SHACK 75:
RRS Shackleton
Scotia Sea
Geophysics
November 1975 - March 1976

R.R.S. Shackleton Cruise 9/75

University of Birmingham Antarctic Research Group

November 1975 to March 1976

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1. Personnel

(a) Ship

Master: P. Warne

Mates: A. Moore, S. Mayle, P. Coombs, G. Evans, R. Coutts.

Enpineers: D. Linton, R. Johnstone, T. Rhys, R. Perriam, D. Pennie, G. Batten, B. Entwistle, B. Winchester L. Wilson.

Doctor: D. Richards

Radio Officer: A. Landry

Cat. Officer: D. Brayley, R. Hopkins.

Bosun: L. Haggis.

(b) I.O.S Barry Electronics.

M. Beney, D. Lewis, B. Hunt, S. Audley, C. Paulson.

(c) Birmingham University

P. Barker, C. Brett, J. Burrell, I. Hill, R. Jahn.
P. Roach, P. Simpson.

Most reliefs of ships and IOS personnel took place in Punta Arenas in January.

2. Cruise Summary

This report covers the 1975-6 Shackleton Antarctic Cruise, between Cape Town in November 1975 and Punta Arenas in March 1976 Appendices discuss associated geophysical operations aboard R.R.S. Bransfield and H.M.S. Endurance during the same season.

Shackleton's previous cruise had been in the Indian Ocean and she had not seen Barry since October 1974, but an extensive refit at Durban had prepared her for the Antarctic and from our point of view the only remaining drawback was that part of our shiptime had to be expended in crossing the South Atlantic against strong head winds to reach the Scotia Sea region where our interest lay. Some advantage may have been obtained from this passage by steaming along a small circle of South Atlantic opening in the hope of deducing from the magnetic anomalies when and how the original 1400km left-lateral offset of the mid-Atlantic Ridge at the Falkland/Agulhas Fracture Zone was eliminated. Apart from that, only one profile through the northern Scotia Sea' was obtained on Leg 1. Leg 2 was devoted to an examination of the relationship of the north Scotia Ridge to the ocean floor to the south, by means of a zigzag traverse eastward to South Georgia and westward again to Punta Arenas. In the western part it was established that a straightforward extensional margin occurs south of Burdwood Bank but further east the boundary is more complex and between 39° and 52°W some kind of transition zone separates the two. On the strength of Leg 2 data a request was made to H.M. Endurance and R.R.S. Bransfield for additional magnetic profiles, which they could obtain without significant expenditure of ship time above normal passage between Fort Stanley and South Georgia. Hopefully with these additional profiles the nature of the transition zone will become clear.

The major part of the third leg between Punta Arenas and Port Stanley was devoted to an examination of the southeastern boundary of Drake Passage spreading. We found an area of probably older ocean floor between the Drake Passage magnetic sequence and the south Scotia Ridge, which widened from about 20km at the Shackleton Fracture Zone in the west to more than 100km further east. In places, but not everywhere, this region appeared to show the same spreading direction as Drake Passage. Because of the time penalty, reflection profiling was not carried out Continuously through the cruise, but here sufficient was

acomplished to reveal the age relationships across the boundary.

Since Colin Brett had to be picked up from Signy I. on 1, 13 leg sufficient extra time was allowed to collect palaeomagnetic samples on Matthews I. and obtain the first reflection profiles across the South Orkney shelf, both projects on Shackleton's list for many years.

The incident with Almirante Storni which occurred at the end of this leg has received considerable publicity. The ship's company were all grateful to Captain Warne for making Fort Stanley and the consequences of stopping would probably have been extremely bad for our programme of research. As it was the consequences, although irritating, mere minor, The ship stayed an extra 10 days in Port Xtanley before being allowed out, but for Leg 4, was confined to an area of the southeast Scotia Ridge bounded by 59° and 62°S, 34° and 41(59)/43(62)°W, which it had been intended originally to visit only briefly during Leg 4. An initial reconnaissance showed the north part to have a sediment-smoothed basin and rise character. In contrast, the southeast part has a very rough, irregular topography, extending to oceanic depths but being generally more shallow. The boundary between these two provinces is a very steep south-facing scarp, about 3000 metres high, with a mega-orientation of 045° but composed of 030° sections with offsets. This might represent a later fragmentation of an originally more extensive basin and rise province, except that the rough topography continues southward with no diminution in roughness beneath the sediments of the Weddell Sea, apparently merely deepening its mean level. Four successful dredge hauls from parts of the scarp and the rough topography to the south should resolve the nature of the northern elevations, but the area remains very intriguing and in some respects apparently unique.

The return track to Punta Arenas included a further reflection profile crossing the South Orkney shelf and a traverse Of the 4Ma "dead" spreading centre south of Cape Born.

Thus Leg 4 proved extremely interesting, but our changed plans and lost time caused us to leave unfinished work across most of the Scotia Sea. In particular some lines remain to be run on the South Georgia shelf for a full understanding of the offshore geology and there is a large data gap in the central Scotia Sea which much of Leg 4 was intended to fill. In this crucial area magnetic lineations have diverse orientations and the boundaries between different provinces are not well defined.

The relationships between this complexity and the known simplicity of Drake Passage to the west and the Sandwich plate to the east are the keys to Scotia Sea evolution and the places of South Georgia and other blocks of the north Scotia Ridge in a pre-drift reconstruction.

The weather throughout the cruise was better than we expected; only on the long passage west on Leg 1, at Cape Horn on Leg 2 and for a few days on Leg 4 were particularly strong winds and high seas encountered. Ice conditions were considerably better than normal. Until south of the South Orkney Is. on Leg 3 we had seen only two bergs, and only on Leg 4 on the south Scotia Ridge were icebergs seen as frequently as in previous seasons much farther north. The new regulations about slowing to 5kts overnight when south of the Antarctic Convergence were nevertheless scrupulously adhered to, and worked well. Cooperation with the ships company on this and all other matters was excellent.

The ship itself behaved well, after its inspection and refit at Durban. Very little time was lost for engine repairs, none of which were so urgent that the ship was put in hazard. The precaution of putting into Punta Arenas mid-season lest necessary repairs exceed the capabilities of Port Stanley was wise, but in the event was not needed,

About 23 days were lost from the cruise, apart from time lost by bad weather. The ship was late leaving Cape Town and was required to arrive two days earlier than scheduled at Punta Arenas. Three times we took the longest possible route to Punta Arenas to avoid Argentina and ten days were lost in Port Stanley following the shooting incident Other consequences of the shooting were thal data from Legs 1 to 3 were left in Port Stanley for safety and did not arrive back in U.K. until May and June. Leg 4 data, all magnetic tapes, dredged rocks and equipment had to be shipped commercially from Peru and were not back in Birmingham until June, sc that we are about two months adrift in data processing.

The cruise did achieve a considerable amount of solid, useful work, which. the shooting incident must not be allowed to overshadow. There is no doubt, however, that we did not solve all of the problems we might have expected to, and we shall be asking for a further cruise. We would very much like this to be a Shackleton cruise in 1978-9, since we know the ship's capabilities and the ship's company knows us. The ship itself and her company probably worked better for us in 1975-6 even than in the very season.'

3. Narrative

Leg 1 Durban to Port Stanley - 6th Nov to 9th Dec. - Scientific personnel from Birmingham started preparation of equipment aboard Shackleton at Durban on. 31st October and by 3rd November this was completed. Due to problems with leaking portholes the ship did not sail until the morning of the 6th, and after compass adjustments off Durban, headed for Cape Town by a track off the continental shelf to obtain a magnetic profile and test all equipment. During these tests, faults were found with magnetomers, echo sounders, gravimeter and the seismic profiling system. Bad weather caused further delay resulting In the shortening of the desired magnetic profile, and the ship berthed in Cape Town at midday on the 11th after log calibration off Robben Island.

A fault in the main radio transmitter delayed sailing from Cape town untill midday on the 14th November The track across the bouth Atlantic was laid off to be a small circle about the pole **oi** opening such that when combined with the data obtained from Durban to Cape Town, the magnetic profile should indicate the motion of the Falkland Plateau away from South Africa. Due to loss of time and continuing magnetometer faults, the two parts of the profile could not be linked and it was not until midday on the 17th that the magnetomer was servicable and the profile re-commenced at 21°E longitude, with simultaneous gravity and bathymetry measurements.

The profile was continued to 39½°W on the 3rd December in predictably heavy head seas, several days being spent averaging less than 4 **knots.** Birmingham personnel maintained scientific watches and conducted tests on equipment for later use, as well as cleaning checking and assembling the Bolt airguns. The ship slowed to 5 knots during the hours of darkness whenever south of the Antarctic Convergence, first crossed on 24th November. After a brief stop for engine repairs at 39½°W the ship headed south into the Scotia Sea maintaining scientific watches, and when the ship slowed at night airgun and hydrophone streamer trials were conducted. The plastic cover of the Flexotir hydrophone sections on the 2-channel array fractured repeatedly on handling in the cold weather and much time was spent on repairs. The pre-amplifier on the E.G. and G 263 array was faulty and trouble was experienced With wave-shape kits in the airguns. All these problems were overcome before the end of the leg. The 'outboard fish for the

P E S. had its fibreglass cover carried away, with resulting damage to the transducer wiring web.

On the 7th December the 6-channel hydrophone array was streame with a 300 in^3 airgun for a continuous profile into Port Stanley across the end of Burdwood Bank and the Falkland Trough. Good sediment penetration was achieved on this line, which supplemented data from the 73/74 cruise. The ship berthed in Stanley at about midday on the 9th. The thermostat circuits in the gravimeter failed briefly during this last profile, but the meter continued to run until being serviced while in port. Richard Jahn disembarked to await the arrival of R.R.S. Bransfield, from which he would conduct a magnetic survey in the Weddell Sea (see Appendix B) Peter Barker joined ship as Chief Scientist.

Leg2 - Port Stanley to Punta Arenas · 12th Dec. co 7th Jan. Xfter loading Geoflex and Aquaflex explosives, the ship sailed in the early afternoon south-eastwards into the Scotia Sea. The objective of the leg was a detailed investigation of the north Scotia Ridge between Burdwood Bank and South Georgia, and of its relationship to the oceanic areas to the south. The 6-channel hydrophone array was streamed as the ship cleared land in order to obtain higher frequency profiling data over a buried continental shelf break using the small Bolt airguns. Unfortunately both of these developed faults but the required data was obtained by using a large gun with 40 in^3 chamber.

The period before Christmas was spent repeatedly crossing the north Scotia Ridge with continuous magnetic, bathymetry and gravity measurements and some seismic profiling. The tracks were designed to complement data from previous cruises and were themselves supplemented by data collected later in the same season by R.R.S. Bransfield and H.M.S. Endurance. The bathymetric highs of the ridge were acoustically opaque and of a varied magnetic character The oceanic boundary to the south appears complex, with poorly developed oceanic magnetic anomalies and considerable topographic relief suggesting complex fracture zones. Two dredge stations were occupied on separate blocks of the ridge and 2 or 3 hauls completed at each to collect a sufficiently large sample to offer hope of distinguishing between in situ rock types and ice-rafted erratics.

During this period the weather was generally calm but with frequent advection fog resulting from persistent northerly wind

he only work affected by heavy weather was a south to north eismic profile across the western end of the South Georgia shelf, here wave noise seriously degraded record quality. There were inor problems with the main steering gear and a main engine earing had to be replaced, necessitating an extra day alongside n Grytviken.. This work was completed on Christmas Eve, Shackleton having arrived in King Edward Cove on the 23rd and nchored until R.R.S. John Biscoe cleared the jetty. Colin Brett mbarked on Biscoe to travel to Stanley and join H.M.S. Endurance (see Appendix A). Christmas Day was spent alongside, the ship sailing early on Boxing Day.

Due to delays previously accumulated and the political necessity of sailing to Punta Arenas via the western end of the Magellan Straits, the work scheduled for the South Georgia continental shelf was restricted to a line run close inshore off the south-east end of the island to establish the magnetic signature of the known land geology, followed by a zig-zag seismic profile westwards across the southern shelf to detail the boundaries of sedimentary basins located on previous cruises.

On leaving South Georgia the main requirement was to head fairly directly westwards to Punta Arenas; the small amount of extra time available made possible a series of dog-legs, including long tracks perpendicular to the strike of Drake Passage magnetic anomalies. The first major dog-leg southward at 42°W was an objective of Leg 1, which was abandoned then because of shortage of time. Weather conditions were generally good, except for intermittent fog, so that by 1st January the ship was ahead of schedule. However the next day the weather deteriorated to a westerly gale and very slow progress was made round Cape Horn. On the morning of the 6th the weather moderated and speed gradually increased. A breakdown occurred in the Sirius gyro but the Arma-Brown was switched in and no scientific time was lost.

In the evening of the 6th Cap Pillar was rounded and the ship docked at Punta Arenas late on January 7th for the mid-season exchange of personnel.

Leg 3 - Punta Arenas to Port Stanley 10th Jan. to 4th Feb. - Shackleton sailed from Puntas Arenas at 1000 on the 10th and headed back to Drake Passage again via the western end of the Magellan Straits. The objective of this leg was to investigate the southern and eastern margins of the ocean floor region created

by the opening of Drake Passage. The track to the area was designei to collect useful bathymetric and magnetic data across Drake Passage itself, the more detailed survey beginning on 15th Jan. The bulk of the work was again magnetic, bathymetric and gravity survey, but with considerable use of the seismic profiler to examine sediment thickness and structure in critical areas. As work progressed the survey moved systematically east and north following the tectonic boundary. During this period the only notable failure of scientific equipment involved the airgun firing cable, which parted probably as a result of allowing insufficient slack when taping it to the air-hose.

By the 28th the survey had reached the central Scotia Sea, an area less well known; hence the survey lines were longer and more widely spaced. to try to establish the major structural trends of the ocean floor. Course was then laid off south-eastwards towards the South Orkney Is. where Colin Brett was to be picked up. The ship passed through Lewthwaite Strait, to anchor off Mathews 1. on the morning of the 29th. Here a four man party was landed to collect palaeomagnetic samples but was unable to reach the desired rock outcrop. Having weighed anchor a shipboard reconnaissanceof the west coast of the island was made resulting in a second landing which met with complete success.

The next 36 hours were spent collecting 6-channel seismic profiler data on two north-south tracks across the South Orkney shelf, before anchoring in Factory Cove- by the B.A.S. base on Signy I. Here Colin Brett rejoined ship after completing his work on H.M.S. Endurance. While he used the shipboard facilities to test equipment from the seismic station at Signy, the ship's company were taken on a guided tour of a nearby penguin rookery by base personnel. The ship sailed in mid-afternoon through Normanna Strait, westward round Coronation I. then north-west towards Stanley, Again the passage was taken as a dog-leg to ga: the maximum scientific use of the time, reinforcing the data collected in the previous two weeks.

After reaching the centre of Drake Passage spreading in about 58°W the ship headed due north to Stanley. Although in a well-known area scientific watches were maintained until about 1230 G.M.T on 4th February when the ship was intercepted by the Argentine destroyer Almirante Storni. The magnetometer was recovered and all other scientific equipment shut down as the ship headed for Stanley at her best speed. Six shots were fired

ahead or over the ship, the ships company spending several hours at emergency stations with the lifeboats swung out. Having been informed that Shacklaton carried explosives, the destroyer veered off to about 1½ miles range on the starboard beam. This action, in combination with the occurrence of patchy fog after 1500 G.M.T and a prompt contact with Falkland Island Radio, probably prevented further escalation of the incident. Shackleton reached Port Stanley at about 1900 G.M.T.

Leg 4 - Port Stanley to Punta Arenas 17th Feb to 13th March - The prolonged stay in Port Stanley was utilised for equipment servicing. In particular, a Satellite Navigator fault, developed in port, was repaired using replacement electronic boards flown out from U.K. The Ship eventually sailed at 6p.m. on the 17th. In accordance with instructions, no data was collected within 200 miles of the Falkland Is., the track being a direct line to the defined survey area on the south-east Scotia Ridge, When beyond 200 miles range normal scientific -watches were resumed. The only course alterations on the way to the survey area were those necessitated on the 20th when the port glass and deadlight in cabin S6 broke, to decrease the amount of water shipped during repairs.

The defined area was reached on the morning of the 21st and course set to follow the northern and eastern limits of the area. Icebergs were fairly common requiring frequent course alterations. Also a very deep depression crossed the area on the 23rd and 24th and courses were set for this reconnaissancestage of the survey to give maximum ship speed in the conditions. On the afternoon of the 24th the Bergen Log failed but was repaired next day, during which there.; was considerable fog. Overnight on 25th the seismic profiler was streamed but the single active section was punctured and water inside the streamer degraded the signal. The following night the 6-channel *arra* was used, being the only one operational, profiling being confined mainly to hours of darkness to economise on ship-time.

On the 28th the reconnaissance was terminated and a dredging Program commenced on topographic features previously identified, usually steep scarps. On this day two hauls were made in the same Place, the first losing the dredge and chain after a failure of the 5 ton weak link, but the second being successful. The following day two more dredge stations were occupied, the first successful, the second being delayed by winch failure and being recovered empty *having* lost the pinger. March 1st saw a continuation of

dredging with another successful dredge (station 1514) and approach to a further site.

At this point a second deep depression arrived and the ship was hove to until midday on the 5th. Time was now so short that course was made directly west towards Drake Passage, obtaining a long 6-channel seismic profile across the South Orkney shelf en route. Normal scientific watches were maintained as the ship passed along Bransfield Strait, through Nelson Strait and into Drake Fassage.

On March 10th the unused seismic explosive was dumped at sea, 17 charges being fired for instructional purposes. On March 11th scientific watches were discontinued and the ship arrived alongside Punta Arenas at 1230 on 13th March. Three of the Birmingham party stayed aboard to complete crating of equipment and rock samples for shipment from Calleo, while the main party flew home from Punta Arenas.

4. Cruise Statistics

Intended Cruise Length - Cape Town 10 Nov. to Punta Arenas 15 March
126 Days

Actual Cruise Length - Cape Town 14 Nov. to Punta Arenas 13 March
120 Days

Time in port (alongside 17, at anchor. 1)	18 days
Time at sea	102 days
Total magnetics time	91 days
Total gravity time	93 days
Total reflection profiling time	1 7½ day
Hove to for bad weather (data collection stopped)	3½ day
"dead" passage time (territorial limits)	4 days
Time lost for ship, engine repairs	2 days
See. Time in Scotia Sea region (i.e. omit S. Atlantic)	83 days
Scotia Sea magnetics	72 days
Scotia Sea gravity	69 days
scotia Sea reflection profiling	17½ day
Station time	2 days

5 Equipment Performance

Satellite Navigator - Worked well throughout the cruise but with minor probelms with the speed and heading interface whereby the speed was not updated satisfactorily but the problem was easily overcome by using manual update. The computer dropped its program a number of times, especially around the middle part of the cruise, there being a definite correlation between program dropping and radio transmission. Considerable improvement was made by inserting a radio interference filter in the mains line. From a scientific point of view the satellite navigator is ideally situated in the laboratory and the T.V. screen and satellite pass warning buzzer were of undoubted assistance to the bridge for timing and advisability of course and speed changes.

Gravimeter - Was its usual reliable self with only a few component failures The power supply for the thermostats failed and -the spare was inoperative. The cross axis gyro failed and the reading lamp blew once when the bow thrust was started up. There was intermittent noise on the cross coupling output of the pen recorder which was possibly due to a dirty potentiometer in the recorder itself. The gravity room door is unsatisfactory in that it has no adequate catch and handles and because of its weight it can be unwieldy in rough weather.

Varian Magnetometers - Generally were reliable after some problems at the beginning of the cruise with the two receivers and two cables which had electrical shorts on them. The magnetometer chart recorder periodically dried up and its tube.. had to be syringed through with water.

P.S.S. - Worked reliably for the duration of the cruise but there are criticisms when compared to the M.S.38. The transmitter seems less powerful and the receiver less sensitive, so much so that during dredging over rough sea floor the output from the pinger could not be detected by the outboard fish. The backing plate on the chart recorder of the P.E.S. had to be removed at the beginning of the cruise because it affected the uniformity of the timing lines. This allowed more air to flow around the paper and in warmer climates the paper became too dry for clear marking.

Airguns and Compressors - All the airguns worked very well although to begin with the 1500 series airgun and spares needed considerable cleaning and sorting. The big gun failed on the shake down cruise due to a badly corroded solenoid valve. An attempt was made to

tow the small 600 series gun at 8 knots but owing to its lack of weight it fired too close to the surface and the ship had to slow to 6 knots. A few extra weights on the tail of the gun would probably sink it to an acceptable depth. Airgun failures occurred twice due to breaks in the firing cable caused by over-stretching. Eventually a firing cable-air hose pair was made up in which most of the strain was taken by the air hose and this proved to be entirely successful. One of the small gun shuttles had been made up incorrectly in Durban thus preventing the gun from sealing. The replacement 1500 series main housing which was reported to be hot on the heels of Shackleton never arrived. The facilities for storing the guns in the rough laboretorv is still inadequate. W feel that vertical storage in simple wooden racks would be convenient and space-saving. Scaling the fun with th e valv e ge ar available is still difficult due to an supply air to t gun suf ficiently suddenly. This situation could be easily remedied by using a quick acting valve release, the valve being fully opened by a quarter turn of the screw. There are still no open ended spanners supplied with the gun and there ought to be some means of securing the gun housings during maintenance work to ease bolt extraction and replacement. The rough laboratory floor takes quite a hammering with continual gun manoeuvres and it demand replacement by a hard wearing, non-slip surface.

Streamers and Winch -- The 6-channel streamer% performance was exemplary for the short time it was used but the snme cannot be sai for the short array. Those older sections of the streamer became very brittle in cold water and suffered cracking when being rewound on the drum, The spare sections, one active and one passive, were stored on deck, tightly coiled in their containers and when they we needed they cracked in the process of unwinding. A hot water spray may have prevented this. The 263 hydrophone was reliable and usefu as a near-shot vertical incidence receiver for shallow water work b its noise level was high and we felt that considerable advantage would derive from the addition of a spring section.

Dredging - Success rate was at an acceptable level but the dredge bucket is too small and the bridle arrangement is unsatisfac in that to some extent it must act as a snow plough and thus reduce intake. A tensiometer was invaluable for monitoring the progress o the dredge but as mentioned before the pinger/outboard fish system

was unsatisfactory. A small amount of time was lost on Leg 4 due to failure of the winch motors caused by sea-water penetrating electrical wiring in the hold. Also, there was a discrepancy between the metering on the winch and the read-out in the laborator when one particular plug-in module (supposedly repaired) was in use. The inside of the winch control box on the fordeck is very corroded and would benefit from an overhaul.

General - Tha communication system is satisfactory except that a portable system should be available for use on deck thus leaving a socket in the open which could be protected from the weather muc more effectively than the present fixed terminals. A separate communication system between the bridge and the laboratory would be welcome, something a little more permanent than the baby alarm which, nevertheless, was of value at the time The glass in the light table is still inadequately supported and of course, it should be frosted.

The non-slip surface on the poop deck is a good safety featu but two of the rubber mats were washed away in a storm. The water-tight doors are still not watertight and the centre pillar of the forward doors has two top bolts still missing from before 73/74 cruise. A minor complaint is the lack of robust, reasonabl comfortable chairs in the laboratory but in general the equipment and facilities provided were excellent, especially in the degree of redundancy available.

6 Explosives

The explosives which we had aboard in the 1975-6 season -were those which had been kept in store for us by I.C.I. at Llantrisant, having been returned unused by us after the **1973-4** season. They were shipped to Port Stanley in October **1975** in the F.I.C. charter vessel nnd embarked aboard Shackleton there in December at the end of Leg 1. It was our intention to conduct a seismic refraction programme on the South Georgia shelf, originally in Leg 2 but then in Leg 4, following delays in the early part of the cruise. Unfortunately our eventual confinement to the southeast Scotia Ridge prevented even this delayed execution of our plans. The presence of explosives in our magazine on 4th February may have helped to prevent further shooting by the Almirante Storni, but had served no other purpose to that date. A quantity was sold to local representatives of Johnson Construction Ltd, builders of the new airstrip at Port Stanley, before the ship left on 17th February. Enquiries of RVB and Birmingham produced a ban on our retaining the remaining explosives aboard after the end of the cruise, for eventual return to U.K. A small amount was therefore fired on the final track to Punta Arenas in the middle of Drake Passage, for instructional purposes, and the remainder ditched in 4000m of water the same afternoon. Quantities concerned are listed in Table 2.

It is worth noting that the Aquaflex and Geoflex both fired perfectly, despite two trips to the Antarctic (i.e. 3 times through the topics) and storage for 2½ years in a variety of magazines shore and afloat.

Table 2

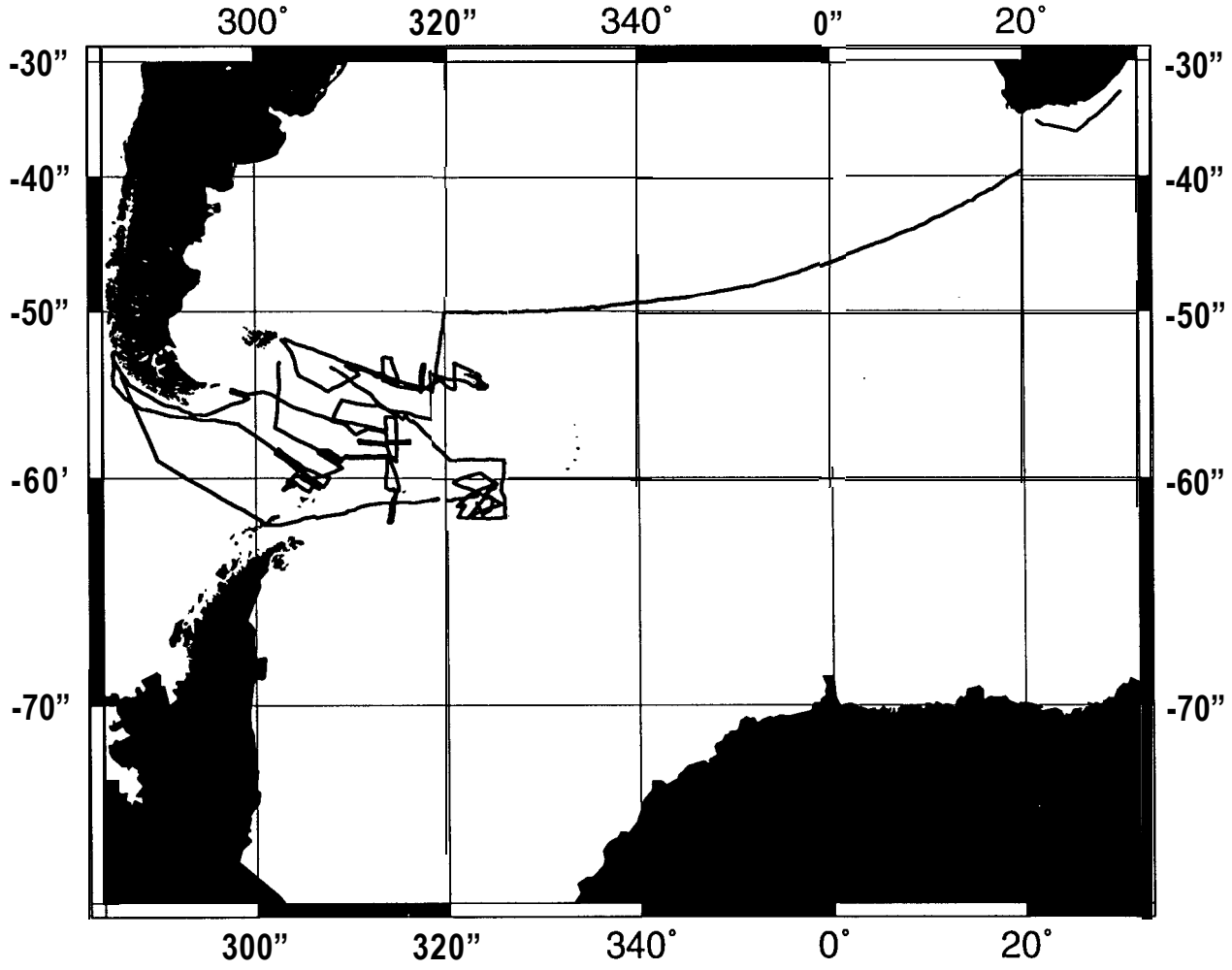
Explosives Use 1975 - 6

Type	Embarked Stanley December	Sold Stanley February	Fired Drake Passage March	Ditched Drake Pass March
Aquaflex connectors	450	-	16	434
Oceanographic cap fuses	300	-	10	290
Aquaflex 50' x 100gr	90	60	12	18
" 100' x 100gr	132	60	-	72
" 100' x 200gr	72	40	3	29
" 200' x 200gr	52	20	-	32
Geoflex 330' x 200gr	188	100	4	84

Shackleton Stations 1975-6 (Cruise 9/75)

CATION NO.	START GMT	DAY	STOP GMT	DAY	LAT S ° '	LONG. W ° '	TYFE	DREDGE NO 'S.
1509	0730	351	1832	351	53 00	46 28	DREDGE	D25, D26, D27
510	1719	355	0035	356	54 15	40 40	DREDGE	D28, D29.
511	0843	059	1737	059	60 15	34 53	DREDGE	D30, D31
512	0800	060	1300	060	60 56	35 45	DREDGE	D32.
513	2028	060	0320	061	60 49	35 58	DREDGE	D33, D34
514	0906	061	1441	061	61 Ø5	35 Ø4	DREDGE	D35.

Shack_75_magnetics



Shack-75gravity