith	Master
G. Long	Chief Officer
S. Jackson	Second Officer
R. Hagley	Third Officer
C. Storrier	Chief Engineer
C. Harman	Second Engineer
C. Phillips	Third Engineer
R. Whitton	Fourth Engineer

SCIENTIFIC OBJECTIVES

To study sea level, vertical current structure and circulation patterns within the Celtic Sea whilst stratified. The experiment complemented an experiment in March-May 1978 which studied the Celtic Sea whilst homogeneous, I.O.S. Cruise Report 72.

To achieve this 19 rigs containing recording current meters, thermistor chains or pressure recorders were deployed for 50 days at 8 stations, Figure 1 and Table 1. The density field was measured during both the deployment and recovery legs by continuous monitoring of sea surface temperature and conductivity and by recording CTD profiles.

NARRATIVE

Deployment - leg 1 (Figure 2)

RRS John Murray left RVS Barry at 1700 GMT on Wednesday 27th August. The pump for the continuous sampling of surface water was installed an hour later and logging commenced at 1836.

The ship headed for Station A and arrived there at first light next morning. Between 0530 and 0930, CTD profile 1 was completed, rigs A1 (CM/PR, U-shaped mooring) and A2 (CM string, 2 meters, U-shaped mooring) were laid successfully, and acoustic tests were carried out. Weather and sea-state conditions were reasonably good, with a 15 kt wind from SW and a moderate swell.

A course was then set for Station C. Position was gained on that station at 15.18 after further acoustic tests en route. Rig C1 (CM string, 4 meters, U-shaped mooring) was laid between 1545 and 1617 after first taking CTD profile 2. The sea was becoming rougher with heavier swell.

Overnight, the ship proceeded from Station C to Station F with two stops for CTD profiles 3 and 4. On arrival at F, CTD profile 5 was taken (at 0547) and subsequently the surface current meter rig F3 was deployed in spite of heavy rain, a 22 kt wind, and an increasingly rough sea. Rig F2, the current meter string of 4 meters on a U-shaped mooring, was laid between 1110 and 1320 but the meteorological station on the selco buoy hit the stern of the ship when going over and was damaged. Rig F1 (CM/PR with camera, U-shaped mooring) was deployed successfully between

1552 and 1620 and a course was set for Station K.

After arrival at K at first light on Saturday the 30th, an attempt to lay rig K2 (CM string, 4 meters, pop-up mooring) failed due to a pyro on the acoustic release firing when being lowered into the water. However, a successful launch of the rig was achieved later, between 1155 and 1215. By this time the sea had become rougher with a heavy swell and conditions were judged to be unsuitable for the deployment of the U-shaped mooring K1 (CM/PR). The ship therefore set sail for Station M. CTD profiles 6, 7, 8 were taken at a position between F and K, at K, and on arrival at M.

A pop-up pressure recorder was laid at M between 1850 and 1855 on the Saturday evening. Then the ship proceeded from M to E overnight with one stop en route for CTD profile 9. At E, CTD profile 10 was obtained at 0625 on the Sunday morning. Then, with the sea state relatively calm, rig E (current meter string, 3 meters, with a pressure recorder, W-shaped mooring) was laid without any difficulty between 0750 and 0832. Subsequently, throughout Sunday, hourly CTD profiles (Nos.11-23) were taken as the ship cruised along a track running roughly parallel to the south coast of Ireland between 12 and 30 nautical miles offshore. The well-known temperature front was located at approximately $51^{\circ}51'N$, $6^{\circ}35'W$ as the ship passed through it at about 2200. At 2350 a course was set for Milford Haven. The water pump, tank, and CTD probe were taken inboard at 0515 on the Monday morning before entering the Haven. It was then found that the MS47 transducer on the side-scan sonar had been lost during the cruise.

The side-scan sonar had not been used apart from some tests with it in the Bristol Channel soon after leaving Barry. When first tested, the side-scan was intermittent in operation. This was traced to the transducer plug. One of the 3 wires was detached from its pin, due to a badly soldered joint, and all 3 joints were remade. The inside of the plug was corroded and stained with sea water (from previous use) and needed servicing. The jetty at Pembroke Dock was reached at 0751 and additional equipment was loaded and empty boxes, reels, etc. sent to RVS Barry.

Deployment - leg 2 (Figure 3)

After a day in port, RRS JOHN MURRAY sailed from Pembroke Dock at 2000 GMT on Monday evening, 1 September 1980. The weather was good. After leaving Milford Haven, the ship stopped for the installation of the surface-sampling water pump. However, during installation, the pump was lost overboard due to the failure of a polypropylene rope stop when lowering the pump into a shoe on the ship's side. Notwithstanding this event, a course was set for Station C.

After arrival at C, at first-light, CTD profile 24 was taken and acoustic tests were carried out. The buoy of rig C1, laid in leg 1, was sighted. Between 0656 and 0717, rig C2 (thermistor chain with Sea Data logger, pop-up mooring) was successfully deployed. The non-toxic water supply on the ship was connected to the CTD tank and the continuous sampling of surface water for temperature, conductivity and salinity - interrupted by the loss of the pump - was resumed.

Between 0800 and 1525 the ship proceeded from Station C to Station F, with a stop for some acoustic tests on the way. At F, rig F4 (thermistor chain, pop-up mooring) was laid between 1525 and 1600. Then, between 1600 and 1728, rig F1 (CM/PR with camera) laid earlier in leg 1 was recovered. The film in the camera was replaced and the flash interval changed. All this equipment was found to be in good condition. Between 1815 and 1852, rig F1 was successfully re-deployed. A close approach was then made to the meteorological buoy of rig F2, launched in leg 1, and inspection indicated that the damage incurred by the meteorological station during launch had remained the same with no further deterioration in its structure. The buoy and pellet of surface current-meter rig F3 were sighted. A CTD profile (No.25) was obtained at 1950 but the sample bottle and thermometers were broken in increasingly difficult sea-state conditions. The day had been fine throughout, with 10-15 kt winds, but the swell had become progressively heavier. After some tests on the acoustics of rig F1, a course was set for Station K at 2016.

In a rough sea, Station K was occupied at 1000 on Wednesday morning, 3rd September. A CTD profile (no sample bottle because of the rough conditions) was obtained at 1010, this being CTD 26 in order of succession. The sea became a little less rough during the morning and it was decided to go ahead with the deployment of rig K3 (thermistor chain, pop-up mooring). This was accomplished satisfactorily between 1130 and 1200. With the winds becoming lighter and the sea swell diminishing somewhat, the deployment of rig K1 (CM/PR, U-shaped mooring) was started at 1300 and completed successfully at 1320. Then the ship headed

for Station G, in fine weather and a calmer sea. CTD profiles 27, 28, 29 were taken on the way to G before reaching that station at 0100 on Thursday morning, 4 September. Soon after first light, acoustic tests were carried out and then rig G3 (thermistor chain, pop-up mooring) was laid between 0642 and 0702. Winds of 20 kts and a heavy cross-swell subsequently developed and prevented the deployment of rig G1 (CM/PR, U-shaped mooring) and then rig G2 (CM string, 5 meters, pop-up mooring). With the forecast of gales for the northern part of the Celtic Sea it was decided, at 1052, to head southwards towards Station L. Conditions were very rough throughout the remainder of the day and no CTD profiles could be obtained as the southward course was followed.

By early morning, Friday 5 September, the ship had reached a position to the south of Station L. The sea was extremely rough with poor prospects for either rig-laying at L, or CTD work for a day or so. In answer to a distress call, a course was then set to the north-east at 0800. Maintaining this course for most of the day, throughout which there were continuing rough seas, a temperature front was crossed at $49^{\circ}12'N$, $5^{\circ}10'W$ and the English Channel was entered. At 2020 the ship headed towards the Cornish coast reaching Falmouth Bay at 0300 on Saturday morning the 6th. In the sheltered calm waters of the Bay, the main winch was prepared for the rigs at Station L and acoustic tests were carried out between 0800 and 0945. Then, in good weather and a fairly subdued sea, RRS JOHN MURRAY set sail for Station L.

The temperature front across the entrance to the English Channel was again recorded (by the surface sampling as before) when the ship passed through it in the vicinity of $49^{\circ}47'N$,

5°30'W at about 1400. Arrival at L was at 0315 on Sunday morning, 7 September. Between 0710 and 1020 a pop-up pressure recorder, rig L2 (thermistor chain, pop-up mooring) and rig L1 (CM string, 4 meters, U-shaped mooring) were laid successfully in quite difficult conditions with a fairly heavy swell running. Rig L2 was deployed at the second attempt: the first effort at it had to be aborted after the pyros of the acoustic release had fired prematurely when the release was being lowered into the water. Then before heading for Station G, CTD profile 30 was taken.

The ship arrived at Station G at 2015 and, because of a threatening weather situation, it was decided to go ahead directly and attempt the deployment of rig G2 (CM string, 5 meters, pop-up mooring) and then rig G1 (CM/PR, U-shaped mooring) in the darkness. In fact both deployments were accomplished completely satisfactorily between 2025 and 2128, even though a fairly heavy swell was running. Then CTD profile 31 was taken, showing a deeper thermocline than had been observed anywhere else hitherto on the cruise.

Overnight, passage was made from Station G to Station F; the latter position was gained at 0735 on Monday morning, 8 September. A survey showed all four rigs at F to be in position and in good condition. The damaged arm of the meteorological station had broken off since it was sighted five days earlier. During the ensuing day, CTD profiles 32-36 were taken at two-hourly intervals en route from Station F to Station A. The buoys of rigs A1 and A2 were sighted and were noted to be in a satisfactory condition, but A1 appeared to be displaced about half a mile from its launch position. A final CTD profile was taken at Station A before heading into the Bristol Channel at 1820.

At first light on Tuesday 9 September, the ship made position $51^{\circ}23'$, $4^{\circ}58.5'$ ready for a further attempt to recover an offshore tide gauge deployed there a few months earlier. From 0830 to 1530, dragging and acoustical tracking were employed to try to release the gauge. The gauge responded to beacon command transmissions and its exact location was fixed. However, it did not respond to release command transmissions. The dragging was also unsuccessful in bringing the gauge to the surface. Recovery of the instrument was therefore abandoned and at 1545 the ship headed for Barry. It reached Research Vessel Base at 1745.

Recovery (Figure 4)

RRS Challenger left Liverpool at 18.00 GMT on 17 October, 1980, after 10 hours delay for repairs to the steering gear and auto-pilot and for obtaining two replacement crew. Since it was windy the pilot could not disembark and was taken to Milford Haven where further, Successful, repairs were made to the auto-pilot. Arrival at Milford Haven was at 18.30 on 18 October and departure was three hours later, when the surface monitoring pump was deployed. A course was set for Station A and 4 CTD profiles (37-40) were recorded on the way. At A the current meter rig was successfully recovered between 07.10 and 07.48 on 19 October but despite a two hour visual and acoustic search the current meter/pressure recorder rig could not be located. Station C was reached at 17.05 and the current meter rig successfully recovered by 17.55. The surface buoy for the thermistor chain rig was known to be in France (it had been recovered by a French trawler at 51° 18'N 6° 34'W on 3 October) and so the rig was dragged for with a Gifford grapnel. This operation was successful and the rig was recovered by 21.14 but the thermistor chain logger was absent. When the surface buoy was returned to Bidston the logger was found to be still attached to it.

On the way to Station F 3 CTD profiles (41-43) were recorded, and the station was reached at 07.10 on 20 October. The current meter/pressure recorder rig was successfully recovered by 07.58. The thermistor chain rig acoustics were switched on at 10.00 and since the surface buoy was not visible the rig was dragged for. It was caught on the first pass and successfully recovered by

12.50 - the surface buoy was broken and had been on the sea floor. A further four hours was spent searching visually, acoustically and by dragging for the remaining two rigs at F without results. The current meter/pressure recorder was then re-deployed by 18.13 with the camera set at a faster flash rate.

A course was set for Station L and 5 CTD profiles (44-48) were recorded on the way. Station L was reached at 15.00 on 21 October and the pop-up pressure recorder rig recovered by 17.40. Since it was too dark to attempt recovery of the other rigs at L, 3 CTD profiles (49-51) were recorded during the night on a line due south of Station L, returning to the station so that recovery could continue next day. The surface buoys of both the current meter and thermistor chain rigs were not visible but both were located acoustically. Dragging for the current meter rig began at 10.04 on 22 October and at 12.04 the ground line was snagged, the grapnel catching on a shackle. Two current meters were recovered both without fins and one with a bent spindle and no rotor. Two current meters and the sub-surface buoy were missing and the ground line had been cut. Dragging for the thermistor chain rig commenced at 13.02 and the rig was caught on the first pass at 13.17. During the recovery both pyros were triggered on separate occasions as the ship rolled and the acoustics hit the ship. However, all the equipment was recovered - the surface buoy was broken and had been on the sea floor.

A programme of CTD profiles on the way to Station G was planned but after 3 (52-54) had been recorded a problem occurred with the generator which powered the winch and no more profiles were taken. Station G was reached at 07.00 on 23 October and the

current meter/pressure recorder rig was found to be 1 mile to the west of its deployed position. It was successfully recovered between 09.38 and 10.24. The thermistor chain rig's acoustics were switched on but its surface buoy was not visible and so the rig was dragged for. The grapnel was deployed at 13.19 and the rig caught at 14.08. The anchors, the acoustics and back up buoyancy were recovered but the thermistor chain was lost. A further three hours was spent searching in vain for the current meter rig.

2 CTD profiles (55 and 56) were recorded on the way to Station K which was reached at 04.43 on 24 October. The surface buoy of the current meter/pressure recorder rig was recovered by 07.29 but the buoy wire broke - the end showed that several strands had previously been cut. The grapnel was deployed at 07.50 the rig caught at 11.11 and all equipment successfully recovered by 11.32. The pop-up current meter rig was released at 12.06 and all equipment was successfully recovered by 12.49 although two current meters were missing rotors and one had a bent spindle. It was known that the surface buoy for the thermistor chain rig was in France, having been recovered by a French trawler at 50°50'N 8°30'W on 20 September. The acoustics had earlier been located and so dragging began at 13.40 and carried on till 16.47 without success. Since it would soon be dark an attempt was made to recover the rig by firing the release and hoping the back-up buoyancy would bring the rig to the surface. The acoustics showed that the pyros had fired but also showed no movement of the rig and so the recovery attempt was abandoned.

5 CTD profiles (57-61) were recorded on the way to Station M which was located at 06.05 on 25 October, popped up and the pressure

recorder recovered by 07.43. A course was immediately set for Station E, which was located acoustically at 14.20. The surface buoy was not visible but the pellet floats marking the sub-surface buoy were. Dragging started at 14.35 and at 15.31 the current meter wire was cut by the trawl warp and the sub-surface buoy came to the surface. The buoy and all three current meters were recovered by 16.00; the meter wire had been cut immediately beneath the bottom meter. The grapnel was re-deployed and immediately the rest of the rig was caught and was on board by 17.27. The surface buoy had been lying on the sea floor and was just a hollow shell.

3 CTD profiles (62-64) were recorded on the way to station F. The current meter/pressure recorder rig there which had been re-deployed was located and recovered by 08.31 on 26 October. A box acoustic search for the two remaining rigs at station F commenced and at 15.42 the acoustics of the current meter rig were switched on. Dragging started at 16.34 at a site 5 miles north of the deployed position and at the same time the pellet floats marking the sub-surface buoy were spotted. Immediately the grapnel caught on an obstruction very close to the rig and the trawl warp parted as the grapnel was being pulled in. Dragging with a new grapnel started at 17.30 and the rig was caught at 17.56. The grapnel slipped off the rig but the sub-surface buoy had been cut adrift leaving the acoustics on the sea floor. The buoy was sighted once but was lost in the darkness. No further recovery work could be done that night so twelve CTD profiles were recorded at hourly intervals at the site. All daylight of 27 October was spent searching for the sub-surface buoy in poor visibility and in 20-30

knot winds. At nightfall the search was abandoned and a course set for Station G.

An acoustic box search for the pop-up current meter rig at Station G started at 08.26 on 28 October and ended at 17.27 having covered an area of 50 square miles. A course was now set for Station A with a detour to make CTD measurements on the top of and in between the banks in the middle of the Celtic Sea. During the night several CTD profiles were missed because of a fault on the generator powering the CTD winch which was repaired and so only 10 profiles were recorded (66-75).

An acoustic test rig was then deployed at 13.04 on 29 October. Acoustic ranging tests were carried out until 16.34 and the rig was recovered by 17.00. 8 CTD profiles were recorded during the night (76-83) and the front between stratified and well mixed water crossed close to A. At 06.00 on 30 October an acoustic box search was started at A in the presence of several trawlers. At 10.20 the search was terminated because a donkeyman needed medical attention and a course was set for Barry. The surface monitoring pump and PES fish were inboard by 10.45.

RRS Challenger docked at RVS Barry at 21.00, having steamed a total of 1657 miles.

COMMENTS ON THE SHIPS

The ship performance of RRS JOHN MURRAY was only just adequate for rig-laying in the rough seas which were encountered. A somewhat larger ship, providing a more stable launch platform, is really required for the kind of work undertaken. However, very considerable skills were shown in the laying procedures and this, with some good fortune with the weather (even though basically unsettled) enabled the full deployment programme to be completed.

RRS CHALLENGER is well suited to rig recovery work but her cruising speed is slow. There were several equipment failures including ones in the auto pilot and steering gear, which delayed the start of the cruise, and in the winch generators, which stopped several CTD profiles being taken.

ACKNOWLEDGEMENTS

We would like to thank the Masters, Officers and Crews of RRS JOHN MURRAY and RRS CHALLENGER for their co-operation and assistance during these cruises.

STATION REPORTS

STATION A1 - U shaped current meter/pressure recorder rig.

Current meter/pressure recorder : 1 (current meter 1747)

Buoy and acoustics : Toroid 2; W2

Deployment

Time : 06.15-06.40 28 August 1980

Position : 51° 00.1'N 5°30.5 W

Decca chain 1B : - , J31.59, F78.13

Water depth : 80m

CTD profile : 1, 36

Recovery : Rig not located despite searches on 19 and 30 October 1980.

Comments : The surface buoy was fitted with a Lensref radar reflector. The buoy was recovered in St. Brides Bay on 1 December 1980.

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STATION A2 - U shaped current meter rig.

Current meters : 4968, 1139 at 55, 30m above
sea floor.

Buoys and acoustics : Selco 13, 32" sphere 4A; S01

Deployment

Time : 07.35-08.18 28 August 1980

Position : 51° 0.4'N 5° 31.7'W

Decca chain 1B : -, J33.01, F78.82

Water depth : 80m

CTD profile : 1, 36

Recovery

Time : 07.10-07.48 19 October 1980

Decca position : -, J32.92, F78.97

Water depth : 82m

CTD profile : 40

Comments : -

STATION C1 - U shaped current meter rig.

Current meters : UCM-2(1), 3277, 4967, 570 at 65,
64, 50, 25m above sea floor

Buoys and acoustics : Toroid 10, 32" sphere 8; SO2

Deployment

Time : 15.45-16.17 28 August 1980

Position : 51° 19.7'N 6° 30.4'W

Decca chain 1B : -, B 41.34, G 71.23

Water depth : 99m

CTD profile : 2, 24

Recovery

Time : 17.15-17.52 19 October 1980

Decca position : -, B 41.64, G 70.68

Water depth : 80m

CTD profile : 41

Comments : -

STATION C2 - Single point thermistor chain rig.

Thermistor chain : Sea Data logger, chain 476 at
80-30m above sea floor.

Buoys and acoustics : Selco 14; 235C

Deployment

Time : 06.56 - 07.17 2 September 1980

Position : 51° 19.8'N 6° 29.9'W

Decca chain 1B : -, B 40.82, G 71.55

Water depth : 107m

CTD profile : 24

Recovery

Time : 18.28-21.14 19 October 1980

Decca position : -, B 40.80, G 71.55

Water depth : 120m

CTD profile : 41

Comments : The rig configuration is shown
in Figure 5. Since the surface
buoy and Sea Data Logger had been
recovered by a French trawler on
3 October 1980 at 51° 18'N
6° 34'W (and were later returned
to Bidston) the rest of the rig
was recovered by dragging, aided
by the acoustics. The thermistor
chain was badly damaged.

STATION E - U shaped current meter and pressure recorder rig.

Current meters : 2575, 3560, 3559 at 70, 55, 30m above sea floor.

Pressure recorder : 284

Buoys and acoustics : Selco 15, 32" sphere 5; W3

Deployment

Time : 07.50-08.32 31 August 1980

Position : 51° 21.4'N 8° 30.8'W

Decca chain 7D : J16.10, -, E52.22

Water depth : 92m

CTD profile : 10

Recovery

Time : 14.35-17.27 25 October 1980

Decca position : J 15.97, -, E52.15

Water depth : 95m

CTD profile : 62

Comments : The pressure recorder and acoustics were deployed in a frame in the middle of the ground-line. The rig was recovered by dragging - the surface buoy had sunk and only its shell was recovered. During the recovery the meter wire was cut by the trawl warp freeing the current meters which were recovered. The pressure recorder was then recovered by further dragging.

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STATION F1 - U shaped current meter/pressure recorder rig.

Current meter/pressure recorder : 5 (current meter 1750)

Buoy and acoustics : Toroid 3; W5

Deployment

Time : 15.52-16.20 29 August 1980

Position : 50° 31.7'N 7° 36.7'W

Decca chain 1B : -, F43.47, E61.60

Water depth : 105m

CTD profile : 5, 25

Recovery

Time : 07.25-08.31 26 October 1980

Decca position : -, F43.46, E61.41

Water depth : 106m

CTD profile : 44, 64, 65

Comments : The bottom frame was fitted with a camera. The rig was recovered and re-deployed twice during the experiment, 16.00-18.52 2 September and 07.28-18.13 20 October.

STATION F2 - U shaped meteorological buoy and current meter rig.

Current meters : 3562, 4389, 3890, 1867 at 90, 80, 65, 35m above the sea floor.

Buoys and acoustics : Selco 6, Slingsby 2A; SO4

Deployment

Time : 11.10-13.20 29 August 1980

Position : 50° 31.0 N 7° 34.0'W

Decca chain 1B : -, F43.63, E59.79

Water depth : 100m

CTD profile : 5, 25

Recovery : Rig not recovered.

Comments : The surface buoy was fitted with meteorological sensors and a logger. Some of these sensors were damaged during the deployment. The rig was searched for on 20 and 26 October, visually and by acoustics and dragging. It was located without the surface buoy on 26 October, 5 miles off station, by its acoustics. During dragging one grapnel was lost and a second cut the sub-surface buoy adrift. The buoy was lost in the darkness. A visual search on 27 October failed to locate the buoy.

STATION F3 - Surface current meter rig

Current meters : UCM-2(2), 2576 at 6 and 7m below
sea surface

Buoys and acoustics : Selco 2, 32" sphere 3A; SO3

Deployment

Time : 06.10-06.35 29 August 1980

Position : 50° 31.1' 7° 32.4'

Decca chain 1B : -, F 42.85, E 60.17

Water depth : 103m

CTD profile : 5, 25

Recovery : The rig was not located despite
searches on 20, 26 and 27 October.

Comments : A diagram of the rig is shown in
Figure 6.

STATION F4 - Single point thermistor chain rig

Thermistor chain : Logger 527, chain 688
 Bury and acoustics : Selco 9; 2320
 Deployment
 Time : 15.25 - 15.58 2 September 1980
 Position : 50° 31.0'N 7° 33.0'W
 Decca chain 1B : -, F 43.22, E 60.61
 Water depth : 104 m
 CTD profile : 25

Recovery

 Time : 12.12 - 12.50 20 October 1980
 Decca position : -, F43.20, E60.68
 Water depth : 106 m
 CTD profile : 44, 64, 65

Comments : A diagram of the rig is shown in
 Figure 5.

The rig was recovered by dragging
 aided by its acoustics although the
 thermistor chain was slightly
 damaged during recovery. The
 surface buoy had sunk and was
 recovered in two hollow pieces.

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STATION G1 - U shaped current meter/pressure recorder rig.

Current meter/pressure recorder ; 3 (current meter 302)

Buoy and acoustics : Toroid 9; W6

Deployment

Time : 21.15 - 21.28 7 September
1980

Position : 49° 39.6'N 8° 31.7'W

Decca chain 7D : B 7.96, -, E 68.75

Water depth : 135 m

CTD profile : 31

Recovery

Time : 09.38 - 10.24 23 October
1980

Decca position : B8.66, -, E68.7

Water depth : 138 m

CTD profile : 55

Comments : The recovery position was 1
mile to the west of the
deployed position.

STATION G2 - Pop-up current meter rig

Current meters : 3982, 2573, 4965, 1002, 2970 at
120, 110, 95, 80, 45 m above the
sea floor

Buoy and acoustics : 40" sphere 6A; 223

Deployment

Time : 20.25 - 20.49 7 September 1980

Position : 49° 42.8'N 8° 32.5'W

Decca chain 7D : B 8.06, -, E68.36

Water depth : 137 m

CTD profile : 31

Recovery : The rig was not located despite
searches on 23 and 28 October.

Comments : -

STATION G3 - Single point thermistor chain rig

Thermistor chain : Logger 526, chain 681 at 135-60 m
above sea floor

Buoy and acoustics : Selco 10; 229C

Deployment

Time : 06.42 - 07.02 4 September 1980

Position : 49° 39.6'N 8° 30.8'W

Decca chain 7D : B7.90, -, E69.35

Water depth : 137 m

CTD profile : 31

Recovery

Time : 13.00 - 14.52 23 October 1980

Decca position : B7.90, -, E69.27

Water depth : 143 m

CTD profile : 55

Comments : The rig configuration is shown in
Figure 5. The rig was located by
its acoustics and partially
recovered by dragging - the
thermistor chain and surface buoy
were missing. The surface buoy
was later recovered by a French
trawler and returned to IOS
Bidston.

STATION K1 - U shaped current meter/pressure recorder rig.

Current meter/pressure recorder : 4 (current meter 1506)

Buoy and acoustics : Selco 11; W4

Deployment

Time : 12.55 - 13.20 3 September 1980

Position : 50° 30.4'N 9° 49.1'W

Decca chain 7D : C 16.80, -, C63.80

Water depth : 118 m

CTD profile : 26

Recovery

Time : 07.29 - 11.32 24 October 1980

Decca position : C16.80, -, C63.75

Water depth : 130 m

CTD profile : 57

Comments

: The buoy wire parted during recovery and so the rig was recovered by dragging.

164

30

STATION K2 - Pop-up current meter rig

Current meters : 4387, 2971, 1865, 4388 at 100,
90, 75, 40m above sea floor

Buoy and acoustics : 40" sphere 6A; 221C

Deployment

Time : 09.41 - 12.15 30 August 1980

Position : 50° 30.1'N 9° 48.4'W

Decca chain 7D : C16.80, -, C64.60

Water depth : 126 m

CTD profile : 7, 26

Recovery

Time : 12.06 - 12.49 24 October 1980

Decca position : C16.4, -, C64.7

Water depth : 130 m

CTD profile : 57

Comments : The pyro releases fired
prematurely during the launch.
The rig was recovered and
successfully deployed.

STATION K3 - Single point thermistor chain rig

Thermistor chain : Logger 526, chain 681, 115-65m
above sea floor

Buoy and acoustics : Selco 7; 2169

Deployment

Time : 11.49 - 11.58 3 September 1980

Position : $50^{\circ} 30.2'$ $9^{\circ} 48.4'$

Decca chain 7D : C 16.48, -, C64.50

Water depth : 113 m

CTD profile : 26

Recovery : The rig's acoustics were located on 24 October 1980 but the surface buoy was missing. The rig was not recovered either by dragging or by firing the release. The surface buoy had been recovered by a French trawler on 20 September at $50^{\circ}50'N$ $8^{\circ}30'W$ and was returned to IOS Bidston

Comments : A diagram of the rig is shown in Figure 5.

1986

STATION L1 - U shaped current meter rig

Current meters : 567, 4966, 3951, 1746 at 90, 80,
65, 35 m above sea floor

Buoys and acoustics : Toroid 1, 40" sphere 1A; S05

Deployment

Time : 09.40 - 10.21 7 September 1980

Position : 48° 47.3'N 7° 3.1'W

Decca chain 1B : D21.93, F33.85, -

Water depth : 127 m

CTD profile : 30

Recovery

Time : 10.04 - 12.24 22 October 1980

Decca position : D22.2, F33.76, -

CTD profile : 52

Comments

: The rig was recovered by dragging.
Both the ground line and meter
wire had been cut and only the
bottom two meters were
recovered, both without fins.
The surface buoy was later
recovered by a French trawler
and returned to IOS Bidston.

STATION L2 - Single point thermistor chain rig

Thermistor chain : Logger 561, chain 692 at 105-55 m
above sea floor

Buoy and acoustics : Selco 8; 237

Deployment

Time : 07.50 - 09.05 7 September 1980

Position : 48° 47.4'N 7° 3.4'W

Decca chain 1B : D21.92, F33.85, -

Water depth : 123 m

CTD profile : 30

Recovery

Time : 13.02 - 13.48 22 October 1980

Decca position : D21.44, F34.12, -

Water depth : 137 m

CTD profile : 52

Comments : A diagram of the rig is shown in Figure 5. During deployment both pyros fired prematurely. The rig was recovered and successfully deployed. The rig was recovered by dragging; the surface buoy had sunk and was recovered in bits. Both pyros were triggered on separate occasions by hitting the stern of the ship. The thermistor chain was damaged.

STATION L3 - Pop-up Teleost pressure recorder

Pressure recorder : 281, WLR 500
Acoustics : 2167
Deployment
Time : 07.30 - 07.40 7 September 1980
Position : 48° 47.7'N 7° 1.4'W
Decca chain 1B : D22.14, F33.13, -
Water depth : 127 m
CTD profile : 30
Recovery
Time : 15.52 - 17.40 21 October 1980
Decca position : D22.5, F33.0, -
CTD profile : 52
Comments : -

STATION M - Pop-up Teleost pressure recorder

Pressure recorder : 287

Acoustics : 2168

Deployment

Time : 18.50 - 18.55 30 August 1980

Position : 51° 8.4'N 9° 47.8'W

Decca chain 7D : C15.20, -, B 62.90

Water depth : 118 m

CTD profile : 8

Recovery

Time : 07.00 - 07.43 25 October 1980

Decca position : C15.28, -, B62.90

Water depth : 123 m

CTD profile : 61

Comments : -

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- Table 2. CTD profile positions
- Table 3. List of equipment deployed
- Table 4. List of equipment lost

Table 1

Summary of station positions and equipment deployed

Station	Position		Water depth below chart datum (m)	Equipment deployed	Meter height above sea floor (m)
	Latitude (N)	Longitude (W)			
A 1 2	51° 00'	5° 31'	83	CM/PR 2CM	- 55, 30
C 1 2	51° 20'	6° 30'	100	4CM TC	65, 64, 50, 25 80 - 30
E	51° 21'	8° 31'	93	3CM, PR	70, 55, 30
F 1 2 3 4	50° 31'	7° 33'	105	CM/PR 4CM 2CM TC	- 90, 80, 65, 35 99, 98 105 - 55
G 1 2 3	49° 41'	8° 32'	140	CM/PR 5CM TC	- 120, 110, 95, 80, 45 135 - 60
K 1 2 3	50° 30'	9° 49'	130	CM/PR 4CM TC	- 100, 90, 75, 40 115 - 65
L 1 2 3	48° 47'	7° 03'	130	4CM TC PR	90, 80, 65, 35 105 - 55 -
M	51° 08'	9° 48'	120	PR	-

TABLE 2. LIST OF CTD PROFILES.

PROFILE NUMBER	DATE	TIME STARTED	POSITION		RIG
			LATITUDE	LONGITUDE	
1	28/ 8/80	8.25	N 51 0.1	W 5 30.0	A
2	28/ 8/80	15.20	N 51 19.9	W 6 30.2	C
3	28/ 8/80	19. 6	N 51 4.1	W 6 47.2	
4	28/ 8/80	22. 5	N 50 53.9	W 7 1.0	
5	29/ 8/80	5.30	N 50 31.3	W 7 32.1	F
6	29/ 8/80	21. 0	N 50 30.0	W 8 18.1	
7	30/ 8/80	7.24	N 50 29.1	W 9 49.7	K
8	30/ 8/80	17.40	N 51 8.1	W 9 48.1	M
9	30/ 8/80	21.30	N 51 13.3	W 9 14.3	
10	31/ 8/80	6.25	N 51 21.3	W 8 31.3	E
11	31/ 8/80	9.42	N 51 20.3	W 8 19.1	
12	31/ 8/80	11. 0	N 51 20.4	W 8 5.8	
13	31/ 8/80	12.10	N 51 20.6	W 7 52.6	
14	31/ 8/80	13.11	N 51 20.1	W 7 40.0	
15	31/ 8/80	14.20	N 51 24.0	W 7 35.0	
16	31/ 8/80	15.31	N 51 33.0	W 7 35.1	
17	31/ 8/80	16.45	N 51 42.2	W 7 35.5	
18	31/ 8/80	18. 3	N 51 44.9	W 7 21.1	
19	31/ 8/80	19.10	N 51 48.6	W 7 9.4	
20	31/ 8/80	20.20	N 51 49.4	W 6 55.3	
21	31/ 8/80	21.30	N 51 51.0	W 6 40.2	
22	31/ 8/80	22.40	N 51 54.2	W 6 25.8	
23	31/ 8/80	23.50	N 51 58.4	W 6 11.2	
24	2/ 9/80	5.16	N 51 20.0	W 6 31.2	C
25	2/ 8/80	19.52	N 50 31.6	W 7 37.0	F
26	3/ 9/80	10. 5	N 50 30.3	W 9 48.8	K
27	3/ 9/80	15.30	N 50 18.2	W 9 28.2	
28	3/ 9/80	17.25	N 50 7.2	W 9 10.4	
29	3/ 9/80	19.45	N 49 57.7	W 8 53.2	
30	7/ 9/80	10.30	N 48 47.6	W 7 3.5	L
31	7/ 9/80	21.45	N 49 41.9	W 8 32.4	G
32	8/ 9/80	9. 0	N 50 36.2	W 7 7.3	
33	8/ 9/80	11.15	N 50 42.1	W 6 43.2	
34	8/ 8/80	13.30	N 50 48.1	W 6 17.9	
35	8/ 9/80	15.45	N 50 55.6	W 5 50.0	
36	8/ 9/80	17.30	N 51 0.	W 5 28.3	A
37	19/10/80	0.10	N 51 29.9	W 5 14.6	
38	19/10/80	2. 6	N 51 20.0	W 5 19.9	
39	19/10/80	4. 0	N 51 10.2	W 5 26.1	
40	19/10/80	5.42	N 51 0.7	W 5 30.5	A
41	19/10/80	21.40	N 51 19.7	W 6 30.6	C
42	20/10/80	0.30	N 51 5.8	W 6 48.6	
43	20/10/80	3.35	N 50 50.4	W 7 9.3	
44	20/10/80	18.40	N 50 27.1	W 7 31.2	F
45	20/10/80	22. 2	N 50 10.9	W 7 28.5	
46	21/10/80	2.10	N 49 50.6	W 7 23.7	
47	21/10/80	6.27	N 49 29.5	W 7 18.0	
48	21/10/80	10.43	N 49 11.1	W 7 7.8	
49	21/10/80	20.49	N 48 37.4	W 7 15.0	
50	22/10/80	1.27	N 48 21.5	W 6 56.3	
51	22/10/80	3.33	N 48 30.5	W 6 55.9	

PROFILE NUMBER	DATE	TIME STARTED	POSITION		RIG
			LATITUDE	LONGITUDE	
52	22/10/80	13.50	N 48 48.6	W 7 2.7	L
53	22/10/80	18.24	N 48 49.6	W 7 27.5	
54	22/10/80	21.16	N 48 59.9	W 7 40.3	
55	23/10/80	18.5	N 49 37.0	W 8 30.0	G
56	23/10/80	22.46	N 50 6.7	W 9 11.3	
57	24/10/80	17.57	N 50 30.1	W 9 47.5	K
58	24/10/80	20.50	N 50 38.8	W 10 7.0	
59	24/10/80	23.10	N 50 48.9	W 10 21.8	
60	25/10/80	2.0	N 50 0.7	W 10 1.4	
61	25/10/80	6.35	N 51 8.1	W 9 48.2	M
62	25/10/80	17.53	N 51 19.4	W 8 31.1	E
63	25/10/80	23.17	N 50 54.8	W 8 2.1	
64	26/10/80	6.0	N 50 27.9	W 7 26.6	F
1065	26/10/80	20.0	N 50 35.2	W 7 34.0	
2065	26/10/80	21.0	N 50 34.7	W 7 35.4	
3065	26/10/80	22.0	N 50 33.8	W 7 37.1	
4065	26/10/80	23.0	N 50 33.0	W 7 39.9	
5065	27/10/80	0.0	N 50 32.6	W 7 43.9	
6065	27/10/80	1.0	N 50 31.1	W 7 43.0	
7065	27/10/80	2.0	N 50 30.9	W 7 44.7	
8065	27/10/80	3.0	N 50 29.3	W 7 44.5	
9065	27/10/80	4.0	N 50 28.6	W 7 43.0	
1165	27/10/80	5.0	N 50 28.2	W 7 44.4	
2165	27/10/80	6.0	N 50 27.1	W 7 42.6	
3165	27/10/80	7.0	N 50 26.6	W 7 42.3	
66	28/10/80	17.30	N 49 32.3	W 8 23.2	
67	28/10/80	19.25	N 49 42.2	W 8 40.3	
68	28/10/80	21.0	N 49 30.9	W 8 45.3	
69	28/10/80	22.23	N 49 40.1	W 8 57.3	
70	29/10/80	6.30	N 50 20.2	W 8 28.4	
71	29/10/80	7.40	N 50 26.2	W 8 20.9	
72	29/10/80	8.35	N 50 30.4	W 8 14.3	
73	29/10/80	9.38	N 50 35.2	W 8 5.6	
74	29/10/80	10.48	N 50 39.3	W 7 58.3	
75	29/10/80	12.32	N 50 40.7	W 7 42.3	
76	29/10/80	18.22	N 50 42.8	W 7 28.9	
77	29/10/80	19.47	N 50 44.9	W 7 12.4	
78	29/10/80	21.28	N 50 47.9	W 6 56.0	
79	29/10/80	22.50	N 50 48.0	W 6 41.1	
80	30/10/80	0.20	N 50 50.7	W 6 26.1	
81	30/10/80	1.55	N 50 54.0	W 6 11.2	
82	30/10/80	3.55	N 50 55.8	W 5 54.2	
83	30/10/80	5.34	N 50 58.7	W 5 38.5	

TABLE 3 List of equipment deployed

1. Current meters

Aanderaa RCM4, Bergen, Norway. 567, 570, 1002, 1139, 1746,
1865, 1867, 2573, 2575, 2576,
2970, 2971, 3277, 3559, 3560,
3562, 3890, 3951, 3982, 4387,
4388, 4389, 4965, 4966, 4967,
4988.

Acoustic current meter UCM-2 1, 2

Christian-Michelsen Institute,
Bergen, Norway. On loan from
RVS, Barry.

2. Thermistor chains

Loggers

Aanderaa TR 1, Bergen, Norway. 463, 526, 527, 561

Type 610, Sea Data Corporation
Mass. U.S.A.

Chains

Aanderaa, Bergen, Norway: 50m 476, 681, 688, 692

75m 573

3. Bottom mounted CM/PR

Moored CM/PR system consisting
of an Aanderaa RCM4 current
meter, direction

1, 3, 4, 5

vane and Digiquartz pressure
sensor (Model 2400A by Paro-
scientific, Washington, U.S.A.)
assembled in a frame at IOS,
Bidston.

4. Pressure recorders

(a) Teleost pop-up recorders
consisting of a data logger and
pressure and temperature sensors
made by IOS, Bidston.

1) Strain gauge pressure trans-
ducer by Bell & Howell,

Baringstoke, U.K.

282, 284

2) Digiquartz pressure trans-
ducer

287

(b) Aanderaa WLR 500 with Digi-
quartz pressure transducer.

5. Acoustic pingers

IOS, Bidston/Wormley

S01, S02, S03, S04, S05,

W2, W3, W4, W5, W6

221C, 223, 229C, 235C,
237, 2167, 2168, 2169,
2320.

6. Surface buoys

(a) Selco type 6, Norcem Plast

Drammen, Norway.

2, 6, 7, 8, 9, 10, 11, 13,
14, 15.

(b) 1.8m diameter toroid,

1, 2, 3, 9, 10.

Cosalt Ltd., Lowestoft, Sussex.

7. Sub-surface buoys

(a) Hollow steel sphere to IOS
design

32" diameter

3A, 4A, 5, 8

Table 4 List of equipment lostA. Not recovered

Current meters - Aanderaa	:	Station F 1867, 2576, 3562, 3890, 4389.
		Station G 1002, 2573, 2970, 3982, 4965.
		Station L 567, 4966
Acoustic	:	Station F UCM-2 (2)
Thermistor chains	:	Station G Logger 463 Chain 573
		Station K Logger 526 Chain 681
Current meter/pressure recorder	:	Station A 1
Meteorological recorder	:	Station F
Surface buoys	:	Station F Selco 2, 6
Sub-surface buoys	:	Station F 32" spheres 2A, 3A
		Station G 40" sphere 5A
		Station L 40" sphere 1A
Acoustics	:	Station A W2
		Station F S03, S04
		Station G 223
		Station K 2169
Corning glass spheres	:	2 at station G
		2 at station K
Surface monitoring pump		

B. Damaged

Thermistor chains	:	Station C 476
		Station F 688
		Station L 692

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- Figure 5. Thermistor chain mooring configuration.
- Figure 6. Surface current mooring configuration.

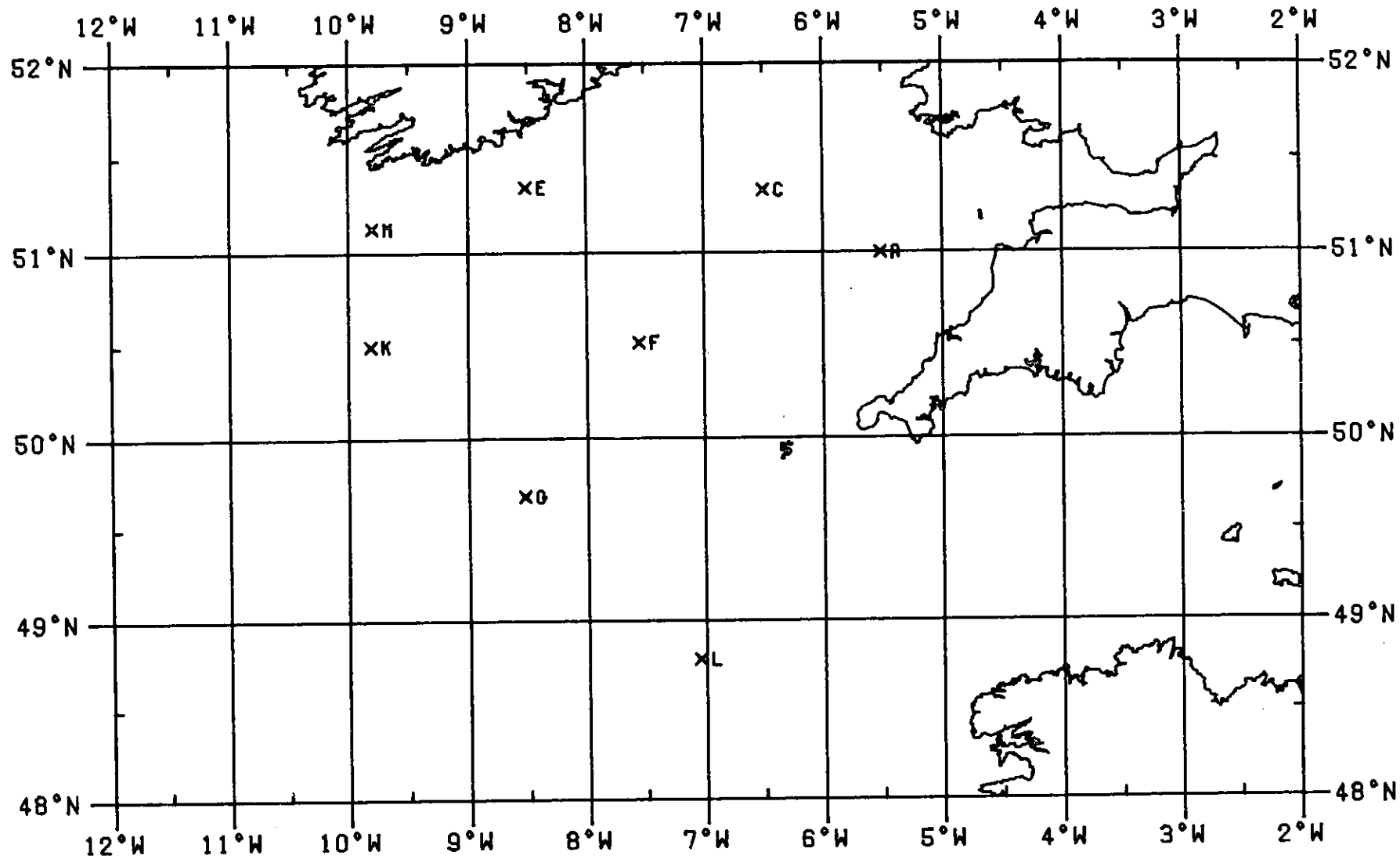


FIGURE 1. STATION POSITIONS AUG/OCT 1980.

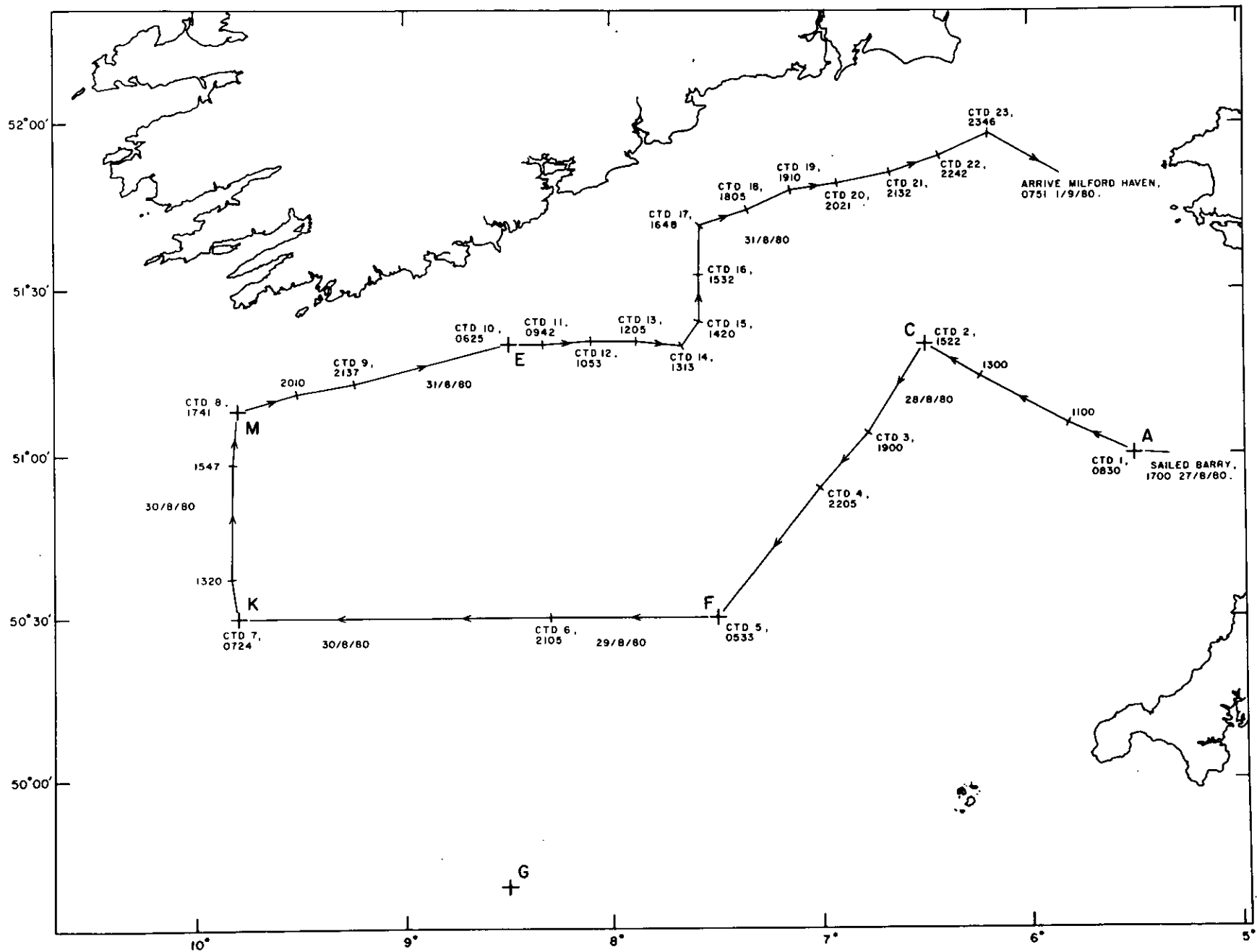


Figure 2. Deployment Leg 1

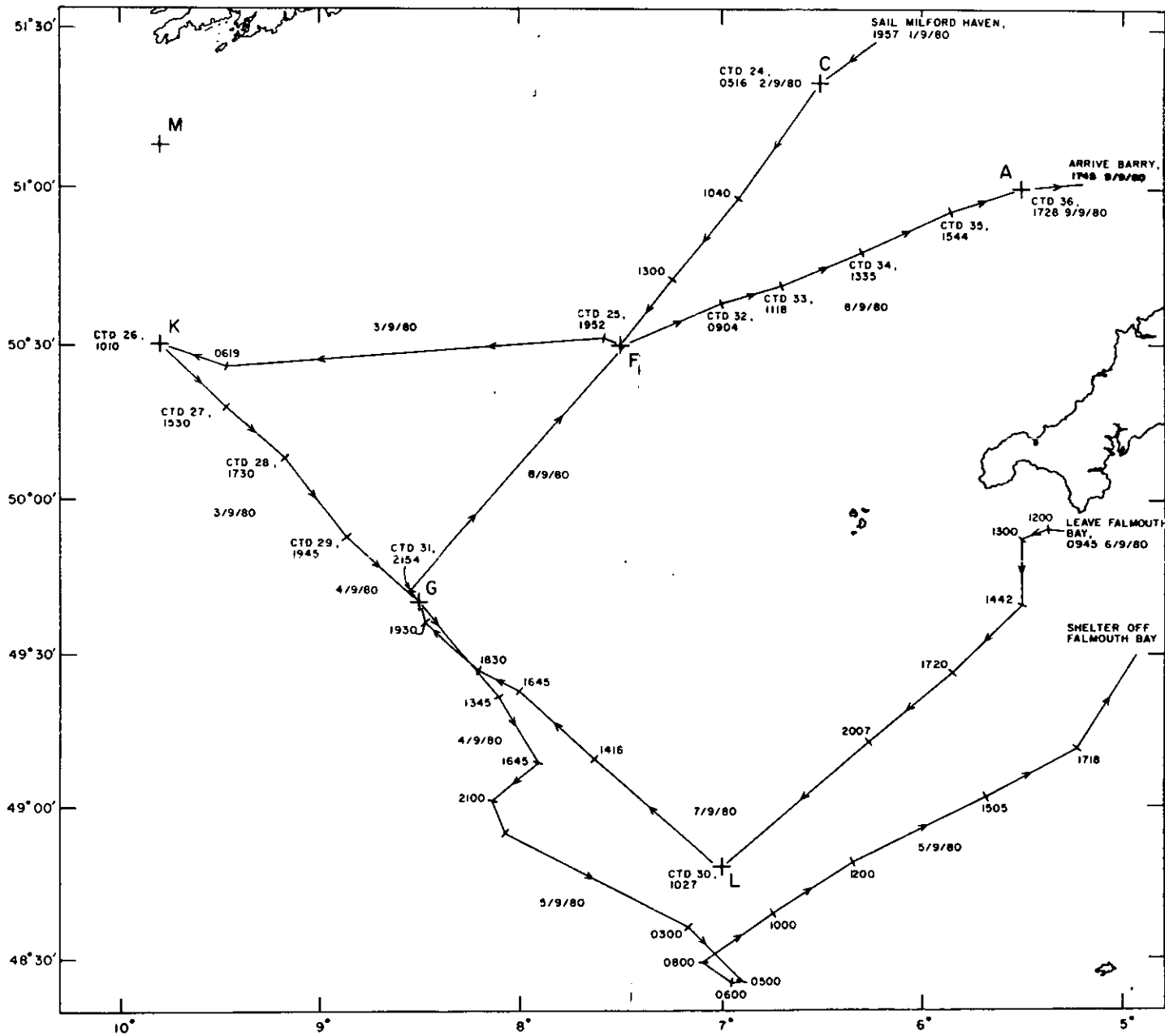


Figure 3. Deployment Leg 2

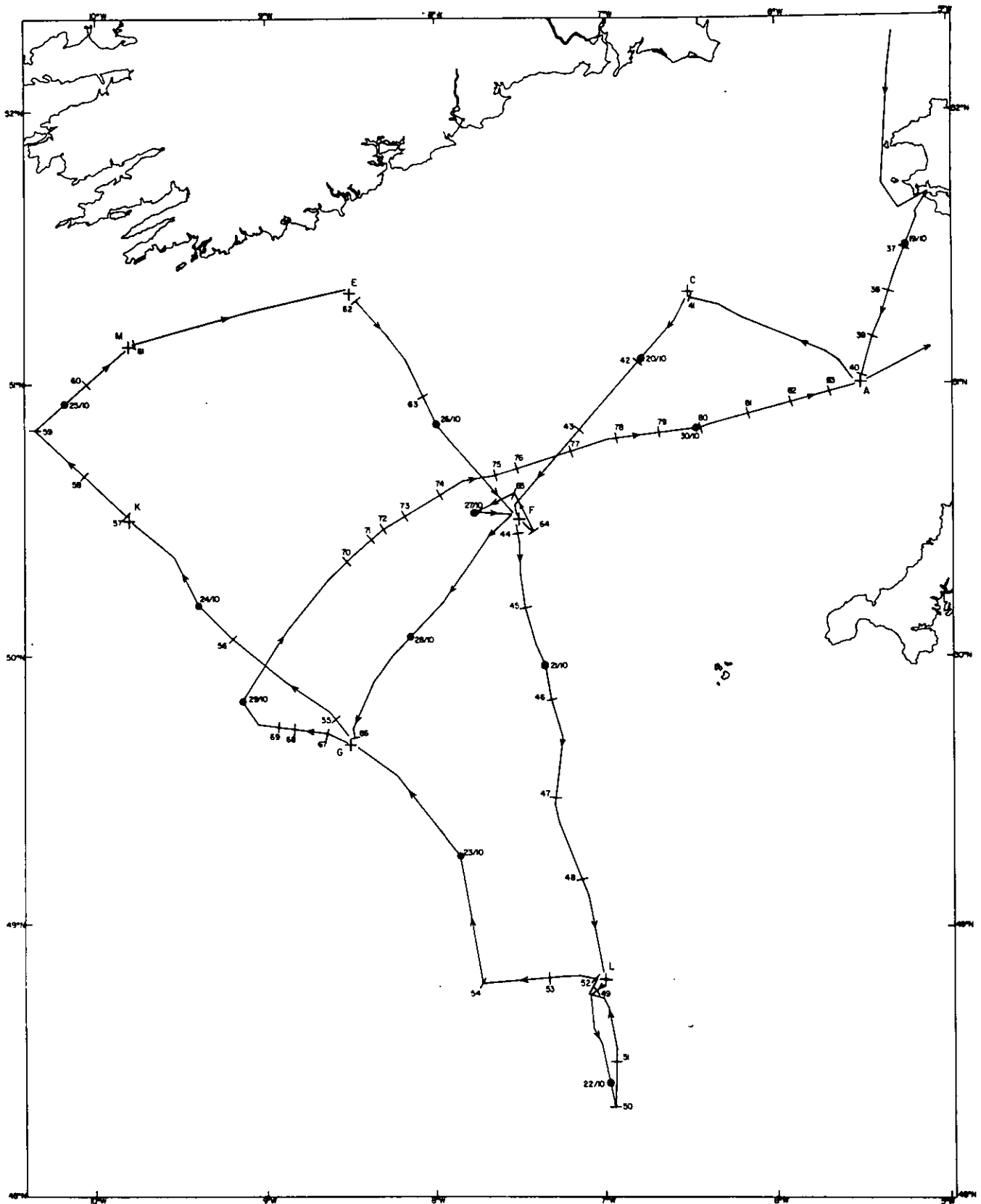


Figure 4. Recovery Leg

