CRUISE REPORT -
ARCTIC PROWLER

TELEGLOBE CANADA SURVEY
FOR TAT-9

by

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CRUISE SUMMARY SHEET

Ship:	Arctic Prowler
Cruise Dates:	June 7th (1825) - June 12th (1000), 1987
Master:	Captain Joseph Murphy
Cruise Number (Identification):	Contract # Arctic Prowler Services Contract # 1611 (contract between McElhanney Services Ltd. and Teleglobe Canada).
Location:	Scotian Shelf to shelf slope.
Navigation:	Loran-C; Sat-Nav.
Equipment:	Nova Scotia Research Foundation V-fin D.T.S.; Klein 100 kHz sidescan sonar; Klein 500 kHz sidescan sonar; and O.R.E. 3.5 kHz profiler.
Scientific Staff:	Ray Auger - navigation (McElhanney) Peter Barr - navigation under contract to McElhanney (Barr Marine) Ray Burke - under contract to McElhanney to operate geophysical systems (R.P.B. Geophysical) Peter Campbell - student observer (Geological Survey of Canada) Mike Kennah - client (Teleglobe Canada) Robert Miller - Q.C. (Geological Survey of Canada) Paul Parsons - equipment manager (McElhanney) Kevin Powell - systems operator (McElhanney) Derek Reed - client (Teleglobe Canada)

INTRODUCTION

The purpose of this cruise was to investigate routes for laying of the TAT-9 fibre-optic telecommunications cable from the mainland of Nova Scotia south of Halifax to the slope area of the Scotian Shelf south of LaHave Bank. The TAT-9 cable is proposed to be laid by 1991. An existing cable, CANTAT 2, which is laid primarily across the Sable Island Bank portion of the shelf, has recently experienced many fishing related breaks. It is believed that fishing is restricted across the Scotian Shelf because of hazards created by an abundance of boulders. For the TAT-9 cable, the route will be chosen to avoid fishing related problems. Two corridors were surveyed, one of which (Corridor #2) was along an existing CanBer telecommunications cable corridor which landfalls at Port Medway. This line was run to transect the CanBer cable at several locations. This served two purposes: (1) to compare this corridor with the other corridor; and (2) to determine if the CanBer cable could be identified on the sidescan sonograms.

1. Corridor #1 began off of Pennant Point and transects LaHave Basin and LaHave Bank and terminated in the slope area south of LaHave Bank (See Fig. 1). Two continuous transects were run to outline the broad corridor.
2. Corridor #2 began off Port Medway and was parallel to the existing CanBer cable. This corridor ran from Port Medway through the western part of LaHave Basin, crossed the western part of LaHave Bank, and terminated to the southwest of LaHave Bank on the Scotian slope.

Figure #2 through to Figure #7 are sidescan sonograms illustrating various features mapped in corridors 1 and 2.

NAVIGATION

See attachment #1.

SIDESCAN

A 100 kHz Klein sidescan sonar was used throughout the survey. The sidescan fish was equipped with a K-wing for stabilization. Time was manually marked at 5 minute intervals on the profiles. This time fix was read off a repeater connected to the navigation centre off of the bridge. The data was recorded graphically on a Klein model 401 wet paper recorder using a split helix. The range used during the survey was generally 150 meters and the paper rate was set at 70 lines per centimetre. The resulting cross-track aspect ratio was approximately 3:1.

The sidescan sonar data was recorded on an 8 channel H.P. recorder (Model # 3968-A) on the following channels:

Channel 5 - sidescan data - port side (FM)

Channel 6 - sidescan data - starboard side (FM)

Channel 7 - trigger/sync (FM)

Channel 8 - voice fix (FM)

D.R. cards did not arrive before sailing dates. The tape speed was set at 1 7/8 ips.

N.S.R.F. DEEP TOW SYSTEM (V-FIN)

The system consisted of a 200 joule single tip sparker with two 9 element streamers (1 and 2) that were both ten feet long. The survey was started with streamer #1 but was switched to streamer #2 due to noise problems. Sparker tips generally lasted about 10 hours at this output (200 joules), before they needed replacing. At 1140/June 8th, the McElhanney TVG was added to the graphic recorder. The V-fin was generally towed at 40 m above the seabed. Filters were set at:

High - 3.5 kHz

Low - 0.9 kHz

V-fin data was graphically recorded on an EPC recorder model 3200, on Channel A at a $\frac{1}{4}$ second sweep. The scale is therefore 250 ms across the page with vertical scale lines equal to approximately 20 m per division. The printer was set at 150 lines/inch. Event marks were automatically put on the graphic record at intervals of 10 minutes.

ITINERARY

Date	Time (Local)	Operation
June 7th, 1987	0830	Arrive at Irving Dock, Dartmouth.
	1515	Leave fuel dock; head for Bedford Basin to set compass. (Ship acquired engine problems after being refuelled, hence late sailing.)
	1600	Steam N.S.R.F. V-fin and Klein 500 kHz sidescan in Bedford Basin.
	1825	Steam by Irving Fuel Dock heading for start of survey.
	2017	Begin survey off Pennant Point.
	2020	Fish changed, no altimeter.
	2110	100 kHz fish back in water with K-wing.
June 11th, 1987	0130	Sidescan down, retrieved from water. Sync problems.
	0520	Sidescan back in water.
June 12th, 1987	0840	End survey.
	1000	Arrive at Irving Dock, Dartmouth.

DISCUSSION

This survey was designed as a preliminary investigation of two broad corridors for the possible siting of TAT-9 from the mainland of Nova Scotia south of Halifax to the slope area of the Scotian Shelf south of LaHave Bank (Fig. 1). Based on the interpretation of this data, Teleglobe Canada Incorporated will choose the corridor which is best suited for their fibre optic telecommunications cable (TAT 9). It is proposed to be laid by 1991 following more detailed surveys.

Due to the many fishing-related breaks of the CANTAT 2 cable on the Sable Island Bank area of the Scotian Shelf, route selection for TAT 9 will attempt to determine areas that are not commercially fished.

Corridor number one (Pennant Point route) is defined by track 1 and track 4 (Fig. 1) and extends from Pennant Point across eastern LaHave Basin and LaHave Bank to the shelf edge.

During the survey, an on-line plot of position was maintained on the Yarmouth-Browns Bank surficial geology map (Drapeau and King, 1972) as a guide to the changing surficial sediment distribution. It was noted that the surficial geology contacts on this map were both accurate and reliable,even though the interpretation was largely based on echogram data. An interpretation of the sidescan sonograms is given in Figure 1.

The nearshore zone, which extends to approximately the 100 metre contour, was characterized by outcropping rock with valleys infilled with sands and/or muds which was mapped by Drapeau and King (1972) as Sable Island Sand and Gravel. This area was dominated by the gravel facies. Sidescan data collected during this survey revealed the seafloor of this nearshore zone to be dominated by ridges of bedrock.

The seafloor between the 100 metre contour and the 200 metre contour was less dominated by bedrock ridges and the surficial sediments became thicker. The sediment distributions were complex: A narrow band of Sambro Sand flanked the outer limit of the Sable Island Sand and Gravel formation; morainic ridges of till were flanked by outcropping beds of Emerald Silt (glaciomarine sediments) and local patches of LaHave Clay became dominant. Other features mapped in this zone were pockmarks in the clay, boulders, iceberg furrows on the till and periodic bedrock outcrop.

LaHave Basin was heavily populated with pockmarks (Fig. 3 and Fig. 7) in the LaHave Clay formation. King and MacLean (1970) first documented pockmarks in the adjacent Emerald Basin. They were 3 metres and larger in diameter, and often occurred as compound pockmarks. The observations of these features were aided by slowing the ship down to 2 knots to allow the high resolution sidescan sonar fish to be towed close to the seafloor.

Trawl marks were common in LaHave Basin and their density increased south of the 200 metre contour of southern LaHave Basin. Because of the abundance of trawl marks in the LaHave Clay and the quiescent conditions in LaHave Basin as well as Emerald Basin, it is believed that the trawl marks encountered represent the total accumulated population (Fig. 3 and Fig. 4).

Between LaHave Basin and LaHave Bank, the number of trawl marks encountered increased dramatically (Fig. 1). Over the till which flanks the outer part of LaHave Basin, several boulders as well as relict iceberg furrows occurred. Several trawl marks and some boulders also occurred over the Sambro Sand which borders LaHave Bank.

LaHave Bank was previously mapped as the gravel facies of the Sable Island Sand and Gravel formation (Drapeau and King, 1972). On the bank, evidence of trawling activity was limited and boulders were widespread. A shipwreck, approximately 40 m long, was located on the mid-western portion of the bank (Fig. 1 and 3).

South of LaHave Bank, Sambro Sand borders the shelf edge. In this zone boulders were numerous and occasional iceberg furrows were seen. At the 200 m contour, trawl marks increased dramatically suggesting an increase in fishing activity. This was seen along a tie line which ran along the shelf edge and connected the two broad corridors (Fig. 5).

Corridor 2 (Port Medway route) was defined by track 2 and track 3 (Fig. 1). It extended from Port Medway across the inner shelf to the western edge of LaHave Basin and LaHave Bank to the shelf edge. Track number 3 was designed to cross the existing CanBer (Canada to Bermuda link) cable at several locations.

The inner shelf in this area, mapped as the gravel facies of the Sable Island Sand and Gravel formation by Drapeau and King (1972), appeared to have a large population of boulders at the seafloor. This was unlike the inner shelf area traversed by corridor number 1. In general, the seafloor of this zone was characterized by many ridges of outcropping bedrock separated by infilled valleys.

Seaward of the 100 metre contour, evidence of trawling increased. Boulders were still quite numerous on the Sambro Sand formation. Iceberg furrows occurred on the glacial till.

Pockmarks were numerous in the LaHave Clay (Fig. 7) of LaHave Basin. Trawl marks on LaHave Clay of western LaHave Basin were also very numerous (Fig. 4 and 6).

Bottom fishing activity appeared to be limited on LaHave Bank. This was probably due to the increase in the numbers of boulders both on the bank, which is mapped by Drapeau and King (1972) as the gravel facies of the Sable Island Sand and Gravel formation, and the Sambro Sand to the west which continues to the shelf edge (Fig. 2). Iceberg furrows are numerous in the Sambro Sand of this area.

Track number 3 was intended to cross the existing CanBer cable at several sites. Figure 2 shows the exposed cable at the seabed.

As a result of this very preliminary investigation of the two broad corridors, initially chosen on the basis of the distribution of surficial sediments and local bathymetry, it initially appeared that corridor number 1 (Pennant Point route) offered the best conditions for protection of an unburied telecommunications cable at the seafloor. Because of the abundance of seafloor hazards (boulders) to bottom trawling along the Pennant Point route, it is presently considered the most favourable route.

ACKNOWLEDGEMENTS

The author would like to thank Teleglobe Canada Limited for making the data collected on this survey available to A.G.C. The long and sometimes strenuous hours logged by Peter Campbell are very much appreciated. This report was reviewed by C.L. Amos and G.B.J. Fader.

FIGURE CAPTIONS

Figure 1 Map showing interpreted surficial features along track. Track 1 and track 4 define the limits of corridor 1 and corridor 2 is defined by track 2 and 3. Corridor 2 appears to have more fishing activity due to a greater number of trawl marks at the seabed than seen in corridor 1. Corridor 1 has many more boulders especially on LaHave Bank.

Figure 2 1) Boulders - Sidescan sonogram showing seafloor covered with boulders and no evidence of trawling. The boulders appeared as short linear features because of the instability of the towed fish.

2) CanBer Cable - Sidescan sonogram collected over short portion of the CanBer cable on the Sambro Sand formation. Note the lack of trawl marks probably arising from the high number of boulders.

Figure 3 3) Pockmarks and Trawl Marks - Sidescan sonogram showing occurrence of pockmarks and trawl marks in Southern Emerald Basin. The pockmarks are small in this area ranging up to 3 m in diameter.

4) Shipwreck (Boulders) - Sidescan sonogram showing a shipwreck approximately 40 m long on LaHave Bank. The bank is dominated by cobbles and boulders giving the sonogram its character of numerous point source high intensity acoustic returns.

Figure 4 Sidescan sonogram showing a large population of trawl marks on LaHave Clay in western LaHave Basin. Because of the low current velocities and lack of sediment transport at the seabed, the trawl marks are preserved in the LaHave Clay. The trawl marks may represent the total accumulated population.

Figure 5 Sidescan sonogram showing a large population of trawl marks along the shelf edge south of LaHave Bank on the Sambro Sand formation. The trawl marks are sub-parallel to the bathymetry and their density suggests intensive trawling in this area.

Figure 6 Sidescan sonogram showing a large population of trawl marks on LaHave Clay of western LaHave Basin (similar to Figure 5). Some of the trawl marks appear to have berms and a central depression covering a 3 m wide zone.

Figure 7 Sidescan sonogram showing a variety of pockmark sizes from western LaHave Basin ranging from 3 m - 15 m in diameter. Note the occurrence of compound pockmarks such as in the lower section at the 0.5 km mark which appears to be formed from clusters of small pockmarks.

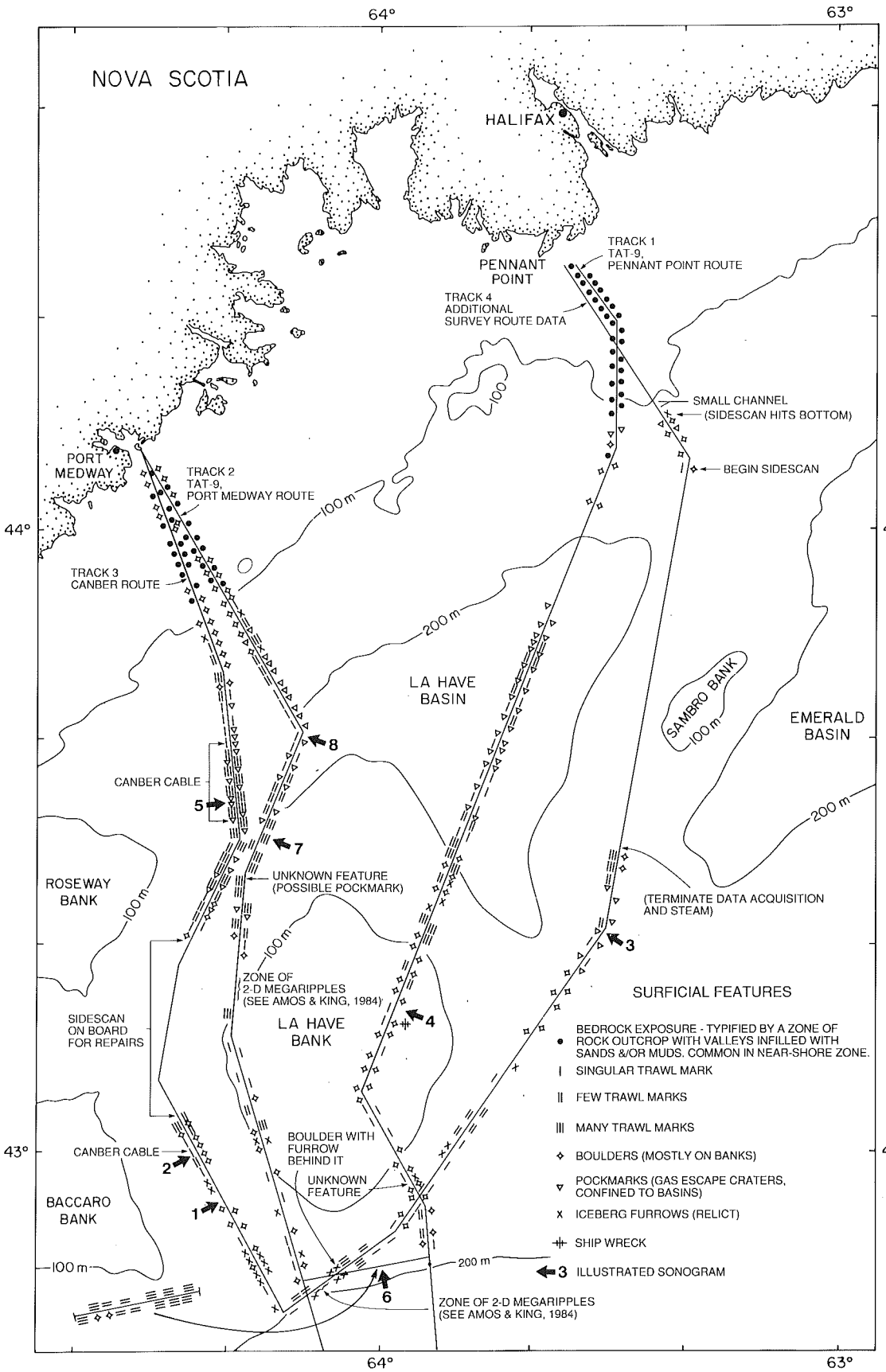

64°
63°
NOVA SCOTIA
HALIFAX
PENNANT POINT
TRACK 1
TAT-9,
PENNANT POINT ROUTE
TRACK 4
ADDITIONAL
SURVEY ROUTE DATA
100
SMALL CHANNEL
(SIDESCAN HITS BOTTOM)
BEGIN SIDESCAN
PORT MEDWAY
TRACK 2
TAT-9,
PORT MEDWAY ROUTE
100 m
44°
TRACK 3
CANBER ROUTE
200 m
LA HAVE BASIN
SAMBRO BANK
100 m
EMERALD BASIN
200 m
CANBER CABLE
5
8
7
UNKNOWN FEATURE
(POSSIBLE POCKMARK)
ROSEWAY BANK
100 m
(TERMINATE DATA ACQUISITION
AND STEAM)
3
100 m
ZONE OF
2-D MEGARIPPLES
(SEE AMOS & KING, 1984)
SURFICIAL FEATURES
SIDESCAN
ON BOARD
FOR REPAIRS
LA HAVE
BANK
4
BEDROCK EXPOSURE - TYPIFIED BY A ZONE OF ROCK OUTCROP WITH VALLEYS INFILLED WITH SANDS &/OR MUDS. COMMON IN NEAR-SHORE ZONE.
SINGULAR TRAWL MARK
FEW TRAWL MARKS
MANY TRAWL MARKS
BOULDERS (MOSTLY ON BANKS)
POCKMARKS (GAS ESCAPE CRATERS, CONFINED TO BASINS)
ICEBERG FURROWS (RELICT)
SHIP WRECK
3 ILLUSTRATED SONOGRAM
43°
CANBER CABLE
2
BOULDER WITH
FURROW
BEHIND IT
UNKNOWN
FEATURE
BACCARO
BANK
1
100 m
200 m
6
ZONE OF 2-D MEGARIPPLES
(SEE AMOS & KING, 1984)
64°
63°

FIG 1

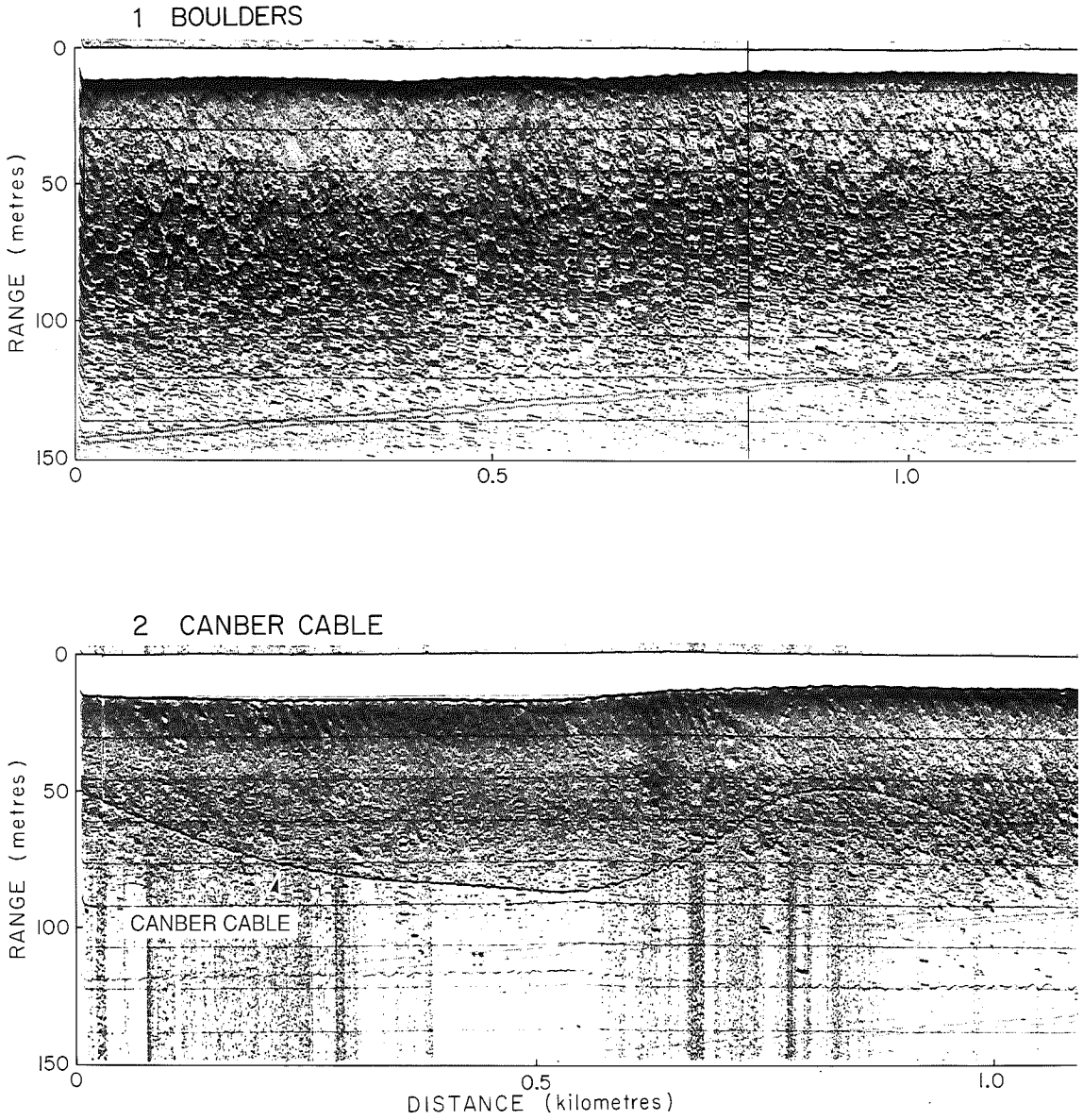
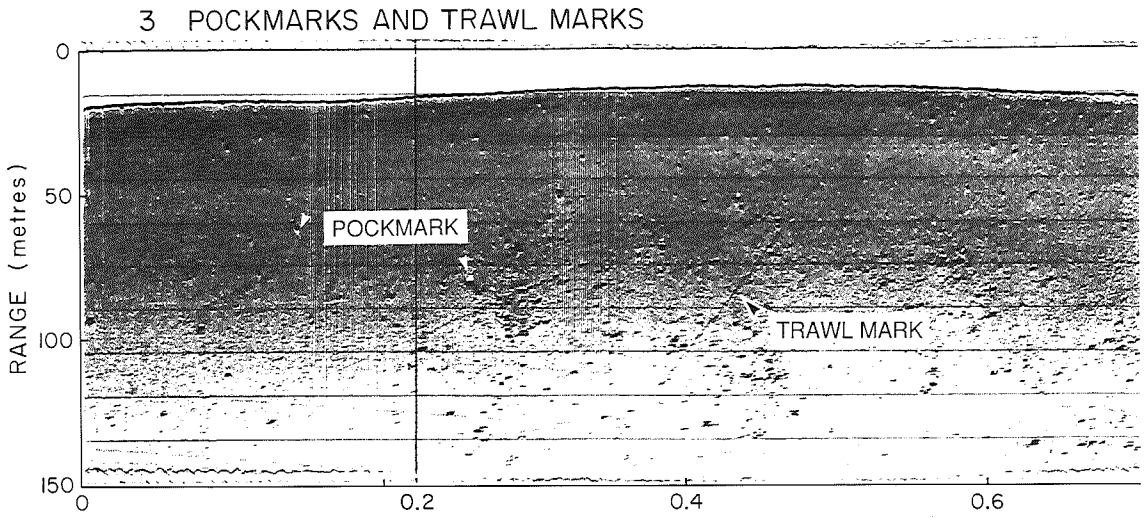

1 BOULDERS
0
50
100
150
RANGE (metres)
0
0.5
1.0
2 CANBER CABLE
CANBER CABLE
DISTANCE (kilometres)

FIG 2


3 POCKMARKS AND TRAWL MARKS
RANGE (metres)
0
50
100
150
0
0.2
0.4
0.6
POCKMARK
TRAWL MARK

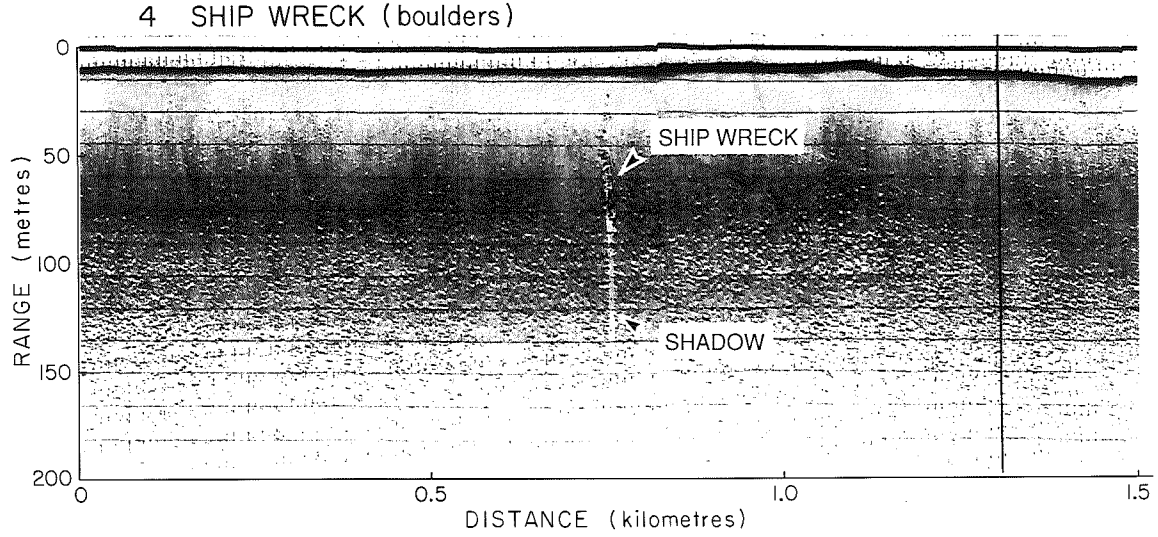

4 SHIP WRECK (boulders)
RANGE (metres)
0
50
100
150
200
0
0.5
1.0
1.5
DISTANCE (kilometres)
SHIP WRECK
SHADOW

FIG 3

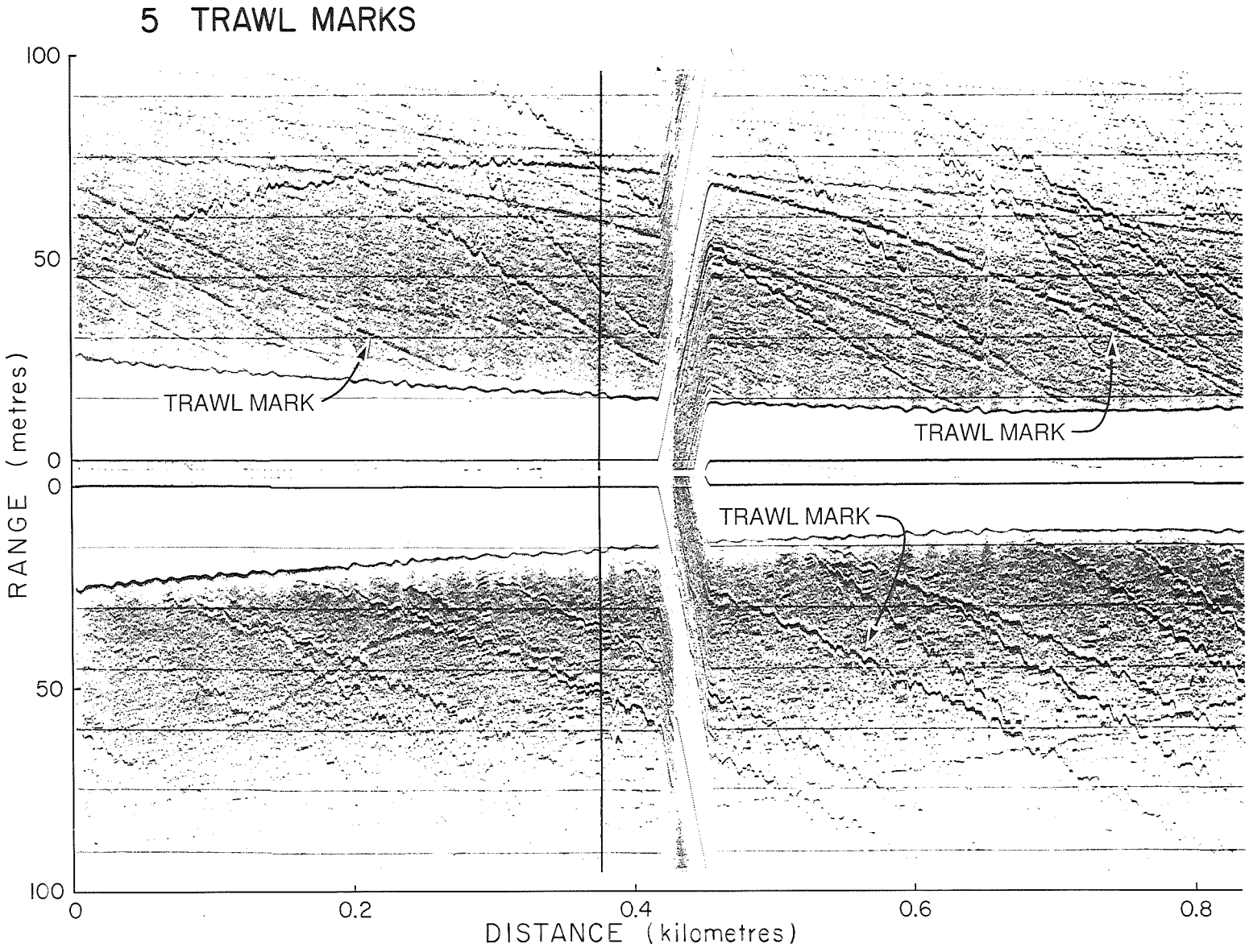

5 TRAWL MARKS
100
50
0
0
50
100
RANGE (metres)
TRAWL MARK
TRAWL MARK
TRAWL MARK
0
0.2
0.4
0.6
0.8
DISTANCE (kilometres)

FIG 4

6 TRAWL MARKS

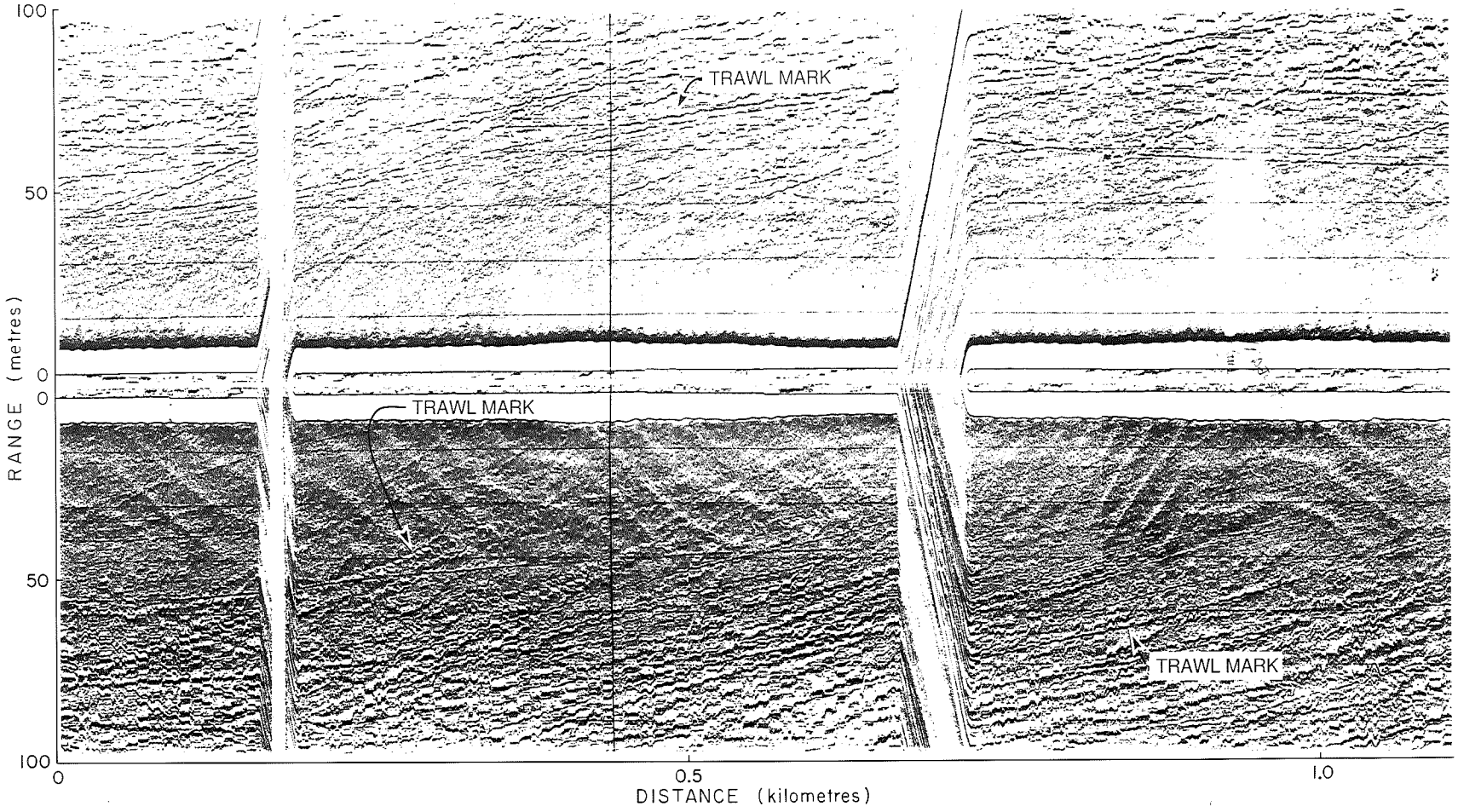


FIG 5

7 TRAWL MARKS

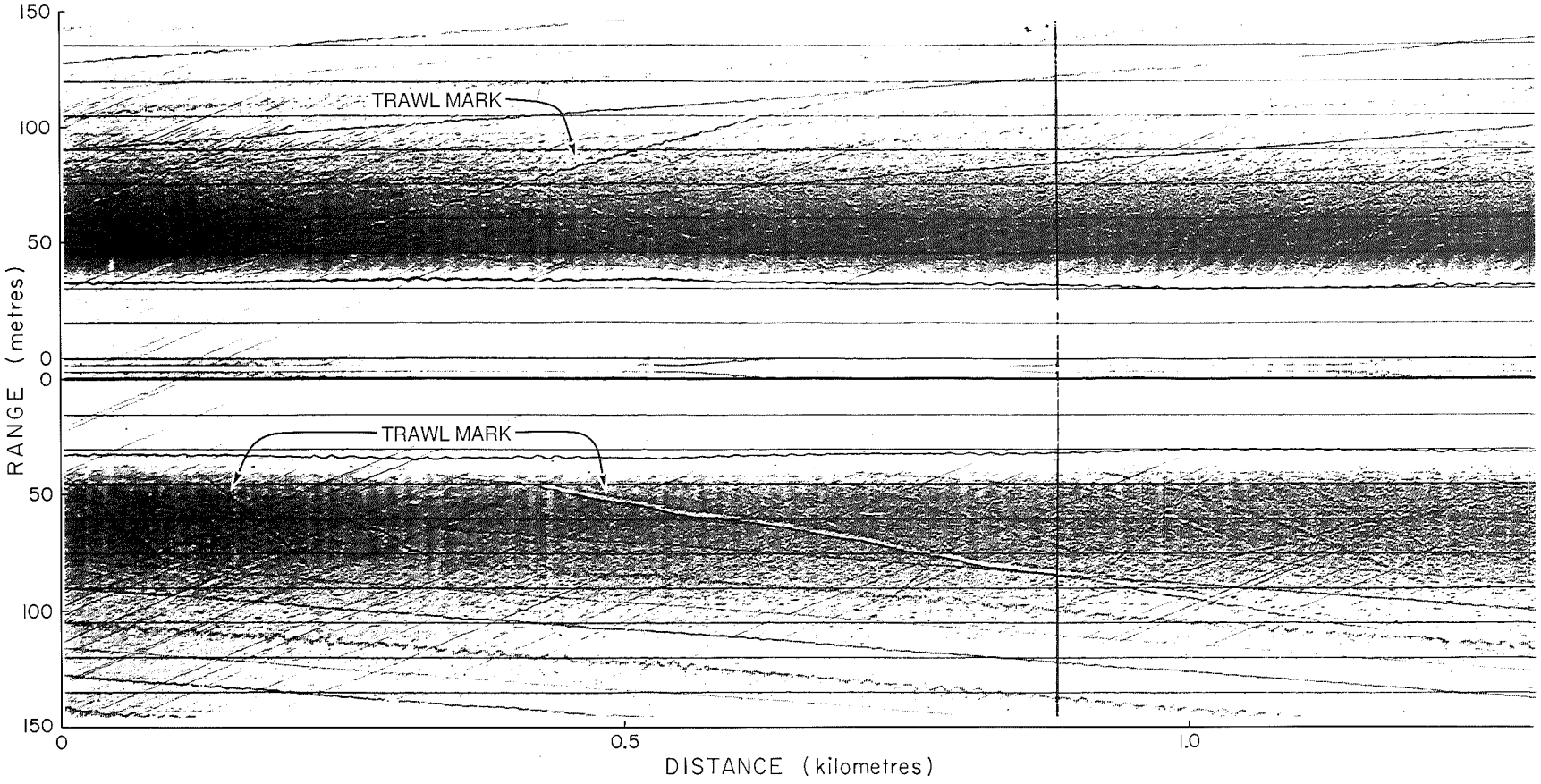


FIG 6

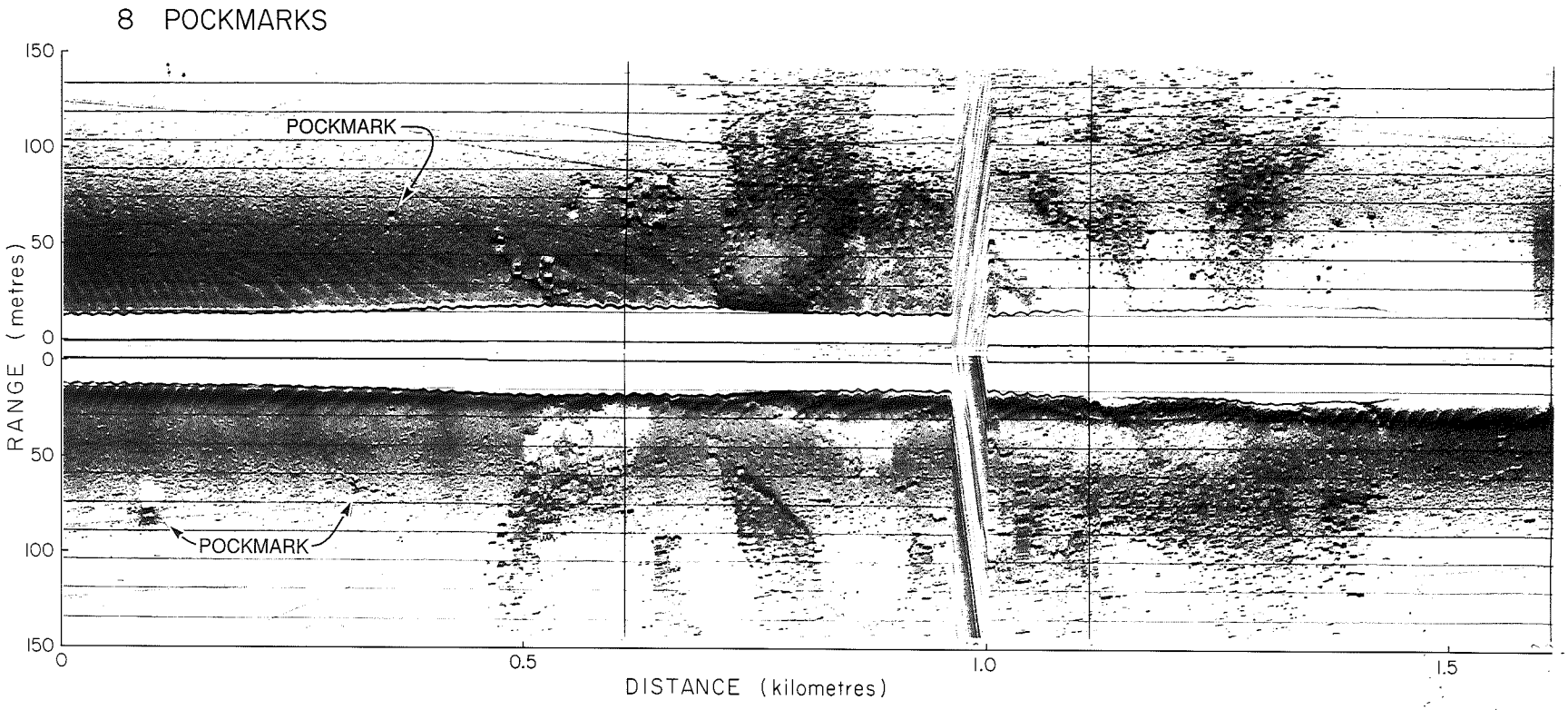

8 POCKMARKS
150
100
50
0
0
50
100
150
RANGE (metres)
POCKMARK
POCKMARK
0
0.5
1.0
1.5
DISTANCE (kilometres)

FIG 7

REFERENCES

Amos, C.L. and King, E.L. 1984. Bedforms of the Canadian eastern seaboard: A comparison with global occurrences. Mar. Geol. 57: 167-208.

Drapeau, Georges and King, Lewis H. 1972. Surficial Geology of the Yarmouth-Browns Bank Map Area. Marine Science Paper 2. Geological Survey of Canada Paper 72-24.

King, Lewis H. and MacLean, Brian. 1970. Pockmarks on the Scotian Shelf. Geological Society of America Bulletin, v. 81, p. 3141-3148, 5 figs.

LIST OF SEISMIC DATA

Klein Sidescan (Arctic Prowler '87)

ROLL #	TIME (GMT)	NOTES
1	2315/June 7 - 1027/June 8	Line #1-3, 1-4, 1-5
2	1028/June 8 - 1152/June 9	shipwreck (0006)
3	0100/June 9 - 0615/June 9	
4	0800/June 9 - 1113/June 9	Line #1-2 TIE
5	1438/June 9 - 1532/June 9	Line #2-2
6	1538/June 9 - 0506/June 10	Line #2-4
7	0508/June 10 - 1815/June 10	Line #2-4 continued; 3-2
8	1817/June 10 - 0258/June 11	Line #3-2
9	0830/June 11 - 2140/June 12	barchans
10	2142/June 11 - 2154/June 11	boulders
11	2200/June 11 - 0242/June 12	Line #4-1, 4-2, possible lift-off moraines.
12	0735/June 12 - 1111/June 12	

N.S.R.F. V-Fin

ROLL #	TIME (GMT)	NOTES
1	2316/June 7 - 1742/June 8	Line #T-3, 1-4, 1-5
2	0744/June 8 - 1555/June 8	Line #1-5
3	1815/June 8 - 0139/June 9	Line #1-5, 1-6
4	0145/June 9 - 1016/June 9	Line #(1-2 TIE), 1-7, 1-8
5	1019/June 9 - 2059/June 9	Line #1-2, 2-1, 2-2
6	2103/June 9 - 0540/June 10	Line #2-3, 2-4
7	0545/June 10 - 1430/June 10	Line #2-4, 2-5, 3-1
8	1434/June 10 - 2247/June 10	Line #3-2
9	2250/June 10 - 0747/June 11	Line #3-2, 3-3, 3-4, 3-5
10	0755/June 11 - 1630/June 11	Line #3-5, (3-4 TIE)
11	1633/June 11 - 0037/June 12	Line #3-4 TIE, 4-1
12	0045/June 12 - 0237/June 12	Line #4-1, 4-2
13	0709/June 12 - 1139/June 12	Line #4-2, 4-3

ATTACHMENT #1

ONLINE NAVIGATION SUMMARY

Teleglobe Canada Cable Route Survey

Navigation was accomplished using the East Coast Loran C chain, relative GIR 5930.

A Loran C 404 receiver acquiring range data in hyperbolic mode (x and y components), was interfaced to a desk top 9826 Hewlett Packard computer. Survey computations relative to navigating the vessel on specific coordinate lines, were processed by the computer [1] for video display, hard copy printout and floppy disc storage[2].

Each event was systematically logged with all pertaining data on printout for easy future access. After consultation with the B.I.O.[3] calibration, increments approximating the variance of ASF corrections over the survey area were entered in the software and retained for all lines for the duration of the survey[4].

A magnavox 1107 dual channel satellite receiver was also used as an ongoing/online check of navigation accuracy. By a software 'range' comparison technique, a concise idea of accuracy was ascertained while the survey was underway. Accuracy for the lines run over the preliminary route was determined to be approximately + or − 100 metres although results show smaller errors than this for the majority of the survey.

No spurious navigation data attributable to cycle jumping or loss of Loran signal, was experienced over the period of on-line survey.

NOTES 1 Navpak Software: REF: Version 6.1.

2 Stored on file at the office of McElhanney Services, Dartmouth, Nova Scotia.

3 Nick Steufberger, B.I.O. Officer in charge - Loran C data.

4 Corrections available from McElhanney office, Dartmouth. Please quote contract report number 206-00203.