I.O.S.

RRS FREDERICK RUSSELL

CRUISE 7/83

21 APRIL – 13 MAY 1983

SEDIMENT AND FAUNAL INVESTIGATIONS ON THE CONTINENTAL SHELF AND UPPER CONTINENTAL SLOPE WEST AND NORTH OF SCOTLAND AND IN THE IRISH SEA

CRUISE REPORT NO. 165

1984

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

INSTITUTE OF OCEANOGRAPHIC SCIENCES

Wormley, Godalming,
Surrey, GU8 5UB.
(0428 - 79 - 4141)

(Director: Dr. A.S. Laughton FRS)

Bidston Observatory,
Birkenhead,
Merseyside, L43 7RA.
(051 - 653 - 8633)

(Assistant Director: Dr D.E. Cartwright FRS)

Crossway,
Taunton,
Somerset, TA1 2DW.
(0823 - 86211)

(Assistant Director: M.J. Tucker)

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WORMLEY

RRS FREDERICK RUSSELL

Cruise 7/83

21 April - 13 May 1983

Sediment and faunal investigations on the continental shelf and upper continental slope west and north of Scotland and in the Irish Sea

Principal Scientist

J.B. Wilson

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ITINERARY

Departed Plymouth	1130GMT	22 April 1983
Arrived Milford Haven	1100GMT	24 April 1983
Departed Milford Haven	1341GMT	24 April 1983
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Departed Kirkwall	1700GMT	3 May 1983
Arrived Lerwick	1115GMT	5 May 1983
Departed Lerwick	1407GMT	5 May 1983
Arrived Plymouth	1014GMT	13 May 1983

SCIENTIFIC PERSONNEL

B.J. Barrow	(Left at Lerwick 5/5/83)	IOS Wormley
E.P. Collins		" "
B.H. Hart		" "
A.R. Stubbs		" "
Mrs. A.J. Williams		" "
J.B. Wilson	Principal Scientist	" "
A.D. Heathershaw	(Left at Milford Haven)	IOS Taunton
G.W.S. Miller	(Left at Milford Haven)	RVS Barry
A.A. Read	(Joined at Milford Haven)	IOS Taunton
Mrs. J.M. Weller	(Joined at Milford Haven)	IOS Wormley

SHIP'S OFFICERS

Master	P.H. Warne
Chief Officer (Leg 1)	M.S. Putman
Chief Officer (Leg 2)	E. Dowell
Second Officer (Leg 1)	R. Chamberlain
Second Officer (Leg 2)	M.S. Putman
Chief Engineer	F.C. Hammond
Second Engineer	N.A.C. Wilson-de-Rose
Third Engineer	F.J. Richards

CRUISE OBJECTIVES

(1) To obtain observational data - colour video tapes, black and white and colour photographs - on the sediments and carbonate producing animals using the Mark III Television and Camera Sledge from locations of interest not investigated during the RRS Challenger Cruise 9/81 (IOS Cruise Report No. 153).

(2) To obtain further dredge samples from the edge of the continental shelf and upper continental slope to the west and north of Scotland from locations not previously sampled.

(3) To investigate the feasability of using the Mark III Television and Camera Sledge for investigations into the bioturbation of sediments in the eastern Irish Sea.

(4) To recover the IOS Taunton current meter mooring situated west of the Scillies and to obtain CTD and XBT profiles from the vicinity of the mooring.

(5) To investigate the occurrence of deep-water corals in the Inner Hebrides using side-scan sonar.

(6) To undertake sea trials of the IOS side-scan sonar systems and to test the upwards looking mode at different speeds and directions.

(7) To obtain further noise level measurements for the RRS Frederick Russell to compare with those obtained in December 1981.

(8) To obtain additional side-scan sonar data from the areas of strong tidal currents in the central English Channel.

NARRATIVE (all times are GMT)

Leg 1.

The sailing from Plymouth was originally scheduled for midday on 21st April but bad weather in the western English Channel and west of the Scillies delayed the sailing for 24 hours. RRS Frederick Russell left Plymouth at 1130hrs on 22nd April. The starboard side-scan pole was lowered into position in Cawsand Bay. We cleared the outer breakwater at 1217hrs and sailed west. The weather was bad and the severe pitching and rolling of the ship made conditions

very difficult for working on board. The location of the IOS Taunton mooring west of the Scillies (49°.52.5'N 7°27.9'W) was reached and after deploying a 'dolphin' to interrogate the mooring, a signal was received from the mooring. On proceeding towards the location, the signal got stronger and the marker buoy was sighted at 0815hrs on 23rd April. Repeated interrogation of the mooring on the release frequency failed to trigger a response. It was only after signals were sent simultaneously from both the 'dolphin' and the hull transducer that the release frequency was successfully switched on. After due consideration of the sea state it was decided to release the mooring. Although the release fired, no mooring was seen. A second firing cycle also failed to release it. The Gifford grapnels were then deployed and several loops of wire were laid round the mooring. On hauling the wire and tightening the coil the mooring popped up and it was recovered successfully at 1914hrs on 23rd April. The spar buoy was then recovered at 2017hrs in spite of the lifting rope parting when the buoy was first lifted. Once the buoy was secured, three CTD and XBT profiles were obtained near the location of the spar buoy.

We then proceeded towards Milford Haven. We arrived off Milford Haven at 1100hrs on 24th April and anchored. A launch from the shore brought Mr. Read and Mrs. Weller out to join the ship. The current meters, spar buoy and other equipment were loaded onto the launch. Dr. Heathershaw and Mr. Miller then boarded the launch and returned to Milford Haven. We weighed anchor at 1341hrs and proceeded out of Milford Haven Bay.

The port side-scan pole and the side-scan fish were deployed at 1420hrs. A fault was detected on the transducer on the starboard pole. The pole was lifted at 1520hrs for repairs and redeployed at 1815hrs. Work proceeded on preparing the sledge. During the night a gale blew up which made the deployment of the sledge in the vicinity of the sandwaves in the eastern Irish Sea impossible. A course was set to the north-east to try to sledge in the more sheltered inshore waters. A grab sample was taken which indicated that the bottom was a soft glutinous mud that clearly would not support the weight of the sledge. We therefore steamed north towards the mouth of the Solway Firth and the sledge was launched on a fine sandy bottom (Tow 1). Underwater visibility was found to be poor. After the sledge was recovered, the new Osprey colour television camera was found to have some water in it. As the weather forecast for the Irish Sea predicted continuing bad weather, it was decided to steam

north overnight towards a location west of Islay. After repairs to the camera the sledge was deployed at 1240hrs (Tow 2). Just two minutes before the scheduled end of the tow the screen went blank. The sledge was recovered and it was found that one of the new Snooperette lights had partially flooded thus causing the bulb to blow. The resulting voltage surge had then blown the bulb in the second light.

We then steamed towards the edge of the continental shelf to commence dredging at 0700hrs on 27 April. Dredge samples were collected at depths of 200m, 325m, and 500m (Stations 3, 4 and 5). We then steamed eastwards up the continental slope to a depth of 200m to launch the sledge (Tow 3). On switching on, although the wheel and the photographic cameras were working, no TV picture was obtained. The sledge was recovered at 1619hrs and the fault was traced to the junction box. After repairs, the sledge was redeployed (Tow 4) and towed successfully at a depth of 225m for 2 hours. It was recovered at 2140hrs and we steamed northwards overnight to the edge of the shelf north-west of St. Kilda. Further dredge hauls were taken at 200m, 300m and 500m down the continental slope between 0740hrs and 1300hrs on 28th April (Stations 6-8). As weather conditions were just acceptable for launching the sledge we steamed south-east to the location of sample S71/119 and close to the line of C81 Tow 13. The sledge was launched at 1715hrs (Tow 5) and towed for two hours.

We then steamed overnight towards the edge of the continental shelf at 59°N. Dredging commenced at 0718hrs on 29th April at 200m (Station 9). We then steamed to 300m depth and deployed the dredge (Station 10). The tow and recovery appeared to be normal but when the pinger surfaced the dredge was seen to be missing. Both weak links and the throttle strop had parted. As the spare dredge required some maintenance before it could be used, we steamed west-south-west to the location of Station C74/55 and the sledge was deployed at 1318hrs (Tow 6). During the recovery, the hydraulic pump supplying the electric cable winch failed and the cable had to be recovered by hand and flaked along the port side alleyway and onto the main deck forward of the bridge. We then steamed to the location of sample station S71/23. During this time the second outlet on the hydraulic pump was connected and the electric cable was wound back onto the winch. The sledge was launched again (Tow 7) at 1859hrs On switching on the camera the lights blew again. The sledge was recovered, the Snooperette lights removed, and the original Vicon light was fitted and tested. The sledge was redeployed at 1959hrs, towed successfully and recovered

at 2227hrs (Tow 7). We then steamed overnight to the edge of the continental shelf just south of the Wyville Thomson Ridge. The starboard side-scan pole and the fish were brought inboard for work to be done on the transducers. Dredge Stations 11 and 12 were undertaken at depths of 200m and 300m respectively. The sledge was then prepared for deployment at a depth of 325m (Tow 8). The deployment at 1216hrs was successful and the sledge was towed for 4½ hours over iceberg plough marks and other features characteristic of the upper slope. It reached a maximum depth of 368 metres. The sledge was recovered at 1832hrs.

We then steamed west to a depth of 500m and took a dredge sample (Station 13). An overnight steam brought us to another location on the edge of the continental shelf. The starboard side-scan pole and the side-scan fish were redeployed. Dredge Stations 14 (200m) 15 (300m) and 16 (500m) were completed successfully. We then steamed south-west along the edge of the continental shelf to dredge just north of the Wyville Thomson Ridge. The dredge was launched at 200m (Station 17) but was lost in an identical manner to the loss sustained at Station 10. Two grab stations were then attempted unsuccessfully. We then steamed overnight towards the Pentland Firth to work a line of grab stations northwards towards the approaches to Kirkwall. Six grab stations were completed. The side-scan poles and fish were brought inboard and RRS Frederick Russell docked in Kirkwall at 1506hrs on 2nd May.

Leg 2.

We sailed from Kirkwall at 1700hrs on 3rd May having made arrangements to have a spare rock dredge sent to Lerwick from Barry. The side-scan poles and fish were deployed at 1900hrs and we steamed overnight to the location of Station C74/109 (a fine sand) in the Fair Isle Channel east of North Ronaldsay. The sledge was launched (Tow 9) at 0643hrs and recovered at 0852hrs. We then proceeded to a location north-west of Fair Isle where coarse carbonate sand was obtained in 1972 (Station JM 72/134). The sledge was launched (Tow 10) at 1316hrs and recovered at 1559hrs. We then steamed to a location south-west of Fair Isle (site of Station C74/113) where the bottom consisted of Glycymeris gravel and cobbles with Flustra. The sledge was launched at 1854hrs and recovered at 2135hrs (Tow 11).

We steamed overnight to the location of Station C74/163 south-south-east

of Lerwick but side-scan surveys indicated the presence of rock ridges on the bottom making the ground unsuitable for sledging. Further side-scan surveys indicated a suitable area to the south-east of the original area. As preparations were being made to launch the sledge, Mr. Barrow was taken ill and it was decided to steam directly to Lerwick as quickly as possible. We arrived at Lerwick at 1115hrs and after consultation with a local doctor, Mr. Barrow was admitted to hospital. We took delivery of the rock dredge that had been sent from Barry and then sailed from Lerwick at 1407hrs.

We steamed north to undertake a side-scan survey to delineate the southern limit of Iceberg plough marks in the northern North Sea to supplement work undertaken on RRS Challenger in 1979. We then proceeded north to dredge at a depth of 200m (Station 26). Weather conditions had deteriorated but dredging was still possible. We then continued north and dredged at a depth of 300m (Station 27) where some live Lophelia was obtained. We then steamed north to a depth of 500m but the weather was too bad to launch the dredge. We hove to to await an improvement in the weather but none was forthcoming. We then steamed south-east towards the site of Station C79/3 on the upper continental slope north-west of Shetland where two dredge Stations (28 and 29) were completed at depths of 200 and 500m respectively. We then steamed south-west to the sand sheet west of Uist (site of Station C79/22). This was reached at 1625hrs on 8th May and the sledge was launched at 1711hrs (Tow 12) and recovered at 2055hrs.

We then steamed overnight to the Sound of Rhum to undertake a side-scan sonar search for evidence of the presence of the deep water coral Lophelia. On completion, a series of trials of the upwards looking side-scan transducers were undertaken at various speeds and both into and with the wind. These were completed at 1208hrs and we steamed south through the Sound of Mull and the Sound of Islay towards the North Channel and the Irish Sea. Weather conditions in the Irish Sea were again poor and it was only possible to steam slowly south towards the north coast of Anglesey to obtain some shelter and to anchor for the night. We anchored in Moelfre Roads at 1908hrs. By morning weather conditions had improved sufficiently to permit some work with the sledge to be undertaken in the eastern Irish Sea. Trials with the sledge on muddy sand and soft mud (Tows 13 and 14) showed that although underwater visibility was very poor, the sledge could be towed successfully on soft bottoms using the wide supplementary runners built on board from materials

bought in Kirkwall. The final sledge tow (Tow 15) was on a sandy bottom to the west of the main muddy sand area. The sledge was recovered at 1925hrs.

We then steamed south towards Cardigan Bay. On reaching the calmer waters of Fishguard Bay, a further series of trials of the upwards looking side-scan sonar system were undertaken at the same speeds and directions as those conducted in the Sound of Rhum. These were completed by 1140hrs and after the side-scan fish and the port and starboard side-scan poles were brought inboard, we set course for Plymouth. Weather conditions were bad for much of the time on the return journey and the movement of the ship made the conditions on board very uncomfortable for all concerned. We docked in Plymouth at 1014hrs on Friday 13th and commenced unloading our equipment at 1200hrs. This operation went relatively smoothly in spite of the date!

Grateful thanks are due to Captain Warne and the officers and men of RRS Frederick Russell for their enthusiastic support of the scientific programme and to my colleagues for all their hard work throughout the cruise.

SUMMARY OF RESULTS

(1) 15 deployments of the Mark III Television and Camera Sledge were made on the continental shelf west and north of Scotland and in the Irish Sea. One deployment was made at 225 metres and one - the deepest deployment achieved to date - was made at 368 metres.

(2) 19 dredge samples were obtained from the edge of the continental shelf and from the upper part of the continental slope down to 500m as part of the IOS investigations into shelf edge faunas.

(3) The modified runners enabled the sledge to be towed successfully over the soft muds in the eastern Irish Sea although poor visibility prevented any worthwhile results being obtained.

(4) The IOS Taunton mooring was successfully recovered and three CTD and two XBT profiles were obtained.

(5) Side-scan sonar records were obtained from the Sound of Rhum.

(6) Two sets of measurements were made using the side-scan sonar transducers in the upwards looking mode.

(7) A second series of noise level measurements for RRS Frederick Russell were taken.

(8) Bad weather in the English Channel prevented the required side-scan sonar data being obtained.

EQUIPMENT REPORTS

TV and Camera Sledge

This was the second cruise for the Mark III TV and camera sledge, the first was Cruise 9/81 on RRS Challenger in June and July 1981 (IOS Cruise Report No. 153). The mechanical description and handling is virtually the same as that for Cruise 9/81. The two major changes were the use of an Osprey Model 1330A colour TV camera instead of the Sony black and white camera, and the installation of a Bergen current meter, between the two PVC stabilizing fins.

The ship's main trawl winch, incorporating its own dynamometer system was used to tow the sledge. Because the trawl wire was not of the non-rotating type, a 10m wire pennant with a swivel at both ends, was installed between the sledge and the trawl wire.

The layout of the machinery on the aft deck and the exceptionally high gantry on RRS Frederick Russell did not lend themselves to the ideal positioning of the electric cable winch and it produced a rather acute 'fleeting' angle.

It was thought that these could be tolerated, however, they were by no means ideal.

During Challenger Cruise 9/81 and for the first part of this cruise, part of the launching procedure entailed waiting until the required length of trawl wire was totally paid out and the sledge was on the sea bottom before connecting the inboard electric cable at the winch to obtain a television picture. This technique resulted in us being "TV blind" for about 10 minutes. To overcome this, following a suggestion from Captain Warne, it was decided to pay out all the necessary electric cable, but to 'fly' the sledge off the bottom, using the sledge pinger to indicate height above the bottom until the inboard cable was connected and the television receiver had been switched on. Using this method we were able to watch the sledge land on the sea bed.

At the second sledge station a fault on the television camera necessitated a

quick recovery. A low D.C. voltage was diagnosed and rectified; the sledge was then re-deployed.

One of the initial objectives of the cruise was to investigate the bioturbation of the sediments in the north-eastern Irish Sea. Because the sea bed was known to consist of fairly soft mud, with the possible danger of the sledge sinking into the mud, a grab sample of the bottom was taken, and it was found to be too soft to deploy the sledge. Wider sledge runners were therefore required. It was decided to purchase the necessary materials to construct wider runners at the mid-cruise port call at Kirkwall and to try a second series of sledge deployments in the Irish Sea towards the end of the cruise. These wider runners proved to be satisfactory and three deployments were made.

After several sledge tows, water was found to be leaking into the television camera. When the camera was dismantled, a deep scratch mark across the 'O' ring groove of the perspex window was discovered which was too deep to machine. A temporary face seal was made using PVC sheeting and this proved to be successful.

The electric cable sheave hanging from the gantry, normally has the swivel seized to prevent the sheave twisting under low load conditions, which tends to snarl the cable. A more substantial method of preventing twisting is required for future cruises.

During this cruise the sledge was towed at a depth of 368m, using the full length (780m) of electric cable.

B.H.H.

Sledge Photographic System

Two non-standard IOS Mk. 4 deep sea cameras were again mounted on the TV sledge to cover photographic requirements of this cruise. These units were originally equipped with shutters in preparation for the 1981 Challenger cruise and following experience gained, they had been subject to minor modifications to improve overall reliability.

In this instance each camera and associated flash were operated as independent systems, one receiving an initiation pulse from the sledge distance covered circuit at selected intervals, the second being directly linked to a manual switch on the main control panel to permit random operation during the progress of each deployment.

Multi-exposure problems previously experienced were eliminated following the introduction of circuit modifications to remove the possibility of simultaneous camera triggering.

During laboratory trials on the recently acquired colour television camera, it became evident that flood lighting levels would have to be raised by an appreciable amount to gain a true colour balance in the video display. This created problems with the photographic system as increased levels of ambient lighting now contributed a significant percentage of required foreground illumination to the field of view covered by the cameras.

The presence of high ambient lighting levels largely nullified the advantage of an ultra short duration flash and this, combined with the relatively rapid sledge movement and the comparatively slow shutter speeds, resulted in image distortion on many of the photographs obtained.

No practical solution was evident during the cruise but an investigation is now being carried out to resolve this problem before further sea trials are attempted.

Intermittent operation of a system occurred during one deployment following the partial failure of an electronic component but otherwise the photographic system functioned in a satisfactory manner throughout the cruise.

E.P.C.

Sledge Compass System

An Aanderaa RCM4 current meter was mounted on the camera sledge at the back between the PVC fins and above the wheel.

Prior to the cruise the instrument had been calibrated for speed, direction and temperature. The direction calibration was carried out with the current meter mounted on the sledge so that compensation could be made for the ferrous metal framework.

On the cruise the meter did not remain on the sledge continuously but was removed after each tow unless there were several tows undertaken in one day. The meter worked well, the only problems arising from faulty tape spools. Data were collected for tows 1 to 4 and 8 to 12 inclusive. The 2 channels of interest were the direction (to give the orientation of the sledge) and the pressure (to give the depth of the sledge). The speed channel could not be used as the sledge framework obstructed the flow.

A.J.W.

Side-Scan Sonar System

Geological Studies

To assist the geological investigations the following side-scan sonar transducers were employed:-

Leg 1	Port Pole	36 kHz, 255 kHz
	Starboard Pole	90 kHz
	Towed Fish	80 kHz Port
		245 kHz Starboard
Leg 2	Port Pole	36 kHz, 255 kHz
	Starboard Pole	MS47 (48 kHz)
	Towed Fish	80 kHz Port

(For Leg 2 the 90 kHz and 245 kHz transducers were mounted in the top of the towed fish and inclined upwards for Sea Surface Studies).

The towed side-scan fish was PES fish No. 4 without the PES transducers, fitted with a cable 150 feet in length (instead of the usual 110 feet) and towed from the normal PES winch on the foredeck. The hull mounted transducers were attached to poles by swivel brackets to allow tilting. The assemblies (based on the Kelvin Hughes MS47 Transit Sonar) could be rigged as required with minimum effort to brackets welded on the ship's hull.

The prime purpose of the side-scan sonar equipment was to help to identify sea floor topography, the nature of the bottom sediments and the extent of the various features observed. This assisted the decisions regarding the deployment of sledge or dredge. For all occasions it was possible to obtain the necessary information from at least one system and usually 2 or more. (A maximum of 4 transducers could be used at any one time).

A number of factors affected the quality of the records. For the hull mounted transducers "quenching" was the main problem. This is the blanketing of the transducer by bubbles preventing transmission of the outgoing pulse or the reception of the returned echoes; the volume of the bubbles increasing with increasing ship motion and bad weather. The side-scan fish being towed at depths greater than 15m did not suffer from quenching but at low speeds (less than about 4 kts) it tended to swing in azimuth and so produce distorted records.

All records suffered from cavitation effects due to bubbles being produced

by the ship's propeller. At speeds greater than about 9 knots cavitation occurred independent of the engine speed or pitch setting. On a previous cruise in December 1981 (Cruise 19/81, IOS Cruise Report No. 121) using an engine speed of 500 rpm and maximum pitch, the minimum ship's speed without cavitation was about 5 knots. On this cruise it was found that by reducing the engine speed to 450 rpm and adjusting the propeller pitch, a speed of 1 knot could be realised without serious interference.

A minor problem was the very irregular receipt of bands of mains interference from an item of ship's machinery (not identified).

Sea Surface Studies

Off Oban, side-scan transducers have been used fixed to a frame and pointing 20° upwards to observe the sea surface (1), the object being to record the presence and behaviour of bubbles and hence determine the nature of the water movements.

To extend these studies to the open sea the fish mentioned above was fitted during the second leg with two upward looking side-scan sonar transducers as follows:-

Port side	245 kHz inclined 20° up
Starboard side	90 kHz inclined 10° up

It was hoped to carry out a series of trials under various conditions but due to bad weather only two trials were possible.

	Trial (1)	Trial (2)
Date	9-5-83	12-5-83
Times (GMT)	0910-1150	0850-1140
Area	Between Rhum & Eigg	Off St Davids, South Wales
Water depth (m)	40-130	30-40
Bottom composition	Mud between rock outcrops	Sand, gravel, sand waves
Wind speed (kts)	30-40	15-25
Wind direction	South-westerly	Southerly
Ship's courses	060° & 240°	010° & 205°
Ship's speeds (kts)	1, 2, 3 & 4 in each direction	
Fish depth (m)	21-25	26-27
Sample time (mins)	20 at each speed	
Recorder range (m)	200 both frequencies	
Pulse lengths (ms)	½ both frequencies	

Bubble streaks were observed at both frequencies out to about 150m range depending on the conditions. The 90 kHz sonograph displayed the greater number of patterns and during the second trial the 245kHz record exhibited high volume reverberation due possibly to a high concentration of suspended sediment. Also changes in sea surface weather patterns were easily seen at both frequencies.

Reference

(1) Thorpe, S.A. and Hall, A.J., 1983. The characteristics of braking waves, bubble clouds and near surface currents observed using side-scan sonar. Continental Shelf Research, 1(4), 353-384.

A.R.S.

INTERNAL AIRBORNE NOISE MEASUREMENTS

In December 1981 (Cruise 19/81 (1)) a set of noise signatures was obtained in various parts of the ship.

At that time there was the possibility that sound insulating material might be fitted and so the present cruise appeared to be an occasion to note the differences. Although the proposals did not materialise it was decided that further measurements would be made:-

(a) To note changes due to the extension to the Master's Cabin and the installation of the Plotting Office.
(b) to produce additional signatures as required to supplement the earlier figures.

Both sets of measurements are contained in the same report (2).

References

(1) Cruise Report No. 121, 1982. Noise Trials, RRS Frederick Russell, 7-11th December, Cruise 19.

(2) Stubbs, A.R., 1983. Noise measurements on RRS Frederick Russell. IOS Internal Document, No. 159.

A.R.S.

TABLE 1 LOCATION OF SLEDGE TOWS

Tow Number	Date	Time	Launch	Recovery	Depth Range (m)	Location
FR83/T1	25/4/83	1818-1942	54°35.4'N 3°52.5'W	54°36.7'N 3°50.8'W	33	South-West of Solway Firth
FR83/T2	26/4/83	1240-1509	55°51.7'N 7°2.3'W	55°50.3'N 7°0.3'W	55-57	West of Islay
FR83/T3*	27/4/83	1427-1619	56°39.4'N 8°59.5'W	56°38.8'N 8°59.45'W	205	Shelf edge west-south-west of Barra Head
FR83/T4	27/4/83	1810-2140	56°39.3'N 8°59.3'W	56°40.9'N 8°58.6'W	200-230	Shelf edge west-south-west of Barra
FR83/T5	28/4/83	1715-2019	58°3.6'N 8°56.7'W	58°4.9'N 8°52.0'W	172	North-west of St Kilda
FR83/T6	29/4/83	1318-1610	58°50.6'N 6°37.8'W	58°49.4'N 6°37.2'W	135-140	Site of C74/55
FR83/T7	29/4/83	1959-2227	58°38.6'N 6°40.1'W	58°37.9'N 6°39.0'W	107-115	Site of S71/23
FR83/T8	30/4/83	1215-1832	59°26.4'N 6°33.75'W	59°28.8'N 6°32.8'W	317-368	Continental slope south of Wyville Thomson Ridge
FR83/T9	4/5/83	1643-0852	59°13.7'N 1°20.3'W	59°12.1'N 1°19.8'W	108-113	Fair Isle Channel
FR83/T10	4/5/83	1316-1559	59°39.2'N 1°41.0'W	59°37.4'N 1°45.4'W	105-110	Fair Isle Channel
FR83/T11	4/5/83	1854-2135	59°28.2'N 1°46.2'W	59°29.6'N 1°46.2'W	98-105	Fair Isle Channel

Tow number	Date	Time	Launch	Recovery	Depth Range (m)	Location
FR83/T12	8/5/83	1711-2055	57°4.8'N 8°33.0'W	57°7.3'N 8°32.9'W	129-138	North-west of Barra Head
FR83/T13	11/5/83	1150-1322	54°4.6'N 3°41.2'W	54°4.2'N 3°40.1'W	38	West of Morecambe Bay
FR83/T14	11/5/83	1449-1600	54°15.7'N 3°40.8'W	54°14.8'N 3°41.2'W	35	South-west of Ravenglass
FR83/T15	11/5/83	1752-1925	54°3.5'N 3°56.8'	54°3.4'N 3°56.2'W	52	West of Morecambe Bay

*Not plotted on Fig. 5. Tow abandoned due to lighting failure.

TABLE 2 STATION POSITIONS

Station No.	Date	Time	Start	Finish	Depth (m)	Gear Used	Number of hauls
FR83/1	25/4/83	1410-1420	54°21.9'N 3°38.5'W	-	27	Day Grab	1
FR83/2	26/4/83	1140-1200	55°50.2'N 6°58.0'W	-	55	Day Grab	1
FR83/3	27/4/83	0728-0820	56°30.7'N 9°3.0'W	56°31.6'N 9°3.0'W	200	Rock Dredge	1
FR83/4	27/4/83	1020-1101	56°34.4'N 9°3.7'W	56°35.0'N 9°4.2'W	325	Rock Dredge	1
FR83/5	27/4/83	1205-1302	56°36.6'N 9°5.1'W	56°37.7'N 9°6.2'W	500	Rock Dredge	1
FR83/6	28/4/83	0740-0813	58°1.7'N 9°11.1'W	58°2.2'N 9°10.2'W	216	Rock Dredge	1
FR83/7	28/4/83	0945-1027	58°2.5'N 9°23.9'W	58°3.0'N 9°23.1'W	315	Rock Dredge	1
FR83/8	28/4/83	1143-1242	58°2.8'N 9°35.8'W	(Mid position)	500	Rock Dredge	1
FR83/9	29/4/83	0718-1751	59°01.0'N 7°23.0'W	59°01.4'N 7°22.3'W	200	Rock Dredge	1
FR83/10	29/4/83	0847-0925	59°2.6'N 7°25.5'W	59°3.1'N 7°24.2'W	300	Rock Dredge	1
FR83/11	30/4/83	0819-0959	59°31.4'N 6°20.7'W	59°30.8'N 6°20.1'W	200	Rock Dredge	1

Station No.	Date	Time	Start	Finish	Depth (m)	Gear Used	Number of Hauls
FR83/12	30/4/83	0956-1047	59°30.8'N 6°29.9'W	59°30.3'N 6°30.6'W	301	Rock Dredge	1
FR83/13	30/4/83	1914-2012	59°27.9'N 6°38.6'W	59°29.0'N 6°39.8'W	15	Rock Dredge	1
FR83/14	1/5/83	0730-0821	60°20.0'N 3°40.7'W	60°19.6'N 3°41.6'W	211	Rock Dredge	1
FR83/15	1/5/83	0921-1005	60°21.3'N 3°48.0'W	60°21.6'N 3°47.0'W	310	Rock Dredge	1
FR83/16	1/5/83	1140-1250	60°26.4'N 4°4.7'W	60°27.4'N 4°3.4'W	500	Rock Dredge	1
FR83/17	1/5/83	1810-1850	59°53.3'N 5°5.6'W	59°54.0'N 5°5.1'W	200	Rock Dredge	1
FR83/18	1/5/83	1940-1948	50°54.8'N 5°1.1'W	-	200	Day Grab	2
FR83/19	1/5/83	2113-2129	59°46.3'N 4°52.2'W	-	135	Day Grab	3
FR83/20	2/5/83	0607-0614	58°45.4'N 4°0.6'W	-	82	Day Grab	2
FR83/21	2/5/83	0706-0713	58°50.3'N 4°57.1'W	-	85	Day Grab	2
FR83/22	2/5/83	0756-0803	58°54.6'N 3°54.1'W	-	75	Day Grab	2
FR83/23	2/5/83	0847-0854	58°59.2'N 3°50.5'W	-	89	Day Grab	2

Station No.	Date	Time	Start	Finish	Depth (m)	Gear Used	Number of Hauls
FR83/24	2/5/83	0938-0952	59°3.9'N 3°46.8'W	-	106	Day Grab	2
FR83/25	2/5/83	1033-1040	59°9.0'N 3°43.7'W	-	135	Day Grab	2
FR83/26	6/5/83	1108-1139	61°42.2'N 0°46.6'E	61°40.0'N 0°50.6'E	200	Rock Dredge	1
FR83/27	6/5/83	1400-1500	62°1.0'N 0°41.1'E	62°0.6'N 0°41.3'E	300	Rock Dredge	1
FR83/28	7/5/83	1242-1315	60°42.4'N 2°46.7'W	60°42.3'N 2°47.8'W	200	Rock Dredge	1
FR83/29	7/5/83	1452-1610	60°41.5'N 3°18.6'W	60°41.35'N 3°19.5'W	515	Rock Dredge	1
FR83/30	9/5/83	0902-0910	56°57.1'N 6°11.1'W	-	98	Day Grab	1

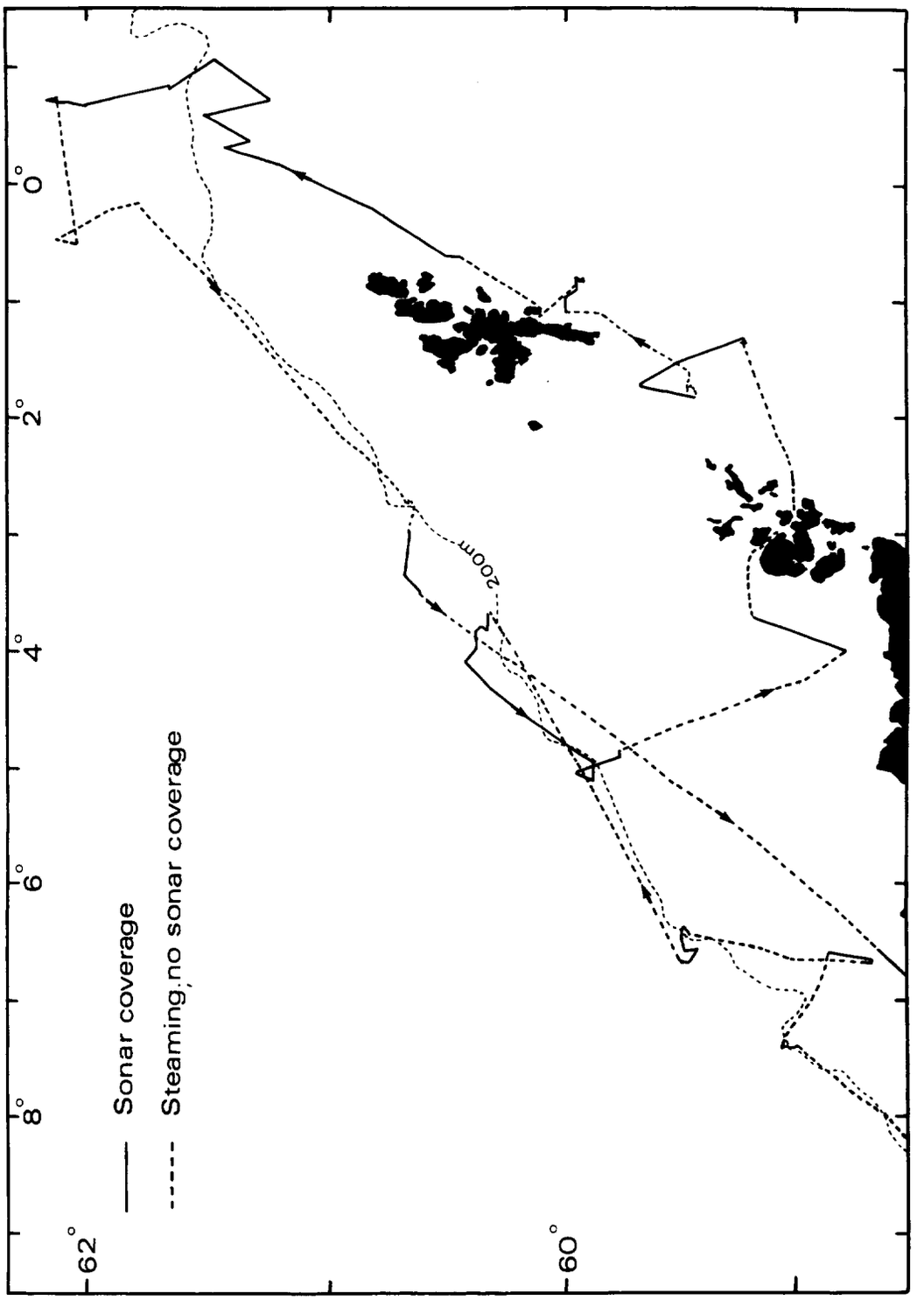

FIGURE 1 - Track chart east and west of Orkney and Shetland showing side-scan sonar coverage

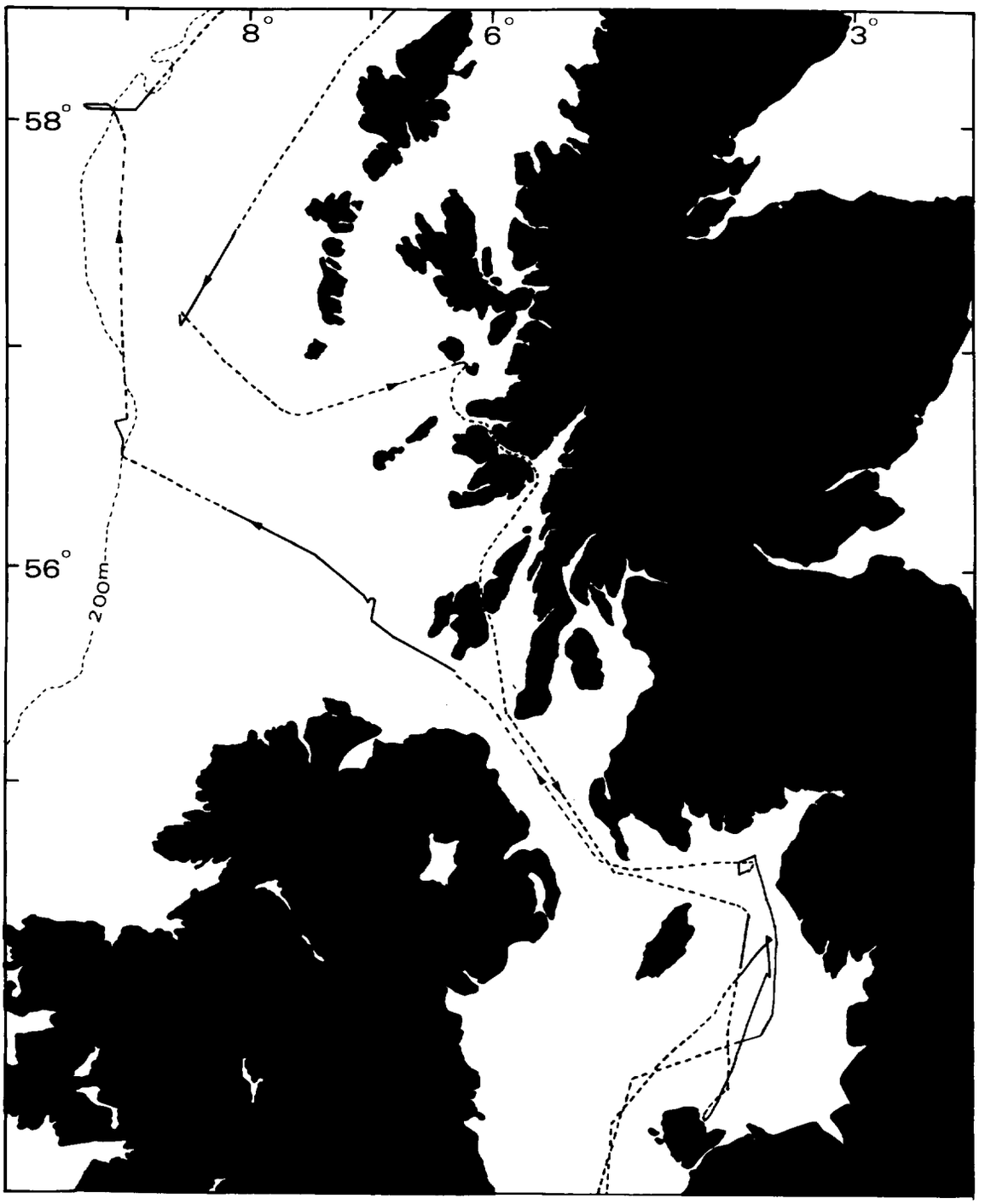

FIGURE 2 - Track chart west of Scotland and in the Irish Sea showing side-scan sonar coverage

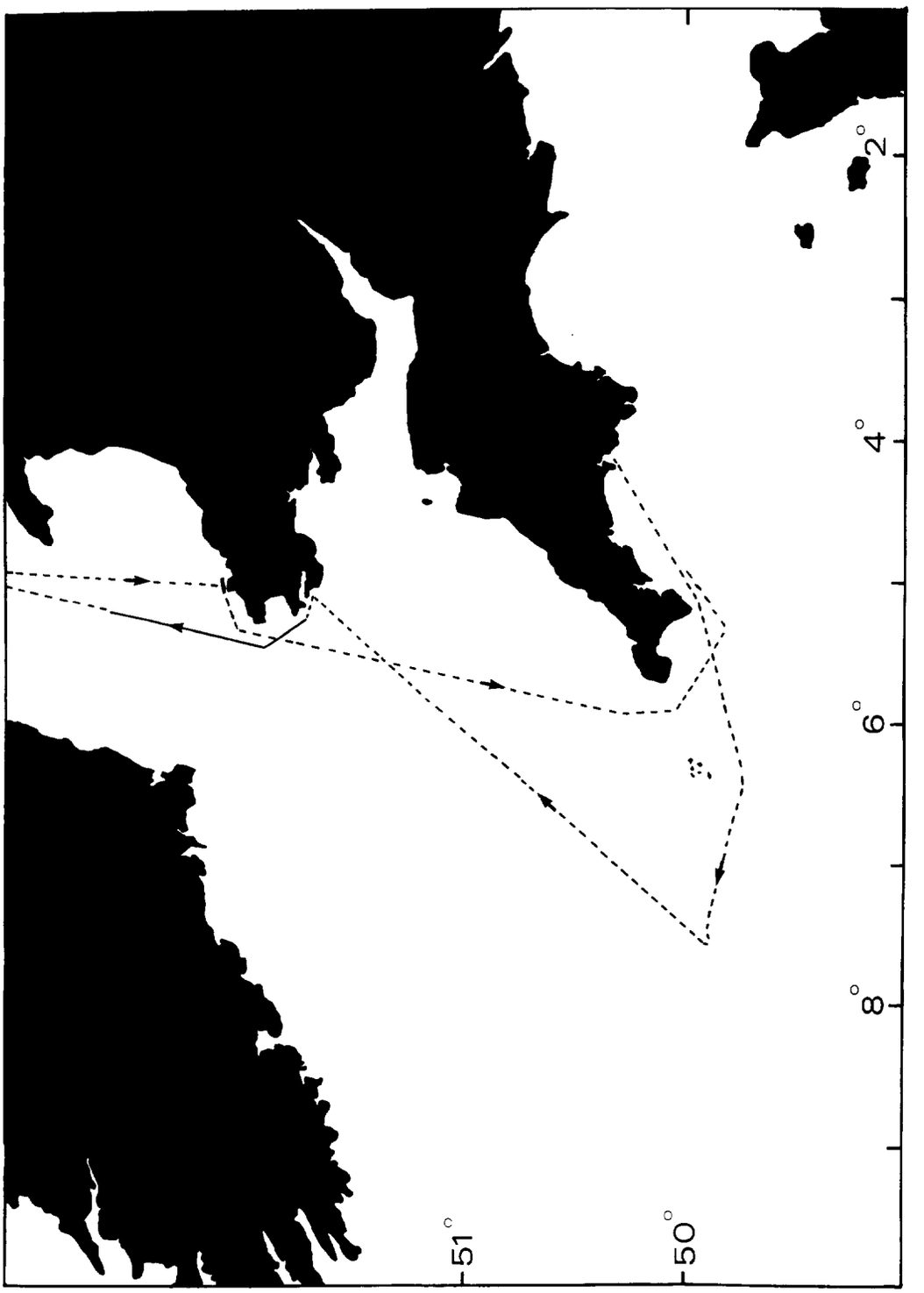

FIGURE 3 - Track chart in St. George's Channel and Western Approaches showing side-scan sonar coverage

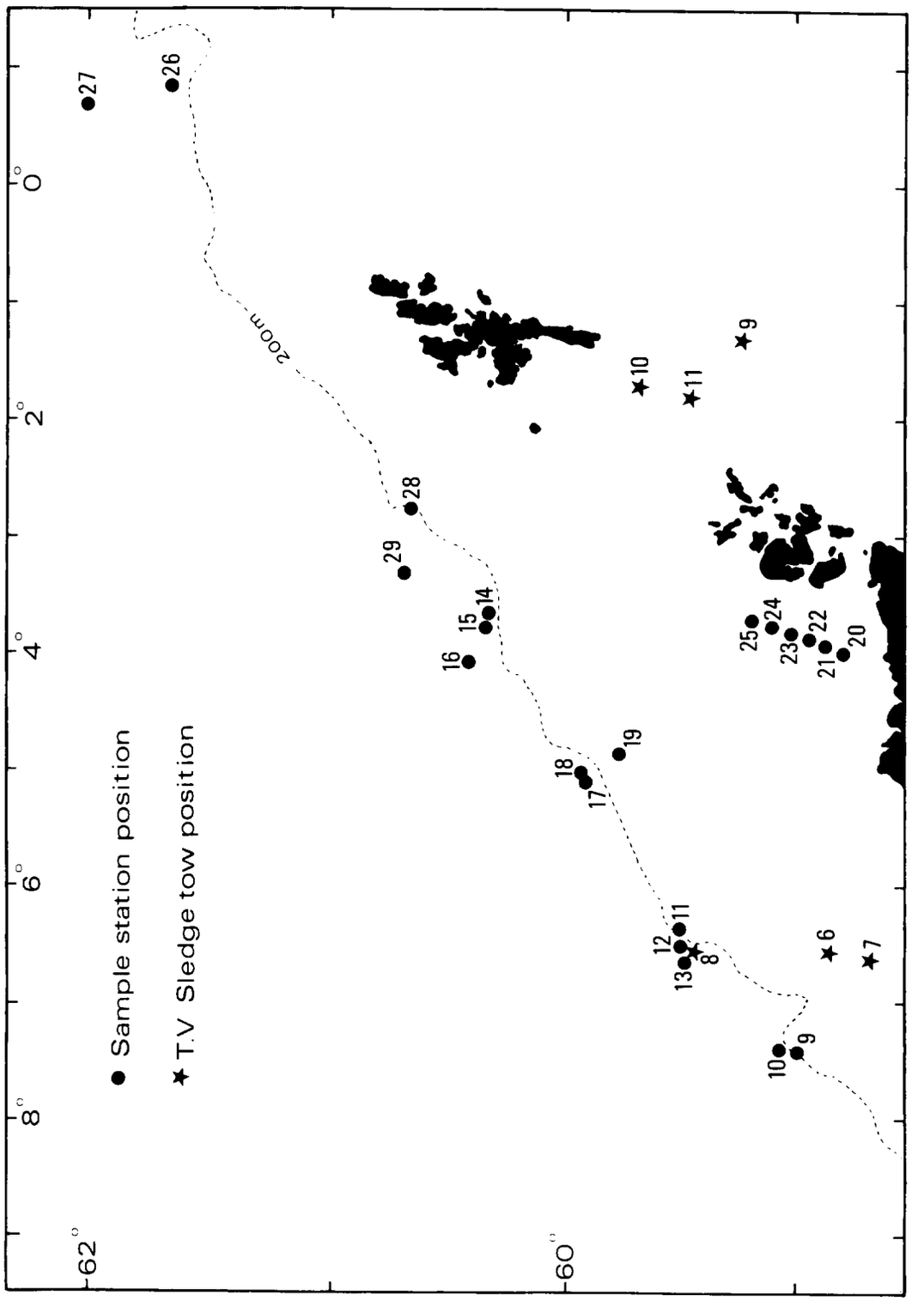

FIGURE 4 - Location on TV Sledge tows and sample stations west and north of Orkney and Shetland

FIGURE 5 - Location of TV Sledge tows and sample stations west of Scotland and in the Irish Sea