Received 7/18/85
In ADMIN 7/19
ROSCOP 8/23/85

UNITED STATES GOVERNMENT
MEMORANDUM

85019

DATE: 16 July 1985

TO: Bill Dillon

FROM: Anne Trehu

SUBJECT: Cruise report

1. Ship's name: USNS Lynch
2. Cruise number: LYNCH70485
3. Parent project: Continental margin deep crustal structure and seismicity
4. Funding agency: ONR and USGS.
5. Funding amount: $430,000 (ONR), $15,000 (USGS)
6. Contract number: N/A
7. Contract start and end: N/A
8. Area of Operations: Carolina Trough
9. Cruise start and end dates: LEG I: June 9, 1985 - leave Yorktown, VA; June 19, 1985 - arrive Yorktown, VA;

   LEG II: June 19, 1985 - leave Yorktown, VA; June 30, 1985 - arrive New London, CN.
10. Chief scientist: Al Ballard (NORDA); for USGS operations: Anne Trehu
11. Cruise data curator: Anne Trehu
12. Scientific party:

    NORDA: Al Ballard, Bill Everard, Bill Eslick, Norm Lombard.

    Scripps: Leroy Dorman (leg I only), David Willoughby, Martin Vogel, James Dolan, Tony Schreiner (leg I only).

    NRL: Richard Wilkenson (leg II only), Lee Houston (leg II only).

    USGS: Anne Trehu, Barry Irwin (leg I only), Jim Dodd (leg II only), Corina Savela, Greg Miller.

    NAVOCEANO: Ken Crawford

13. Ship's captain: John W. Arans

14. Purpose of cruise: The purpose of the cruise was to determine the velocity structure of the crust at the continent-ocean boundary beneath the Carolina Trough. This information is needed to model the tectonic and thermal process of rifting. To achieve this goal, we shot three long explosive refraction lines along the axis of the trough and perpendicualr to USGS CDP line 32; a fourth refraction line was shot parallel to line 32 (Figure 1). Airgun refraction profiles were also shot along these lines where possible. Placement of the lines was based on the results of CDP line 32 and on regional gravity and magnetic data. Line 1 was shot along the axis of the deepest part of the Carolina Trough where the nature of and depth to pre-rift basement is not known. Line 2 was shot over landward most oceanic crust seen on line 32. Line 4 was shot over the unstretched continental crust landward of the hinge zone. Line 3 was shot parallel to CDP line 32 across lines 1 and 4. Line 5 is an airgun profile that was shot along and across the Brunswick magnetic anomaly.

15. Navigation techniques: Navigation was provided by the USGS mini-INS system. Shot intervals were based on time. The output format of the INS proved very useful for steering the ship to the sites of instrument pickups and deployments and for staying on the shooting lines and redefining the lines to pass over instrument sites. NORDA also supplied LORAN and satellite receivers.

16. Scientific equipment employed: ocean bottom seismometers (6 Scripps and 8 USGS); 1000 in^3 airgun (NORDA); explosives (NORDA); CTD (NAVOCEANO); continuous wave source (NRL); single channel hydrophone streamer (NAVOCEANO); shot instant hydrophone (NORDA); 3.5 kHz echosounder (NAVOCEANO).

17. Tabulated information:
    a. Number of days at sea: Leg I-11; Leg II-11.

    b. Number of km of each type of continuous data: explosive refraction - 465 km; airgun refraction and single channel streamer - 305 km; continuous wave source - 340 km; 3.5 kHz - 1500km.

    c. Number of stations: 19 USGS OBS; 6 Scripps OBS; 4 CTD.

    d. Number of submersible dives: 0.

18. Additional comments: This cruise represents the first major deployment of the OBS designed by Bruce Ambuter, programmed by Ogden Hammond and tested and modified by Greg Miller. A major problem with the instrument preamp developed by Bruce, which had contaminated the data collected during previous experiments on the Blake Plateau and in Newberry crater, was solved for this cruise. As a result of Greg's redesign of the preamp and extensive testing of the system, I feel confident that the data recorded is a faithful representation of the data coming from the sensors. However, several problems that had never been observed during lab testing or short test deployments manifested themselves in the field. Several instruments "chewed" tape, probably because of failure to detect the "end of track" marker; we hope to be able to retrieve data

from these tapes after manually untangling the tapes and modifying the data playback and transcription programs to deal with tapes that do not have a complete header. Several instruments wrote their header but failed to record this data; the reasons for this failure appear to be varied. The programs for several deployments aborted prematurely; most of these instruments worked long enough to record the explosive shots. Several release mechanisms failed for various reasons resulting in one lost instrument and two close calls; a second instrument was lost because of error in determining the water depth at the deployment site. Questions have arisen about the timing accuracy of the system as presently configured.

Although permission to shoot explosives had been granted to NORDA in advance of the cruise, poor communication between various Navy branches resulted in a temporary suspension of our permit while we were shooting line 4. We were also forced to reorganize the cruise and shoot line 1, which had been planned for leg I, during leg II. Because we were only granted a 48 hour period in which to shoot lines 1 and 3, we had to deploy all instruments for both lines at once, resulting in few instruments/line and eliminating airgun reshoots. I had hoped to examine data from line 1 before deploying instruments for line 3 in order to place off-line instruments at the proper range to detect the PmP wide angle reflection. As soon as I started playing back the data from line 1, I saw that PmP appears to be a very distinctive phase in this region, but that our offline instruments for line 3 were not at the proper range to exploit this arrival to image the depth to Moho across the margin.

In spite of these problems, we were able to collect an excellent dataset. A portion of the record section from the vertical component of OBS A8 on line 1 is shown in figure 2. A 170 km-long three-component, explosive refraction line with a 1.5 km shot interval along the entire line is unprecedented along the U.S. Atlantic continental margin. These data were plotted on board using the program written by Janet Fredricks. This field playback system was very useful and would have been yet more useful had our shooting schedule been more flexible. With a few minor changes in the program and a faster plotter, we should be able to leave the ship with data analysis well underway! I also feel confident that with time and support Greg will be able to track down and solve the remaining problems and that, in tandem with deep seismic reflection, we have an invaluable tool for unraveling the mysteries of deep crustal structure along the continental margin.

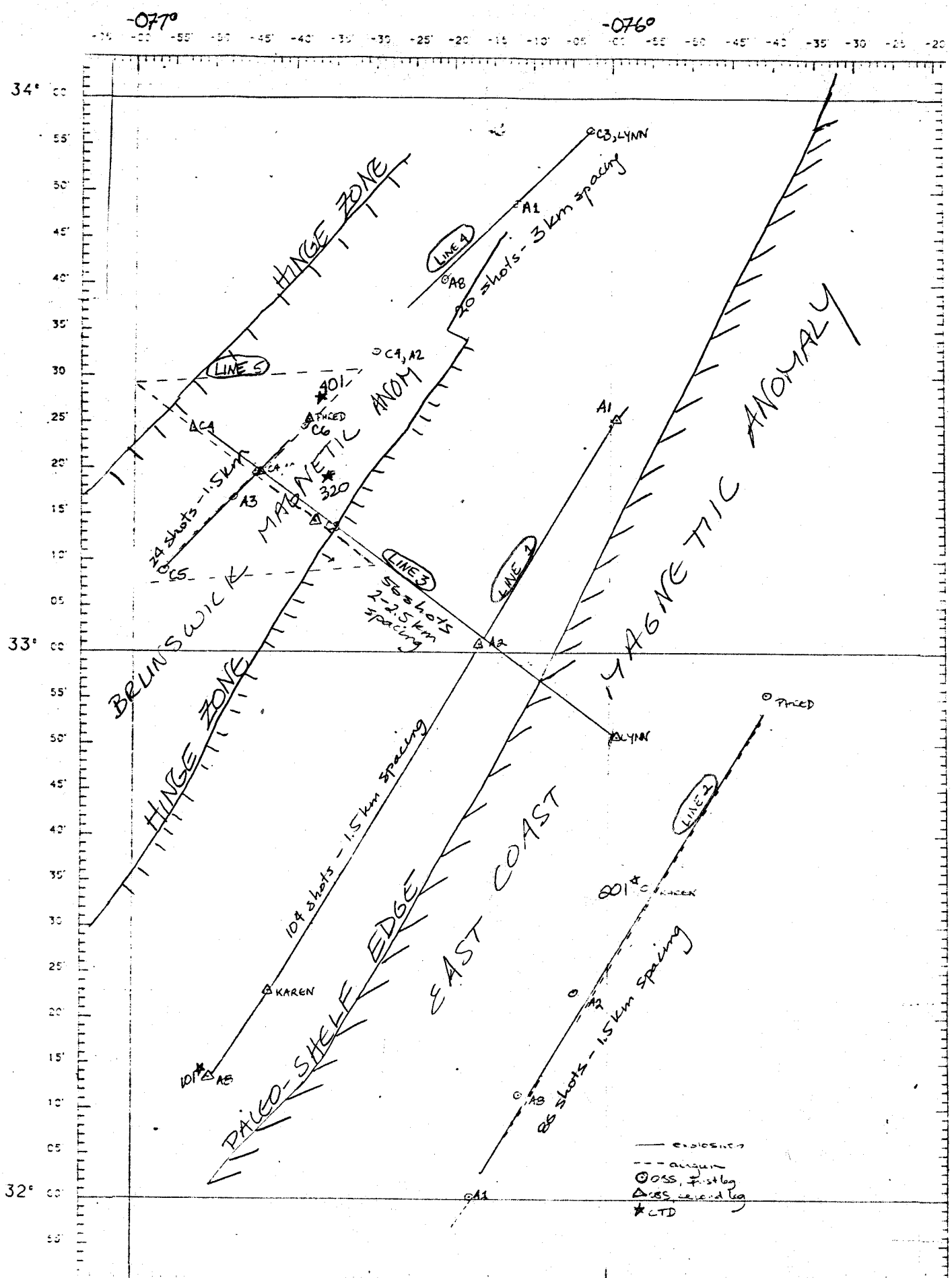
cc: Tom Aldrich, Bob Bowles, Greg Miller, Barry Irwin, Jim Dodd, Corine Savela, Red Bailey, Al Ballard, Joe Gettrust, Leroy Dorman, Kim Klitgord

e. Table of station information:

station number	type	date[1]	latitude	longitude	depth (m)	remarks
L4-C3	OBS-USGS	6/9-6/11	33°57.05	76°02.91	494	V,H1,H2,P;32s[5]
L4-A1	OBS-USGS	6/9-6/11	33°49.02	76°12.03	470	V,P;64s
L4-A8	OBS-USGS	6/10-6/12	33°40.85	76°20.96	445	chewed tape [2]
L4-C4	OBS-USGS	6/10-6/12	33°32.99	76°30.11	419	no data - no tape
L4-A2	OBS-USGS	6/10-6/12	33°33.01	76°30.07	419	V,H1,H2;32s
L4-C6 ?	OBS-USGS	6/10-6/12	33°25.00	76°39.02	390	no data ?
L4-A3	OBS-USGS	6/10-	33°17.19	76°48.15	362	lost OBS - no tape
L4-C5	OBS-USGS	6/10-6/12	33°08.84	76°56.74	375	chewed tape borrowed
L2-A2	OBS-USGS	6/13-6/16	32°22.77	76°04.00	2330	V,P;64s
L2-A8	OBS-USGS	6/13-6/16	32°11.29	76°11.48	2430	V,H1,H2;32s
L2-A1	OBS-USGS	6/13-6/16	31°59.98	76°17.56	2550	no data - no tape
L3-C4 ?	OBS-USGS	6/21-6/25	33°24.21	76°52.75	250	V,H1,H2,P;32s borrowed ?
L3-C3	OBS-USGS	6/21-6/22	33°15.06	76°37.37	533	no data - no tape
L1-A1 ?	OBS-USGS	6/21-6/28	33°25.28	75°59.22	2050	no data ?
L1-C5	OBS-USGS	6/20	33°25.81	75°59.28	2010	lost OBS - no tape
L1-A2	OBS-USGS	6/20-6/26	33°01.26	76°16.20	1280	no data - no tape
L1-A8	OBS-USGS	6/24-6/26	32°13.47	76°50.68	1125	V,H1,H2;32s - borrowed
L5-C4	OBS-USGS	6/27-6/28	33°19.91	76°44.91	375	V,H1,H2,P;32s
L5-A8	OBS-USGS	6/27-6/28	33°19.94	76°44.86	375	chewed tape
L4-LYNN	OBS-Scripps	6/9-6/11	33°57.47	76°01.53	509	3
L2-PHRED	OBS-Scripps	6/14-6/15	32°55.45	75°40.35	3225	

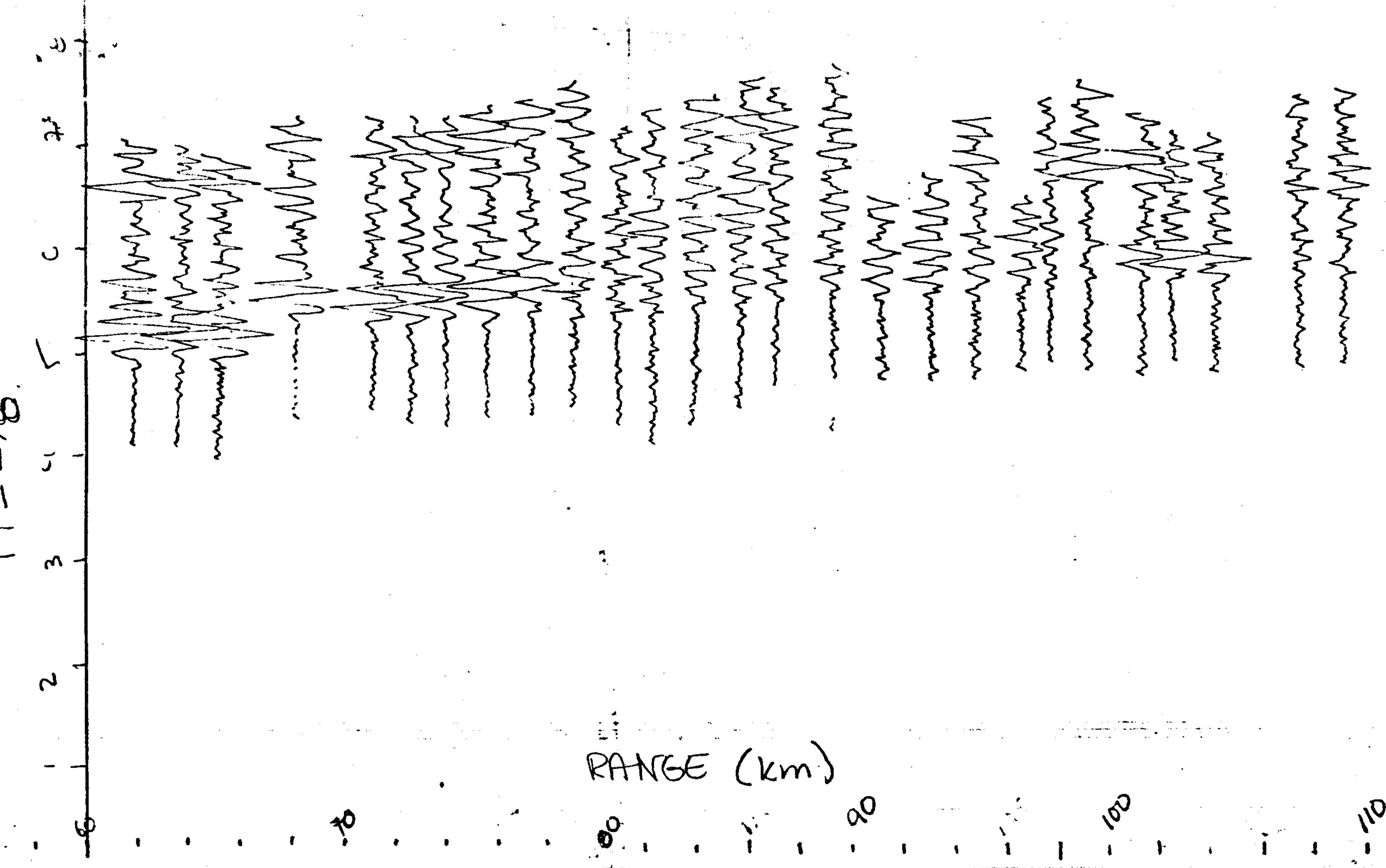
1) from deployment to pickup.
2) data may be retrievable.
3) data return from Scripps OBS is not known at this time.
4) maximum depth of CTD cast.
5) components recorded (V-vertical geophone, H1-horizontal geophone, H2-horizontal geophone, P-hydrophone); number of seconds of data.

L2-KAREN	OBS-Scripps	6/14-6/15	32°34.33	75°55.35	2650
CW-KAREN	OBS-Scripps	6/21-6/23	32°50.62	75°59.66	2575
L3-PHRED	OBS-Scripps	6/21-6/25	33°26.38	76°39.44	352
L3-LYNN	OBS-Scripps	6/23-6/26	32°51.01	75°58.84	2580
L1-KAREN	OBS-Scripps	6/24-6/26	32°22.84	76°43.62	1087
401	CTD	6/10	33°28.84	76°36.72	320[4]
101	CTD	6/24	33°13.50	76°50.66	1050
320	CTD	6/22	33°19.20	76°35.81	475
201	CTD	6/15	32°38.72	75°54.42	2400



June 1985

figure 1


RANGE (km)
60
70
80
90
100
110

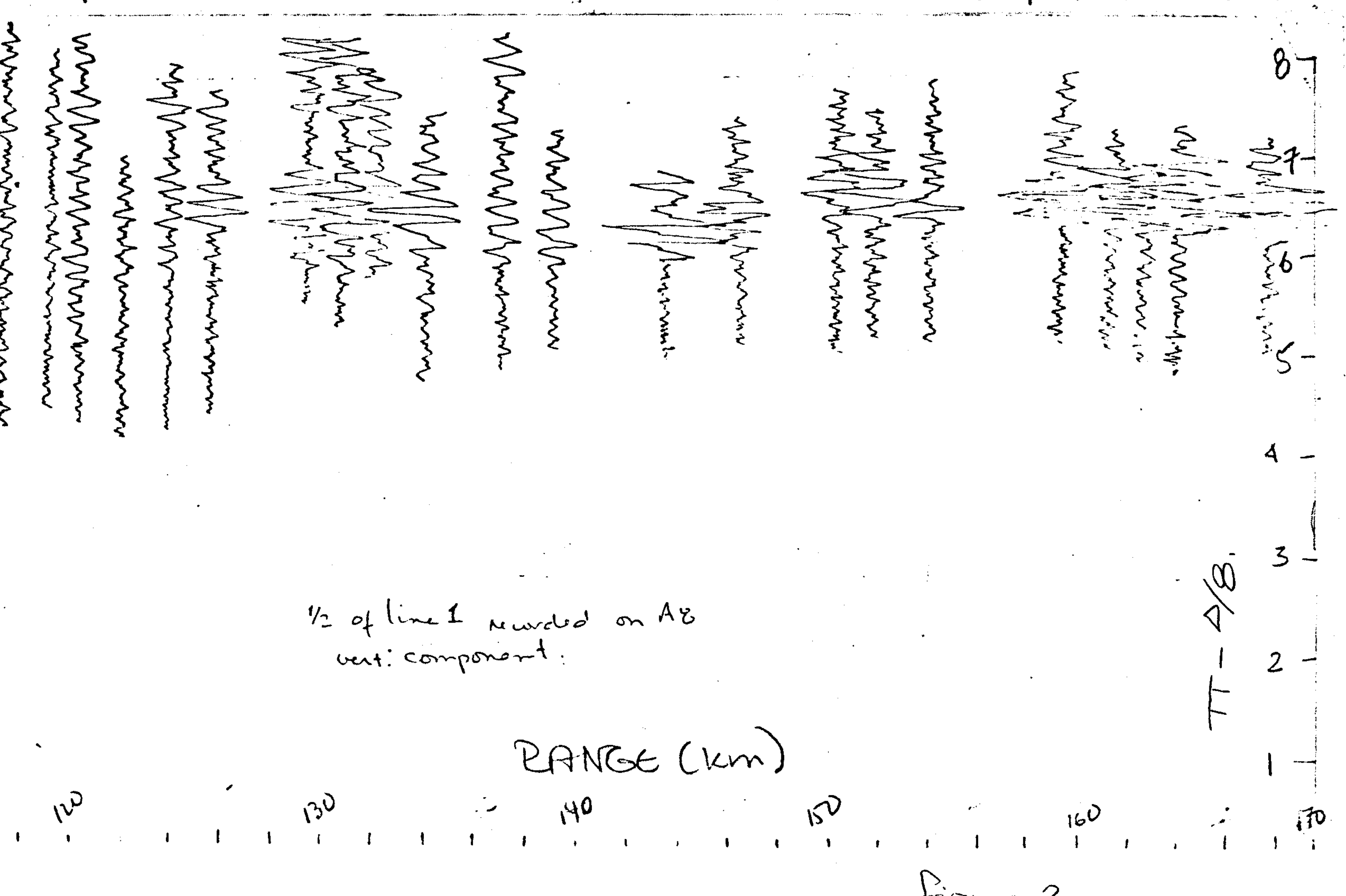

½ of line 1 recorded on A8
vert. component
RANGE (km)
120
130
140
150
160
170
8
7
6
5
4
3
2
1

figure 2