INSTITUTE OF GEOLOGICAL SCIENCES

GEOPHYSICS DIVISION

MARINE GEOPHYSICS UNIT
REPORT NO. 14 PROJECT NO. 70/5

CRUISE REPORT FOR m.v. SURVEYOR
4 September-14 October, 1970

Surveys in the Barra Head area

by

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Personnel

The project was organised to utilise a period when a Navy Hi-fix Chain was established in the area, the period being split into four parts; the personnel involved in each of the cruise legs being as follows:

P.C = Party Chief C.S = Chief Surveyor

Leg 1	Sept 4-14	M C Tully (P.C)	IGS MGU
		N Kenolty	IGS MGU
		C Deegan	IGS CSU II
		T Fitton	NERC RVU
		J Pearson	Student Worker
		I Inoue	Visiting Scientist
		A Mould (CS)	Hunting G & G
		Two Surveyors	Hunting G & G
	Sept 4-10	R McQuillin	IGS MGU
		R A Floyd	IGS MGU
Leg 2	Sept 15-23	M C Tully (PC)	IGS MGU
		S E Arnold	IGS MGU
		M Hands	IGS MGU
		C Deegan	IGS CSU II
		T Fitton	NERC RVU
		M Konorniczak	Student Worker
		A Mould (CS)	Hunting G & G
		Two Surveyors	Hunting G & G
	Sept 15-19	T Francis	IGS Blacknest
		I Porter	IGS Blacknest
Leg 3	Sept 24-Oct 1	M C Tully (PC)	IGS MGU
		S E Arnold	IGS MGU
		R A Floyd	IGS MGU
		M Hands	IGS MGU
		C Deegan	IGS CSU II
		T Fitton	NERC RVU
		A Mould (CS)	Hunting G & G
		Two Surveyors	Hunting G & G

Leg 4	Oct 2-14	J Sunderland (PC)	IGS MGU
		S E Arnold	IGS MGU
		M Hands	IGS MGU
		D Ardus	IGS CSU II
		D Thomas	RVU
		P Frith	Bath University
		J Joseph	Bath University
		A Salkield	Bath University
		A Mould (CS)	Hunting G & G
		Two Surveyors	Hunting G & G
	2-7	C O'Brien	IGS AGU

Narrative: Leg 1

Commencement of the survey was delayed over 24 hours because the Decca Hi-fix Chain had been set up transmitting the incorrect frequency. Through contact with the master station on Colonsay, ship receiver crystals were changed as a temporary measure until the whole Chain could be adjusted. During the rest of the leg only a very limited amount of survey work was possible due to bad weather, the ship eventually seeking shelter in Oban on September 10th. A further period of work was possible between September 12th and 14th, but altogether only about 600km of line were surveyed during the entire leg, and less than 30% of time had been engaged on productive survey.

Narrative: Leg 2

The ship, during this leg, was operated on manual steering due to an equipment failure in the ship's automatic steering system. First job after leaving Oban was to visit Colonsay to have the ship's Hi-fix equipment re-crystalled, the Chain having been changed over to its specified frequency during the in-port period. Hi-fix signal was lost on one occasion and re-referencing was necessary. Virtually no time was lost due to bad weather. About 24 hours were spent on an attempt to test a pop-up seismic system for Dr T Francis (IGS Blacknest Group). The pop-up system was dropped in deep water east of Barra late on 18th September, but on returning to the site early on 19th September no trace of either marker buoy or pop-up system was to be found. A search was made until late on 19th September, then abandoned and routine surveying oontinued. On 20th September Messrs Tully and Deegan transferred

to HMS Hecla, then working in the area, for a short visit to observe the Navy's geophysical operations. Approximately 1000km of line were surveyed during this leg.

Narrative: Leg 3

Weather during the period of Leg 3 was so bad that only 18 hours productive work was possible, though a number of attempts were made to commence surveying. Force 10 gales and a large Atlantic swell made work impossible for most of the time, and such work as was achieved was undertaken in marginal conditions. This leg was terminated 2 days early because of continuing severe weather forecasts.

Narrative: Leg 4

Work planned for this leg included, as well as routine surveying, trials with a Bath University sonar equipment, and an attempt to locate the pop-up seismograph lost during Leg 1. Bad weather severely hampered all project work, and the first job could not be attempted until 5th October, the ship having to shelter off Barra during yet another period of gale-force winds.

Early on 5th October, a deep-tow sonar system was put into operation to search the area in which the pop-up seismograph had been lost. Unfortunately, this resulted in a further loss of valuable equipment, the sonar fish, after this had struct a submarine peak. This peak was not shown on the Admiralty Chart being used on the ship; even though at its summit the water depth was only 25 fathoms in surrounding depths of at least 80 fathoms. In future, it is clear that a bathymetric survey should always precede a deep-tow search with a sonar fish; also, a fairly high-speed cable winch is necessary so that adjustments of tow-depth can be made in quick response to detected topographic variations.

After the loss of the sonar fish, the ship was again driven to shelter for a further 45 hours of gales and force 10 storms. When these had passed the ship returned to the seismometer site and in moderately good conditions an acoustic command was operated in a further attempt to surface the pop-up system. This failed. Search for the instrument was therefore abandoned.

The next task was that of evaluating the Bath University sonar system, but first, C O'Brien was landed on Tiree to allow him to return to London. Although sea-state was only about 4, Commander Frith was reluctant to launch the sonar fish, so the ship was again delayed, awaiting calmer conditions. A 30m tow cable was used allowing only 15m submersion of the fish, thus limiting trials to areas of depth less than 100m. Firstly, a 6 x 1 km strip of outcrop area was scanned in the Passage of Tiree with E-W and W-E profiles, of which part was also scanned with N-S and S-N profiles (Fig 2). Secondly, an area near Skerryvore of more variable sea bed conditions was studied, with expected sediment type variations as well as possible outcrops. On completion of this work, the Bath equipment was evaluated along Line 30 (Fig 1) for performance during routine regional geophysical surveys using gravity meter, magnetometer, sparker etc. The sparker caused some interference with the sonar but this varied with the spark source used and may have been due to electrical pick-up rather than acoustical interference; in any case it was not serious. The major limitation of the Bath system was seen to be operational rather than instrumental. As soon as sea state 4 was reached, Commander Frith judged that conditions were too rough for continued use. Normal routine geophysical operations are possible up to sea-state 6 and in British waters, a high percentage of productive time at sea is worked between states 3 and 6.

Routine surveying continued for a further period before yet another gale forced an early return to Oban on the evening of October 9th for a scheduled call in port. The ship sailed again early on October 11th to enjoy a period of almost perfect weather. About 3 hours were lost because of slow communication by R.T with the Hi-fix master station. It should be noted that provision of an SSB radio is essential on all projects using Hi-fix. Some 3 hours gravity data were lost due to overheating of the optics "chopper" motor. Good results and high productivity continued until 13.00 hrs on October 14th when the survey work ended. Work achieved during this leg included a further 520 line-km.

Equipment Performance

LaCoste Romberg Gravity Meter: No major faults occurred. Difficulty with analogue readout was traced to dirty contacts and quickly remedied. The instrument worked well on both 50Hz and 60Hz supplies. No damage resulted from the severe weather, even though, due to one spell of unexpectedly heavy rolling, the platform had been hard against its stops before the operator was able to clamp and secure it. Base connections at Oban showed negligible drift.

E G & G seismic profiling equipment: A number of minor faults occurred but all were quickly repaired. Lines were surveyed using either 1000 joule or 2000 joule sparker sources. When 2000 joules were used, an E G & G 9-element sparker was fired simultaneously with a Geomechanique multi-electrode sparker source, each at 1000 joule. Over the continental slope, 7000 joule was used but poor penetration resulted. The system was not suited to deep water work, being designed, in terms of both source and hydrophone, as a relatively high-frequency seismic system. Work over the slope will require low-frequency hydrophone arrays and low-frequency sources, such as air-guns, if good results are to be obtained. A Huntec Mk 2A seismic recorder was kept mainly on stand-by due to there being a shortage of consumable spares for this equipment; also, it was subject to high noise levels, the cause of which was not traced until after the cruise was over.

Varian magnetometer: The system worked without fault.

MS 32 Echo-sounder: This echo-sounder was adequate for most survey requirements up to depths in excess of 200 fathoms. Theequipment was bar-checked every few days.

Sonar equipment: For most of the survey the ship's Simrad sonar was in operation. The transducer mounting system devised by RVU for the MS43 was very susceptible to sea and harbour damage so that operations with this equipment were severely limited.

Other equipment: Separate reports have been prepared on operations with the Bath sonar, and on the trial with the sea-bottom seismograph.

Results

Figure 1 and Table 1 give summaries of the amount of data obtained on routine survey. Productivity during this project was very low due mainly to prlonged periods of very bad weather. Trials with the sea-bottom seismograph, its loss and subsequent attempts to find it were also very time consuming. Trials with the Bath sonar were very successful in that good results were obtained and the main limitations of the system were defined.

A Bouguer anomaly gravity map for the area was prepared and cross-over erros were not generally greater than $\pm$ 2 milligals in an area of large anomaly variations.

Interpretation of the seismic results, commenced on the ship, is continuing and will be incorporated in future published geological interpretations.

It should be noted that corrections for tidal variation, which in the area is less than 2m, were considered of questionable value, and were not applied to bathymetric reduction during Leg 4. Depths are accurate to about $\pm$ 1.5m, the main limitation being the accuracy to which the echo-trace could be read in large sea-state conditions.

TABLE 1

Coverage of Survey Lines

J = Joules, sparker source energy * = Record obtained

Line No	Grav.	Sparker	Mag.	Sonar	Miles	MS32
1	*	1,000J	*	*	16	*
2	*	2,000J	*	*	32	*
3	*	"	*	*	28	*
4	*	"	*	*	24	*
5	*	"	*	*	23	*
6	*	"	*	*	33	*
7	*	"	*	*	80	*
8	*	"	*	*	8	*
9	*	"	*	*	18	*
10	*	"	*	*	60	*
11	*	1,000J	*	*	22	*
17	*	2,000J	*	*	49	*
13	*	"	*	*	60	*
14	*	"	*	*	49	*
15	*	"	*	*	35	*
16	*	"	*	*	59	*
17	*	"	*	*	35	*
18	*	"	*	*	41	*
19	*	"	*	*	57	*
20	*	"	*	*	16	*
21	*	"	*	*	51	*
22	*	"	*	*	48	*
23	*	"	*	*	45	*
24	*	"	*	*	25	*
25	*	"	*	*	37	*
26	*	"	*	*	20	*
27	*	"	*	*	67	*
28	*	"	*	*	27	*
29	*	"	*	*	19	*
30	*	"	*	*	37	*
31	LINE ABANDONED					
32	*	"	*	*	72	*
33	*	"	*	*	29	*

Line No	Grav.	Sparker	Mag.	Sonar	Miles	MS32
34	*	2,000J	*	*	26	*
35	*	"	*	*	17	*
36	*	"	*	*	19	*
37	*	"	*	*	15	*
38	*	"	*	*	42	*
39	*	"	*	*	44	*
40	*	"	*	*	57	*
41	*	"	*	*	10	*
42	*	"	*	*	12	*
43	*	"	*	*	18	*
44	*	"	*	*	20	*

FIG 1 (EAST)

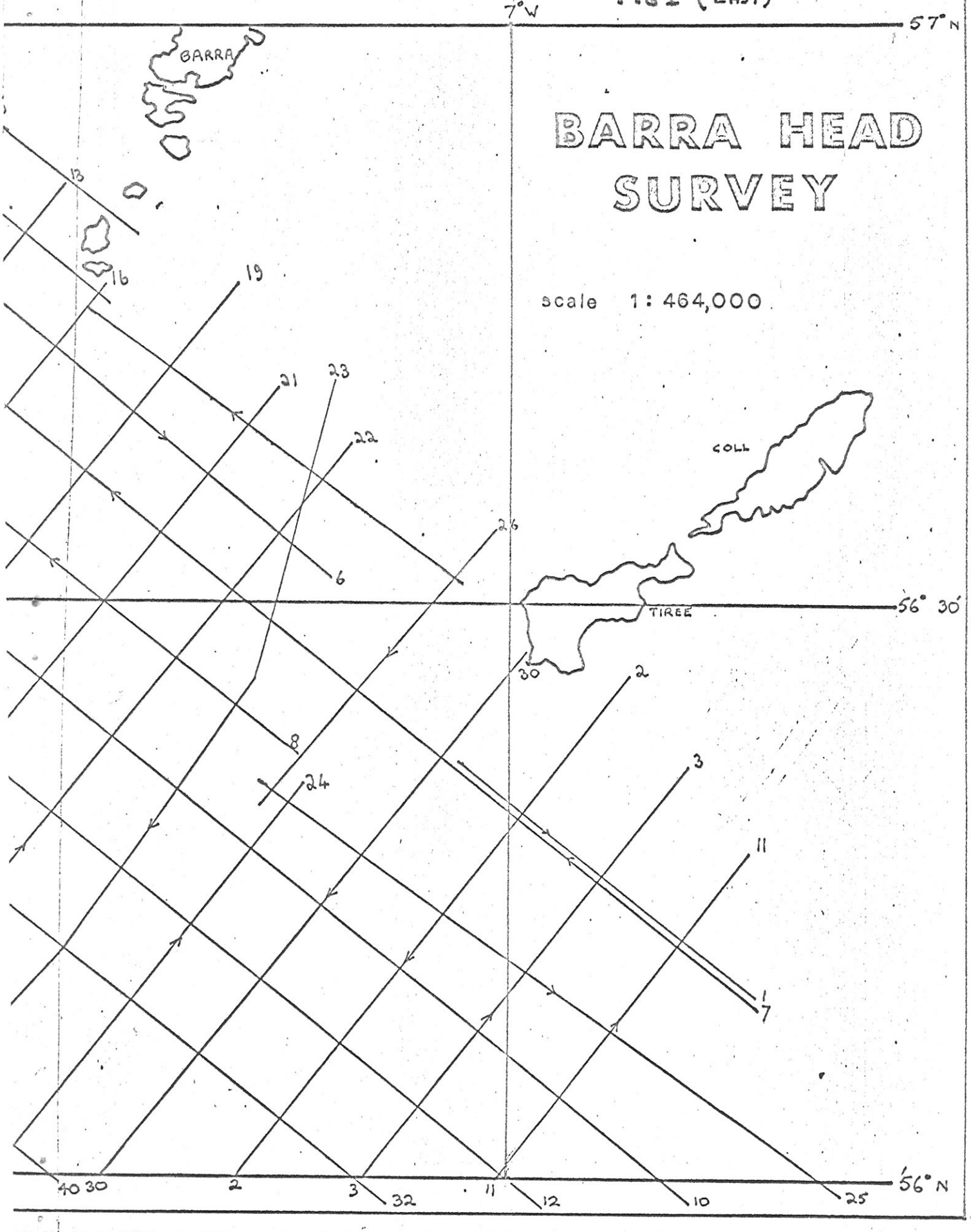
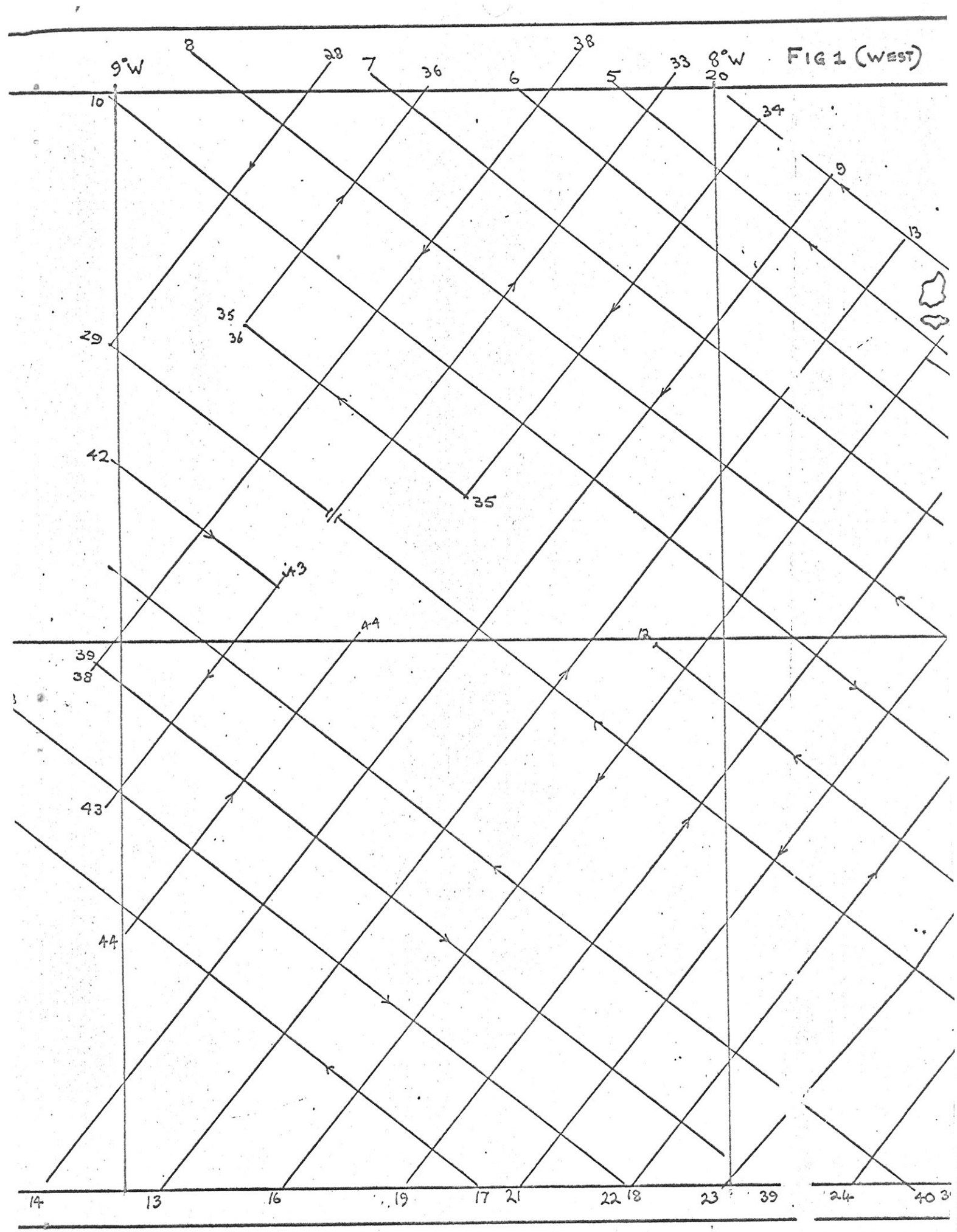

7°W
57° N
BARRA
BARRA HEAD
SURVEY
scale 1: 464,000
COLL
TIREE
56° 30'
56° N
13
16
19
21
23
22
26
6
30
2
3
11
1
7
8
24
40
30
2
3
32
11
12
10
25

FIG 1 (WEST)


9°W
8°W
8
28
7
36
38
6
5
33
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34
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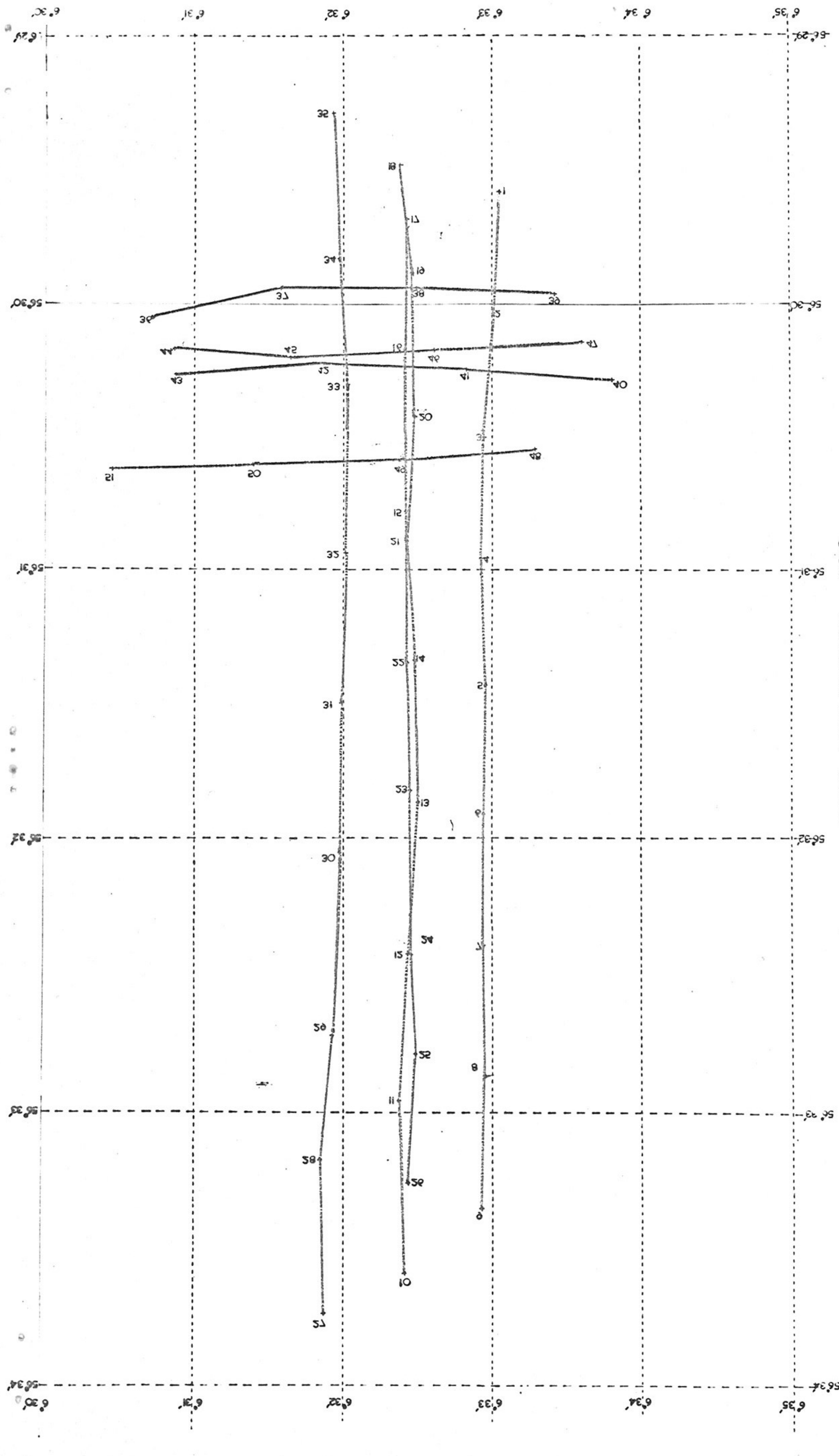
FIG 2



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PASSAGE of TIREE
Sonar Survey
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