

INSTITUTE OF GEOLOGICAL SCIENCES

GEOPHYSICAL DIVISION

MARINE GEOPHYSICS UNIT

Report No.21

CRUISE REPORT FOR SURVEY 71/5,
m.v. RESEARCHER, 25 June - 30 July, 1971.
REGIONAL GEOPHYSICAL SURVEYS OFF NORTH-
WEST SCOTLAND

by

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OBJECTIVE

The cruise was planned entirely as a continuation of the Institute of Geological Sciences programme of regional geophysical survey of the Continental Shelf around the British Isles. The area chosen joins the Moray Firth survey completed in 1970 and the Hebrides survey completed in 1968; Marine Geophysics Unit Report Nos. 9 and 22.

As the area extends beyond the edge of the continental shelf into deep water in excess of 200 fathoms, it was decided to evaluate an airgun power source against the sparker source for work over the Continental Slope. To this end an airgun was hired from Bolt Associates, USA to be used with a low-frequency Geomechanique hydrophone. During normal survey work, a sparker source was used for shallow seismic profiling, recorded concurrently with gravity meter, magnetometer and echosounder/pinger. On board was a new data logger system undergoing first sea trials. Navigation was by Decca Hifix and Decca Main Chain.

NARRATIVE

The m.v. Researcher left Stornoway on 25 June after a 24 hour delay due to crew difficulties. After referencing the Hifix system and testing the geophysical equipment, a return to Stornoway was made to disembark one scientist and to check the gravity meter base reading. Survey work commenced late afternoon on the 26 June and continued uninterrupted until 29 June when the sparker system failed and Hifix signal was lost: operations ceased for 10 to 12 hours. Unfortunately major loss of signal in the Hifix necessitates re-referencing the system once signals have been restored but adjustments against Main Chain readings help to avoid too much loss of time. One other 4 hour Hifix loss was encountered before eventual return to Stornoway on 2 July for fresh water.

After sailing early on 3 July, the survey progressed until 6 July with only minor delays due to instrument failures. Weather conditions then gradually worsened to force 6, and in a moderate swell the ORE sub-bottom profiler winch became detached from its mountings. The winch then crashed over the ship's side but fortunately the cable did not part, and winch and transducer remained suspended

from the towing boom. The gear could not be recovered in the heavy seas, and the ship had to be taken to shelter off Stornoway before such a recovery was possible.

Diving facilities had been requested to stand by at Stornoway but fortunately these services were not required. Stornoway was entered late that day for equipment repairs to be carried out.

Survey work was continued in the Minch using Main Chain Decca for the following two days until a return to Stornoway on 8 July for a scheduled stop.

The m.v. Researcher left Stornoway on 11 July after being delayed by bad weather and surveying continued for two days when the ship had to return to Stornoway because of a crew-members illness. After a brief stop, surveying continued in the Minch for the rest of the day. Unfortunately worsening weather forced an abandonment of work and the ship went to anchor overnight. During the bad weather the ORE frame was again damaged.

As the weather was still very bad on 14 July decided to return to Stornoway for shelter and for extensive modifications to the ORE installation. Sailing was delayed due to bad weather till 16 July but the seas were too rough to work so the ship lay at anchor for another day.

Better weather conditions of 17 July saw the start of surveying again. As the weather calmed considerably it was decided to head for deep water and use the airgun. Previously on 9 July a new davit had been fitted aft for towing the system. The airgun was successfully launched and fired and the Geomechanique hydrophone was then launched. Very good records were obtained with the system over the next 48 hours or so despite faults in the compressor and a broken air hose. Work had to be adjourned on 20 July for a return to Stornoway to change personnel and to repair part of the data logging system.

The m.v. Researcher left Stornoway late on 21 July and surveying continued, except for a 12-hours break due to bad weather, until 28 July when the Captain had an accident and required medical attention. The ship arrived in Stornoway in the early hours of the morning of 29 July. As this was only 18 hours before the scheduled end of the cruise it was decided not to sail again but to spend the time

packing up equipment. The ship was demobilised by mid afternoon of 30 July. Weather conditions during the last leg of the survey were never good and the resulting records were not of the best. However quite a lot of work was achieved.

INSTRUMENTATION

La Coste - Romberg gravity meter: Very little trouble was encountered with this instrument. The only failures recorded were when signal interference from the data logger occurred and this was found to be associated with removal of the plugs to the encoder unit. Secondly, some record was lost when adjustments were made at sea to the platform. Quite rough sea states and at times quite a large swell were encountered and the gravity meter behaved very well under the circumstances. On three occasions due to severe rolling the platform went off level which may have been due to the platform hitting the stops in the transverse (x) axis.

Barringer magnetometer: Difficulties were encountered only twice. The first, an excessively noisy signal, was self-cured without repairs being made. A recurrence of this fault was overcome by changing the fish, and one suspects that some water may have entered the junction between the cable and transducer, but time did not allow us to check the defective fish. Otherwise records were good and no trouble was encountered.

E.G. & G. Shallow Seismic System: On board at least one complete set of equipment was kept on standby so that breakdowns did not necessarily stop work. For most of the survey the system was run at 1000 joules using a RVU or CALAN multi-electrode spark array. There were two recorders on board - an E.G. & G. 254 and a Huntec Mk II A. The E.G. & G. 254 gave good service though the gain controls could be modified to produce better results. The Huntec recorder is not properly matched to the 263C hydrophone and the amplified signal from the hydrophone tends to overload the recorder giving noisy records. However, when using the airgun and Gas^{cs} mechanique hydrophone, the Huntec is far superior to the 254 recorder. The paper drive system appears to be out of alignment in the Huntec and after several minutes operation, creases occur on the paper. This fault has not been properly corrected yet. The playback system with the Huntec has been little used due to faults in the tape

recording system.

Faults have occurred both trigger units on board. Two condensers blew in one unit and it is now operational on 800 joules only, a fault in the safety line probably added to a short circuit occurring in the capacitors. Other faults were few and little or no time was lost using this equipment.

ORE Sub-bottom Profiler: The ORE was used throughout the survey, mainly as an echosounder though when possible sub-bottom echoes have given geological information. The instrument itself gave little trouble except when paper dust collected on the optical system. The mounting on deck however proved on two occasions to be inadequate. In a moderate to heavy swell the ORE transducer heaves in the water causing severe strain to the winch mounting. Twice this mounting broke from the deck and on one occasion went over the ship's rail. Fortunately nothing was lost and modifications made in Stornoway should have solved the problem. In weather and sea states greater than 6, normal survey work was continued but the ORE was recovered and not used.

Bolt Airgun and Geomechanique Hydrophone: These provided the basis of the deep water seismic equipment and will be discussed together. The airgun worked continuously with no trouble for quite long periods. The only break downs in firing were due to the compressor which was plagued by dirty fuel and to broken air hose which was easily replaced. It had been originally planned to tow the gun alongside the ship from the forward ship's derrick but the vibration was too severe. Therefore a new davit was made and fitted aft and the gun was towed over the stern using the after ships derrick. This arrangement proved very successful.

The hydrophone was towed astern and had to be manhandled throughout as no winch was available from R.V.U. Recovery proved not as difficult as first imagined but it took about 10 people nearly an hour before complete recovery was possible. Both active sections were used and tested and both worked well giving excellent results when used with the airgun and the Huntec recorder. Sparker sources proved inadequate and were in the wrong frequency spectrum at the power tried (5000 joules) to give good signals for this hydrophone.

Hifix Navigation: The Hifix receiver was fitted to the ship at Stornoway previous to the start of the survey. The chain had been set up and was in operation before we sailed. A Decca Engineer was on board the ship for the whole of the survey. The master station was at Cape Wrath with the two slaves at the Butt of Lewis and Westray in the Orkneys. A single side band radio had been installed so we were in constant communication with the stations and this proved most useful.

To reference the Hifix set meant crossing the base line extensions which were conveniently situated round Cape Wrath. This referencing was done whenever the ship left Stornoway or when the signal was lost. For small periods of signal loss surveying could continue using Main Chain Decca until reference area was reached again. Time lost during the survey which could be attributed to loss of signal has been small, no more than about 48 hours in all. Accuracy within the system has been very good.

Plotting was on a 1:100,000 UTM series of sheets prepared with the Hifix lattice printed on them. Fair charts of 1:100,000 and 1:250,000 UTM series were contracted to be drawn by Tilbury surveyors, and facilities for doing this were available on board the ship.

RESULTS

During the period of the cruise over 3,100 nautical miles or 5,800 kilometres of survey line were surveyed. The quality of the records were generally good, but when the weather was poor, record quality suffered accordingly, especially the gravity records. During the survey over 200 kilometres of line were surveyed using the airgun and Geomechanique hydrophone in water depths well in excess of 100 fathoms. Resolution was good and over 1 second of penetration was recorded for most of the area surveyed. At all times a geologist from the Continental Shelf Unit II was on board interpreting the seismic and magnetic results.

Gravity values were noted at the 10 minute fix interval allowing for $3\frac{1}{2}$ minutes delay and Bouguer Anomaly values were calculated. These were plotted on 1:250,000 UTM sheets, then contoured to give a provisional anomaly map. A final gravity map will be produced when the results have been digitised and computer reduced in London Office.

Unfortunately it was not possible to interface the gravity meter to the data logger during this cruise which would have obviated the need to digitise analogue records.

TABLE I
PERSONNEL

NAME	UNIT	LEG 1	LEG 2	LEG 3
M C Tully	M.G.U.	P.C.	P.C.	P.C.
S E Arnold	M.G.U.	*	*	*
R A Floyd	M.G.U.	*	*	-
N Kenolty	M.G.U.	-	*	*
B Billen	M.G.U.	*	-	-
M Bacon	M.G.U.	-	-	*
R Ferrari	M.G.U.	-	-	*
R Bradley	R.V.U.	*	*	*
J Perry		-	-	*
N Fannin	Cont. Shelf II	*	-	-
C Deegan	Cont. Shelf II	-	*	-
N Ruckley	Cont. Shelf II	-	-	*
D Smith	Tilbury	*	*	*
I Stiffle	Tilbury	*	*	*
I Diprose	Decca	*	*	*
G A Day	M.G.U.	was on board for one day of the 1st leg		

Key:

P.C. Party Chief

* On board

TABLE II
SYNOPSIS OF DATA OBTAINED

<u>Line</u>	<u>Date</u>	<u>Gravity</u>	<u>Mag</u>	<u>PDR</u>	<u>Data</u> <u>Logger</u>	<u>Sparker</u> <u>Energy</u>	<u>Type</u>	<u>Bolt</u> <u>Airgun</u>	<u>Fix</u> <u>Nos.</u>	<u>Miles(n)</u>	<u>Kilom</u>
1	26.6.71	Fix 12~	*	*	-	1000J	Calan	-	102	135	250
2	27.6.71	*	*	*	-	1000J	Calan	-	72	80	148
3	28.6.71	*	*	*	-	1000J	Calan	-	61	73	135
4	28.6.71	*	*	*	-	1000J	RVU	-	67	75	139
5	29.6.71	*	*	*	-	-	-	-	29	33	61
6	29.6.71	*	*	*	*	900J	Calan	-	54	67	124
7	30.6.71	*	*	*	*	900J	Calan	-	62	70	130
8	30.6.71	*	*	*	*	900J	Calan	-	14	38	70
9	30.6.71	*	*	*	*	900J	Calan	-	91	65	120
10	1.7.71	*	*	*	*	1900J	Calan/RVU	-	41	52	96
11	1.7.71	*	*	*	*	1900J	Calan/RVU	-	40	52	96
12	2.7.71	*	*	*	*	900J	Calan	-	97	132	244
13	3.7.71	*	*	*	*	{ 900J 1000J	{ Calan RVU }	-	56	77	142
14	4.7.71	*	*	*	*	1000J	RVU	-	54	72	133
15	4.7.71	*	*	*	Mag Log	1000J/ 3000J	RVU	-	53	72	133
16	4.7.71	*	*	*	Mag Log	1000J	RVU	-	51	72	133
17	5.7.71	*	*	*	Mag Log	1000J	RVU	-	53	71	132
18	6.7.71	*	*	*	Mag Log	1000J	RVU	-	44	68	126
19	6.7.71	*	*	-	Mag Log	1000J	RVU	-	19	24	44
20	7.7.71	*	*	-	Mag Log	1000J	RVU	-	16	23	43
21	7.7.71	*	*	-	Mag Log	1000J	RVU	-	17	27	50
22	7.7.71	*	*	-	Mag Log	1000J	RVU	-	19	31	57
23	7.7.71	*	*	-	Mag Log	1000J	RVU	-	20	31	57
24	8.7.71	*	*	-	Mag Log	1000J	RVU	-	13	16	30
25	8.7.71	*	*	-	Mag Log	1000J	RVU	-	20	26	48
26	8.7.71	*	*	-	Mag Log	1000J	RVU	-	4	5	9
27	8.7.71	*	*	-	Mag Log	1000J	RVU	-	3	5	9
28	11.7.71	*	*	*	Mag Log	1000J	RVU	-	82	84	156
29	12.7.71	*	*	*	Mag Log	1000J	RVU	-	70	84	156
30	13.7.71	*	*	*	Mag Log	1000J	RVU	-	24	32	59
31	13.7.71	*	*	*	Mag Log	1000J	RVU	-	10	12	22
32	17.7.71	*	*	*	Mag Log	1000J	RVU	-	63	91	168
33	18.7.71	*	*	*	Mag Log	1000J	RVU	1000psi	66	83	154
34	18.7.71	*	*	*	Mag Log	3000J	RVU	1000psi	60	75	139
35	19.7.71	*	*	*	Mag Log	3000J	RVU	1000psi	42	53	98
36	19.7.71	*	*	*	Mag Log	-	-	1000psi	33	45	83
37	19.7.71	*	*	*	Mag Log	-	-	1000psi	11	17	32
38	19.7.71	*	*	*	Mag Log	-	-	1000psi	29	43	80
39	20.7.71	*	*	*	Mag Log	-	-	1000psi	12	15	28
40	20.7.71	*	*	*	Mag Log	1000J	Calan	-	32	45	83
41	22.7.71	*	Noisy Fixes	*	* * *	1000J	Calan	-	21	25	46
42	22.7.71	*	40-69	*	*	1000J	Calan	-	69	85	158
43	22.7.71	*	*	*	*	1000J	Calan	-	65	87	161
44	23.7.71	*	*	*	*	1000J	Calan	-	70	90	167
45	23.7.71	*	*	*	Mag Log	1000J	Calan	-	48	60	111
46	24.7.71	*	*	*	*	1000J	Calan	-	37	58	107
47	24.7.71	*	*	*	Mag Log	1000J	Calan	-	62	82	152
48	25.7.71	*	*	-	Mag Log	1000J	Calan	-	78	72	133

<u>Line</u>	<u>Date</u>	<u>Gravity</u>	<u>Mag</u>	<u>PDR</u>	<u>Data</u> <u>Logger</u>	<u>Sparker</u> <u>Energy</u>	<u>Type</u>	<u>Bolt</u> <u>Airgun</u>	<u>Fix</u> <u>Nos.</u>	<u>Miles(n)</u>	<u>Kilom</u>
49	26.7.71	*	*	-	*	1000J	Calan	-	63	86	159
50	26.7.71	*	*	*	Mag Log	1000J	Calan	-	78	88	163
51	27.7.71	*	*	*	Mag Log	1000J	Calan	-	42	48	89
52	27.7.71	*	*	*	Mag Log	1000J	Calan	-	35	44	81
53	28.7.71	*	*	*	Mag Log	1000J	Calan	-	35	42	78
54	28.7.71	*	*	*	Mag Log	1000J	Calan	-	36	43	80
55	28.7.71	*	*	*	Mag Log	1000J	Calan	-	14	16	30
56	28.7.71	*	*	*	Mag Log	1000J	Calan	-	53	70	130
									<u>Total</u>	3167	5862

* records obtained

AREA SURVEYED

