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ARCTIC OCEAN PROPAGATION MEASUREMENTS (U)

JUL 61, R. J. HECHT

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25 July 1961

by

Richard J. Hacht

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FORT THUMBULI NEW LONDON, CONNECTICUT
ARCTIC OCEAN PROPAGATION MEASUREMENTS

by

R. J. Hecht

USL Technical Memorandum No. 911-010-61

25 July 1961

ABSTRACT

The basic data that have been reduced to analyzable form as of 15 February 1961 and figures showing velocity structure, ambient noise, spectra of received charges, and acoustic energy level versus range are presented.

INTRODUCTION

Sound propagation measurements using explosives as sound sources were made in the western Arctic Ocean during the summers of 1958 and 1959. The sound transmission experiments were carried on at ice stations Alpha and Bravo (T-3) during 1958, and Charlie and Bravo (T-3) during 1959 (see Fig. 1 and reference (a)). Interstation propagation measurements were carried out both years, but only those from 1958 have been analyzed. In 1958 signals from 1/2 lb. charges of TNT detonated at 50-foot depth by the USS BURTON ISLAND were also received at T-3. During August and September of 1959 a P2V aircraft made six flights over the Arctic Ocean making acoustic transmission runs while both ice stations were operating as receiving stations. In this way nearly all of the Beaufort Sea and neighboring parts of the Arctic Ocean were investigated acoustically. Fig. 2 shows the locations of the tracks of the six flights and locations of the charges dropped.
While the acoustic experiments were carried out, positions of
the ice stations were determined by sun lines. The positions of
the dropped practice depth charges were supplied by the aircraft.
At the ice stations hydrographic stations were taken at more or less
regular intervals as well as measurements of water depth. The
accuracy of the ranges in the figures is considered to be ±5% or
better.

The explosive sounds were received on a DT-98 hydrophone,
amplified and recorded broadband on a dual channel Magnecorder.
During 1959 many of the signals were recorded in the FM mode also.
The signals were also recorded on a dual channel paper recorder vs.
GMT time.

DATA PROCESSING

The magnetic tape recordings of signals from explosives were
processed by passing the broadband signals through a set of logit
filters. Each filter output was detected by a square law detector
and integrated over the time during which the signal arrived. The
result is proportional to $\int p^2 \, dt$.

The ambient noise was processed on the 11 channel data reader
reference (b)). The reader would average one second samples at a
sampling rate of two seconds. Any given ambient noise sample
covered a period of 1 to 2 minutes. The ambient noise spectra that
show very quiet conditions may represent electronic system noise,
therefore some caution should be used in the interpretation.

The paper recordings of the charge detonations and signals re-
ceived were of such accuracy to permit the determination of the
travel time between the ice stations to within an accuracy of ± .25
sec. during the 1958 experiment. The range between the two stations
and the range to a detonated charge from a P2V run were obtained by
measuring the distances between the two plotted points on a trans-
verse Mercator projection of the polar area. The temperature,
salinity, and depth information from the hydrographic stations were
converted to velocity profiles with Kuwahara’s tables and formulas
(references (c) and (d)).

CONCLUSION

This report presents all basic data so far reduced and analyzed
from the Arctic Project as of 15 February 1961. Partial analyses
of these data appear in references (e), (f) and (g).
LIST OF REFERENCES


(g) R. J. Hecht, "Explosive Sound Propagation in the Polar Sea" (in preparation).
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RECEIVER DEPTH 200 FEET
SOURCE DEPTH 50 FEET
CHARGE 3-1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS
INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE
RECEIVER DEPTH 400 FEET

Fig. 155 - Level vs. Range Plots for Data Collected at Station Charlie during P2V Flights for the Logit Filter Center Frequency of 17.8 cps.

SYMBOL FOR DATE OF P2V RUN
- AUGUST 8
- AUGUST 10
- AUGUST 14 AND 15
- AUGUST 27
- SEPTEMBER 1
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15

RECEIVER DEPTH 200 FEET
SOURCE DEPTH 50 FEET
CHARGE 3.5 LBS POUNDS TNT
SYMBOLS SUPERIMPOSED ON ARROWS INDICATE SOURCE DEPTH 50 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 500 FEET

Fig. 156 - Level vs. Range Plots for Data Collected at Station Charlie during P2V Flights for the Logit Filter Center Frequency of 22.4 cps.

**Symbol for Date of P2V Run**
- August 8
- August 10
- August 14 and 15
- August 27
- August 31 and September 1
- September 14 and 15

- Receiver depth 200 feet
- Source depth 50 feet
- Charge 3-1/2 pounds TNT
- Symbols surmounted on arrows indicate source depth 200 feet
- Circled symbols indicate receiver depth 400 feet

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Fig. 157 - Level vs. Range Plots for Data Collected at Station Charlie during P2V Flights for the Logit Filter Center Frequency of 28.2 cps.

SYMBOL FOR DATE OF P2V RUN

* AUGUST 8
* AUGUST 10
* AUGUST 14 AND 15
* AUGUST 27
* AUGUST 31 AND SEPTEMBER 1
* SEPTEMBER 14 AND 15

RECEIVER DEPTH 200 FEET
SOURCE DEPTH 50 FEET
CHARGE 3.1/2 POUNDS TNT

SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 400 FEET
Fig. 150 - Level vs. Range Flots for Data Collected at Station Charlie during P27 Flights for the Logit Filter Center Frequency of 35.5 c/s.

Symbol for Date of P27 Run
- August 8
- August 10
- August 14 and 15
- August 27
- August 31 and September 1
- September 14 and 15

Receiver depth 200 feet
Source depth 50 feet
Charge 3-1/2 pounds TNT
Symbols surmounted on arrows indicate source depth 200 feet
Circled symbols indicate receiver depth 400 feet

Fig. 159 - Level vs. Range Plots for Data Collected at Station Charlie during P2V Flights for the Logit Filter Center Frequency of 44.6 cps.

Symbol for Date of P2V Run
- AUGUST 8
- AUGUST 10
- AUGUST 14 AND 15
- AUGUST 27
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15

Receiver Depth 200 Feet
Source Depth 50 Feet
Charge 3 1/2 Pounds TNT
Symbols Surmounted on Arrows Indicate Source Depth 200 Feet
Circled Symbols Indicate Receiver Depth 400 Feet

Fig. 160 - Level vs. Range Plots for Data Collected at Station Charlie during P2V Flights for the Logit Filter Center Frequency of 56.2 cps.

- Symbol for Date of P2V Run:
  - ● August 8
  - ▲ August 10
  - ● August 14 and 15
  - ● August 27
  - ▲ August 31 and September 1
  - ▲ September 14 and 15

- Receiver Depth: 200 Feet
- Source Depth: 50 Feet
- Charge: 3-1/2 Pounds TNT
- Symbols surmounted on arrows indicate source depth 200 feet
- Circled symbols indicate receiver depth 400 feet

Fig. 161 - Level vs. Range Plots for Data Collected at Station Charlie during P2V Flights for the Logit Filter Center Frequency of 70.7 cps.

SYMBOL FOR DATE OF P2V RUN

- AUGUST 8
- AUGUST 10
* AUGUST 14 AND 15
* AUGUST 27
△ AUGUST 31 AND SEPTEMBER 1
△ SEPTEMBER 14 AND 15

RECEIVER DEPTH 200 FEET
SOURCE DEPTH 50 FEET
CHARGE 3-1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 400 FEET

Fig. 162 - Level vs. Range Plots for Data Collected at Station Charlie during
P2V Flights for the Logi Filter Center Frequency of 89.1 cps.

SYMBOLS FOR DATE OF P2V RUN
• AUGUST 8
• AUGUST 10
x AUGUST 14 AND 15
• AUGUST 27
△ AUGUST 31 AND SEPTEMBER 1
SEPTEMBER 14 AND 15
************
RECEIVER DEPTH 200 FEET
SOURCE DEPTH 50 FEET
CHARGE 3 1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS
INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE
RECEIVER DEPTH 400 FEET
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Fig. 198 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 11.2 cps.

SYMBOL FOR DATE OF P2V RUN
- AUGUST 8
- AUGUST 10
- AUGUST 14 AND 15
- AUGUST 27
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15
- *********
- RECEIVER DEPTH 400 FEET
- SOURCE DEPTH 50 FEET
- CHARGE 3-1/2 POUNDS TNT
- SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
- CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET

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Fig. 200 - Level vs. Range Plots for Data Collected at Station Bravo during PZV Flights for the Logit Filter Center Frequency of 17.6 cps.

- SYMBOLS FOR DATE OF PZV RUN
  - AUGUST 8
  - AUGUST 10
  - AUGUST 14 AND 15
  - AUGUST 27
  - AUGUST 31 AND SEPTEMBER 1
  - SEPTEMBER 14 AND 15
  - RECEIVING DEPTH 400 FEET
  - SOURCE DEPTH 50 FEET
  - CHARGE 3-1/2 POUNDS TNT
  - SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
  - CIRCLED SYMBOLS INDICATE RECEIVING DEPTH 200 FEET

Fig. 201 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 22.4 cps.

SYMBOL FOR DATE OF P2V RUN
- AUGUST 8
- AUGUST 10
- AUGUST 14 AND 15
- AUGUST 27
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15

RECEIVER DEPTH 400 FEET
SOURCE DEPTH 50 FEET
CHARGE 3.1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET


CONFIDENTIAL
Fig. 202 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 28.2 cps.

SYMBOL FOR DATE OF P2V RUN

- AUGUST 8
- AUGUST 10
- AUGUST 14 AND 15
- AUGUST 27
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15

RECEIVER DEPTH 400 FEET
SOURCE DEPTH 50 FEET
CHARGE 3-1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET

Fig. 203 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 35.5 c/s.

 SYMBOL FOR DATE OF P2V RUN

@ AUGUST 8
@ AUGUST 10
x AUGUST 14 AND 15
@ AUGUST 27
△ AUGUST 31 AND SEPTEMBER 1
+ SEPTEMBER 14 AND 15

RECEIVER DEPTH 400 FEET
SOURCE DEPTH 50 FEET
CHARGE 3 1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET

U.S.L. Tech. Memo No. 911-31-61
Fig. 204 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 44.6 cps.

Symbol for Date of P2V Run
- August 8
- August 10
- August 14 and 15
- August 27
- August 31 and September 1
- September 14 and 15

Receiver Depth 400 Feet
Source Depth 50 Feet
Charge 3-1/2 Pounds TNT
Symbols surmounted on arrows indicate source depth 200 feet
Circled symbols indicate receiver depth 200 feet
Fig. 205 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 56.2 cps.

- SYMBOL FOR DATE OF P2V RUN
  - • AUGUST 8
  - ▲ AUGUST 10
  - x AUGUST 14 AND 15
  - ▲ AUGUST 27
  - ▲ AUGUST 31 AND SEPTEMBER 1
  - + SEPTEMBER 14 AND 15
- RECEIVER DEPTH 400 FEET
- SOURCE DEPTH 50 FEET
- CHARGE 3 1/2 POUNDS TNT
- SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
- CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET

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Fig. 26 - Level vs. Range Plots for Data Collected at Station Bravo during P27 Flights for the Logit Filter Center Frequency of 70.7 cps.

SYMBOL FOR DATE OF P27 RUN

- AUGUST 8
- AUGUST 10
- AUGUST 14 AND 15
- AUGUST 27
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15

RECEIVER DEPTH 400 FEET
SOURCE DEPTH 50 FEET
CHARGE 3-1/2 POUNDS TNT

SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET

U.S.L. Tech. Memo. No. 511-017-61
Fig. 207 - Level vs. Range Plots for Data Collected at Station Bravo during P2V Flights for the Logit Filter Center Frequency of 89.1 cps.

SYMBOL FOR DATE OF P2V RUN
- AUGUST 8
- AUGUST 10
- AUGUST 16 AND 15
- AUGUST 27
- AUGUST 31 AND SEPTEMBER 1
- SEPTEMBER 14 AND 15

RECEIVER DEPTH 400 FEET
SOURCE DEPTH 50 FEET
CHARGE 3.1/2 POUNDS TNT
SYMBOLS SURMOUNTED ON ARROWS INDICATE SOURCE DEPTH 200 FEET
CIRCLED SYMBOLS INDICATE RECEIVER DEPTH 200 FEET

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