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Department of Geological Sciences

University of Birmingham

Cruise Report

R.R.S. Bransfield

Jan. 1975 - Mar. 1975

Marine magnetic anomaly investigations in the Scotia and Weddell Seas, Antarctica.

R.A, Jahn.
April, 1975

1. Ship Personnel

S. Lawrence	Stuart	Captain
N. Beer	Nick	Chief Officer
B. Cramond	Bruce.	2nd Officer
H. Monkton	Hugh.	3rd Officer
G. Carter	Graham.	4th Officer
A. Allison	Alan	Chief Engineer
H. Speakman	Harry.	Chief Electrician
H. O'Gorman	Hugh	Radio Officer
E. Heathorn	Eric.	Catering Officer

B.A.S. Personnel

Dr. R.J. Adie	Ray	Deputy Director
Dr. N. Bonner	Nigel	Head of Life Sciences

F.I.D. Assistants

A. Allman	Andy	Physicist	Halley Bay
P. Biggs	Pete	Postal Clerk	To Port Stanley
R. Bryant	Bob	Physicist	Halley Bay
C. Cuthbert	Colin	Meterorologist	To U.K.
D. Francis	Dave	Physicist	Argentine Is.
R. Goodall	Bob	Physicist	South Georgia
B. Jones	Brian	Base Commander	To U.K.
D. Jones	Davi	Ionosphericist	To U.K.
C. Sweetingham	Clive	Ionosphericist	Halley Bay
A. Tirapani	Alan	Ionosphericist	Halley Bay

2. Introduction

Marine magnetic anomaly investigations in the Scotia Sea by the Antarctic Marine Group of the University of Birmingham during the past 15 years have helped greatly to elucidate the complicated plate tectonics of the area. However, little is known about the spreading history of the Weddell Sea and how this may have affected the Scotia Sea. The present cruise was an attempt to supplement the magnetic data obtained during a preliminary Weddell Sea reconnaissance by R.R.S. Shackleton

last season, prior to hopefully conducting a full-scale survey next season. To this end, the present cruise can be counted a success. In addition, magnetic data on several other passage lines within the Scotia Sea, and along the Brunt Ice Shelf near Halley Bay, have been collected. Table 1 lists when and where magnetic data were obtained prior to my leaving the ship at Mar del Plata or 10 March, and Figures 1 and 2 are sketch maps showing where data were taken.

A description of the various legs and preliminary results obtained follows, together with a section describing the performance of various items of ship's and scientific equipment. All times shown are in GMT.

3. Cruise Description

Leg 1. Stanley to Right Whale Bay, South Georgia

The magnetometer fish was streamed at 0000/28th January on leaving Port William harbour and laboratory watchkeepers instructed in their duties. The P.D.R. was not working properly at the beginning of this leg - the transmission pulse was being put on the extreme right-hand side of the chart record. The magnetometer was switched off at ~1506/28th January whilst the reason for the very noisy record was investigated. This was eventually traced to insufficient polarisation current being sent to the fish and magnetic survey was re-commenced at 1730/28th January. By this time the P.D.R. fault had been corrected and good magnetic data were obtained from 52° 10' S.52° 06'W to the entrance of Right Whale Bay, South Georgia at 53° 54' S.37° 40' W which was reached at 0955/30th January and the fish landed. During this leg, the satnav produced no useable fixes between 1448/29th January and 0312/30th January. However, it is hoped that recomputation of the fixes using the Doppler data may be possible at the University. Also, during a 13-hour period on 29th January, the laboratory clock gained 9 minutes! This excessive drift was reduced to a few seconds per day once the clock was shock-mounted on a layer of foam rubber.

TABLE 1

Leg No.	FROM	TO	DATA TAKEN GMT/DAY/YR	GMT/DAY/YR
1	Stanley	Right Whale Bay, South Georgia	1730/028/75	0955/030/75
2	Right Whale Bay	Stromness Bay, South Georgia	1350/030/75	1650/030/75
3	South Georgia	South Orkney Is.	2335/032/75	1220/034/75
4	South Orkney Is.	Halley Bay	0005/036/75	0640/039/75
5	Mobster Creek	Depot No. 9.	1905/044/75	2110/044/75
6	Depot No. 9.	Mobster Creek	1235/052/75	1640/052/75
7	Halley Bay	South Orkney Is.	2350/052/75	0555/056/75
8	South Orkney Is.	South Georgia	1245/056/75	2224/057/75
9	South Georgia	~ 47°S	0905/064/75	0700/066/75
10	Stanley	South Shetlands,	1020/077/75	2200/079/75
11	South Shetlands	Stanley.	1415/098/75	1853/100/75
12	Stanley	Argentine Is.	2305/104/75	1300/107/75
13	Bransfield Strait	Signy	1210/109/75	1902/110/75
14	Signy	South Georgia	2304/111/75	0713/113/75

In addition, it is anticipated that magnetics will be done between Stanley and the South Shetland Islands and vice-versa; Stanley and the South Orkney Islands; and from South Orkney Islands to South Georgia later in the season

Leg 2. Right Whale Bay to Stromness Bay, South Georgia

This short leg was done from 1350/30th January until 1650/30th January along the South Georgia coast. Little of magnetic interest was seen.

Leg. 3. South Georgia to South Orkney Island

Leg. 8. South Orkney Island to South Georgia

Leg 3 was commenced at 2335/1st February from 56° 56' S, 36° 03' W and finished at 1220/3rd February on the South Orkney Shelf. The east Scotia Basin magnetic anomalies were well seen - most of the data being satellite fixed. Only in the period from 0954 to 1448/2nd February were no good quality satellite fixes received.

The latter part of leg 8 followed a course that was parallel to the leg 3 track and about 20n.m. eastwards of it. The aim of this was to accurately determine the strike of the anomalies in the area. Previous data had been fixed by celestial navigation and the resultant anomaly orientations were only generally known. However, leg 8 had to be abandoned at ~ 2224/26th February when the ship hove to in very rough seas at 56° 25'S, 37° 30' W. Bathymetry was lost from 1730/26th February due to extreme cavitation under the ship's hull. It is hoped that a further leg parallel to these tracks and displaced a few nautical miles eastwards will be possible later in the season.

The first part of leg 8 involved magnetics around the western and northern sides of the South Orkney block. This track was selected because it was of geomorphological interest to Dr. C. Clapperton and Dr. D. Sugden of the University of Aberdeen.

Leg 4. South Orkney Island to Halley Bay

Leg 7. Halley Bay to South Orkney Island

The magnetometer fish was streamed from 60° 51' S.45° 18' W at 0005/5th February just after leaving Signy Island. Leg 4 then continued to 75° 24' S.26° 50' W via intermediate points 62° 56' S.41° 00' W and 71° 30'S.28° 00'W. Leg 7

followed a course parallel to leg 4 and between 10 n.m. and 15 n.m. westwards from it. Both the satellite navigator and the P.D.R. worked perfectly on these legs. Many anomalies were seen on both tracks, particularly between 63°S and 70°S, and a preliminary correlation of these anomalies suggests an orientation of about 90°. Thus north-south spreading may have occurred to open the Weddell Sea. Further detailed work in future seasons should help to unravel the spreading history of the Weddell Sea.

Leg. 5. Mobster Creek to Depot No. 9.

Leg. 6. Depot No. 9 to Mobster Creek

These legs along the Halley Bay coast were done at the suggestion of Dr. R.J. Adie to investigate possible magnetic anomalies associated with previously observed bathymetric features. Figure 2 shows the ship's track determined from a radar plot of the Brunt Ice Shelf, together with P.D.R. readings in metres. A large anomaly of about 1500 gammas amplitude was seen on both legs; the peak of this extensive anomaly trending as indicated by the line XX' on the figure. It is hoped that a full land-based magnetic survey may be done within the next year or so to supplement the coastal data.

Leg. 9. South Georgia to 47° S.

Cumberland Bay was left at 0730/5th March and the magnetometer streamed but it was immediately discovered that the equipment was faulty. This was eventually traced to the pin connections in the cable reel plug being damaged and so the spare fish had to be streamed. In addition, the P.D.R. was putting the transmission pulse in the centre of the chart record and this fault also had to be corrected. The leg was eventually commenced with all equipment functioning at 0905/5th March and coninued until 0700/7th March, when 47°S was passed

4. Performance of scientific and ship's equipment

a) Redifon RSN-1 satellite navigator

The general performance of this piece of equipment on hire to the University of Birmingham has been less than

perfect. The major problem was the periods of several hours when only SS04 fixes (fixes with a high residual in the computations) were produced. This meant that magnetic data collected during these periods was unfixed and thus of little value. Fortunately for the Weddell Sea data, only high quality fixes were received southbound from Signy Is. and this state of affairs continued until South Georgia was reached on the northbound track. Other small problems that have occurred include:

i) various bars of the 7-bar neon display tubes have failed.

ii) a capacitor in the rear of the high-speed paper tape reader "burst into flames" but fortunately did not impair the reader's operation.

iii) during the first half of the cruise, it was found that there was an 8-second difference between W.W.V. time-signals and the accurately maintained 2-minute "beep" transmitted from the satellite!

iv) the AUX 20 routine which defines the maximum difference between a satellite fix and the D.R. position at the fix time before the fix is used to update the computer, has apparently not been obeyed on several occassions.

By next season, these problems should have been resolved with Redifon and a vibration-free mounting devised.

b) Kelvin Hughes M.S.38 metric P.D.R.

Following its servicing in Baltimore, the P.D.R. has worked fairly satisfactorily. Only a few hours bathymetry have been lost whilst minor recorder faults have been corrected. I understand that the recorder is to undergo major servicing on its return to the U.K. and in this case, it may be very useful to extend the ship's sea-trial to deep water (> 2000m) so that the P.D.R. can be adequately tested. Its performance in the Solent is - as past experience has shown - absolutely no guide to its deep-water reliability.

If a full magnetic survey is done next season in the Weddell Sea, then it would be a good idea to have a spare recorder (on loan from the Research Vessel Base?) mounted

in the laboratory and using the same transmitter and hull transducer presently on board. Not only would this prove a useful standby instrument, but an accurate time mark from the laboratory clock system could be marked on the record rather than the present system of using the recorder's internal clock which is subject to considerable drift. Also, a laboratory P.D.R. display would allow the bathymetry to be reduced by laboratory watchkeepers as it was being obtained rather than the sounding rolls being gone through 2-3 days after thd data has been obtained.

Very little bathymetry was lost because of cavitation under the ship's hull resulting from rough seas and the hull transducer is felt to be perfectly adequate for future seasons.

c) Barringer Oceanographic Magnetometer and clock unit

Apart from periodic slidewire cleaning, the magnetometer electronic unit (on loan from the Research Vessel Base) has required no attention. The magnetometer fish was changed over at Halley Bay but had to be changed back at the beginning of leg 9 because of damage to the plug connector on the cable reel.

The clock unit has worked perfectly, only losing a few seconds per day since it was mounted on foam rubber to dampen the laboratory vibration. The event marker box also worked perfectly, providing 10-minute time marks on the magnetometer chart record.

d) Laboratory

The infamous laboratory vibration has not proven to be a problem for equipment providing it is properly shock-mounted, nor does it seem to have unduly affected most of the laboratory watchkeepers. My only complaint concerns the use of the laboratory as a general store for any odd boxes, crates, gas cylinders etc. that cannot apparently be stored anywhere else. None of this stuff was tied down

on leaving Port Stanley and this could have proved hazardous for both watchkeepers and unattended equipment in a rough sea.

The 3kW wall-mounted fan heater was adequate for most of the cruise, although additional heating would have been useful at very southerly latitudes. However, I understand that two 1kW ceiling-mounted electrical heaters will be installed for next season, and these should provide sufficient extra heating.

e) FID watchkeepers

In general, there have been no problems with FID assistance for laboratory watchkeeping. However, there was agreement amongst southbound watchkeepers that details about watchkeeping duties plus selection of assistants should occur earlier than this season. Since magnetics started as soon as I joined the ship in Port Stanley, most watchkeepers were somewhat unprepared to commence regular watches, particularly as they had only been infomred 24 hours beforehand that they would be assistants. There should be no problem in remedying this situation next season.

Acknowledgements

I am deeply indebted to Captain Stuart Lawrence and the officers of R.R.S. Bransfield for their willing assistance with, and interest in, the magnetics programme. I especially wish to thank Bruce Cramond both for supervising the navigational data and for producing the original radar map of the Halley Bay coastline from which Figure 2 is taken. I am also grateful to Harry Speakman for his prompt attention to the P.D.R. when it was faulty, and finally, I must thank all of the FID watchkeepers for their cheerful assistance at all times.

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