I.O.S.

R R S CHALLENGER
CRUISE 9/81

16TH JUNE – 1ST JULY 1981

SEDIMENT AND FAUNAL INVESTIGATIONS ON THE CONTINENTAL SHELF TO THE WEST AND NORTH OF SCOTLAND

CRUISE REPORT NO 132
1982

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)

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

(Assistant Director: M.J. Tucker)

R.R.S. CHALLENGER
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Institute of Oceanographic Sciences,
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ITINERARY

Departed Barry	0900 hrs	16th June 1981
Arrived Ardrossan	0800 hrs	1st July 1981

SCIENTIFIC PERSONNEL

B.J. Barrow		I.O.S. Wormley
E.P. Collins		" "
B.H. Hart		" "
C.D. Pelton		" "
R.A. Phipps		" "
P.I. Wallin		" "
Mrs J.M. Weller		" "
Mrs A. Williams		" "
J.B. Wilson	Principal Scientist	" "

SHIP'S OFFICERS

Master	G. Long
Chief Officer	D. Coverdale
Second Officer	S. Jones
Third Officer	R. Hagler
Chief Engineer	B. Anderson
Second Engineer	C. Harman
Third Engineer	R. Perriam
Fourth Engineer	B. Entwhistle

CRUISE OBJECTIVES

(1) To obtain observational data in the form of video tapes, black and white and colour photographs using the Mark III TV and camera sledge at locations of particular interest on the continental shelf to the west and north of Scotland. The locations of the sledge tows were determined from data obtained from samples and sonographs taken on previous cruises.

(2) To obtain further dredge samples from the edge of the continental shelf and the upper continental slope west of the Shetlands.

(3) To obtain further data on the occurrence of the coral Stenocyathus vermiformis on the edge of the continental shelf west of the Shetlands.

(4) To collect live specimens of the polychaete Ditrupa arietina and the coral Caryophyllia smithii for continued growth and behavioural investigations and of the scaphopod Antalis entalis to observe its living position in relation to the sediment.

(5) To obtain further side-scan sonar coverage of the continental shelf west and north of Scotland to supplement existing IOS data.

(6) To collect some surface sediment samples suitable for microfaunal investigations.

NARRATIVE (all times are GMT)

RRS Challenger departed from Barry at 0900 on 16th June and cleared the lock at 0935. Most of the passage time down the Bristol Channel and northwards through the Irish Sea was used to complete the preparation and testing of the equipment for the sledge and to complete the fitting out of the laboratory spaces for the work of the cruise. The PES fish and MS47 transducer were deployed at 0700 on 18th June 81.5 km west of Islay and the sledge was launched at 0930 72.5 km west of Islay. In order to gain experience in launching and towing the Mark III sledge from RRS Challenger, only the TV camera was fitted to the sledge for the first tow (Line 1). The pins of the plastic shackles used to attach the trawl floats to the electric cable were sealed with PVC tape for the first trial tow. Experience gained showed that the taping was not necessary and it was not carried out on any of the subsequent tows. A problem was encountered with the port side PES sheave which carried the electric cable outboard from the A frame. It turned athwartships when not under load. After the first tow it was seized in the fore and aft position and it gave no further trouble throughout the cruise. Following

the successful first tow which lasted 1 hour and the smooth recovery of the sledge, the Benthos Type 374 Underwater Camera loaded with black and white film and the IOS flash were fitted to the sledge and the sledge was launched in an area where Ditrupa and Caryophyllia were known to occur (Line 2). The sledge was towed successfully for 4 hours and 20 minutes and recovered without difficulty. Useful video data was obtained but unfortunately none of the photographs came out as the camera and flash were not synchronising. Five grab stations were worked at the end of the line and these contained numerous young live Ditrupa.

The ship then steamed overnight to a location 28 km south-west of Barra Head (location of Station S71/142) but after an echo-sounding survey it was decided that the bottom was too rugged to risk launching the sledge and we steamed north-west to another launch site on a gravel floor with some sand patches where the sledge was launched and towed successfully for 2½ hours (Line 3). The sledge was recovered and we steamed a further 12 miles to the north-north-west for another sledge tow on sand patches with Caryophyllia (Line 4). The sledge was recovered at 2130 and the side-scan pole was brought inboard to enable us to steam at full speed towards Muckle Flugga. On 20th June while steaming, it was found that the port side bearing on the winch used to handle the electric cable had partly sprung. After some time and the assistance of the ship's engineers the fault was repaired.

The side-scan pole was redeployed at 1100 and the sledge was launched at 1150 (Line 5) on 21st June 39 km west of Muckle Flugga. The sledge was recovered at 1602 and we steamed towards the edge of the continental shelf to dredge near the station where the coral Stenocyathus vermiformis was obtained from RRS Challenger in 1979. Three dredge hauls were obtained at three stations and additional locations for Stenocyathus were recorded. A side-scan survey crossing the edge of the continental shelf several times was run for the remainder of the night. The sledge was launched at 0600 at the Stenocyathus locality (Line 6) and towed successfully for over 4 hours at a depth of 200 m. The sledge was recovered at 1030. Two dredge stations were then worked at 200 and 250 m on the upper part of the continental slope. During the first of these stations three officers from the fishery protection vessel, HMS Anglesey, came on board and were shown round the ship.

We then steamed to a location 18.5 km west of Mainland, Shetland where samples had yielded Ditrupa. Some Ditrupa were observed (Line 7) but the density was much lower than that observed in the earlier sledge tows further south. The sledge was

recovered at 2241 and we steamed overnight towards the Fair Isle Channel to investigate the large sand waves observed there during RRS Challenger cruises in 1974 and 1979. A PES and side-scan survey was conducted to determine the best line and the sledge was deployed at 0920 on 23rd June (Line 8). The strong current gradually forced the ship to run with it resulting in a much more oblique traverse across the sand wave than that originally planned. The sledge was recovered at 1315. A further side-scan survey indicated other suitable sand waves and the sledge was again launched at 1720 (Line 9) and was towed up the steep 'avalanche' face of the sand waves with spectacular results. The sledge was recovered at 2118.

We steamed overnight to the next area of interest 59 km south-west of Foula (site of Station C74/88). The sledge was launched at 0620 on 24th June (Line 10) and recovered at 0918 after a successful tow over ground including several areas of extensive shell gravels composed almost entirely of Glycymeris shells and valves. A dredge station was worked at one of the locations along the tow where Glycymeris gravels were observed. We then steamed to a location 44 km west of Mainland, Orkney (Station JM72/120) where interesting Caryophyllia and Ditrupa samples were obtained from RRS John Murray in 1972. The sledge was launched at 2130 (Line 11) and recovered at 0012.

We then steamed overnight towards Rona and surveyed the ground east of the island to find a suitable area to tow the sledge. The sledge was launched at 0925 on 25th June (Line 12) and recovered at 1213. A series of grab stations were then worked using both the Day Grab and the Exeter Grab. The side-scan pole was brought inboard at 1326 in order to steam at full speed towards the island of Boreray and the location of the next sledge tow. The side-scan pole was redeployed at 0455 on 26th June and the sledge launched at 0541 (Line 13) on an area of rippled sand with Caryophyllia sampled from MV Surveyor in 1971 (Station S71/119). The sledge was recovered at 0928 and we steamed to an area thought to be gravel on the basis of side-scan data. The sledge was launched at 1318 (Line 14) and towed over the gravel towards a ridge which turned out to be composed of cobbles and boulders and is probably a moraine. The sledge towed well over the boulders but on recovery it was found that it had sustained slight damage to the crash bars protecting the cameras and flash units.

We steamed overnight to the site of two important shell gravel samples obtained from MV Surveyor in 1971 (Stations S71/141 and 142). An attempt was made to collect more material for further investigation but unfortunately this was unsuccessful. We steamed south-west to some patchy ground 30 km west-north-west of Barra Head and the sledge was launched at 0810 (Line 15) and towed over sand,

gravel waves and some larger boulders till 1155. During the tow, the marker buoy was lost when the sledge passed over a large boulder. Grab samples were then collected from the gravel seen at the beginning of the tow. We then steamed south-west to the site of some unusual sand patches which were observed to run in two directions on sonographs obtained from RRS Discovery in 1965. A survey along the original 1965 line using the MS47 side-scan established that the particular pattern of patches was still there and the sledge was launched at 1725 (Line 16) to investigate them. During this tow some colonial coelenterates were observed associated with areas of cobbles. It was decided at 1943 to try to turn round with the sledge deployed and return on a reciprocal course to make further observations of these. The ship's speed was brought up to 3.5 kts and the sledge was lifted off the bottom. The ship gradually turned to port and the turn was successfully completed at 2005 when the speed was reduced to 0.5 kts and the sledge returned to the bottom. The sledge was recovered at 2223 and we steamed overnight to the extensive area of rippled sand close to the site of the second sledge tow to obtain photographs and further video coverage.

The sledge was launched at 0605 on 28th June (Line 17) and towed over the rippled sand containing numerous Ditrupa and Caryophyllia. It was recovered at 0937. We returned to a point on the tow which indicated that Caryophyllia was abundant and collected many live corals and Ditrupa using the rock dredge. Another site on the line was selected where an attempt was made to obtain a box core of the sand using the RVS Reineck box corer to study bioturbation. This was only partially successful because, although a sample was successfully taken, it proved to be difficult to close the box on deck and part of the sample was lost. We then steamed to the line of the second tow and launched the sledge at 1400 (Line 18) for a further run over the rippled sands. The sledge was recovered at 1646. We then steamed west to the site of the early Holocene lag gravel discovered from RRS Challenger in 1974 (Station C74/10). The sledge was launched at 1955 (Line 19) and towed over sand patches and small gravel waves. It was recovered at 2310 and we steamed westwards overnight to the site of a bioclastic gravel sampled from RRS Challenger in 1974 (Station C74/19). After a survey of the line, the sledge was launched at 0720 (Line 20) and towed over gravel waves containing a high proportion of Ditrupa fragments. It was recovered at 1038.

It was then decided to attempt a tow at 250 m to gain further experience of towing the sledge in deep water. We steamed west to the edge of the continental shelf and although the wind was westerly and therefore not ideal it was decided to tow down the slope. The sledge was deployed at 1440 (Line 21) with 600 m of

wire and 650 m of cable out. An accumulator was rigged and the sledge initially towed well. An unexpected current forced us to tow south rather than west causing considerable tension on the electric cable. As a gale warning was given for the area it was decided to terminate the tow. Recovery was complicated at times by the extreme cable angle and the tension made it difficult at times for the winch to pull the cable. The sledge was recovered at 1623. It was found that there was slight damage to the frame, the lamp had been bent round and the plastic housing for the marker buoy was broken. Evidence showed that the sledge had tilted over on to its port side, then turned right over and subsequently righted itself without damage to any of the cameras or to the junction box.

We then steamed eastwards towards the large area of rippled sand 89 km west of Islay to conduct a side-scan sonar survey to determine its extent. This continued overnight and until 1350 on 30th June. Weather conditions made it impossible to obtain any useful results with the side-scan on courses other than about 090^{o} or 270^{o} during the last few hours of the survey. At 1350 the side-scan pole and PES fish were brought inboard and we set course for Ardrossan to arrive there after breakfast on 1st July.

This was a particularly successful cruise. The weather, apart from the last day, was excellent. All systems on board RRS Challenger worked well throughout the cruise.

Warm thanks are due to Captain Long and the officers and men of RRS Challenger for their help and support which contributed greatly to the success of the cruise. Particular thanks are due to my colleagues for their enthusiastic support and hard work, both before and during the cruise which made the sledging operations such a success.

SUMMARY OF RESULTS

(1) 21 tows were completed with the TV and Camera Sledge. A total of 56 video tapes (approximately 56 hours of video recording) were obtained. Up to 400 black and white and colour photographs were taken on most of the tows.

(2) Five dredge samples from the edge of the continental shelf and upper continental slope were collected to supplement the existing IOS sample cover as part of a study of the sediments and faunas at the edge of the continental shelf.

(3) Several additional locations for the coral Stenocyathus vermiformis were recorded.

(4) Many live specimens of the polychaete Ditrupa arietina were collected. Several of these were young individuals about 15 mm long and particularly suitable for further growth studies. Some 40 live specimens of the coral Caryophyllia smithii were also obtained suitable for further behaviour studies. Nine thermos flasks containing Ditrupa and Caryophyllia were successfully transported to Wormley where they were kept overnight in the constant temperature chamber prior to being taken to the Marine Laboratory at Plymouth.

(5) Shipboard investigations into the living position of the scaphopod Antalis entalis showed that it does live below the surface of the sediment with the posterior end just above, at or just below the sediment surface.

(6) Further side-scan sonar coverage was obtained from parts of the continental shelf to the west and north of Scotland to supplement existing IOS records.

(7) Two samples suitable for microfaunal study were collected 24 km east of Rona. Additional samples were to be collected on 30th June but bad weather prevented this.

J.B.W.

EQUIPMENT REPORTS

TV and Camera Sledge

The main equipment used on the cruise was the Mark III TV and camera sledge based on the original design by Dr Holme and Mr Barrett of M.B.A. The Mark III design was based on experience gained in operating the Mark II sledge on trials from RRS Sarsia in 1979 and 1980. The Mark III sledge is much wider and stronger than Mark II. The main construction of the sledge consists of two skis, upon which is mounted a structure of 1½" diameter mild steel tubing. Two lengths of steel angle span the width of the sledge, and carry the cameras and flash units. Two P.V.C. fins mounted 'aft' help stabilize the sledge. An important feature are the 'roll over' bars, which help to right the sledge, should it turn upside down.

A distance-measuring wheel similar to that on the Marks I and II sledges was attached to the rear end of the sledge and performed well after slight modifications. In the event of the sledge becoming totally detached from the ship, a command pinger and a marker buoy system were mounted on the sledge.

From the experience gained on the last Sarsia sledging cruise a new system for handling has been developed. This worked very well and enabled us to sledge at

21 stations for periods of between 2-5 hours in depths ranging from 100-230 metres.

The ship's starboard auxiliary winch handled the main warp, the warp passing through a metering sheave mounted on the A-frame.

The electric cable was attached to a 12 mm diameter pre-stretched terylene rope, by means of polypropylene clamps spaced at 5 metre intervals. A 'bite' consisting of an additional 25 cm was added to each 5 metres of the electric cable to allow for the stretch of the terylene rope. The rope would also be used as an emergency recovery line should the main towing warp break.

Plastic floats 8" in diameter were attached to the polypropylene clamps at 15 metre intervals by means of quick release plastic shackles, to buoy the electric cable, and prevent the cable being dragged along the sea bed. They also help one to preserve the cable relative to the ship's position.

The electric cable and terylene rope were handled by a portable hydraulic winch, driven by a 3 phase electric pump at a hydraulic pressure of 1500 p.s.i. The only major problem encountered with the hydraulic winch was that of a main shaft bearing becoming loose due to the incorrect assembly of the driving gears. This was rectified and no further problems occurred.

Deployment: The sledge was deployed at a speed of 2 kts with the ship's head to wind. The electric cable was made buoyant using the plastic trawl floats and a differential of plus 50 m against the towing warp was maintained throughout all stages of deployment and towing. When the sledge was approaching the bottom the ship's speed was reduced to approximately 1 kt and the towing warp was paid out to full scope - about 2.5 times the full working depth.

Towing: The sledge was towed by a wire rope bridle (8 mm diameter) coupled to a weak-link (6 mm diameter wire), coupled to a 5 ton swivel, which was coupled to a non rotating main warp (10 mm in diameter). In the event of the 'weak-link' breaking, a 10 mm diameter safety strop was attached between the swivel and the back of the sledge. Fortunately this was not put to the test. The electric cable joined the sledge horizontally and at a point to the rear, where it was clamped in position. In the event of the sledge rolling over, the cable was less vulnerable in this position.

Normally the ship towed head to wind, the speed over the ground was determined by altering to obtain the best picture on the TV monitor. The ship's speed was generally adjusted to keep the sledge moving at about 0.5 m/sec. At sea state 4-6 the pitching of the ship was a problem, causing the sledge to stop and start due to

snatching on the towing warp. Some accumulation was tried without too much success.

Recovery: The only problem with recovery was maintaining the towing and electric cable streaming aft in the prevailing wind and current. When this was achieved the sledge was brought aboard with comparative ease. In general working the sledge aboard RRS Challenger did not present too many problems and an efficient working system during tows was soon developed without requiring an unacceptably large number of people to operate the sledge.

During the final tow at a depth of 120 m the weather deteriorated, and the wire-angles over the stern became acute. After 20 minutes towing it was decided to recover the sledge. High drag was experienced on the electric cable and terylene rope, and recovery was slow for the first 250 m. Upon recovery it was observed that the sledge had rolled over, one fin had been bent, and the T.V. light support tube had snapped, but fortunately the instrumentation was still intact. During the twenty-one hauls attempted during the cruise, few mechanical and handling problems were encountered apart from those of the last haul.

Transponder: This was triggered from general sledge noise and so was not able to display any of the sledge parameters it was designed for. Because there were no problems with the deployment of the sledge to full scope, all that will be required for future sledge operations is a location beacon to assist recovery in the event of the loss of the sledge.

B.J.B.
B.H.H.

Photographic Camera System

Following the decision to install two IOS Mk 4 deep-sea cameras on the TV sledge, it became necessary to equip the selected units with shutters to facilitate operation in conjunction with a video and associated flood lighting system. Power and space limitations within the camera pressure housings created a number of technical problems during the introduction of these modifications and although still in the development stage at this time, a high degree of efficiency was maintained throughout the trials.

Difficulties were experienced with shutter synchronisation when attempting to operate the two cameras as a stereo pair on the sledge as the presence of flood lighting demanded relatively high shutter speeds to eliminate image distortion in this instant. With this factor in mind, preliminary tests had emphasised the problems of attempting to mechanically align two shutters with a single strobe.

Final assembly of the second camera had not been achieved until shortly before the sailing date, therefore the time factor precluded the possibility of developing the system further at this stage and the decision was taken to operate these units as independent systems, each equipped with an individual flash.

Following the satisfactory completion of preliminary tests, colour material was used exclusively in the second camera during the final stages of the cruise. Unfortunately, examination of colour records, following processing in a shore based laboratory, revealed the fact that a high percentage of photographs obtained by the unit had been subjected to double exposure. This proved to be an unexpected set back as no evidence of multi-exposure had been discovered on monofilm developed on board during the cruise.

The automatic output control feature of the Mk 4 flash unit gained an acceptable record density level throughout despite variations in the reflective quality of subject matter covered and appreciable changes in ambient lighting levels. Partial flooding of a pressure case caused intermittent flash operation during one station. Only minor damage was sustained through salt water contamination and affected components were replaced at sea. Further shutter synchronisation problems were encountered initially when testing a recently acquired Type 374 Benthos camera on the sledge. Satisfactory results were however ultimately obtained following modifications to the associated control circuits. The Benthos camera operates in conjunction with external ancillary equipment which complicated the sledge installation and increased work loads between stations, but the unit embodies some excellent features capable of being exploited during further trials.

Invaluable experience was gained with a multi camera system in this instant and as a result, modifications will be initiated to eliminate many of the problems encountered during the cruise.

E.P.C.

Electrical Interference

Transmissions on the telex machine installed just prior to the cruise produced interference on the video and also blacked out the recording signal on the MS47.

B.J.B.

TABLE 1 LOCATIONS OF SLEDGE TOWS

Tow Number	Date	Time	Launch	Recovery	Depth (m)	Location
C81/T1*	18/6/81	0910-1200	55°48.91'N 7°38.02'W	55°50.41'N 7°34.86'W	117-132	West of Islay (C74/6-10)
C81/T2*	18/6/81	1630-2100	55°50.98'N 7°48.82'W	55°47.95'N 7°52.56'W	140-155	West of Islay (C74/6-10)
C81/T3*	19/6/81	1250-1520	56°51.76'N 8°25.90'W	56°53.16'N 8°26.84'W	134-138	West of Barra
C81/T4	19/6/81	1835-2103	57°3.4'N 8°34.6'W	57°5.4'N 8°32.7'W	138-150	West of South Uist
C81/T5	21/6/81	1150-1545	61°00.0'N 1°31.5'W	60°54.1'N 1°35.0'W	133-140	West-north-west Muckle Flugga
C81/T6*	22/6/81	0630-1015	60°45.50'N 2°37.22'W	60°44.20'N 2°36.78'W	168-198	Shelf edge west of Mainland, Shetland
C81/T7	22/6/81	1950-2230	60°21.8'N 2°02.4'W	60°21.9'N 2°07.3'W	114-121	West of Ve Skerries
C81/T8	23/6/81	0920-1240	59°20.4'N 1°59.5'W	59°18.0'N 1°55.3'W	95-108	Fair Isle Channel
C81/T9	23/6/81	1720-2105	59°16.0'N 2°2.5'W	59°20.2'N 2°3.0'W	85-104	Fair Isle Channel
C81/T10	24/6/81	0610-0907	59°39.7'N 2°37.2'W	59°42.7'N 2°34.4'W	90-94	Site of C74/88
C81/T11	24/6/81	2130-2400	59°12.2'N 4°6.3'W	59°14.4'N 4°2.2'W	114-120	North east of Sule Skerry
C81/T12	25/6/81	0926-1155	59°7.9'N 5°28.2'W	59°7.6'N 5°25.0'W	83-99	East of Rona

Tow Number	Date	Time	Launch	Recovery	Depth (m)	Location
C81/T13*	26/6/81	0605-0905	58°02.65'N 8°58.46'W	58°06.90'N 8°53.96'W	171-175	North-west of St Kilda
C81/T14*	26/6/81	1318-1725	58°01.99'N 8°17.64'W	58°05.55'N 8°18.63'W	138-144	North-east of St Kilda
C81/T15*	27/6/81	0805-1130	56°40.27'N 8°5.34'W	56°44.82'N 8°3.40'W	125-136	South-west of Barra Head
C81/T16*	27/6/81	1725-2205	56°25.06'N 8°19.28'W	56°25.60'N 8°22.26'W	146-160	West of Tiree (Discovery 1965)
C81/T17*	28/6/81	0605-0925	55°49.24'N 7°41.64'W	55°50.90'N 7°45.06'W	126-142	Site of C74/7
C81/T18*	28/6/81	1400-1635	55°48.93'N 7°45.86'W	55°47.53'N 7°42.94'W	128-131	Site of C74/8
C81/T19	28/6/81	2000-2300	55°45.7'N 8°1.1'W	55°49.8'N 7°59.7'W	112-137	Site of C74/10
C81/T20	29/6/81	0740-1015	55°42.0'N 8°53.0'W	55°45.4'N 8°54.5'W	111-118	Site of C74/19
C81/T21	29/6/81	1435-1550	55°41.1'N 9°15.2'W	55°40.3'N 9°12.8'W	126-130	Shelf edge north-west of Malin Head

*Detailed track plots prepared for these tows.

TABLE 2 STATION POSITIONS

Station No.	Date	Time	Start	Finish	Depth (m)	Gear Used	Number of Hauls
C81/1	18/6/81	2241-2324	55°48.3'N 7°51.8'W	-	145	Day Grab	5
C81/2	21/6/81	2105-2120	60°49.2'N 2°29.2'W	60°49.7'N 2°30.0'W	215	Rock Dredge	1
C81/3	21/6/81	2240-2300	60°49.3'N 2°33.4'W	60°49.8'N 2°34.5'W	250	Rock Dredge	1
C81/4	22/6/81	0025-0045	60°43.9'N 2°32.3'W	60°45.3'N 2°32.5'W	150	Rock Dredge	1
C81/5	22/6/81	1240-1310	60°47.4'N 2°36.0'W	60°47.2'N 2°37.0'W	200	Rock Dredge	1
C81/6	22/6/81	1415-1440	60°47.2'N 2°38.1'W	60°47.4'N 2°38.8'W	230	Rock Dredge	1
C81/7	24/6/81	0955-1010	59°42.0'N 2°36.4'W	59°42.2'N 2°35.2'W	75	Rock Dredge	1
C81/8	24/6/81	1115-1135	60°39.8'N 2°33.8'W	60°39.2'N 2°33.2'W	90	Rock Dredge	1
C81/9	25/6/81	1234-1326	59°07.3'N 5°23.6'W	-	105	Day Grab & Exeter Grab	6
C81/10	27/6/81	0519-0524	56°43.2'N 7°57.1'W	-	115	Day Grab	2
C81/11	27/6/81	0612-0616	56°42.0'N 7°58.8'W	-	116	Day Grab	2
C81/12	27/6/81	0650-0657	56°42.2'N 8°00.0'W	-	120	Day Grab	2

Station No.	Date	Time	Start	Finish	Depth (m)	Gear Used	Number of Hauls
C81/13	27/6/81	1217-1227	56°44.5'N 8°5.8'W	-	127	Day Grab	2
C81/14	27/6/81	1312-1318	56°41.9'N 8°5.3'W	-	135	Day Grab	2
C81/15	27/6/81	1336-1342	56°43.3'N 8°6.7'W	-	130	Day Grab	2
C81/16	28/6/81	1007-1025	55°50.2'N 7°44.4'W	-	122	Rock Dredge	1
C81/17	28/6/81	1203-1210	55°49.6'N 7°41.1'W	-	131	Reineck Box Corer	1

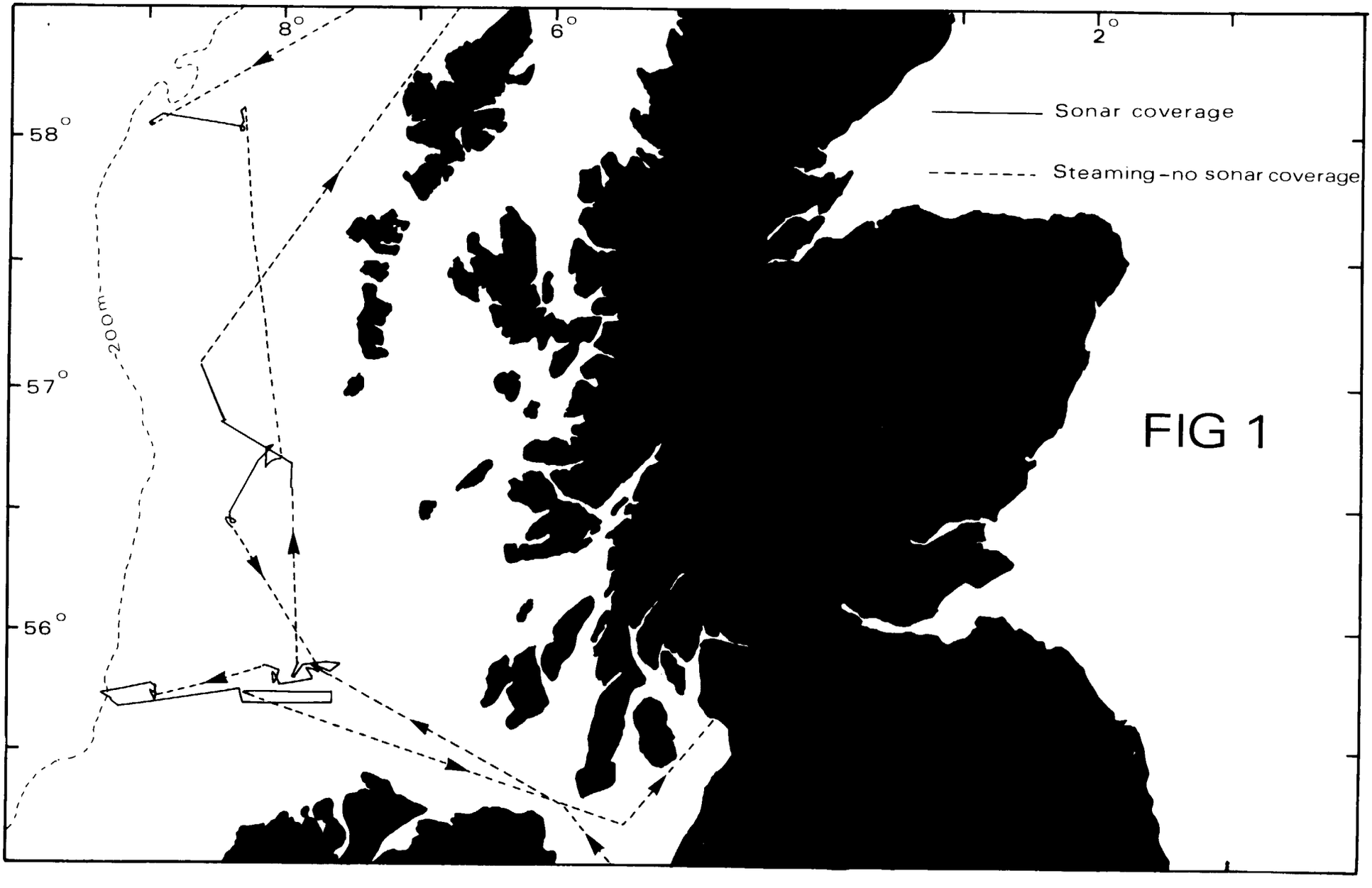
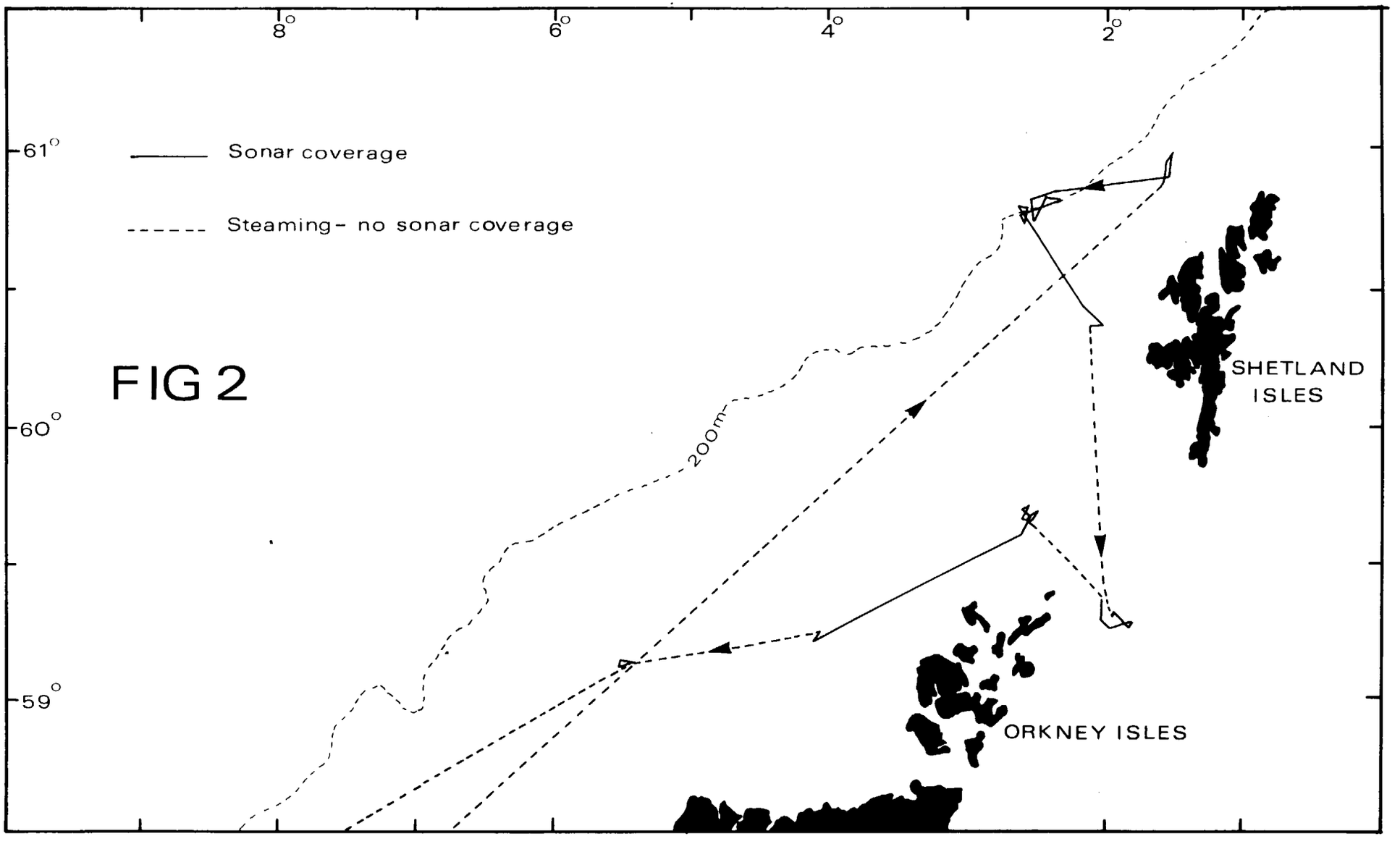


FIG 1


8°
6°
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2°
61°
60°
59°
Sonar coverage
Steaming- no sonar coverage
200m
SHETLAND ISLES
ORKNEY ISLES

FIG 2

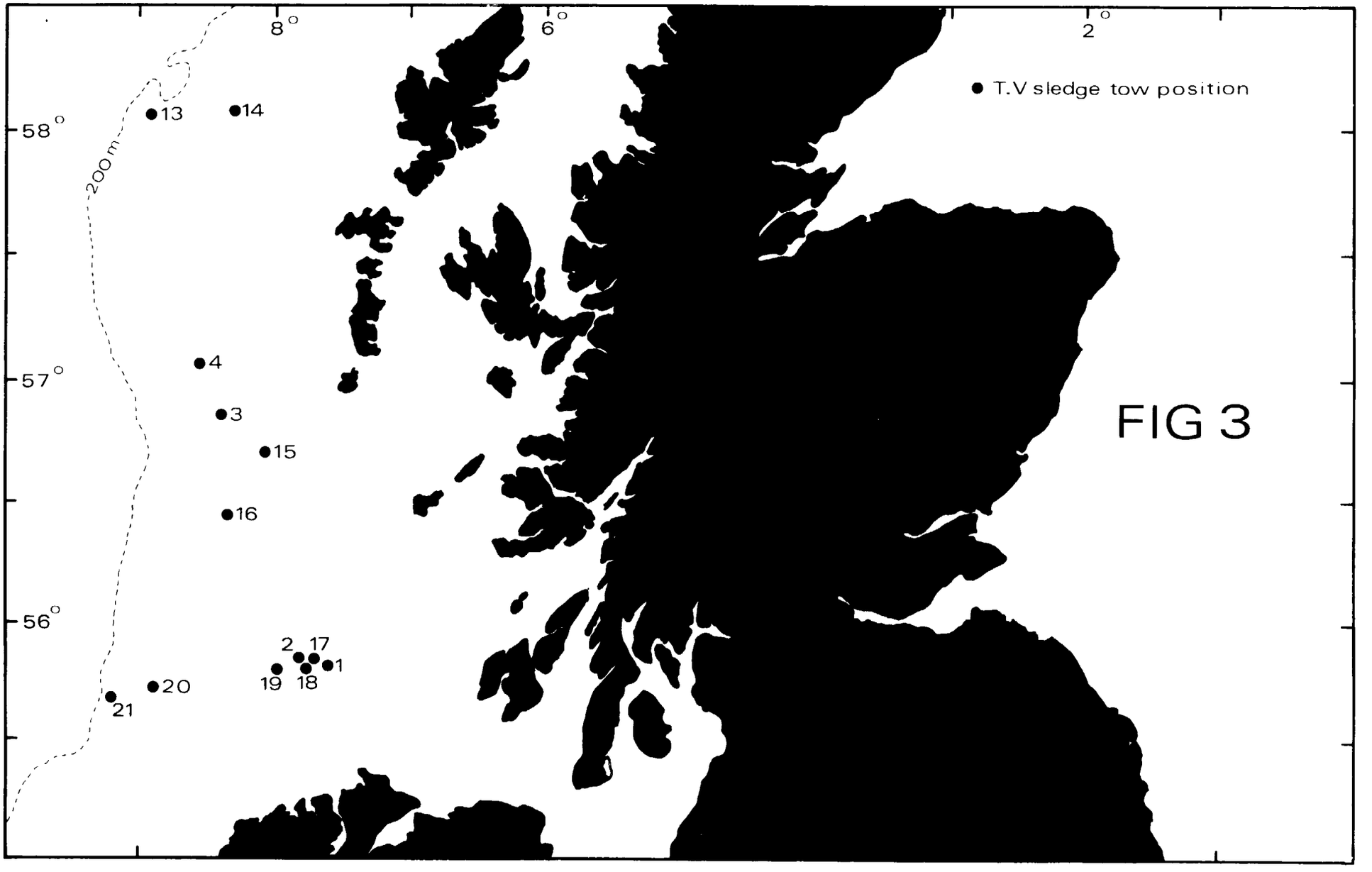

8°
6°
2°
58°
57°
56°
200m
13
14
4
3
15
16
2
17
1
19
18
20
21
● T.V sledge tow position

FIG 3

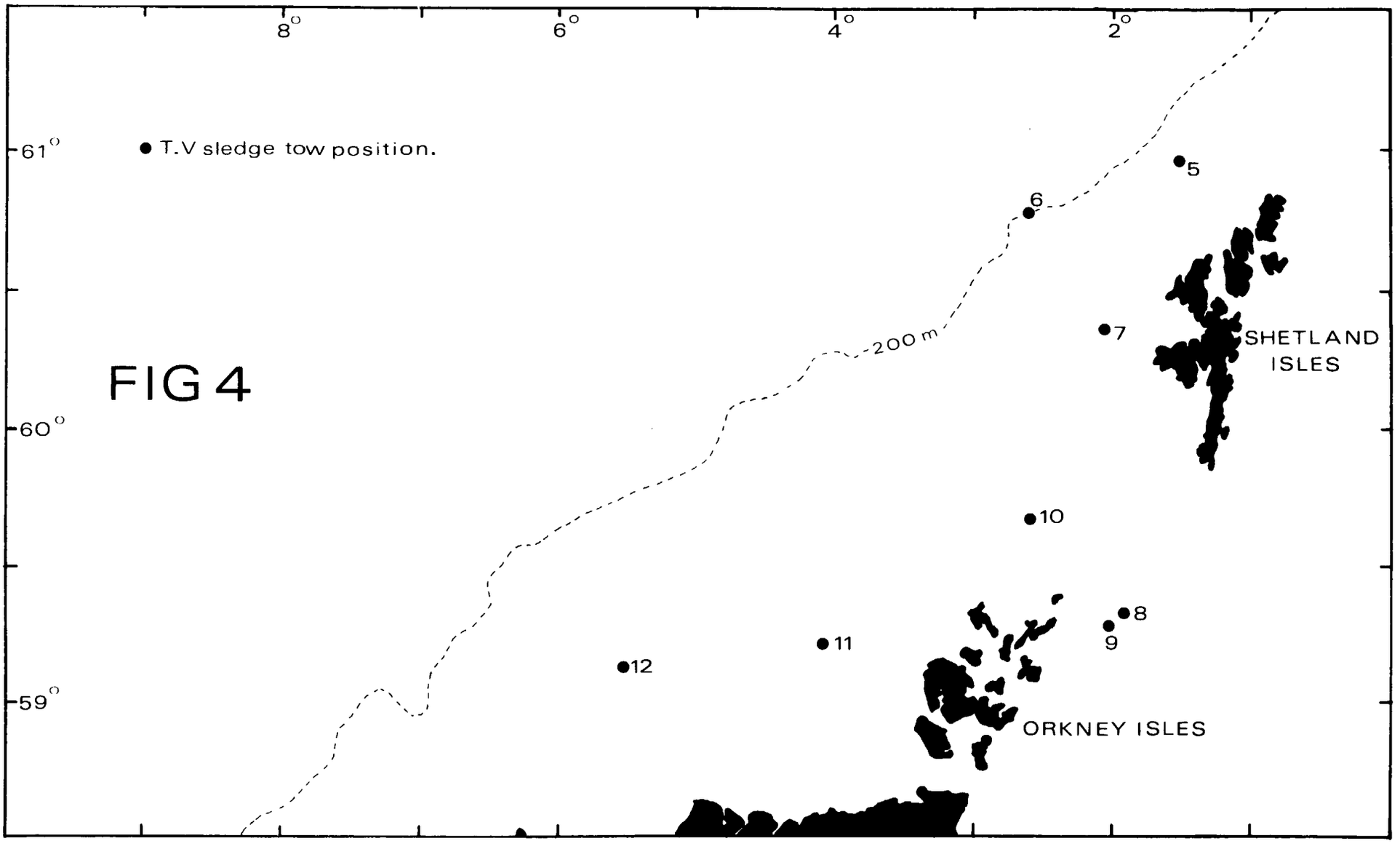

8°
6°
4°
2°
61°
60°
59°
● T.V sledge tow position.
5
6
7
10
8
9
11
12
200 m
SHETLAND ISLES
ORKNEY ISLES

FIG 4

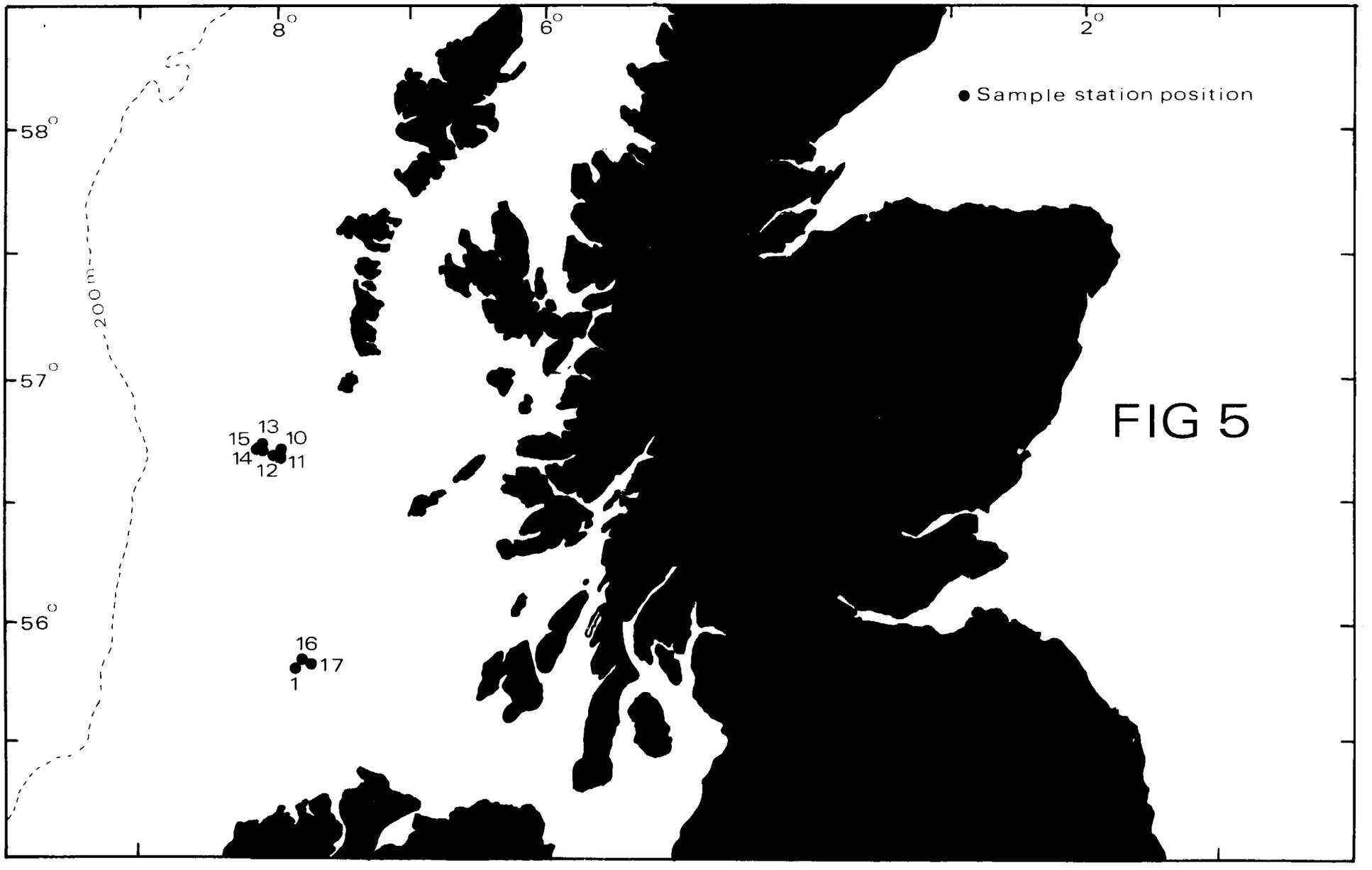
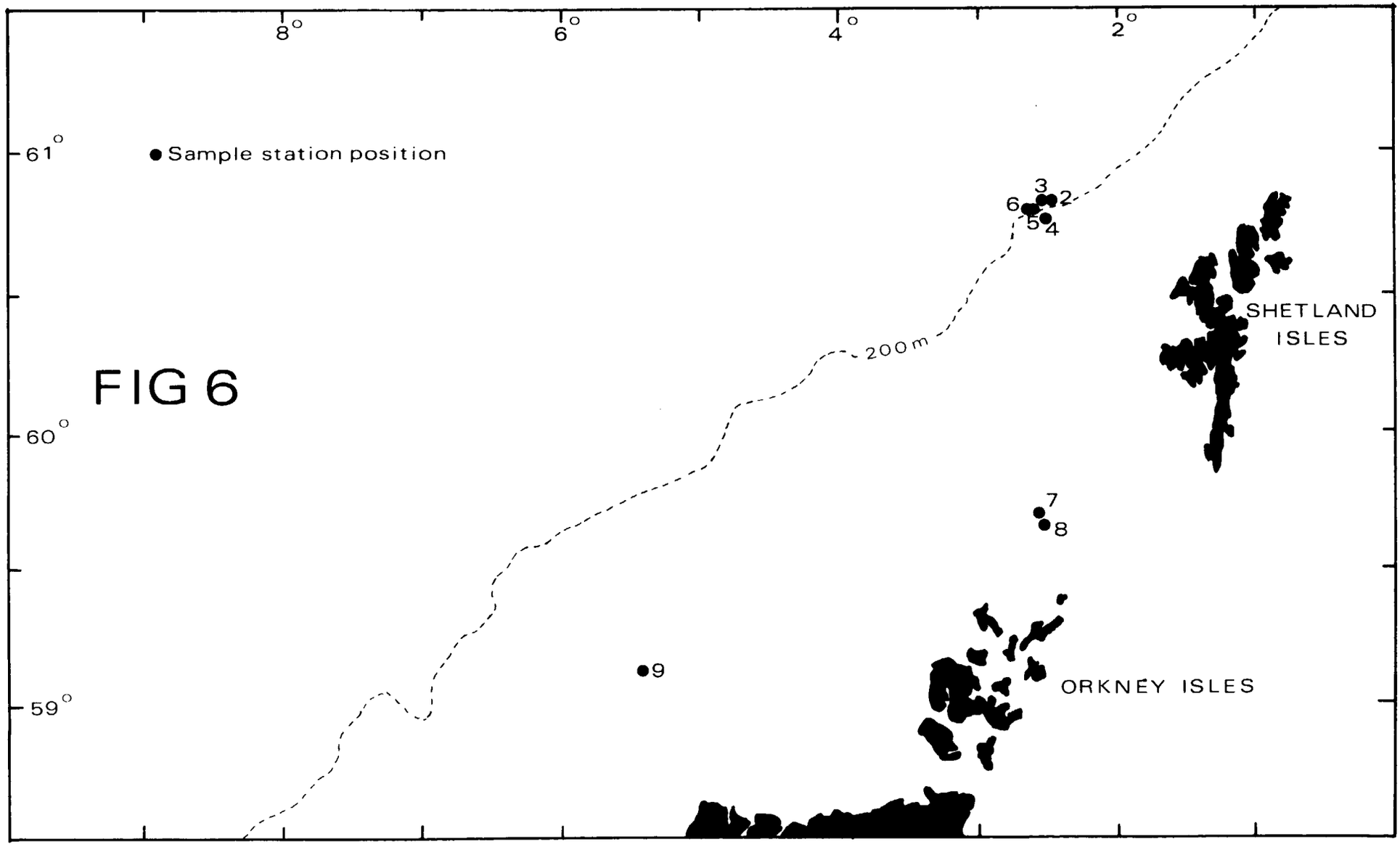

8°
6°
2°
58°
57°
56°
200m
Sample station position
15
13
10
14
12
11
16
17
1

FIG 5


8°
6°
4°
2°
61°
60°
59°
● Sample station position
FIG 6
200m
1
2
3
4
5
6
7
8
9
SHETLAND ISLES
ORKNEY ISLES