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HORIZONTAL-GRADIENT ACOUSTICAL RAY-
TRACE PROGRAM TRIMAIN

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Washington, D. C.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Interest has arisen in the last few years to develop analytical models of the undersea acoustic environment which are suitable for use on digital computers. To realistically represent the sound-field structure which exists in the ocean, one must consider the variation of sound speed in two dimensions: depth and range. A computer program, TRIMAIN, was written in Fortran IV in which the sound-speed field for a given region is divided into triangular segments of the range-and-depth plane. In each segment the sound-speed field, in terms of $(1/c)^2$, is defined by a linear function of range and depth. The ray paths for this field become parabolic		

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19. (Cont'd)

Caustics
Spreading loss
Inhomogeneous media
Multiple profiles
Linear segmented bottom
Calcomp plotting
Computer applications

20. (Cont'd)

trajectories in each triangular segment. All the rays are advanced to a given range at one time, and an interpolation in depth is performed to arrive at the intensity values. Four types of intensity calculations are available: a completely random phase summation, a completely coherent phase summation, a statistical influence over depth, and an average over a convergence zone. Additional output options are ray depth distributions, ray printplots, and Calcomp ray plots, including plots of input sound speeds and of bathymetric profiles.

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HORIZONTAL-GRADIENT ACOUSTICAL RAY-TRACE PROGRAM TRIMAIN

INTRODUCTION

The growth in computer capability over the last 15 years coupled with interest in underwater acoustics has prompted the creation of several computer programs for acoustical ray tracing. For short-range calculation, for which the sound-speed profile can be considered to be the same throughout the given domain and the bottom topography can be considered flat, computation time is conserved by using a single profile program which takes advantage of the periodic form of the ray trajectories, such as the program RTRACE [1]. For long-range acoustical ray tracing, for which the bottom profile as well as the horizontal velocity structure is quite varied, a more general program [2-4] is required. One example of this is the program TRIMAIN, the principal features of which are as follows:

- Acoustic velocity gradients in the sound speed field are accounted for by reading in sound-speed profiles as a function of range and depth. Sound-speed profiles may be introduced at any point in range, and there is no limit to the number which may be used, although each new profile slows the program. A maximum of 50 input and internally generated points are allowed per profile. The sound-speed profiles are assumed to be piecewise linear functions of depth and range. An excellent source of sound-speed-profile data is the NODC tapes [5].
- A variable bottom may be read in as a piecewise linear function of depth, with a maximum of 250 points as the end points of the linear pieces.
- The range-and-depth plane is divided into triangular regions whose vertexes are all initially at ranges equal to the ranges of the endpoints of the linear bottom segments.
- The rays are assumed to be parabolic in each triangle, and it is their intersections with the triangle boundaries that are calculated.
- All the rays are advanced at one time to a given range, rather than tracing one ray at a time all the way to the end of the track.
- Four types of intensity calculation are available: type I random phase summation, type I coherent phase summation, type II (average over depth), and type III (average over convergence zone). Unmodified ray theory is used throughout. (Caustics will be discussed later.)
- The volume attenuation in the medium is assumed to follow a modified Marsh-Schulkin formula.
- Bottom-loss values (in dB), may be entered as a function of grazing angle, one value per degree, or the Marine Geophysical Survey (MGS) bottom-loss values may be used by specifying the class and the range to which that value is to be used.
- A bottom-phase-shift table may be entered for coherent phase calculation if known; it is read in as a value in radians, one value per degree.

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- The sea surface is represented as a flat, specularly reflecting boundary with a constant user-specified reflection coefficient and a constant phase shift of 180° .
- A source beam pattern may be read in at 1-degree intervals.

Several output options are available:

- A printplot of intensity vs range,
- A printout of intensity vs range values,
- A printplot of the ray trajectories vs range,
- A Calcomp plot of ray trajectories vs range,
- Ray depth distribution at specified ranges,
- A Calcomp plot of the input sound-speed profiles,
- A printplot of the input, or of the input and interpolated, sound-speed profiles,
- An eigenray printout if intensity calculations are performed,
- Punched cards for intensity values or eigenrays.

Up to ten output control cards may be specified.

The calculated results from TRIMAIN have been compared with experimental results, (Appendix B), and good agreement exists between the two.

The time required to run the program depends on a number of factors, such as the number of rays, the number of range increments, and the output requested. A sample case using 81 rays, 200 range increments, one receiver, and two profiles took 7 minutes and 48 seconds.

The core requirement for the program and system routines is 43,503 decimal locations. Also, some sort of deferred printout equipment is required, such as a drum, or the data may be written on tapes and the tapes printed.

The original development [6] of this computer code was due to Mr. Edward L. Wright, who is now at Harvard Observatory, Cambridge, Massachusetts. The author has added a number of features which were not in the original program and has revised certain sections. The function of each subroutine will be outlined in this report for the convenience of those individuals who might be interested in modifying the program.

BASIC EQUATIONS

The basic differential equations which are solved in TRIMAIN for ray position and time are:

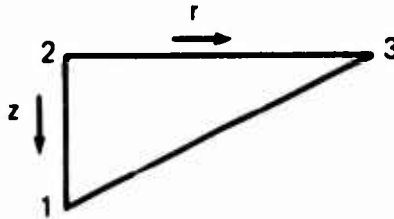
$$n(\vec{r}) = \frac{1}{c(\vec{r})}, \quad (1)$$

$$(d/ds)T = n(\vec{r}), \quad (2)$$

$$(d/ds) [n(\vec{r})(d/ds)\vec{r}] = \vec{\nabla}n(\vec{r}). \quad (3)$$

Eq. (1) states that the index of refraction as a function of range is equal to the reciprocal of the sound speed as a function of range. Eq. (2) is the equation for the ray time, where T is time and ds is arc length. Eq. (3) is the Lagrangian equation, where $\vec{\nabla}$ is the Lagrangian; it gives the ray path and accounts for the refraction.

We will now develop an equation for velocity fit. If we have the triangle



where depth is in the 2 → 1 or z direction and range is in the 2 → 3 or r direction, then the following equations hold:

$$\frac{1}{c_3^2} - \frac{1}{c_1^2} = G_r(r_3 - r_1) + G_z(z_3 - z_1), \quad (4)$$

$$\frac{1}{c_2^2} - \frac{1}{c_1^2} = G_r(r_2 - r_1) + G_z(z_2 - z_1), \quad (5)$$

$$\frac{1}{c^2} = \frac{1}{c_1^2} + G_r(r - r_1) + G_z(z - z_1), \quad (6)$$

where G_r is the gradient in the r direction and G_z is the gradient in the z direction. Eq. (6) gives the reciprocal of the sound speed squared at a range r and depth z in the triangle. We will specialize to the case $r_2 = r_1$, because we will always be getting vertical profiles.

TRIMAIN INPUT

Following will be a list describing the data deck of the program TRIMAIN, and for illustration the sample data deck shown in Fig. 1 will be referred to. The Roman numbers itemizing the list are the card group numbers at the right in Fig. 1.

- I. *Title (columns 1-80).* In the restarting case, the word RESTART is placed in columns 1-7. If a dump is desired if program runs out of time again, DUMP is placed in columns 9-12.
- II. *Source Parameters*

<u>Variable</u>	<u>Columns</u>	<u>Remarks or Meaning</u>
Source depth	1-8	In meters. (In Fig. 1 the source depth is 500 meters.)
Frequency	9-13	In kilohertz (0.05 kHz in Fig. 1)

<u>Variable</u>	<u>Columns</u>	<u>Remarks or Meaning</u>
Attenuation switch	14	0 (as in Fig. 1) means no volume attenuation; nonzero means $\alpha = 0.0003025f^2 + 44f^2/(4100 + f^2)$ dB/km, where f is the frequency in kilohertz.
Source level	15-19	Level in decibels (0.0 in Fig. 1)
Beam pattern switch (to be referred to later as ITBP)	20	0 (as in Fig. 1) means no beam pattern; nonzero means the beam pattern will be read in later.
Down tilt	21-25	Tilt of the beam-pattern axis in degrees (0.0 in Fig. 1).
Surface loss	26-30	Surface loss in decibels (0.0 in Fig. 1).
Bottom-loss switch	31	1 means an infinite bottom loss, so that no table will be read in; 0 (as in Fig. 1) means a loss table will be read in later.
Bottom-phase switch (ISCP)	32	1 means a bottom-phase-shift table will be read in; 0 (as in Fig. 1) means no table will be read in.
Curved earth (receiver)	33	1 (as in Fig. 1) means a curved earth correction for the receiver; 0 means no curve.
Curved bottom points	34	1 (as in Fig. 1) means a curved earth correction for the bottom; 0 means no curve.
Plot (Calcomp) profiles	35	2 means input and interpolated profiles are plotted; 1 (as in Fig. 1) means only input profiles are plotted; 0 means no plot.
Printplot profiles	36	1 means printplot-input profiles; 0 means no plot; 2 (as in Fig. 1) means printplot-input and interpolated profiles.
Calcomp plot profiles in kilometers or nautical miles	37	1 means plot nm; 0 (as in Fig. 1) means km.
Plot length	38-45	Calcomp plot length in inches (24.0 inches in Fig. 1).

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<u>Variable</u>	<u>Columns</u>	<u>Remarks or Meaning</u>
Bottom-reflection termination (NBR5)	46-50	Maximum number of bottom hits allowed before a ray is terminated; if blank (as in Fig. 1) or 0, 2500 will be used.
Surface-reflection termination (NSRS)	51-55	Maximum number of surface hits allowed before a ray is terminated; if blank (as in Fig. 1) or 0, 2500 will be used.
Loss termination (ALIM)	56-65	Maximum loss allowed before a ray is terminated; the input value is a positive number in dB, such as 200.0; if blank (as in Fig. 1) or 0, a value of 300.0 will be used.
Multiple replacement option IA	66	If IA is blank (as in Fig. 1) or 0 and ITBP = 0, angle cards are read from the card reader; if IA is blank or 0 and ITBP = 1, angle fan cards and beam-pattern cards are read from the card reader. If IA = 1 and ITBP = 0, the last set of fan cards for which multiple replacement option LA (in column 71) is 1 will be used, and if ITBP = 1 a new beam pattern will then be read in. If IA = 2, which requires that ITBP = 1, the old beam pattern will be used and a new set of angles will be read. If IA = 3, the old angle set and beam-pattern set is used.
Multiple replacement option IB	67	If IB is blank or 0, bottom-loss cards are read from the card reader, and if ISCP = 1, phase-shift cards are read. Bottom classes 0 through 5 are assumed to have a zero phase shift, so phase-shift cards are not read for these classes. If IB = 1, the old bottom-loss set is used, and a new bottom-phase-shift set is read in if ISCP = 1. If IB = 2, a new bottom-loss set will be read in, and if ISCP = 1, the old bottom-phase-shift set will be used. If IB = 3 and ISCP = 1, the old bottom-phase-shift and bottom loss will be used.

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<u>Variable</u>	<u>Columns</u>	<u>Remarks or Meaning</u>
Multiple replacement option IP	68	If IP is blank or 0, a new set of output control cards will be read in; if IP = 1, the old set will be used.
Multiple replacement option ID	69	If ID is blank or 0, a new bottom track will be read, if ID = 1, the old bottom track will be used.
Multiple replacement option IS	70	If IS is blank or 0, a new set of sound-speed profiles will be read; if IS = 1, the old set will be read.
Multiple replacement option LA	71	If LA = 1, the current deck will be used later; if LA is blank or 0, no portion of this deck will be used later. Thus in the following pages the discussion of the various input sections are subject to the provisions of this section.
Restart Option	73-76	If restart capability is desired, the word DUMP is placed in columns 73-76.

III. Ray Initialization Cards

A. Fan Cards

<u>Variable</u>	<u>Columns</u>	<u>Remarks</u>
Up-angle limit	1-10	In degrees; the sign convention is + for up and - for down. (In Fig. 1 there are three fan cards, each on a separate line; the three up-angle limits are 15° down, 15° up, and 75° up.)
Down-angle limit (DAL)	11-20	DAL = -DAL for input. (In Fig. 1 the three down-angle limits that pair with the up-angle limits are 75° down, 15° down, and 15° up.)
Angular step	21-30	The step input is always positive. (In Fig. 1 the step is 1° from 75° down to 15° down, ¼° from 15° down to 15° up, and 1° from 15° up to 75° up.)

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<u>Variable</u>	<u>Columns</u>	<u>Remarks</u>
Continuation Switch	31-35	0 means this is the last fan card; 1 means more cards follow.
Source Level	36-40	Decibels added for this fan to the source level in columns 15-19 on card II. This is left blank (as in Fig. 1) if no additional beam pattern on the transmitter is desired.
Phase	41-45	Phase in radians for this fan.

B. Beam Pattern Cards

If the beam pattern switch on card II (column 20) was nonzero, the beam pattern is read in, 20 values to a card, which is four columns per value, in decibels below the axial value. The first value is on axis, the next 1° off, etc. A blank or zero after the axial value ends the readin; the last nonzero value is extended to all higher angles.

IV. Bottom-Loss Cards

Cards are read with a variable (referred to as RUNTIL) in columns 1-8 in kilometers (in an F8.4 format) and IClass in columns 9-10 (I2 format). RUNTIL is the last range for IClass. (In the Fig. 1 example 457.0 6 means class 6 until 457 km (assuming another RUNTIL after this which is 0.0). *The last RUNTIL must be negative or zero.* The associated class will be used for the rest of the run. The possible values for IClass are 0-9:

0	zero bottom loss
1-5	MGS bottom class loss curves
6-9	user supplied tables.

The first time an IClass of 6 (as in Fig. 1), 7, 8, or 9 is read, a bottom-loss table is read, one value per degree, in decibels, 20 per card (in a 20F4.2 format) until a blank appears. (In Fig. 1 the table with an IClass of 6 is

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	blank
(zero grazing angle)								(9 degrees)		

When an IClass of 6, 7, 8, or 9 is read in after the first time, the table does not need to be read in again. In reading in a table the last nonzero value is extended

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to all higher angles. If ISCP \neq 0 on card II, a phase-shift table will be read after each loss table (classes 6-9; classes 0-5 have zero phase shift). The phase-shift table is read in, 20 values per card, 1° per value. The phase shifts are in radians. A zero value terminates read in; the last two nonzero values are used to extrapolate the phase shift to zero. (In Fig. 1 no phase-shift table was read in. The bottom-loss tables in Fig. 1 establish the following:

<u>Grazing Angle (degrees)</u>	<u>Loss Until 457 km (dB)</u>	<u>Loss After 457 km (dB)</u>
0	0	4
1	1	5
2	2	6
3	3	7
4	4	8
5	5	9
6	6	10
7	7	11
8	8	12
9	9	13
10	10	14
11	10	14
12	10	14
↓	↓	↓
90		

V. *Output Control Cards*

Output control cards specify the range and depths at which intensities are to be calculated, whether a ray plot or ray tape will be made, whether ray depth distributions will be printed, etc.

<u>Variable</u>	<u>Columns</u>	<u>Remarks</u>
R1	1-6	First range in kilometers.
DR	7-12	Range step in kilometers. If DR is negative, the range spacing will be logarithmic, with constant factor $f = 1 + \text{abs}(DR)/R_1$.
R2	13-18	Last range in kilometers. (In Fig. 1 the ranges specified are 100, 200, ..., 1000 kilometers on the first group V card, 5, 10, 15, ..., 1000 kilometers on the second card, 1, 2, ..., 100

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<u>Variable</u>	<u>Columns</u>	<u>Remarks</u>
		kilometers on the third card, and 0, 1, 2, ..., 1000 kilometers on the fourth card.)
IC	19-20	Continuation switch. 0 means this is the last output control card; (as on the last OCC in Fig. 1) otherwise more will be read in.
ISCP	21	Switch for type I coherent phase; 1 means on, and 0 means off.
IT1	22	Switch for type I random phase; 1 means on, and 0 means off. MUST = 1 when ISCP = 1.
IT2	23	Switch for type II; 1 means on, and 0 means off.
IT3	24	Switch for type III; 1 means on, and 0 means off.
IPER	25	Switch for type I eigenrays; 1 means on, and 0 means off.
LLMR	26	1 means Lloyd's mirror effect is included.
JVSR	27	0 means no intensity-vs-range plot for this output control card; 1 means a plot of type I vs range; 2 means a plot of type II vs range; 3 means a plot of type III vs range; 4 means coherent phase vs range. Only one intensity-vs-range plot can be made.
IRD	28	Switch for ray depth distribution (1 means on, as on the first group V card in Fig. 1), and 0 means off.
IRP	29	Switch for ray plot.
IRT	30	Switch for ray tape for Calcomp plot.

If any of the switches in columns 21-25 are on, receiver depths are needed. The first six, in meters, are on the output control card itself, as follows:

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<u>Variable</u>	<u>Columns</u>
RCD(1)	33-40
RCD(2)	41-48
RCD(3)	49-56
RCD(4)	57-64
RCD(5)	65-72
RCD(6)	73-80

If there are more than six, the next ten depths follow the output control card on one card, and then, if needed, the 17th through 26th on another card. Twenty-six is the maximum available. Receiver depths are read until a zero or blank is found. (In Fig. 1 five receiver depths are specified on each of the first three cards: 50, 150, 250, 350, and 450 meters.) If none of the switches 21-25 are on, then no intensities will be calculated, so no receiver depths are necessary. These and some earlier spaces are then used for the ray plot, as follows:

<u>Variable</u>	<u>Columns</u>	<u>Remarks</u>
DR	7-12	Becomes the spacing in kilometers between lines in the ray plot.
R2	13-18	Becomes the end of the ray plot.
RCD(1)	33-40	Becomes the number of rays to be plotted, $1 \leq N \leq 25$. This must be punched with a decimal point. (On the fourth group V card in Fig. 1, 25 rays are specified to be plotted.)
RCD(2)	41-48	Becomes the maximum depth for the ray plot, in meters.

All these variables will be set to default values if not specified because of intensities. The defaults are: 1 kilometer spacing, 15 rays plotted, and the maximum bottom depth. Even if DR and R2 are set, the defaults for number of rays and (as in Fig. 1) maximum depth may be used if the columns are left blank.

VI. *Bottom Track*

A. *Ranges and Depths*

There are 10 values to a card, with range and depths in pairs with respective units in kilometers and meters. The first range must be zero. A later blank or zero or negative value terminates the input. As many

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cards as necessary, up to 50 cards for 250 ranges, will be read. Thus R_1 is in columns 1-8 of card 1, D_1 is in columns 9-16 of card 1, R_2 is in columns 17-24, D_2 is in columns 25-32, etc. The format for range and depth is 10F8.4.

VII. Sound-Speed Profiles

A. Range and Title

On the first card for each velocity profile, 0 is placed in column 1 if the curved-earth correction is desired. The range to the profile in kilometers is in columns 2-8. The title is in columns 9-80.

B. Depth and Velocity

There are 10 values per card after the range-and-title card. The first value on the card is the depth in meters for this profile. The second value is the sound speed in meters/second, at the first depth. As many sound speeds as depths are read in. A blank or negative value terminates input. The format for all cards is 10F8.4. (The number of input and internally generated points in a sound-speed profile cannot exceed 50; the number of internally generated points can be reduced by reading in profiles with common depths.)

VIII. Program Termination

An end-of-file card terminates each data set or case. If multiple cases are desired, the program will go back to the first card, after the end-of-file card. To terminate the run two end-of-file cards should be placed after the last case.

CONTROL CARDS FOR TRIMAIN

There are several equip cards, which have different functions (Fig. 2). Some of the cards are used for delayed printout, and some are used to punch cards. When using the program, one should change his job card to the form 7₉ JOB (30), charge, ID, time, rather than the usual form 7₉ JOB, charge, ID, time. The change from JOB to JOB (30) allows 30 additional logical units; without this change the program will abort.

If the output is not desired from a certain unit, it may be omitted by using the BY statement. Thus if one wanted to omit the output from logical unit 35, then one should have 7₉ EQUIP, 35=BY, where BY means bypass. The PR designation on an equip card means that unit will be printed. A PU designation means that logical unit will punch cards. The function for each card is as follows:

- 7₉ DEMAND, 50000B - This card is required for the restart option.
- 7₉ EQUIP, 3=PL - This card forces plotting of profiles if the program aborts, if the plot is requested.

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SEQUENCE 60660 STARTED PRINTING 06/06/73 AT 132946 ON LPOO
DRUM SCOPE 2,1 COMPUTER ONE, MAX. DEMAND IS 54000R VERSION 006 11/24/72
SEQUENCE NUMBER 606660 STARTED AT TIME 132726 DATED 06/06/73
JOB(30),8150162,014RGR,10
DEMAND,50000B
COMMENT,THIS JOB PRODUCES DELAYED PRINTOUTS
EQUIP,1=PT,W1,W0,(TEST CASE,1,1,999),DA
EQUIP,3=PL
EQUIP,15=PT,L0,(TEST,1,1,999),DA
EQUIP,16=PT,L0,,DA
EQUIP,20=PT,W1,R0,(TRIMAIN,01,01,999)
EQUIP,35=EY
EQUIP,36=EY
EQUIP,37=PR
EQUIP,38=PR
EQUIP,39=PR
EQUIP,41=PR
EQUIP,42=PR
EQUIP,45=EY
EQUIP,46=EY
EQUIP,47=EY
EQUIP,48=EY
EQUIP,49=EY
***BINARY CHECK***
BANK,(0),LUPP
LOAD,20
RUN,10,10000
    
```

Fig. 2 — Example of control cards; this is the front page from the sample run

- 79 EQUIP, 35=BY(PU) - This will punch the bottom track and receiver depths if set equal to PU. Format 10F8.3.
- 79 EQUIP, 36=BY(PU) - This will punch intensity values in 16F5.1 format, for each range point. Each type of intensity will be punched for each receiver.
- 79 EQUIP, 37=PR - This produces a ray depth distribution if requested.
- 79 EQUIP, 38=PR - This produces a printplot of intensity vs range if requested on an output control card.
- 79 EQUIP, 39=PR - This prints the intensity values for the types specified.
- 79 EQUIP, 41=PR - This prints the Type I eigenrays when they are requested.
- 79 EQUIP, 42=PR - This produces the printplot of the ray trajectories when requested.
- 79 EQUIP, 45=BY(PU) - If this is set equal to PU, it will punch type I coherent intensity values for the contouring program. If should be set up for 19 receivers.

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- 7₉ EQUIP, 46=BY(PU) - If this is set equal to PU, it will punch type I random intensity values for the contouring program. It should be set up for 19 receivers.
- 7₉ EQUIP, 47=BY(PU) - If this is set equal to PU, it will punch type II intensity values for the contouring program. It should be set up for 19 receivers.
- 7₉ EQUIP, 48=BY(PU) - If this is set equal to PU, it will punch type III intensity values for the contouring program. It should be set up for 19 receivers.
- 7₉ EQUIP, 49=BY(PU) - This punches type I eigenrays; it punches everything that is printed in the eigenray printout.
- 7₉ EQUIP, 1=MT,HI,WØ,**,DA--OUTPUT TAPE FOR CALCOMP PLOT OF RAY PATHS

The equip cards may be left in the deck if a certain option is not desired; there will be no output from that unit unless a write operation is performed in the program.

SUBROUTINES

The main, or executive, program TRIMAIN is used chiefly for selecting options and calling the proper subroutine to compute the desired quantities. The subroutines are shown in Fig. 3, and these will be discussed on the succeeding pages. All of the output control cards (group V), title cards (group I), and source depths, frequency, etc. (group II) are read in by the main program. A listing of TRIMAIN and the subroutines is found in Appendix A. A comparison of calculated and experimental values is found in Appendix B.

Subroutine INITRAYS

The subroutine INITRAYS (whose cards are identified in the right margin in Appendix A by INIT 1, INIT 2, ..., INIT 81) reads in the angle cards and the beam-pattern cards and sets up the initial values of each ray's tangent of the angle, depth, phase, and signal level. (card group numbers will be listed in the section). Information from card group II from the main program is passed in the common block /PATTERN/ (INIT 3, Appendix A), which contains the source depth, beam-pattern switch, degrees of down tilt, and source level (in decibels). INITRAYS then reads in card group III, comprising the fan cards and the beam pattern cards. Rays are started from the lowest angle of each fan to the top. If the low angle of a fan equals the highest angle of the previous fan, a continuous ray group results. Otherwise a buffer ray with zero signal strength separates the fans, and type I intensity calculations will not interpolate over the gap.

Subroutine BRLTRD

The subroutine BRLTRD reads in the bottom-loss cards (group IV) and sets up the first loss table. On entry, dummy parameter RB is equated to ISCP (card group II), is

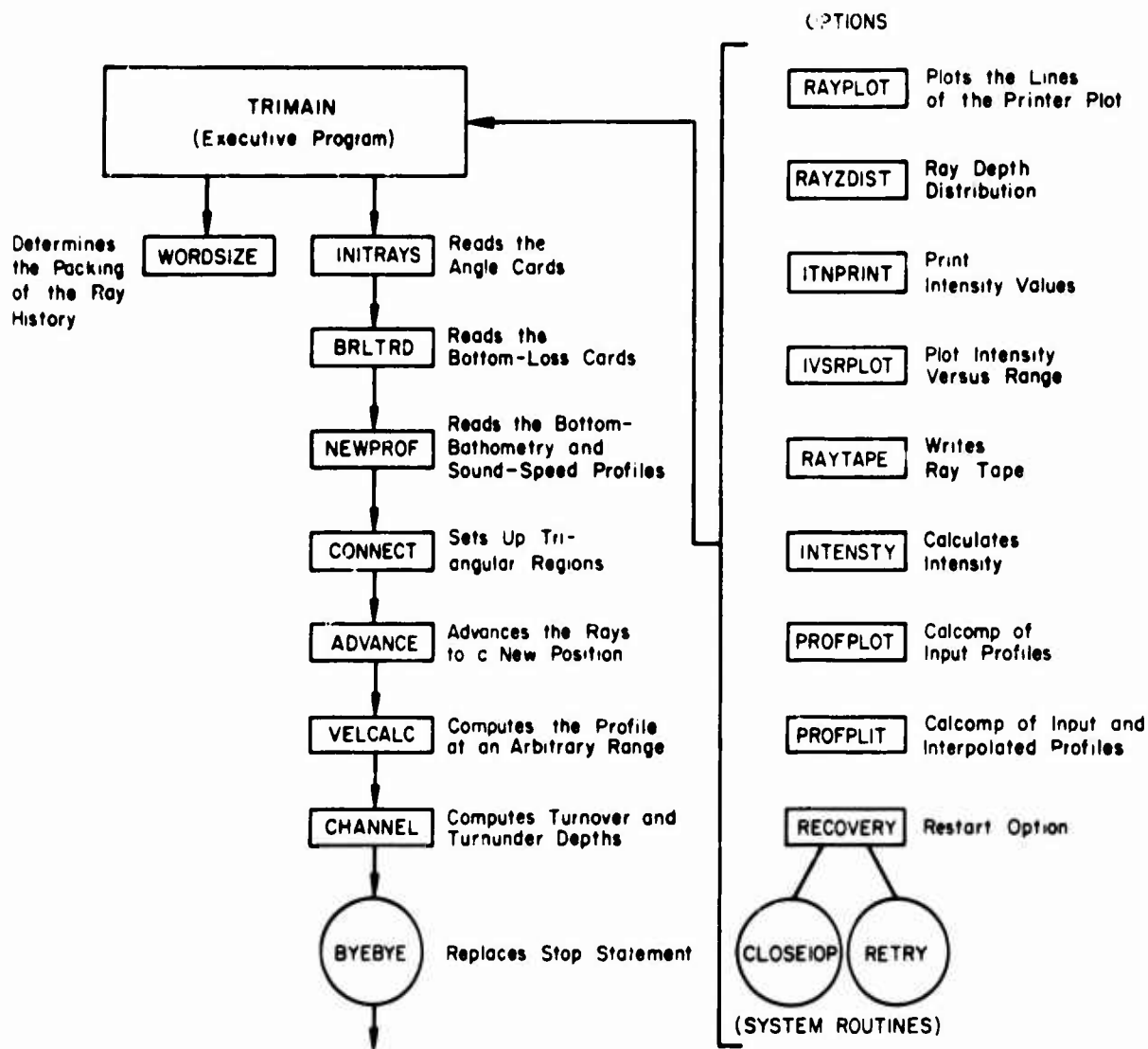


Fig. 3 - Function of each subroutine of the program TRIMAIN

either 1.0 or 0., and determines whether phase-shift tables will be read. On exit, RB is set to the range in kilometers until which the first loss table is to be used. The term ENTRY NWBRLT (as in BLRD 146) resets the loss table and RB. TRIMAIN will call NWBRLT whenever the rays pass RB. For example, if there are two loss tables, one for 0 to 100 km and the second for 100 km to the end of the run, BRLTRD will read in both tables, set BRLT and BPST in the common block /MIRRORS/ (BLRD 3, Appendix A) and set RB to 100. Later a call to NWBRLT sets BRLT and BPST to the second table of values, and RB to 1.E30 (i.e., 10^{30} km \gg end of run). Subroutine BRLTRD includes the Marine Geophysical Survey (MGS) classes 0 through 5, plus user classes 6

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through 9 stored in array BR, or user loss and phase classes 6 and 7, stored in arrays BR and BP. If a class 0 through 5 is specified, bottom phase classes do not have to be read in. A maximum of four user classes are available without phase shifts, and two classes are available with phase shifts. If classes 0 through 5 are used, a maximum of 50 cards is allowed.

Subroutine NEWPROF

Subroutine NEWPROF reads the bottom ranges, bottom depths (group VI), and the first two sound-speed profiles (group VII) on the first call. It then interpolates a profile for the first bottom point. Succeeding calls generate a new interpolated profile for each bottom point, unless this would pass the last read-in profile. In that case, a bottom point is interpolated to the profile range, and the profile is returned. A new profile is then read in. Thus the basic action of NEWPROF is to move $R2$ (range to the current profile), $N2$ (number of points in the current profile), $Z2$ (depth array), and $V2$ (sound-speed array) to $R1$ (range to the previous profile), $N1$ (number of points in the previous profile), $Z1$ (depth array for the previous profile), and $V1$ (sound-speed array for the previous profile) and set new values for $R2$, $N2$, $Z2$, and $V2$. It returns the maximum bottom depth in ZMAX. The printed output of NEWPROF is illustrated in Figs. 4a and 4b.

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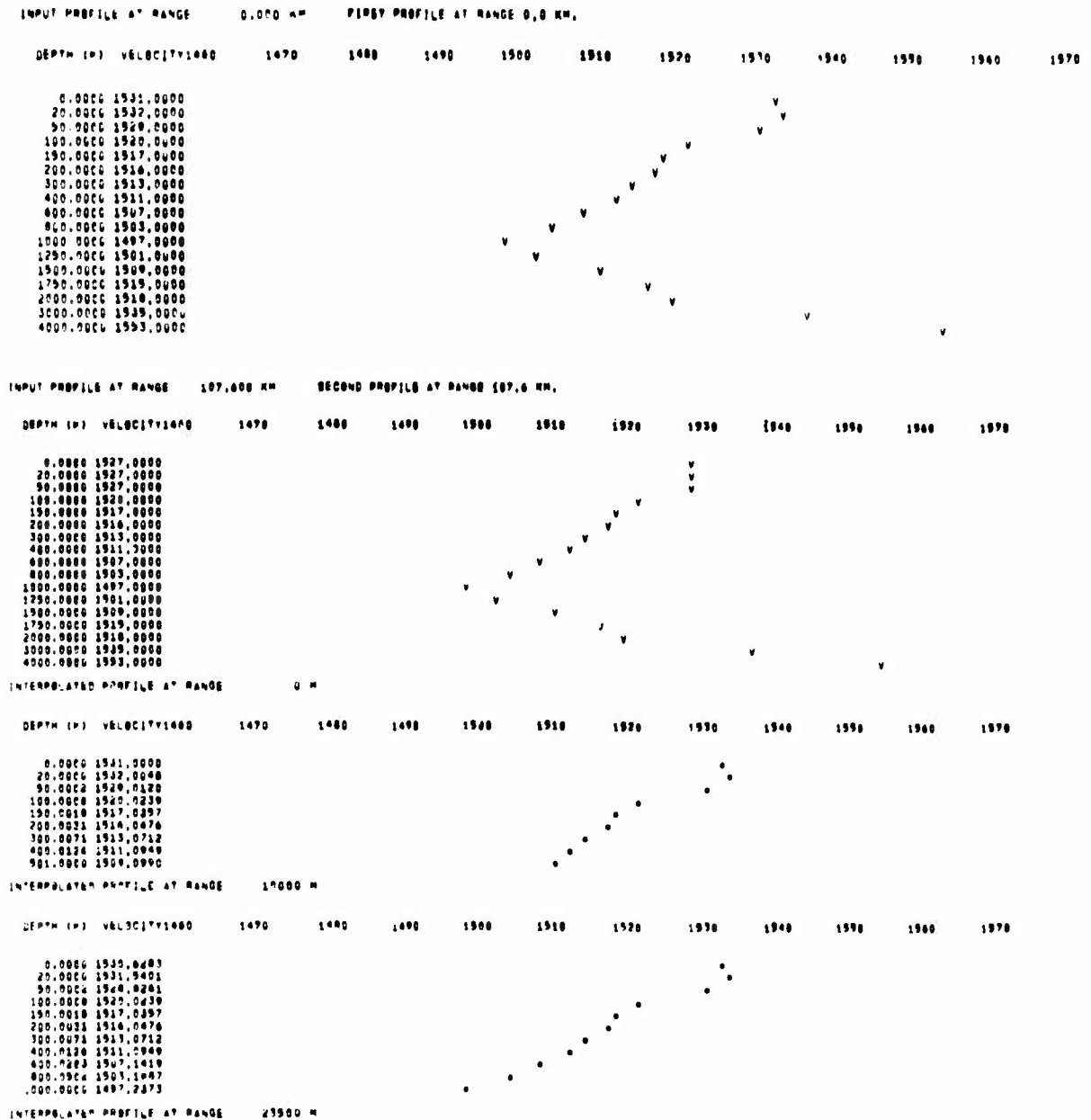


Fig. 4a — Output of NEWPROF. The first two input profiles are those of the sample case given in Fig. 1.

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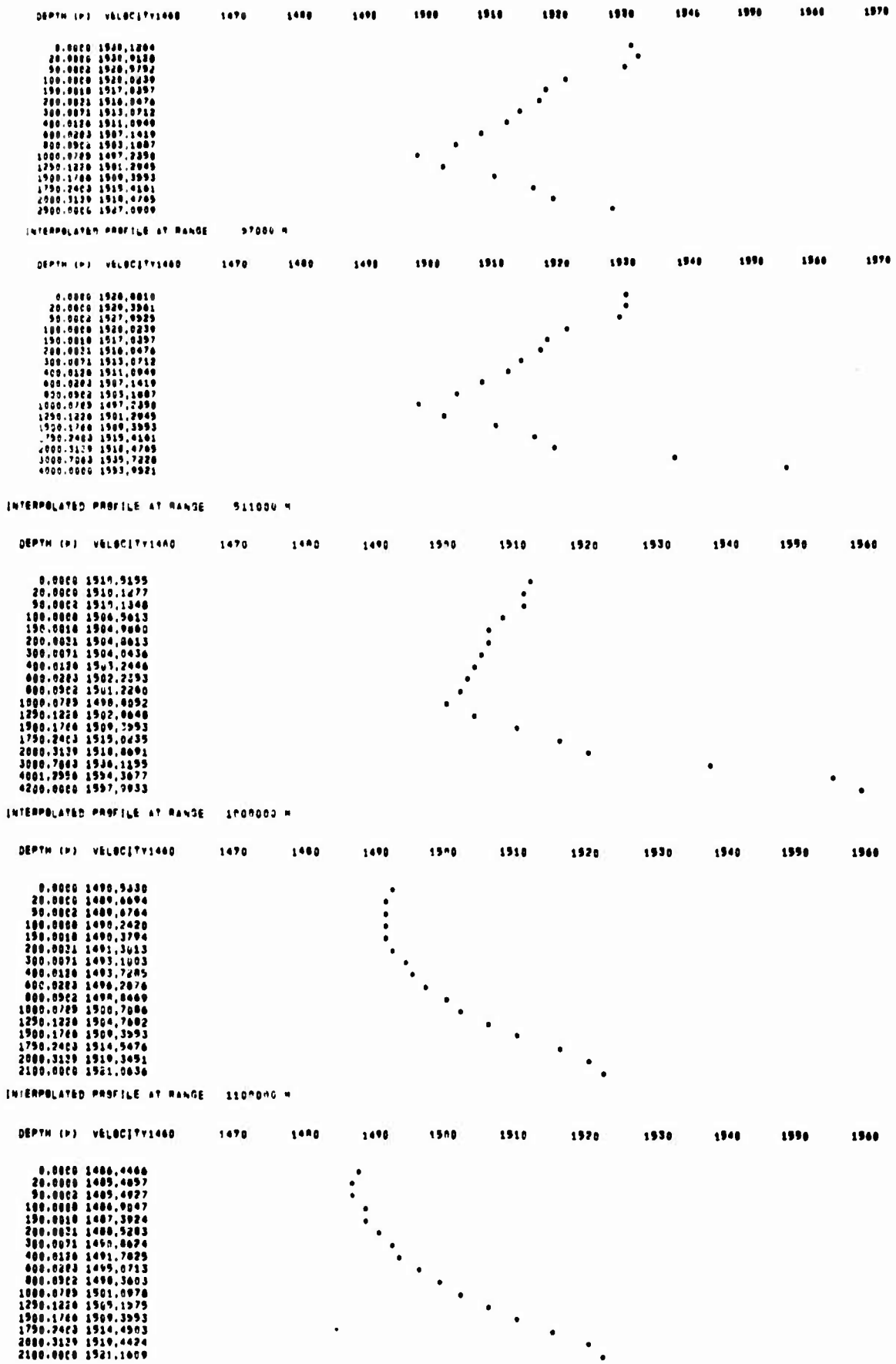


Fig. 4b — Additional portion of the output of NEWPROF shown in Fig. 4a

Subroutine CONNECT

Subroutine CONNECT uses $R1, N1, Z1, V1, R2, N2, Z2,$ and $V2$ from NEWPROF and connects the points into triangular (Δ) regions. The coefficients of the triangles go into the common block /TRIANG/ (CONN 3, Appendix A). The variables in TRIANG are the following:

AP, BP	coefficients of the Δ boundary in the prime frame, which is centered at RZERO and ZZERO and rotated by an angle θ ,
AL, BL	coefficients of the lower Δ boundary in the ocean frame.
ZZERO, RZERO	ocean frame coordinates of the center of the prime frame.
AA, BB	coefficients of $1/c^2$ in the prime frame, i.e., $1/c^2 = AA + BBz'$,
SST, CCT	sin and cos of θ , the angle between the ocean and the prime frames.

In the listing of the subroutine, the following conditions are true:

$$AL + BL \cdot R = \text{equation for boundary of triangle,}$$

$$AA + BZ \cdot Z + BR \cdot R = \frac{1}{c^2}.$$

A typical network of triangular regions is illustrated in Fig. 5.

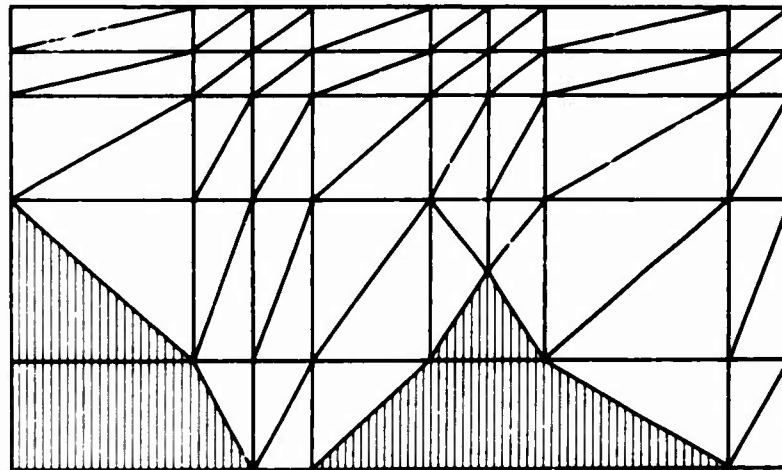


Fig. 5 — Typical network of triangular regions

Subroutine WORDSIZE

Subroutine WORDSIZE calculates some machine-dependent quantities. Four numbers are packed into array NCOUNT by using *ITN*, which is $ITN = \sqrt[4]{1/4 \text{ JBIG}}$, where JBIG is the largest integer, which will fit into one computer word. The four numbers in each location in NCOUNT are: number of turnovers for this ray, number of bottom reflections, number of turnunders, and number of surface reflections. ENTRY RAYTAPE writes one record on the ray tape. The first record will contain the title card. Each record contains:

NRAY (number of ray),
 Range (meters),
 Bottom depth (meters),
 Tan γ (up is positive)
 Ray depth (meters),
 Signal strength (multi-
 plicative factor),
 NCOUNT (ray history),
 Travel time (seconds),
 Phase (radians).



Each one contains NRAY words. All tan γ 's precede all ray depths, etc.

Subroutine ADVANCE

The basic function of subroutine ADVANCE is to advance the rays in the common block /RAYS/ from RSTART to RMAX. The procedure is as follows: First the proper triangle is found, the parabolic path is found, and intersections are calculated with the earliest intersection being used. Then surface and bottom reflections are performed. If ray is not at RMAX, the new triangle is determined, and a loop is made in the procedure to the calculation of intersections.

The explanation of various sections is as follows:

TANSUM (ADVA0012, Appendix A) is the tangent sum formula

$$\tan (\theta_1 + \theta_2) = \frac{\tan \theta_1 + \tan \theta_2}{1 - \tan \theta_1 * \tan \theta_2}$$

DELTA gives the time increment of a ray in terms of the range increment DR, the two tangents *T* and *S*, and the vertex velocity $CMIS = 1/c_m^2$.

The DO 100 IRAY = 1, NRAY (ADVA0015) (card sequence number) selects each ray in turn.

ADVA0018 checks to see if a ray has been terminated.

ADVA0019 through ADVA0023 move the ray variables into local variables.

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The DO 20 I = 1, NRT! (ADVA0024 through ADVA0030) checks each triangle to see if the ray is in it. If a ray is on a boundary, it is in the layer it is pointing toward.

CT(cos θ), ST(sin θ), (rotation), and ZO and RO (displacement) define the primed frame of reference in which there is no r' gradient.

ZRP and RRP are the initial primed ray position.

CIS = 1/c2 at the ray.

Note: that TGR from TGAM (IRAY) is + for up rays and - for down rays, whereas TGRP = DZ'/dr' is + for down rays and - for up rays.

ALPHA (α) is the path curvature:

$$Z' = ZRP + TGRD*(r' - RRP) + ALPHA*(r' - RRP)^2$$

$$TA = 2\alpha = \frac{d^2Z'}{dr'^2}$$

The quadratic equation solved in advance is

$$C + Py - \alpha y^2 = 0,$$

where $y = DRP$ = change in $r' = RPNEW - RRP$. ALPHA (α) is often small and is zero for isovelocity layers. For small α the root

$$y = (P - \sqrt{P^2 + 4\alpha C}) / 2\alpha$$

is unstable. However, if α is small, the iteration $y = (\alpha y^2 - C)/P$ converges fast. The statement $DRP = (ALPHA*((ALPHA*DRP**2 - C)/P)**2 - C)/P$ is a double application of the above iteration and is used when

$$F = P - \sqrt{P^2 + 4\alpha C} \ll P.$$

When α = 0, special linear path statements are used (ADVA0055 through ADVA0065 and ADAV0171 through ADVA0174). After statement 40 (ADVA0085), the next position is selected.

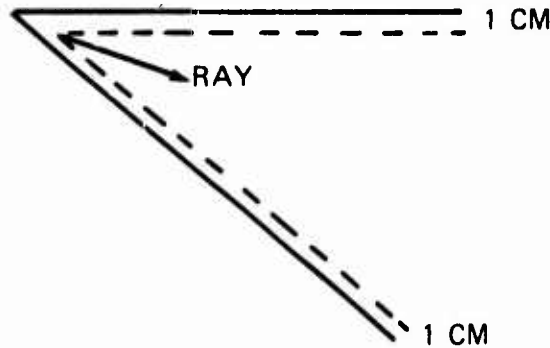
ONUP is true if a ray is on the upper boundary of a layer, meaning within 1 centimeter of the boundary and pointing in. ONLW is true if a ray is on the lower boundary.

There are four possibilities, in RPNEW, ZPNEW, ZNEW, and RNEW arrays. In general, the rule is

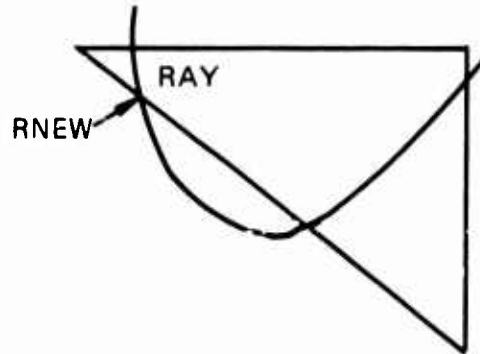
$$RNEW = \min(RNEW(k)) \text{ such that } RNEW(k) > RR.$$

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When a ray is on a boundary however the solution closest to the ray on that boundary is thrown out (ADVA0095, ADVA0096, ADVA0099, and ADVA100). Note, as shown in the following sketch, that a ray can be on both boundaries if it is on a corner.



If $R_{NEW} > R_{MAX}$, then the ray hits the vertical boundary (following sketch) and one goes to statement 50.



The cards from ADVA0129 to ADVA0163 increment the ray variables and decide on the next triangle.

ADVA0135 checks for vertices.

ADVA0136 decides whether a vertex is over or under.

ADVA0142 through ADVA0148 handles surface reflections.

ADVA0151 through ADVA0161 handles bottom reflections.

Statement 50 starts the vertical boundary section. The boundary in the primed frame is $Z' = AV + BVr'$.

If $ST = 0$, $BV \rightarrow \infty$; hence small ST 's are handled by statement 60.

When two intersections are possible, the one with the smallest depth change is used.

Statement 52 checks for vertices.

The statements ADVA0204 and ADVA0205 (545) check the ray's final depth to be sure it is in the correct layer.

Volume attenuation is approximated by 0.0001α (dB)/km $V\Delta T$ decibels, since one should have $S = \int v dt$ instead of $V\Delta T$.

The local variables are restored in the table ADVA0208 through ADVA0212, and a new ray is taken at statement 100.

Statements 60 through 68 (ADVA0214 through ADVA0235) use an iterative scheme to find the intersection with a vertical boundary. For $ST = 0$ or $\alpha = 0$ the first step is exact. The convergence limit is 1 centimeter, but seven steps are taken at once, so the usual error is very small.

Statement 80 terminates a ray and prints out the message RAY TERMINATED.

Statement 100 is the end of the outer loop of subroutine ADVANCE.

Subroutine PROFPLOT

Subroutine PROFPLOT plots the input velocity profiles and also the bottom track on a Calcomp plot (Fig. 6). They may be plotted in range increments of nautical miles or kilometers. In Fig. 6 the three profiles are at 0, 107.6, and 1135.4 km, which ranges are indicated by + symbols on the abscissa axis. The total plot length is specified to give a suitable scale.

Subroutine RAYZDIST

Subroutine RAYZDIST prints out a ray depth distribution (Fig. 7) each time it is called. The following items will be printed: NRAY = number of ray, NTO - number of turnovers, NTU = number of turnunders, NSR = number of surface reflections, NBR = number of bottom reflections, DEPTH = current depth of ray, THETA = ray angle at the point in degrees, TIME = travel time of ray in seconds to this range. The losses column is $10 \log_{10} SS$, and is initially

$$10 \log_{10} [(\cos \theta_0) \Delta \theta_0] + \text{SORLEV} - \text{beam pattern.}$$

If $\text{SORLEV} = \text{beam pattern} = 0$ dB, and $\Delta \theta_0 = 1^\circ$, then losses start out -17.6 dB for a horizontal ray. In the plot line, B is the bottom, $+$ is the lower vertex depth, $*$ is the present ray position, $-$ is the upper vertex and S is the surface.

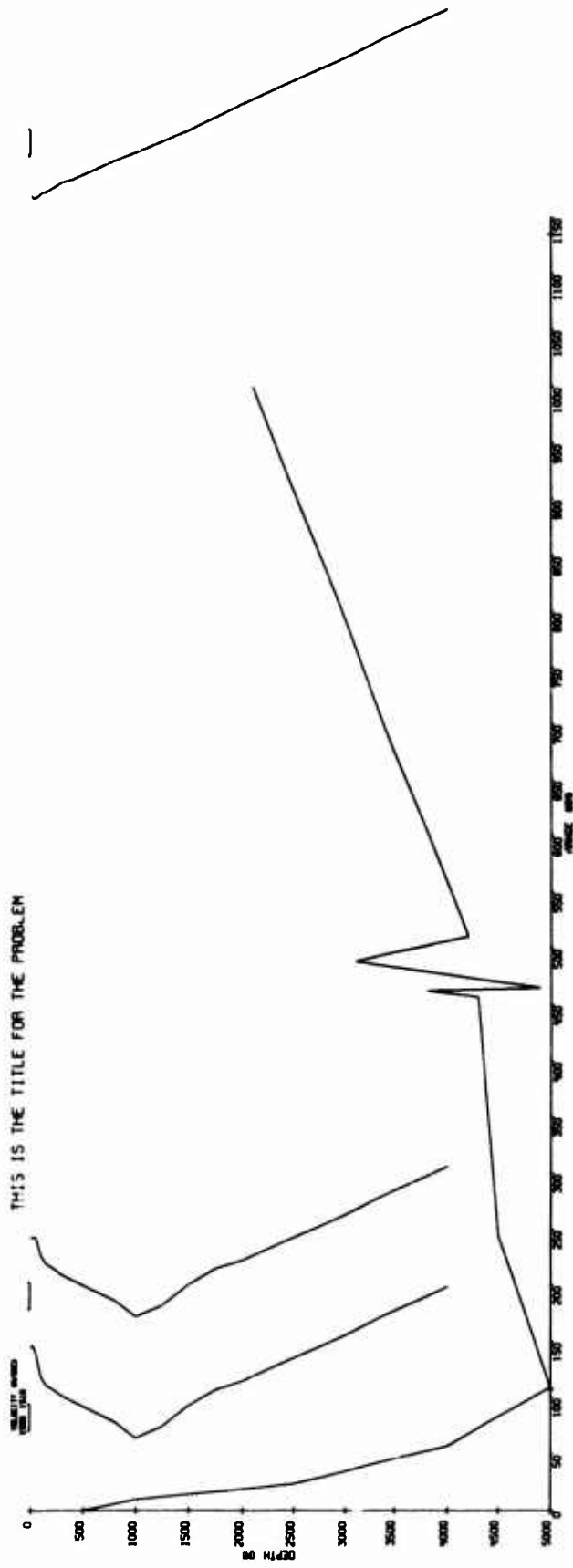


Fig. 6 - Colcomp plot of input profiles and the bottom track

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RAY DEPTH DISTRIBUTION AT 900,000 M

BOTTOM DEPTH 3600,000 M

SCALE 91,400 M/POSITION

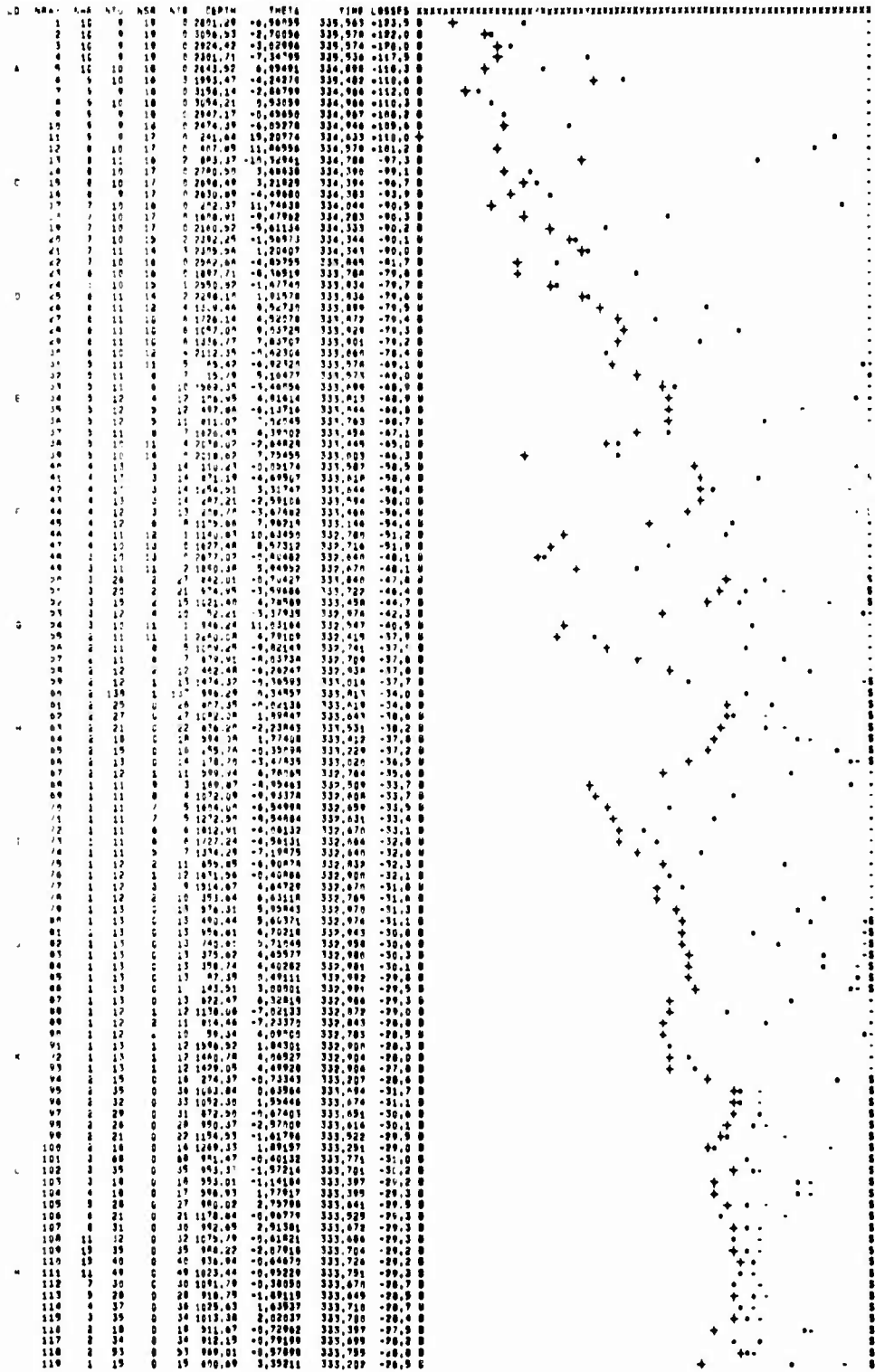


Fig. 7 - Example of the output from RAYZDIST (first of four pages)

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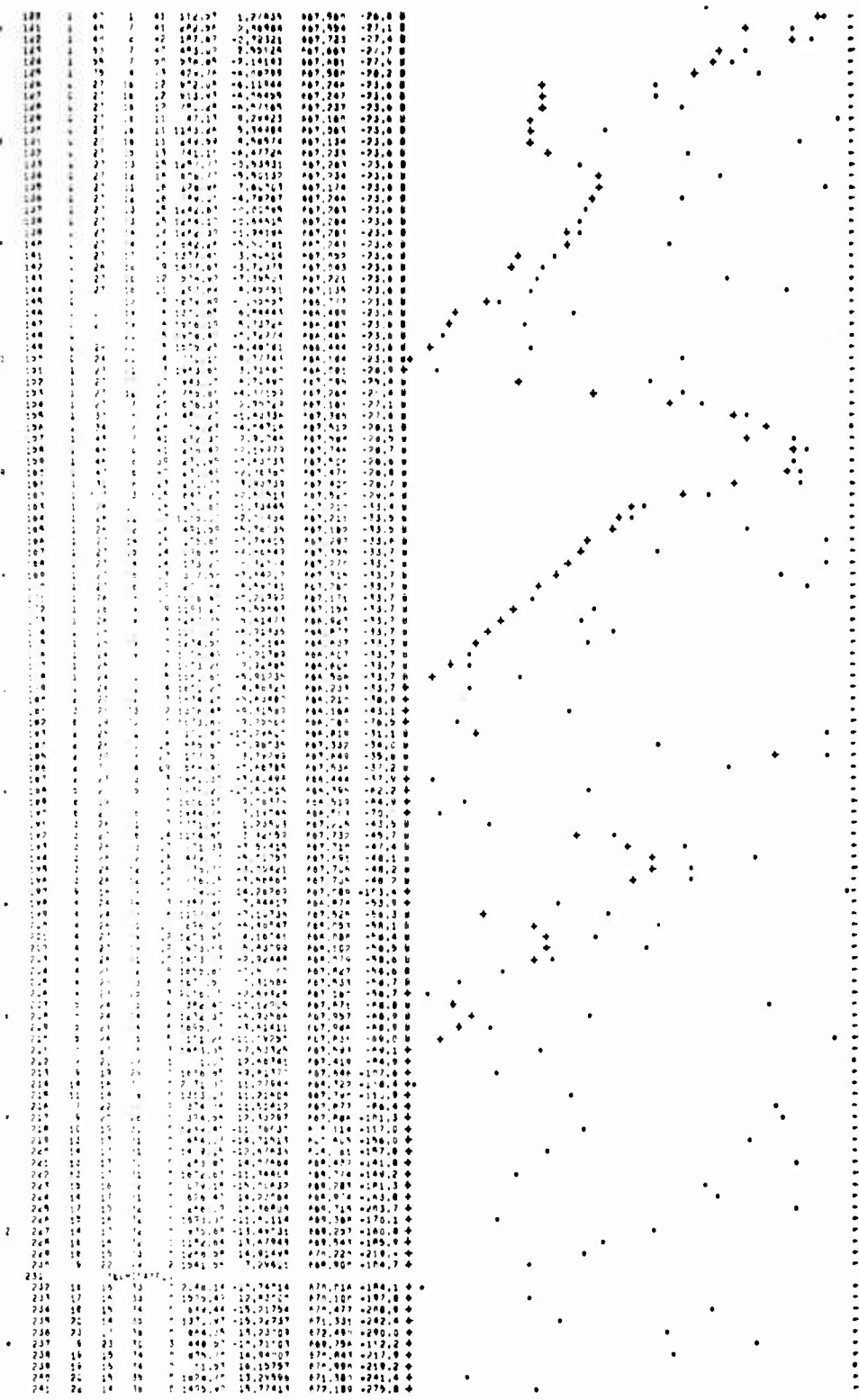
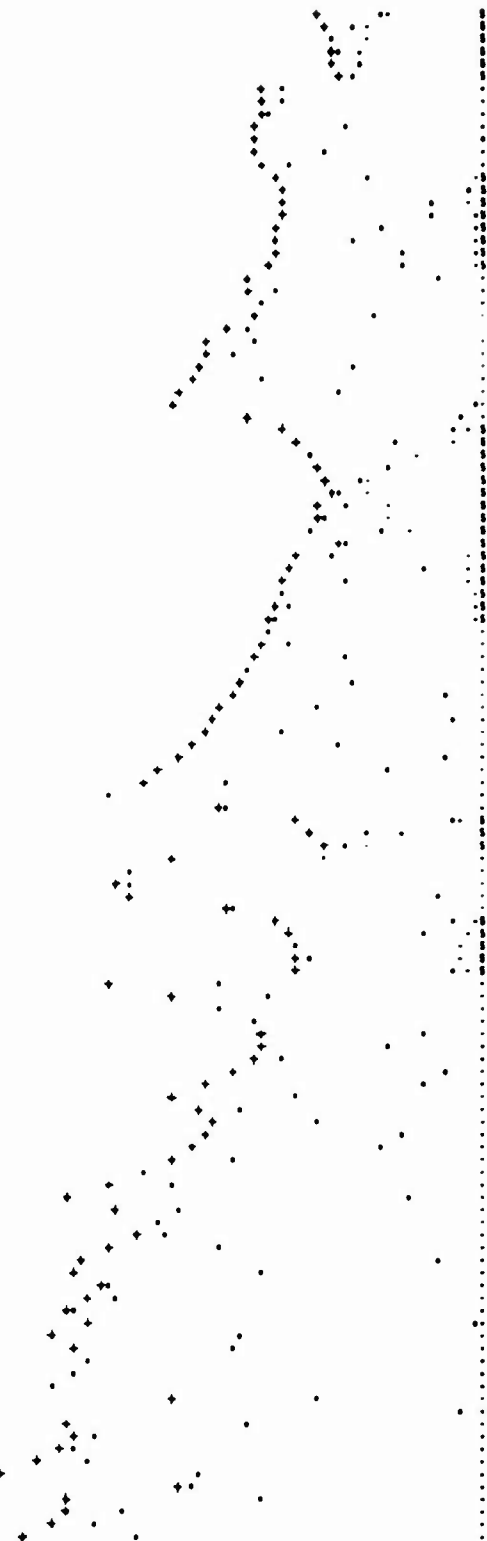


Fig. 7 (Continued) — Example of the output from RAYZDIST (second of four pages)

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140	1	21	0	27	792.10	+1.19531	333.910	-96.0
141	1	20	0	20	8.0000	-2.10000	333.617	-97.1
142	1	20	0	30	1172.76	+0.99809	333.000	-97.0
143	1	20	0	34	1147.20	+1.00000	333.079	-97.7
144	1	20	0	34	899.61	-0.31000	333.000	-97.0
145	1	20	0	47	800.20	-0.00770	333.730	-98.2
146	1	17	1	12	1000.76	1.00000	332.983	-93.0
147	1	17	1	12	1000.27	0.00000	332.984	-93.0
148	1	17	1	12	1000.01	0.00000	332.984	-93.0
149	1	17	1	11	1214.27	-7.78020	332.001	-93.0
150	1	17	1	11	10.21	1.00000	332.709	-93.0
151	1	17	1	11	1171.00	-7.10021	332.070	-93.0
152	1	17	1	11	1171.00	0.00000	332.070	-93.0
153	1	17	1	11	1171.00	0.11000	332.070	-93.0
154	1	17	1	11	80.20	0.00000	332.002	-93.0
155	1	17	1	11	251.77	0.30027	332.001	-93.0
156	1	17	1	11	370.20	0.41029	332.000	-93.0
157	1	17	1	11	712.07	0.00000	332.000	-93.0
158	1	17	1	11	800.07	0.00000	332.001	-93.0
159	1	17	1	11	300.10	0.00010	332.072	-93.0
160	1	17	1	11	300.21	0.00117	332.071	-93.0
161	1	17	1	11	274.11	0.00000	332.000	-93.0
162	1	17	1	11	300.01	0.00000	332.070	-93.0
163	1	17	1	11	1070.27	0.23020	332.000	-93.0
164	1	17	1	11	790.71	-7.10004	332.001	-93.0
165	1	17	1	11	1724.21	-7.10029	332.000	-93.0
166	1	17	1	11	1070.00	-0.33101	332.000	-93.0
167	1	17	1	11	1070.00	-0.30000	332.000	-93.0
168	1	17	1	11	470.07	-0.41113	332.000	-93.0
169	1	17	1	11	1011.29	-0.43073	332.000	-93.0
170	1	17	1	11	1070.00	-0.41200	332.000	-93.0
171	1	17	1	11	74.00	0.10100	332.000	-93.0
172	1	17	1	11	271.00	-0.00100	332.000	-93.0
173	1	17	1	11	410.07	3.00000	332.000	-93.0
174	1	17	1	11	677.00	3.00000	332.000	-93.0
175	1	17	1	11	1011.00	0.00000	332.000	-93.0
176	1	17	1	11	1011.00	0.00000	332.000	-93.0
177	1	17	1	11	1011.00	0.00000	332.000	-93.0
178	1	17	1	11	1011.00	0.00000	332.000	-93.0
179	1	17	1	11	1011.00	0.00000	332.000	-93.0
180	1	17	1	11	1011.00	0.00000	332.000	-93.0
181	1	17	1	11	1011.00	0.00000	332.000	-93.0
182	1	17	1	11	1011.00	0.00000	332.000	-93.0
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185	1	17	1	11	1011.00	0.00000	332.000	-93.0
186	1	17	1	11	1011.00	0.00000	332.000	-93.0
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189	1	17	1	11	1011.00	0.00000	332.000	-93.0
190	1	17	1	11	1011.00	0.00000	332.000	-93.0
191	1	17	1	11	1011.00	0.00000	332.000	-93.0
192	1	17	1	11	1011.00	0.00000	332.000	-93.0
193	1	17	1	11	1011.00	0.00000	332.000	-93.0
194	1	17	1	11	1011.00	0.00000	332.000	-93.0
195	1	17	1	11	1011.00	0.00000	332.000	-93.0
196	1	17	1	11	1011.00	0.00000	332.000	-93.0
197	1	17	1	11	1011.00	0.00000	332.000	-93.0
198	1	17	1	11	1011.00	0.00000	332.000	-93.0
199	1	17	1	11	1011.00	0.00000	332.000	-93.0
200	1	17	1	11	1011.00	0.00000	332.000	-93.0
201	1	17	1	11	1011.00	0.00000	332.000	-93.0
202	1	17	1	11	1011.00	0.00000	332.000	-93.0
203	1	17	1	11	1011.00	0.00000	332.000	-93.0
204	1	17	1	11	1011.00	0.00000	332.000	-93.0
205	1	17	1	11	1011.00	0.00000	332.000	-93.0
206	1	17	1	11	1011.00	0.00000	332.000	-93.0
207	1	17	1	11	1011.00	0.00000	332.000	-93.0
208	1	17	1	11	1011.00	0.00000	332.000	-93.0
209	1	17	1	11	1011.00	0.00000	332.000	-93.0
210	1	17	1	11	1011.00	0.00000	332.000	-93.0
211	1	17	1	11	1011.00	0.00000	332.000	-93.0
212	1	17	1	11	1011.00	0.00000	332.000	-93.0
213	1	17	1	11	1011.00	0.00000	332.000	-93.0
214	1	17	1	11	1011.00	0.00000	332.000	-93.0
215	1	17	1	11	1011.00	0.00000	332.000	-93.0
216	1	17	1	11	1011.00	0.00000	332.000	-93.0
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219	1	17	1	11	1011.00	0.00000	332.000	-93.0
220	1	17	1	11	1011.00	0.00000	332.000	-93.0
221	1	17	1	11	1011.00	0.00000	332.000	-93.0
222	1	17	1	11	1011.00	0.00000	332.000	-93.0
223	1	17	1	11	1011.00	0.00000	332.000	-93.0
224	1	17	1	11	1011.00	0.00000	332.000	-93.0
225	1	17	1	11	1011.00	0.00000	332.000	-93.0
226	1	17	1	11	1011.00	0.00000	332.000	-93.0
227	1	17	1	11	1011.00	0.00000	332.000	-93.0
228	1	17	1	11	1011.00	0.00000	332.000	-93.0
229	1	17	1	11	1011.00	0.00000	332.000	-93.0
230	1	17	1	11	1011.00	0.00000	332.000	-93.0
231	1	17	1	11	1011.00	0.00000	332.000	-93.0
232	1	17	1	11	1011.00	0.00000	332.000	-93.0
233	1	17	1	11	1011.00	0.00000	332.000	-93.0
234	1	17	1	11	1011.00	0.00000	332.000	-93.0
235	1	17	1	11	1011.00	0.00000	332.000	-93.0
236	1	17	1	11	1011.00	0.00000	332.000	-93.0
237	1	17	1	11	1011.00	0.00000	332.000	-93.0
238	1	17	1	11	1011.00	0.00000	332.000	-93.0
239	1	17	1	11	1011.00	0.00000	332.000	-93.0
240	1	17	1	11	1011.00	0.00000	332.000	-93.0
241	1	17	1	11	1011.00	0.00000	332.000	-93.0



THE TOTAL NUMBER OF LINES PRINTED FOR THIS JOB WAS 740

Fig. 7 (Continued) — Example of the output from RAYZDIST (fourth of four pages)

Subroutine CHANNEL

Subroutine CHANNEL calculates CM (vertex velocity) from ZR (ray depth) and T (tangent of the ray angle) and then finds ZTO (ray turnover depth) and ZTU (ray turn-under depth). The entry RCALC then calculates

$$R = \int_{ZTO}^{ZTU} \frac{1}{\tan \theta} dz,$$

where R is the cycle length of the ray, which is used for the type III intensity calculations. The entry WDENS then calculates the probability density $P(Z)$ that a ray will be found at a depth z :

$$P(z) = \frac{1}{(\tan \theta)/R},$$

which is the type III depth distribution.

Subroutine VELCALC

Subroutine VELCALC calculates a velocity profile at each selected range for internal calculations (not a profile range or bottom point) using the information in the common block /TRIANG/.

Subroutine RAYPLOT

Each entry to RAYPLOT plots one line of the printer plot. In addition the first entry prints the heading for the plot, determines which rays will be plotted, and sets the scale. NP and ZMAX are used only on the first entry. Fig. 8 is an example of the printer plot.

Subroutine PROFPLIT

Subroutine PROFPLIT plots both the input and interpolated profiles on a Calcomp plot. They may be plotted in nautical miles or kilometers. The total plot length is specified in inches. The bottom track is also plotted.

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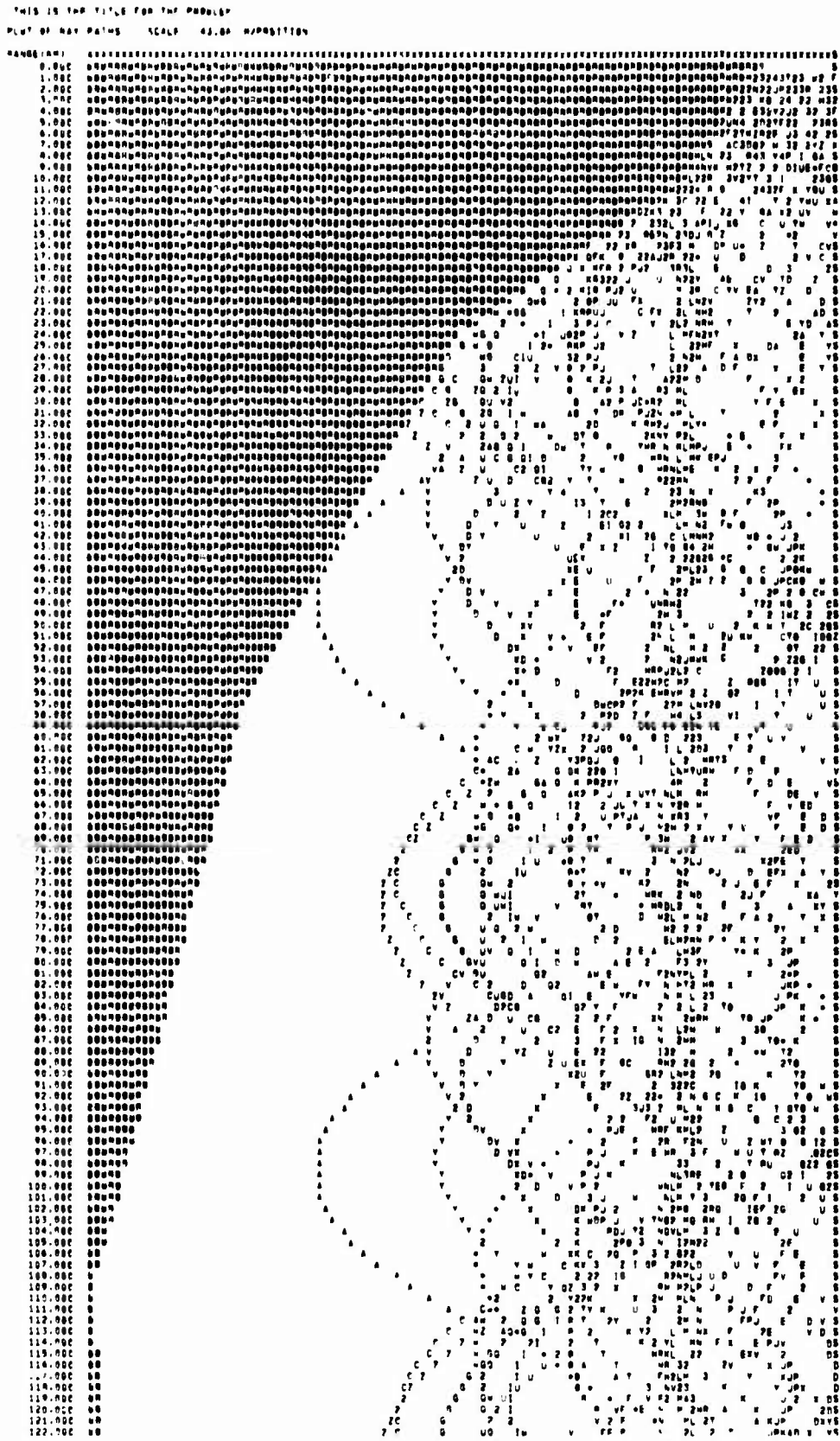
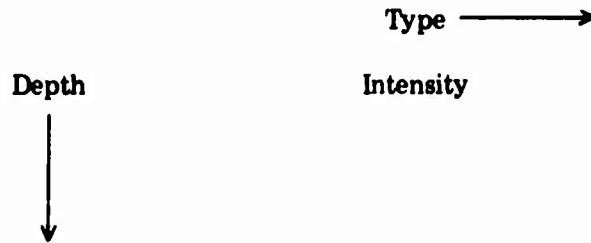


Fig. 8 - Ray plot

Subroutine ITNPRINT

Subroutine ITNPRINT prints out the intensities. If receiver depths are the same for all intensity calculations, a table of intensities such as shown in Fig. 9 is printed. Otherwise a printer plot for each range with the arrangement



is printed.

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RECEIVED INTENSITY VS RANGE AT DEPTHS

RANGE	TYPE	50,000	100,000	150,000	200,000	250,000
1.000	R	-97.4	-97.9	-97.5	-97.6	-97.3
2.000	R	-92.3	-97.0	-92.7	-92.7	-92.4
3.000	R	-85.0	-90.7	-86.4	-86.0	-85.0
4.000	R	-87.6	-90.1	-86.5	-86.6	-86.3
5.000	S	-71.8	-72.3	-72.0	-71.6	-70.0
6.000	R	-69.3	-71.3	-70.6	-70.8	-70.5
7.000	R	-76.4	-80.1	-80.4	-79.8	-72.4
8.000	R	-77.4	-80.1	-71.6	-70.6	-74.2
9.000	R	-80.0	-84.6	-79.4	-70.2	-72.8
10.000	R	-78.3	-85.8	-76.2	-75.3	-75.9
11.000	S	-80.1	-77.9	-77.3	-76.6	-74.1
12.000	R	-82.4	-85.1	-78.0	-77.1	-74.0
13.000	R	-85.4	-87.4	-87.7	-86.1	-78.2
14.000	R	-91.6	-83.8	-87.7	-88.8	-81.2
15.000	R	-93.1	-85.0	-84.4	-84.0	-87.2
16.000	R	-94.4	-86.0	-87.0	-87.9	-84.7
17.000	S	-94.4	-83.7	-84.0	-81.8	-79.4
18.000	R	-94.3	-87.8	-85.3	-88.7	-89.5
19.000	R	-92.1	-90.5	-87.3	-89.3	-89.5
20.000	R	-114.7	-96.9	-86.8	-90.0	-90.5
21.000	R	-113.7	-113.7	-90.7	-88.1	-81.5
22.000	R	-113.8	-114.4	-93.3	-89.7	-89.8
23.000	S	-99.5	-86.7	-84.1	-82.3	-72.9
24.000	R	-116.4	-115.3	-114.8	-94.5	-88.9
25.000	R	-129.6	-117.5	-121.3	-122.4	-88.7
26.000	R	-136.8	-120.1	-120.3	-122.3	-122.5
27.000	R	-143.0	-119.4	-121.9	-121.6	-123.5
28.000	R	-149.4	-127.7	-121.9	-123.0	-123.0
29.000	S	-98.2	-87.8	-84.9	-79.3	-84.1
30.000	R	-143.0	-132.2	-120.8	-123.2	-123.3
31.000	R	-142.7	-139.9	-121.2	-122.9	-125.2
32.000	R	-147.1	-132.7	-120.8	-123.7	-98.9
33.000	R	-149.5	-143.8	-118.6	-124.0	-99.4
34.000	R	-147.1	-141.6	-109.8	-123.3	-99.6
35.000	S	-99.0	-88.7	-85.3	-84.6	-84.9
36.000	R	-158.5	-132.9	-119.6	-122.9	-99.4
37.000	R	-159.8	-134.7	-118.5	-123.0	-121.5
38.000	R	-160.2	-134.1	-114.6	-124.0	-111.2
39.000	R	-159.0	-145.8	-121.9	-124.2	-113.3
40.000	R	-160.0	-136.6	-123.0	-114.2	-114.3
41.000	S	-100.8	-89.3	-88.0	-89.2	-89.6
42.000	R	-166.6	-139.7	-123.5	-114.5	-92.9
43.000	R	-166.0	-165.7	-121.4	-117.9	-94.0
44.000	R	-165.6	-135.5	-127.5	-118.5	-86.3
45.000	R	-163.6	-121.4	-129.6	-116.5	-88.6
46.000	R	-164.0	-124.3	-124.1	-118.8	-85.1
47.000	S	-101.6	-89.9	-86.6	-85.8	-86.2
48.000	R	-163.1	-124.8	-101.4	-80.0	-86.3
49.000	R	-164.0	-104.3	-89.9	-78.3	-88.4
50.000	R	-162.3	-101.7	-81.3	-79.5	-87.8
51.000	R	-94.3	-94.7	-81.5	-81.1	-82.3
52.000	R	-96.2	-96.4	-80.3	-80.9	-83.6
53.000	S	-102.3	-90.6	-87.1	-86.2	-86.7
54.000	R	-97.5	-97.4	-82.9	-82.2	-83.8
55.000	R	-98.3	-99.4	-79.2	-81.3	-83.5
56.000	R	-98.1	-98.9	-83.1	-89.0	-79.0
57.000	R	-98.6	-99.8	-83.3	-81.6	-78.9
58.000	R	-100.1	-100.2	-81.6	-87.7	-84.1
59.000	S	-102.9	-90.9	-81.6	-86.8	-87.1
60.000	R	-100.4	-84.5	-78.8	-89.5	-89.2
61.000	R	-99.7	-85.7	-83.3	-88.9	-89.6
62.000	R	-101.3	-74.0	-84.3	-86.7	-88.1
63.000	R	-101.2	-79.2	-82.8	-84.4	-87.5
64.000	R	-100.9	-85.9	-82.5	-84.1	-89.2
65.000	S	-103.4	-91.3	-88.0	-84.9	-87.5
66.000	R	-120.0	-92.3	-85.1	-86.4	-89.0
67.000	R	-123.4	-91.1	-85.2	-86.7	-86.8
68.000	R	-85.1	-95.3	-94.2	-86.3	-89.2
69.000	R	-93.5	-91.0	-88.3	-101.3	-94.2
70.000	R	-99.4	-93.8	-94.2	-100.5	-96.5
71.000	S	-103.9	-91.7	-88.3	-83.1	-87.9
72.000	R	-110.0	-93.8	-97.1	-97.6	-93.6
73.000	R	-110.1	-94.0	-97.9	-98.3	-98.9
74.000	R	-116.4	-110.1	-101.5	-100.5	-98.0
75.000	R	-117.1	-107.8	-100.7	-101.1	-101.1
76.000	R	-106.7	-106.4	-97.0	-102.0	-102.8
77.000	S	-104.3	-92.0	-88.7	-87.9	-88.3
78.000	R	-115.1	-108.9	-104.9	-99.1	-102.7
79.000	R	-128.9	-114.5	-113.7	-100.2	-108.0
80.000	R	-140.4	-124.1	-122.0	-128.5	-101.5
81.000	R	-133.0	-125.7	-119.9	-129.9	-127.7
82.000	R	-135.3	-123.3	-122.2	-130.5	-119.1
83.000	S	-105.1	-92.4	-89.0	-88.3	-88.6
84.000	R	-138.1	-136.9	-127.4	-125.0	-120.2
85.000	R	-138.9	-130.2	-129.2	-116.8	-111.6
86.000	R	-144.4	-135.2	-127.4	-120.2	-93.4
87.000	R	-142.3	-134.7	-128.5	-121.3	-87.1
88.000	R	-140.9	-143.8	-130.0	-123.7	-87.4
89.000	S	-105.3	-92.7	-89.3	-88.5	-88.9
90.000	R	-144.4	-137.2	-135.9	-124.0	-87.3
91.000	R	-155.9	-138.9	-134.3	-123.2	-81.1
92.000	R	-156.4	-144.6	-138.8	-130.2	-91.6
93.000	R	-156.8	-134.4	-130.8	-84.4	-82.9
94.000	R	-156.5	-141.0	-130.0	-82.7	-87.7
95.000	S	-105.6	-93.8	-89.6	-88.4	-88.2
96.000	R	-300.0	-143.2	-126.6	-89.9	-87.5
97.000	R	-300.0	-300.0	-90.9	-83.5	-87.4
98.000	R	-370.0	-140.5	-92.1	-86.2	-89.5
99.000	R	-171.1	-124.6	-88.6	-87.5	-89.3
100.000	R	-111.1	-111.1	-88.5	-91.8	-89.1

Fig. 9 — Example of an output from ITNPRINT (first of three pages). The symbols that the subroutine uses in the second column are R for type I random phase calculations, S for type I coherent phase calculations, 2 for type II calculations, and 3 for type III calculations.

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85.000	1	-129.7	-93.2	-80.9	-89.1	-80.4
85.000	R	-113.1	-113.1	-95.4	-90.4	-83.3
86.000	R	-101.9	-102.9	-95.9	-93.9	-87.8
87.000	R	-103.4	-103.4	-87.4	-91.9	-86.7
88.000	R	-104.5	-104.5	-88.1	-87.0	-86.6
89.000	R	-105.2	-105.2	-94.7	-87.1	-81.3
89.000	J	-106.1	-93.4	-90.1	-88.3	-88.7
90.000	R	-105.6	-105.6	-87.2	-86.8	-88.2
91.000	R	-105.9	-103.7	-88.1	-88.8	-90.1
92.000	R	-106.1	-90.7	-91.2	-90.4	-83.8
93.000	R	-106.2	-106.2	-89.8	-79.0	-88.2
94.000	M	-106.1	-106.2	-84.2	-88.7	-85.5
95.000	J	-106.5	-93.7	-90.3	-89.6	-88.9
95.000	R	-106.0	-81.4	-87.2	-90.6	-82.0
96.000	R	-105.6	-91.0	-88.4	-92.6	-81.7
97.000	R	-86.2	-88.9	-89.7	-91.3	-82.5
98.000	R	-103.8	-85.3	-90.1	-90.2	-81.7
99.000	R	-103.4	-87.6	-87.9	-90.4	-80.8
100.000	J	-106.8	-93.9	-90.6	-89.8	-88.1
100.000	J	-106.8	-93.9	-90.6	-89.8	-88.1
100.000	R	-112.5	-97.4	-90.4	-88.8	-85.9
109.000	J	-107.0	-94.2	-90.8	-90.0	-88.3
110.000	J	-105.4	-91.5	-91.1	-88.4	-88.6
115.000	J	-106.2	-93.3	-91.5	-88.9	-88.8
120.000	J	-106.8	-93.4	-91.8	-88.3	-81.0
125.000	J	-107.2	-93.7	-92.0	-89.7	-81.2
130.000	J	-107.6	-91	-92.2	-90.5	-81.4
135.000	J	-95.5	-91.1	-92.1	-90.5	-81.7
140.000	J	-99.8	-91.8	-91.6	-90.4	-81.9
145.000	J	-100.1	-92.2	-91.9	-90.6	-82.1
150.000	J	-100.3	-90.5	-92.4	-91.0	-82.3
155.000	J	-101.2	-92.9	-92.7	-91.2	-82.4
160.000	J	-101.7	-92.7	-92.9	-90.6	-82.6
165.000	J	-101.9	-91.1	-92.3	-90.9	-82.7
170.000	J	-99.2	-91.6	-92.3	-91.4	-82.9
175.000	J	-100.3	-92.9	-92.8	-91.5	-83.1
180.000	J	-101.0	-90.4	-93.1	-91.8	-83.2
185.000	J	-101.4	-91.8	-93.4	-91.9	-83.4
190.000	J	-101.6	-91.4	-90.8	-92.1	-83.4
195.000	J	-101.9	-92.1	-91.5	-92.3	-83.5
200.000	J	-97.6	-92.7	-91.8	-92.5	-83.7
200.000	J	-97.6	-92.7	-91.8	-92.5	-83.7
205.000	J	-99.5	-93.0	-92.8	-92.7	-83.8
210.000	J	-100.1	-93.3	-92.6	-93.0	-84.0
215.000	J	-100.8	-93.3	-93.1	-93.2	-84.1
220.000	J	-101.2	-93.4	-93.5	-93.3	-84.2
225.000	J	-78.3	-93.9	-91.9	-93.4	-84.4
230.000	J	-99.1	-94.2	-92.3	-93.6	-84.4
235.000	J	-99.3	-94.4	-92.5	-93.7	-84.5
240.000	J	-99.5	-94.6	-93.0	-93.7	-84.6
245.000	J	-98.1	-94.8	-93.6	-94.0	-84.8
250.000	J	-99.2	-94.7	-90.6	-94.1	-84.9
255.000	J	-99.6	-94.3	-93.1	-94.3	-85.0
260.000	J	-98.5	-94.4	-93.9	-94.4	-85.1
265.000	J	-99.2	-92.8	-93.7	-94.5	-85.0
270.000	J	-99.2	-93.7	-93.9	-94.6	-85.2
275.000	J	-99.6	-93.4	-92.1	-94.7	-85.3
280.000	J	-99.8	-94.2	-93.5	-94.8	-85.4
285.000	J	-100.0	-94.7	-92.7	-95.0	-85.5
290.000	J	-100.3	-95.0	-93.6	-95.1	-85.6
295.000	J	-100.6	-95.3	-93.8	-95.2	-85.7
300.000	J	-100.4	-93.9	-94.8	-95.3	-85.8
300.000	J	-100.4	-93.0	-94.8	-95.3	-85.8
305.000	J	-100.7	-94.4	-94.1	-95.3	-85.9
310.000	J	-100.7	-94.7	-94.1	-95.4	-86.0
315.000	J	-100.9	-94.8	-94.4	-95.5	-86.1
320.000	J	-100.8	-94.9	-94.7	-95.6	-86.2
325.000	J	-98.4	-95.1	-94.9	-95.7	-86.4
330.000	J	-99.8	-94.6	-95.1	-95.9	-86.4
335.000	J	-100.3	-93.3	-95.2	-96.0	-86.7
340.000	J	-100.6	-94.9	-95.3	-96.0	-86.9
345.000	J	-100.9	-94.7	-95.2	-96.1	-86.6
350.000	J	-101.1	-93.4	-95.4	-96.2	-86.5
355.000	J	-101.2	-94.7	-95.6	-96.2	-86.9
360.000	J	-101.4	-95.0	-95.7	-96.2	-86.1
365.000	J	-101.5	-94.5	-95.8	-96.3	-86.2
370.000	J	-101.6	-94.7	-95.9	-96.4	-86.3
375.000	J	-101.8	-94.9	-96.0	-96.5	-86.4
380.000	J	-99.5	-94.8	-96.1	-96.6	-86.5
385.000	J	-100.2	-95.0	-96.2	-96.7	-86.6
390.000	J	-100.8	-95.2	-96.2	-96.8	-86.3
395.000	J	-101.0	-95.2	-96.3	-96.8	-86.1
400.000	J	-99.7	-95.5	-96.4	-96.9	-86.5
400.000	J	-99.7	-95.5	-96.4	-96.9	-86.5
405.000	J	-98.5	-95.7	-96.5	-97.0	-86.7
410.000	J	-99.2	-95.9	-96.5	-96.2	-86.8
415.000	J	-97.8	-95.9	-96.6	-96.0	-86.9
420.000	J	-98.1	-96.1	-96.7	-96.2	-87.0
425.000	J	-97.6	-96.2	-96.8	-96.3	-87.1
430.000	J	-96.8	-96.3	-96.9	-96.5	-87.1
435.000	J	-96.9	-96.5	-97.0	-96.2	-87.2
440.000	J	-97.4	-96.4	-97.0	-96.7	-87.2
445.000	J	-97.8	-96.7	-97.1	-96.9	-87.3
450.000	J	-93.5	-96.9	-97.3	-97.0	-87.4
455.000	J	-95.2	-97.0	-96.4	-97.1	-87.5
460.000	J	-96.1	-97.0	-97.4	-97.2	-87.6
465.000	J	-96.0	-97.1	-97.5	-97.3	-87.6
470.000	J	-96.4	-97.2	-97.5	-97.4	-87.7
475.000	J	-96.6	-97.2	-97.6	-97.4	-87.7
480.000	J	-96.3	-97.3	-97.6	-97.5	-87.8
485.000	J	-96.9	-97.4	-97.7	-97.6	-87.8
490.000	J	-97.3	-97.1	-96.7	-97.3	-87.9
495.000	J	-97.5	-97.2	-97.2	-97.6	-88.0
500.000	J	-97.5	-97.4	-97.4	-97.7	-87.4
500.000	J	-97.5	-97.4	-97.4	-97.7	-87.4

Fig. 9 — Example of an output from ITNPRINT (second of three pages)

B. G. ROBERTS

205.000	3	+96.7	+97.6	+97.5	+97.8	+97.8
210.000	3	+97.0	+97.7	+97.5	+97.8	+97.8
215.000	3	+97.2	+97.9	+97.3	+97.9	+98.0
220.000	3	+97.4	+97.0	+97.5	+97.9	+97.8
225.000	3	+97.2	+98.0	+97.7	+98.0	+97.8
230.000	3	+97.6	+97.8	+97.9	+98.1	+97.9
235.000	3	+96.8	+97.4	+98.0	+98.2	+97.6
240.000	3	+96.8	+97.7	+98.0	+98.2	+97.7
245.000	3	+97.1	+97.8	+97.9	+98.3	+97.7
250.000	3	+97.2	+97.8	+98.0	+98.3	+97.9
255.000	3	+97.3	+97.9	+98.1	+97.8	+98.0
260.000	3	+96.9	+97.8	+98.2	+98.2	+98.1
265.000	3	+96.0	+97.7	+98.3	+98.3	+98.2
270.000	3	+96.7	+97.1	+98.4	+98.1	+98.3
275.000	3	+96.9	+97.2	+98.5	+97.5	+98.3
280.000	3	+96.4	+97.2	+98.5	+97.9	+98.3
285.000	3	+96.5	+97.1	+98.5	+98.1	+98.4
290.000	3	+94.5	+97.4	+98.6	+98.2	+97.3
295.000	3	+96.4	+97.5	+98.5	+98.1	+98.1
300.000	3	+96.6	+97.4	+98.4	+98.3	+97.8
305.000	3	+96.8	+97.4	+98.4	+98.3	+97.8
310.000	3	+97.0	+97.4	+98.3	+98.3	+97.5
315.000	3	+97.2	+97.4	+98.6	+98.4	+97.9
320.000	3	+97.5	+97.4	+98.3	+98.5	+98.1
325.000	3	+97.6	+97.5	+98.5	+98.3	+98.2
330.000	3	+97.7	+97.4	+98.5	+97.9	+98.2
335.000	3	+97.8	+97.4	+98.6	+98.1	+98.3
340.000	3	+97.9	+97.4	+98.7	+97.5	+98.4
345.000	3	+98.1	+97.4	+98.7	+98.0	+98.5
350.000	3	+98.0	+97.4	+98.8	+98.2	+98.5
355.000	3	+98.3	+97.7	+98.8	+98.3	+98.6
360.000	3	+98.4	+97.7	+98.8	+98.4	+98.6
365.000	3	+98.5	+97.7	+98.8	+98.4	+98.6
370.000	3	+98.6	+97.7	+98.8	+98.4	+98.6
375.000	3	+98.7	+97.5	+98.5	+98.5	+98.7
380.000	3	+98.8	+97.4	+98.4	+98.6	+98.7
385.000	3	+98.9	+97.2	+98.4	+98.6	+98.7
390.000	3	+98.8	+97.1	+98.2	+98.6	+98.8
395.000	3	+98.6	+97.1	+98.2	+98.6	+98.8
400.000	3	+98.6	+97.1	+98.2	+98.6	+98.8
405.000	3	+98.4	+97.1	+98.2	+98.6	+98.8
410.000	3	+98.7	+97.1	+98.2	+98.9	+98.9
415.000	3	+98.9	+97.1	+98.2	+98.9	+98.9
420.000	3	+98.6	+97.2	+98.3	+98.9	+98.7
425.000	3	+99.0	+97.2	+98.3	+98.9	+98.9
430.000	3	+99.1	+97.2	+98.2	+93.9	+98.0
435.000	3	+99.2	+97.2	+98.2	+98.1	+98.0
440.000	3	+99.3	+97.2	+98.2	+98.5	+98.0
445.000	3	+99.3	+97.4	+98.4	+98.6	+98.1
450.000	3	+99.3	+97.4	+98.4	+98.6	+97.1
455.000	3	+98.8	+97.5	+98.5	+97.3	+97.4
460.000	3	+98.7	+97.4	+98.4	+97.2	+97.4
465.000	3	+98.7	+97.4	+98.4	+98.9	+97.6
470.000	3	+98.7	+97.4	+98.3	+98.7	+97.6
475.000	3	+98.9	+97.4	+98.4	+98.3	+97.8
480.000	3	+98.5	+97.4	+98.4	+98.4	+97.9
485.000	3	+98.7	+97.4	+98.4	+98.4	+97.9
490.000	3	+98.7	+97.4	+98.3	+98.9	+98.0
495.000	3	+98.4	+97.4	+98.3	+98.9	+98.0
500.000	3	+98.4	+97.4	+98.3	+98.9	+98.0
505.000	3	+97.9	+97.4	+98.2	+98.8	+97.9
510.000	3	+98.2	+97.4	+98.1	+98.7	+97.9
515.000	3	+98.4	+97.4	+98.0	+98.7	+97.9
520.000	3	+98.4	+97.4	+97.8	+98.6	+97.9
525.000	3	+98.5	+97.4	+97.8	+98.6	+97.9
530.000	3	+98.6	+97.4	+97.3	+98.5	+97.8
535.000	3	+98.7	+97.4	+97.9	+98.6	+97.8
540.000	3	+98.8	+97.4	+97.8	+98.6	+97.9
545.000	3	+98.8	+97.4	+99.0	+98.5	+98.1
550.000	3	+98.9	+97.4	+99.0	+98.5	+98.1
555.000	3	+98.9	+97.4	+99.0	+98.3	+98.3
560.000	3	+98.9	+97.4	+99.0	+98.2	+98.5
565.000	3	+98.9	+97.4	+98.9	+98.1	+98.7
570.000	3	+99.0	+97.4	+98.9	+98.1	+98.7
575.000	3	+99.1	+97.4	+98.9	+98.1	+98.7
580.000	3	+98.4	+97.4	+98.9	+98.0	+98.6
585.000	3	+98.3	+97.4	+98.8	+97.7	+98.6
590.000	3	+98.4	+97.4	+98.8	+97.4	+98.6
595.000	3	+97.6	+97.4	+98.8	+97.2	+98.7
600.000	3	+97.6	+97.4	+98.8	+97.2	+98.7
605.000	3	+97.6	+97.4	+98.8	+97.1	+98.7
610.000	3	+97.7	+97.4	+98.8	+98.8	+98.6
615.000	3	+98.1	+97.4	+98.8	+98.4	+98.6
620.000	3	+98.2	+97.4	+98.8	+98.3	+98.5
625.000	3	+98.3	+97.4	+98.7	+98.2	+98.2
630.000	3	+98.3	+97.4	+98.7	+98.2	+98.6
635.000	3	+98.3	+97.4	+98.8	+98.2	+98.7
640.000	3	+98.4	+97.4	+98.8	+98.6	+98.9
645.000	3	+98.5	+97.4	+98.8	+98.3	+98.9
650.000	3	+98.6	+97.4	+98.8	+98.1	+98.9
655.000	3	+98.6	+97.4	+98.8	+98.1	+98.9
660.000	3	+98.6	+97.4	+98.8	+98.1	+98.9
665.000	3	+98.6	+97.4	+98.8	+98.1	+98.9
670.000	3	+97.9	+97.4	+98.5	+98.9	+98.8
675.000	3	+97.9	+97.4	+98.4	+98.9	+98.8
680.000	3	+98.1	+97.4	+98.4	+98.9	+98.7
685.000	3	+98.1	+97.4	+98.3	+98.8	+98.7
690.000	3	+98.1	+97.4	+98.3	+98.8	+98.7
695.000	3	+98.1	+97.4	+98.3	+98.8	+98.7
700.000	3	+98.2	+97.4	+98.3	+98.8	+98.6
705.000	3	+98.3	+97.4	+98.4	+98.9	+98.6
710.000	3	+98.3	+97.4	+98.4	+98.9	+98.7

Fig. 9 — Example of an output from ITNPRINT (third of three pages)

Subroutine IVSRPLOT

Subroutine IVSRPLOT plots intensity versus range (Fig. 10). The first entry prints the heading, chooses the correct type of calculation, and then plots a line or the first range. Each succeeding call plots just a line for another range. Only one type may be plotted per data case.

Subroutine INTENSTY

Subroutine INTENSTY calculates all intensities. The switches ISCP, IT1, IT2, and IT3 determine what is calculated. When one selects coherent phase (ISCP = 1) one must also select random phase (IT1 = 1). Coherent phase intensity takes the phase of the ray into account in the calculations. If SL is a function of the random-phase sound level, then the coherent sound level is $(\sqrt{SL} \cdot \cos(P))^2 + (\sqrt{SL} \cdot \sin(P))^2$, where P is the phase angle. To get each, set IT2 = 1 for type II calculations and IT3 = 1 for type III calculations.

The only caustic correction which is applied to type I calculations is a ray-separation criterion: if two rays are closer together than 0.001 meter in depth, the eigenray for these two rays is thrown out. Type II and Type III intensity calculations do not have caustics.

Subroutine RECOVERY

Subroutine RECOVERY has two entry points: DUMP and RESTART. Its function is to enable one to restart a program. DUMP writes all the core locations on a tape when it is called, and RESTART restores core to its previous condition when it is called by reading the tape from DUMP.

Subroutine RETRY

Subroutine RETRY enables one to restart a program in which the multiple replacement option has been used (as was discussed for card II in the Input Description). Its chief function is to read any profile cards which have not yet been read and to write them on logical unit 6 for subroutine NEWPROF to read when required.

Subroutine CLOSEIOP

The function of subroutine CLOSEIOP is to alleviate a systems problem in punching intensity cards when using RESTART. Without this subroutine the cards would be punched in binary instead of BCD when RESTART is called. This subroutine might not be required in another computer system, if the proper moding of logical units is accomplished automatically.

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THIS IS THE TITLE FOR THE PROBLEM
 RECEIVED INTENSITY VS RANGE

RECEIVER AT DEPTH PLOTS AS

50.000 1
 150.000 2
 250.000 3
 350.000 4
 450.000 5

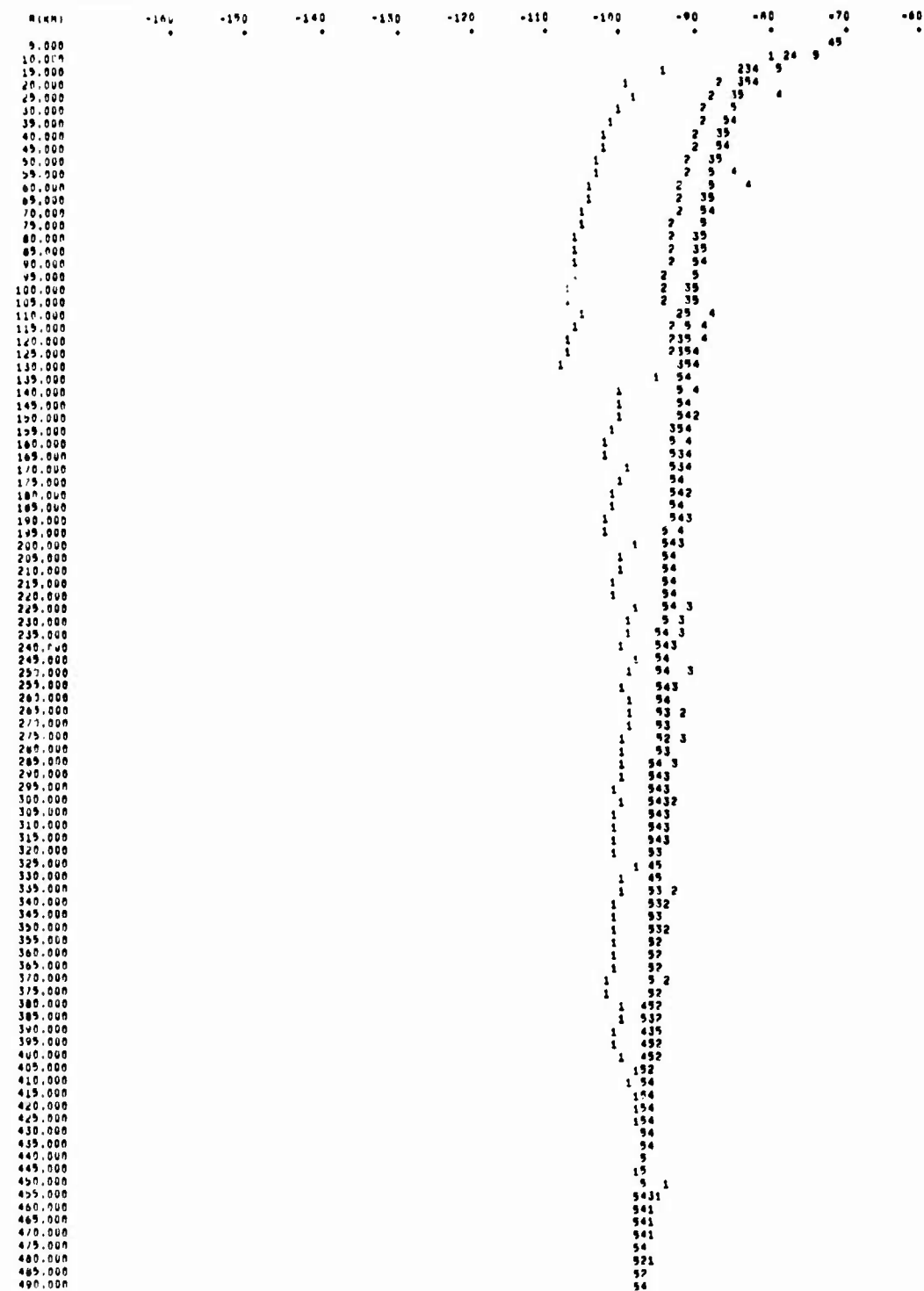


Fig. 10 -- Example of the output from IVSRPLOT

Subroutine BYEBYE

Subroutine BYEBYE is called in place of the Fortran statement STOP to terminate the program. It was written to avoid a CDC3800 systems problem when DUMP is called in the executive program. It might not be necessary to have this in another computer system, in which case the STOP statement could be reinserted, if desired.

DIFFERENT INTENSITIES IN TRIMAIN

In subroutine RAYZDIST (ray depth distribution) a quantity is printed titled LOSSES (Fig. 6). This quantity is equal to $10 \log_{10} (S)$, where S represents all the losses due to bottom interactions, surface interactions, and volume attenuation. Spreading loss is not included in these figures.

In subroutine INTENSTY a quantity is printed for the eigenray printout called SL (DB). If we let $SS(I)$ denote the quantity called S in RAYZDIST for the current ray and $SS(I-1)$ denote S for the previous ray, then we let $S1 = \secant(\text{current ray angle}) [SS(I-1)]$ and let $DS = \secant(\text{previous ray angle}) [SS(I)-S1]$. The ray depth at a given point may be identified as $ZZ(I)$. So if we are considering ray I , then $Z1 = ZZ(I-1)$ and $DZ = ZZ(I) - Z1$. If ZR is the receiver depth, then we let $F = (ZR - Z1)/DZ$. We let $RMAX$ be the range to this point in meters. Then we define a quantity $SL = (S1 + F DS) / [RMAX \text{ ABS}(DZ)]$. Thus the quantity printed for $SL(DB)$ is $10 \log_{10} (SL)$.

The third parameter which is printed is the type I intensity and is derived in subroutine INTENSTY. This set consists of summing all the eigenrays, or the SL , for a given receiver and range point and then computing

$$10 \log \sum_{i=1}^N SL_i \text{ (incoherent or random phase sum),}$$

where N is the number of eigenrays determined for this point. If the Lloyd's mirror switch is not on, the final intensity value can be arrived at as stated, but if the Lloyd's mirror switch is on, each eigenray is multiplied by a factor before they are summed; thus it is not always possible to sum the eigenrays as printed to arrive at the final intensity.

The type II intensity calculation was initially proposed [2] using a Gaussian distribution, which smears a ray over a displaced bundle of intensity. $DZBAR$ is a size parameter for that smearing and is defined by $DZBAR = SDZ/SW$, where we are using the mean absolute difference between ray depths, weighted by the signal strength of the ray, such that

$$SW = \sum_{i=2}^{NRAY} W_i = \sum_{i=2}^{NRAY} \min(SS_i, SS_i - 1),$$

which is the sum of the weights, and

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$$SDZ = \sum_{i=2}^{NRAY} W_i (ZZ_i - ZZ_{i-1})$$

which is the sum of the weighted mean differences.

If DZBAR is less than a wavelength, then DZBAR is set equal to a wavelength. $DZM = ZB/\sqrt{NRAY}$, where ZB is the bottom depth and $NRAY$ is the number of rays traced. If DZBAR is greater than DZM , then $DZBAR = DZM$. This is a check to see that DZBAR is not a large fraction of the bottom depth. If 100 rays were traced, then DZBAR would never be larger than 1/10 of the bottom depth.

If RMAX is the range at this point, then let $F = 2.0 * RMAX * DZBAR$. Let $ER = e^{-(ZR/DZBAR)}$, where ZR is the receiver depth, let $EB = e^{-(ZB/DZBAR)}$, and let $EZ = e^{-(ZZ(I)/DZBAR)}$. Now $SL = B * \sec\theta * SS(I) / F$ where B is the volume attenuation. If a ray is close to the bottom, it does not get its full share of the intensity, since the intensity is distributed exponentially on either side of the ray. Thus, it is necessary to renormalize the distribution by saying $SL = SL / (1 - .5 * ((EB/EZ) + EZ))$.

We now want to calculate the quantity $A = e^{-(ABS(ZZ(I) - ZR) / DZBAR)}$, which expression is always less than 1.0. The final expression for each ray is then $S_i = SL * A$. The final intensity at a receiver is given by computing, in subroutine ITNPRINT,

$$10 \log \sum_{i=1}^N S_i .$$

In calculating the Type III intensity [2] it is assumed that a current velocity profile prevails to represent a local average over a convergence zone, which wipes out the phase of a ray. The ray turnover and turnunder depths are calculated for each ray, and then the ray cycle length is computed. Next the expression $SL = B * SS(I) / RMAX$ is computed to get cylindrical spreading. If a given receiver is between the turnunder and turnover depths, entry WDENS is called, which returns the parameter S , the signal strength parameter, which represents the probability density that the ray is at this depth. This probability density $T = 1 / ABS(TAN\theta)$ is normalized in WDENS by dividing by the ray cycle length. The cylindrical spreading term is multiplied by signal-strength parameter S_i to get a contribution for each ray which is then summed as

$$10 \log \sum_{i=1}^N SL_i * S_i$$

to arrive at the final values.

EIGENRAY OUTPUT OPTION

The computer coding for the eigenray output option appears within the subroutine INTENSTY. If a request is made either for type I random intensity or type I coherent intensity, then it is possible to obtain an eigenray output (Fig. 11) by setting column 25 on the output control card (card group V in Fig. 1) equal to 1. The concept of an eigenray may be envisioned as an interpolated ray which will strike a receiver and is found by linearly interpolating between two rays which bracket a receiver. For certain cases eigenrays will be formed from rays which do not bracket a receiver. This is caused primarily by consecutive rays which have different histories; in this case there is some ray between the two existing rays which would give an eigenray if it were traced. Thus the program extrapolates a value. The program prefers two rays with the same history which bracket a receiver. This represents an IQUAL of 1. If it cannot achieve this, if the next ray history is different from the current ray history, if the previous ray history is the same as the current ray history, and if the receiver is within a distance of 1/2 the ray separation, a forward extrapolation is performed and IQUAL = 2. The same condition may happen on the first two rays of a set, and in this condition IQUAL = 3. If an interpolated ray is found later, the IQUAL = 3 ray will be thrown out, and the IQUAL = 1 ray used. This is indicated by ** after the IQUAL = 1, and the ray which is replaced is the last ray with a 3* at the same receiver depth. The number which is listed for NRAY is the current ray number, and this forms an eigenray in conjunction with the previous ray. The NBR column gives the number of bottom reflections for this ray. The NTU column is the number of turnunders for this ray. NSR gives the number of surface reflections and NTO gives the number of turnovers. RANGE is the distance in meters from the source to this receiver. DEPTH is the ray depth for a given receiver at this range. THETA is an interpolated value for the ray arrival angle at the receiver. TIME is the travel time in seconds to this receiver from the source and is also an interpolated value between the travel times for two rays bracketing a receiver. SL(DB) is discussed in the preceding section of this report.

EIGENRAY SET					TEST CASE FOR INTENSITY						
NRAY	NBH	NTU	NSR	NTO	RANGE	DEPTH	THETA	TIME	SL(DB)	IQUAL	REM
8	0	7	7	0	370000	350.0000	-10.6075	248.56510	-106.4	3	.
8	0	7	7	0	370000	700.0000	-9.6028	248.60291	-106.5	1	
17	0	11	0	10	370000	350.0000	5.4116	249.38608	-99.5	2	
17	0	11	0	10	370000	700.0000	5.1751	249.36221	-99.5	1	
28	0	7	7	0	370000	350.0000	9.4668	248.56477	-107.9	1	
28	0	7	7	0	370000	700.0000	8.9143	248.52884	-107.9	1	
17	0	22	0	21	740000	700.0000	6.7384	498.73865	-103.7	2	
26	0	22	22	0	1110000	350.0000	4.3020	746.19729	-113.1	1	
26	0	22	22	0	1110000	700.0000	4.6851	746.16336	-113.1	1	

Fig. 11 - Example of an eigenray printout

THE LLOYD'S MIRROR OPTION FOR RECEIVERS

Some examples of the Lloyd's mirror beam pattern are presented in Fig. 12. The receiver depth is at the point where all the lines converge for each plot.

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FREQUENCY = 50 HERTZ RECEIVER DEPTH = 18.289 FREQUENCY = 50 HERTZ RECEIVER DEPTH = 91.440



FREQUENCY = 100 HERTZ RECEIVER DEPTH = 18.289 FREQUENCY = 100 HERTZ RECEIVER DEPTH = 91.440

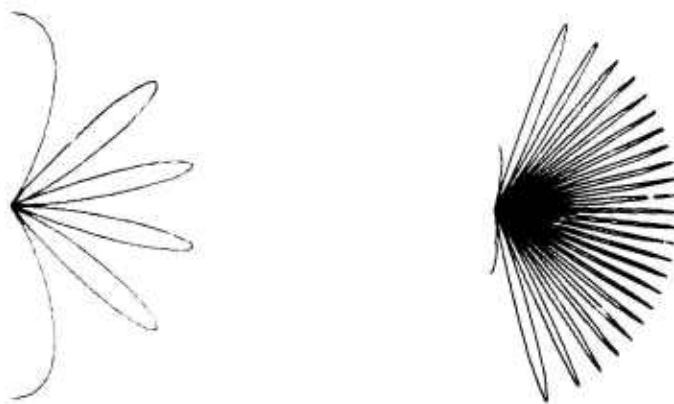


Fig. 12 — Examples of Lloyd's mirror beam patterns for receivers

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The computer coding for the Lloyd's mirror option for receivers appears within the subroutine INTENSTY. The switch LLMR, in column 26 of the output control cards, is a receiver Lloyd's mirror switch. When the switch is off (0 or blank), the old intensity is returned, and when on (nonzero), the beam pattern

$$2 \sin^2 \left(\frac{2\pi z}{\lambda} \sin \theta \right) ,$$

where z is the depth, is used for type I random phase, type I coherent phase, Type II, and Type III intensity calculations for all receiver depths. For Type I and II calculations, θ is the ray angle, and for Type III calculations Snell's law is used to calculate the ray angle at the receiver. One can calculate some intensities with and some without the Lloyd's mirror by specifying them on different output control cards.

ADDITIONAL INSTRUCTIONS FOR THE RESTART OPTION

If the restart option is desired, a tape for output must be provided and a backup tape can be provided. Logical unit 15 is the primary output tape. Logical unit 16 is the backup output tape. Logical unit 17 may be used as a second backup tape, but this is optional. If the tape on logical unit 15 was bad when the program attempted the dump and it had to write on logical unit 16 or 17, then that tape would become logical unit 15 for restart. Logical units 16 and 17 may be omitted if you are sure you have a good tape on logical unit 15. The control deck should then have these cards:

79 EQUIP, 15 = MT, LO,**, DA

79 EQUIP, 16 = MT, LO,**, DA (optional)

79 EQUIP, 17 = MT, LO,**, DA (optional)

For dumping on tape the job request form should be as follows:

<u>Logical Unit No.</u>	<u>Input</u>	<u>Output</u>	<u>Save</u>	<u>Tape No.</u> (if not specified, the Computation Center sells you one and assigns a number)
15	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Number for tape
16 (Optional)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Number for tape
17 (Optional)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Number for tape
20 (Program tape)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	573
1 (Used only for ray tape)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Number for tape

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In addition the second card in each case should contain the word DUMP in columns 73 through 76 if a restart capability is desired. If the program runs out of time, one may restart it according to the following procedure.

1. Change the job request form for logical units 15 and 1 as follows:

<u>Logical Unit No.</u>	<u>Input</u>	<u>Output</u>	<u>Save</u>	<u>Tape No.</u>
15	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Number for tape
1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Number for tape

However, the output block for logical unit 15 is checked only if a dump is desired again if the program runs out of time, and the input block for logical unit 1 is checked only if the ray tape is being restarted.

2. The first card after your run card must contain RESTART in columns 1 through 7. If a dump is desired again if the program aborts because of lack of time, DUMP is entered in columns 9 through 12 of the same card. One looks through the listing and determines what cards were read last, pulls out all these cards and places the remaining cards behind the card containing the word RESTART. If the multiple replacement option is being used, the profile remaining to be read should be read in from the case in which $LA = 1$. For the next case all cards would have to be read in again. Also the run must have progressed at least one range increment before dump can be called. Thus, if these conditions are not met, the entire deck must be resubmitted. Also, if the last data card read was an end-of-file card, then the first data card read must be the restart card and then the end-of-file card is read. If multiple replacement is being used, one should have the restart card and then a blank card followed by a card with the word START in columns 1 through 5, followed by remaining data. This can be determined by looking at the comment which is printed at the end of the program. Reference 7 is a more complete writeup on the restart option.

CAUTIONS TO THE USER

The following are some cautions to the user:

- If you have six receivers, then you must insert a blank card after the output control card containing the six receivers.
- The number of input and internally generated points in a sound-speed profile cannot exceed 50. The number of internally generated points can be reduced by reading in profiles with common depths.
- Do not read in the second speed-profile at a range less than the second bottom point; otherwise a diagnostic is printed and program aborts. Thus the range to your second bottom point should equal or be less than the range to the second profile.

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- The source depth and sound-speed depth for any profile should not be the same; otherwise a diagnostic is printed and the program aborts. To correct this fault, change the source depth by 0.01 meter.
- The first bottom point must be at range zero.
- The maximum number of rays which may be traced is 1000.
- If the program runs for a long time and produces no results, you have specified too large a distance between bottom points or output values and the program is forced to set up long thin triangles. In this case there is difficulty in arriving at the proper ray intersections with the triangles. To correct this condition, insert either additional bottom points or additional output at shorter range increments.

PROGRAM TRIPLT

Program TRIPLT performs a Calcomp plot of the ray trajectories (Fig. 13). It reads an output tape from the main program and plots selected rays to a given range. Cubic splines are employed to give the proper trajectories. A maximum of 512 rays and a maximum of 2000 range increments may be plotted. A portion of the range may be plotted by specifying the number of records (one record being one range increment). A description of the input follows.

The input ray tape should be read in on logical unit 1. Thus the first equip card should be

7₉ EQUIP, 1 = MT, density, RO, label.

Logical unit 2 should be equipped for the disk file as 7₉ EQUIP, 2 = DF.

Logical unit 10, the plot unit, may be equipped as 7₉ EQUIP, 10 = PL or 7₉ EQUIP, 10 = MT, LO, label, DA (to write an output tape to be plotted later).

The job request form should be checked as follows:

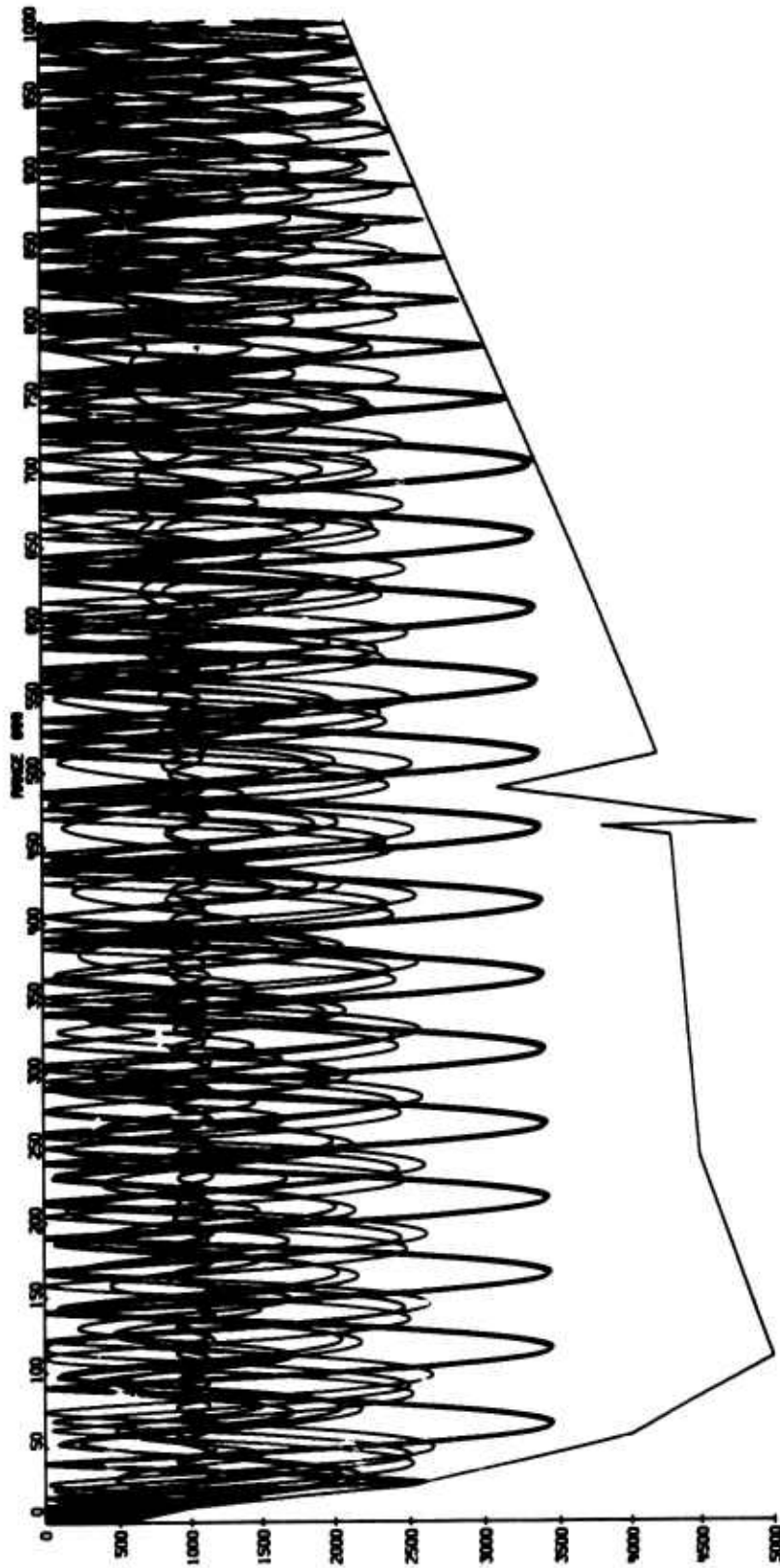


Fig. 13 — Example of a Calcomp plot

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<u>Logical Unit No.</u>	<u>Input</u>	<u>Output</u>	<u>SAVE</u>	<u>Tape Serial No.</u>
1	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Input Tape No.
2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	DF
10	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Output Tape No.

Logical unit 10 need be specified only if writing an output tape; if the plot is to be done on line, the 7₉ EQUIP, 10 = PL may be used or the card may be omitted. Computer 1 should be specified on the job request form also, because it contains the plotter package. The data deck input is as follows:

<u>First-card Columns</u>	<u>Variable</u>	<u>Meaning</u>
1-2	ITNC	Total number of cases.
<u>Second-card Columns</u>	<u>Variable</u>	<u>Meaning</u>
1-8	AL	Plot length in inches, which must be ≤ 120.0 .
9-16	ZMAX	Maximum depth of plot, in either feet or meters.
17-20	NRMAX	Number of records to be plotted. There is one record for each range increment on the tape. Plots for a portion of the range from range ZERO may be made by specifying the number of records to that point. To plot the entire range a number may be specified which is larger than the actual number but less than 2001.
21-25	IKNM	If $IKNM < 0$, the range scale will be plotted in nautical miles; if $IKNM > 0$, the range scale will be in kilometers.
26-30	IFMC	If $IFMC < 0$, the depth scale will be plotted in feet; if $IFMC > 0$, the depth scale will be plotted in meters.

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Second-card Columns	Variable	Meaning
31-35	NFSK	Number of files to skip on the tape before plotting this case.
36-40	ITTR	If $ITTR < 0$, a title card is read to replace the title on the tape; if $ITTR > 0$, the title from TRIMAIN will be used for the title.
41-45	NSR1	Maximum number of surface hits allowable. The ray will be terminated at this surface hit. If this is left blank, the previous limits from TRIMAIN will be used.
46-50	NBR1	Maximum number of bottom hits allowable, analogous to NSR1.
51-60	ALIM1	Maximum dB loss allowed per ray, similar to NSR1 and NBR1. It is read in as a positive floating-point number, such as 200.0.
Third-card Columns (If $ITTR < 0$)	Variable	Meaning
1-80	TITLE	Title of the plot. This card is omitted if $ITTR > 0$ in columns 36 through 40 of the second card; if this card is omitted, the fourth card becomes the third card.
Fourth-card Columns (or Third-card Columns if $ITTR > 0$)	Variable	Meaning
1-4	NRPLOT(1)	Number of the first ray to be plotted, which corresponds to the number of the ray in the program TRIMAIN.
5-8	NRPLOT(2)	Number of the second ray to be plotted.
...	...	

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Fourth-card Columns (or Third-card Columns if ITTR > 0)	Variable	Meaning
76-80 ...	NRPLOT(20) ...	Number of the 20th ray to be plotted.
Additional-card Columns	Variable	Meaning
1-80	NRPLOT(N)	Numbers of the rays to be plotted, continued 20 per card until the desired number N is reached.

An end of file card terminates each case. The cards beginning with the second card are repeated ITNC times for multiple cases.

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2. "The Hudson Laboratories Ray Tracing Program," Technical Report 150, Hudson Laboratories of Columbia University, Dobbs Ferry, New York.
3. J.J. Cornyn, Grass: "A Digital-Computer Ray-tracing and Transmission-Loss Prediction System," Volume 1-Overall Description," NRL Report 7621, Dec. 1973.
4. H. Weinberg, "A Continuous-Gradient Curve Fitting Technique for Acoustic-Ray Analysis," J. Acoust. Soc. Am. 50, 971 (1971).
5. B.G. Roberts, Jr., "Retrieval Program for Archival Nansen-Cast Data," NRL Report 7633, 1973.
6. E.L. Wright, "Ray-tracing with Horizontal and vertical Gradients," J. Acoust. Soc. Am. 48, 92(A) (1970).
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Appendix A

LISTING OF THE PROGRAM

.4A

07/25/73

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PROGRAM TRIMAIN                                TRIM 1
DIMENSION JUNK(10), R1(10),DR(10),R2(10),STRCD(26,10),JNRC(10),INTTRIM 2
1 (10),IT(6,10),IRT(10),IRD(10),ISCPEQ(6),Z(2,50),V(2,50),T1(9) TRIM 3
EQUIVALENCE (ISCP,ISCPFQ)                    TRIM 4
COMMON /MIRRORS/ FSRL,RRLT(200),RPST(200)     TRIM 5
COMMON /INFO/ RSTART,RMAX,OMEGA,ATT,IPRAY,ITN,ITN2,ITN3,IBIG, TRIM 6
1 ISCP,IT1,IT2,IT3,IPFR,IFTIMS,LTRY,LTER,LTRP,LPIN,IATT TRIM 7
COMMON /PROFIL/ RONE,N1,Z1(50),V1(50),RTHO,N2,Z2(50),V2(50),IBOTC,TRIM 8
1 IPFL                                          TRIM 9
COMMON /LELDAESS/ LNRC,RCD(100),DINT(400)     TRIM 10
COMMON /PRP/ IPROP,IKNM,PLTL,RM,IPC0,IFPR     TRIM 11
DATA (LTRY=1),(LTER=41),(LTRP=42),(LPIN=60)   TRIM 12
COMMON /PATTERN/ SD,ITAP,DATD,SORLEV          TRIM 13
COMMON /PIDEF/ PI,DTR,THOPI                  TRIM 14
COMMON /LIMITS/R1,DR,R2                     TRIM 15
COMMON /TLE/ ITITLE(10)                     TRIM 16
COMMON/ABC/PUNCHDB(16),INCR,NRRS,NSRS,ALIM,IFT,IFT1 TRIM 17
COMMON /IFC/ IFE,IA,IB,IP,ID,IS,LA          TRIM 18
COMMON /RANST/ RTWOM,IREC,IFSK,SDS          TRIM 19
PI=4.*ATAN(1.) SIFT=0 SIFT1=0 S IPC0=0 STHOPI=PI*PISDTR=180./PI TRIM 0
1 READ 900,ITITLES IOPY=ITITLE(1) S WRITE (19) ITITLE TRIM 21
REWIND 19                                     TRIM 22
IF (E0F,60) 155, 2                             TRIM 23
2 IF (I0PT.EQ.0)RESTART )GO TO 104 S GO TO 122 TRIM 24
900 FORMAT(1,0A8)                               TRIM 25
155 IF (IFE.EC,1) GO TO 152 S IFE=1 S GO TO 1 TRIM 26
122 PRINT 901,ITITLE S RSTART=0.0 SRMAX=0.0 S NTPLT=0 TRIM 27
901 FORMAT(1)HORIZONTAL GRADIENT RAY TRACE (,10AR) TRIM 28
READ 902,SD,FKHZ,IATT,SORLEV,ITBP,DATD,SLDR,IABOT,ISCP,NRECUR, TRIM 29
1IBOTC,IPFL,IPROP,IKNM,PLTL,NBRS,NSRS,ALIM,IA,IB,IP,ID,IS,LA,IBOT TRIM 30
AL1=ALIM S SCS=SD                               TRIM 31
FSRL=0.(.-,SLDB) SIF (ALIM,NE,0.0)ALIM=POWERF(1,0,0)(-ALIM/0.0))TRIM 32
902 FORMAT(F8.3,F5.3,I1,F5.2,I1,2F5.2,7I1,F8.3,2I5,F10.3,6I1,1X,18) TRIM 33
OMEGA =2000.*PI*FKHZ SIF (ALIM,EO,0.0)ALIM=1.0E-30 S S2=FKHZ**2 TRIM 34
PRINT 903,SD,SORLEV,FKHZ,ITBP,DATD,NBRS,NSRS,AL1,IA,IB,IP,ID,IS,LA,TRIM 35
1,I0PT                                           TRIM 36
903 FORMAT(1)SOURCE DEPTH=F8.2, LEVEL=F6.1, FREQ(KHZ)=F6.3, BEATRIM 37
1MPATTERN =,I2,3X, ANGLE=F5.1,5X, NBRS=,I5,5X, NSRS=,I5,5X, DB TRIM 38
2LIMIT=F10.3,/,5X, IA=,I1,5X, IB=,I1,5X, IP=,I1,5X, ID=,I1, TRIM 39
35X, IS=,I1,5X, LA=,I1,5X, I0PT=,A8) TRIM 40
IF (NRECUR,GT,0)AND,IBOTC,GT,0)SD=SD*(1.+.5*SD/6371221.3) TRIM 41
ATT=0.0003025*S2 +44.*S2/(4100.*S2) TRIM 42
IF (IATT,EC,0) ATT=0. S IF (NBRS,EO,0) NBRS=2500 S IVSR=0 TRIM 43
PRINT 904,ATT,SLDB S IF (NSRS,EO,0) NSRS=2500 TRIM 44
904 FORMAT(1)VOLUME ATTENUATION=F10.6, DB/KM. SURFACE LOSS=F7.2, TRIM 45
1 DB, TRIM 46
CALL INITRAYS S DB 905 J=1,10 SR1(J)=0.0 SDR(J)=0.0 TRIM 47
505 R2(J)=0.0 SIF (IABOT,NE,0) GO TO 15 S RR=ISCP TRIM 48
CALL BRTRCD(RB) SIF (LA,EO,1.0R,IB,EO,1.0R,IR,EO,3) REWIND 9 TRIM 49
IF (LA,EO,1.0R,IB,EO,2) REWIND 8 S GO TO 1A TRIM 50
15 PRINT 905 TRIM 51
RB=1.E30 TRIM 52
905 FORMAT(1)BOTTOM ABSORBS ALL INCIDENT SOUND ENERGY* TRIM 53
10 N=1 SIF (IP,EO,0)AND,LA,EO,0.0R,LA,EO,1) LPC=60 SIF (IP,EO,1)LPC=4 TRIM 54
20 IF (LPC,EO,60)READ(LPC,906)R1(N),DR(N),R2(N),IC,(IT(1,N),I=1,6),JVSTRIM 55
1R,IRD(N),IRP, IRT(N),IPRAY,(STRCD(I,N),I=1,6) TRIM 56

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IF(LPC.EQ, 4)READ(LPC) R1(N),DR(N),R2(N),IC,(IT(I,N),I=1,6),JVSTRIM 57
1R,IRD(N),IRP, IRT(N),IPRAY,(STRCD(I,N),I=1,6) TRIM 58
IF(LA.EQ,1)WRITE( 4) R1(N),DR(N),R2(N),IC,(IT(I,N),I=1,6),JVSRTIM 59
1,IRD(N),IRP, IRT(N),IPRAY,(STRCD(I,N),I=1,6) TRIM 60
906 FORMAT(3F6.2,12,11I1,1Y,6F8,4) TRIM 61
INT(N)=0 TRIM 62
DO 22 I=1,5 TRIM 63
22 INT(N)=INT(N)+IABS(IT(I,N)) TRIM 64
IF (IT(5,N).GT.0) IPER=IT(5,N) TRIM 65
IF(INT(N),EQ.0) GO TO 30 TRIM 66
PRINT 907,R1(N),DR(N),R2(N),(IT(I,N),I=1,6) TRIM 67
IF(DR(N).LT.0.) DR(N)=-1.*DR(N)/R1(N) TRIM 68
IM=6 TRIM 69
23 IF(STRCD(IM,N).GT.0.) GO TO 25 TRIM 70
24 IM=IM+1 TRIM 71
IF(STRCD(IM,N).GT.0.) GO TO 26 TRIM 72
IF(IM,LE.1) 26,24 TRIM 73
25 IL=IM+1 TRIM 74
IM=IM+10 TRIM 75
IF(LPC.EQ,60)READ (LPC,908),(STRCD(I,N),I=IL,IM) TRIM 76
IF(LPC.EQ, 4)READ (LPC) (STRCD(I,N),I=IL,IM) TRIM 77
IF(LA,EQ,1)WRITE ( 4) (STRCD(I,N),I=IL,IM) TRIM 78
C THE SWITCH ITIM IS NOW LLMR, THE LLOYDS MIRROR SWITCH FOR ALL TRIM 79
C RECEIVERS ON A GIVEN RANGE PAN CARD TRIM 80
907 FORMAT(=OUTPUT RANGES=,3F8.2,5H ISCP,12,4H IT1,12,4H IT2,12,4H TRIM 81
13,12,5H IPER,12,5H LLMR,12) TRIM 82
908 FORMAT(10F8.2) TRIM 83
GO TO 23 TRIM 84
26 JNRC(N)=IM TRIM 85
PRINT 909,(STRCD(I,N),I=1,IM) TRIM 86
IF (NRECUR.LE.0) GO TO 29 TRIM 87
DO 31 I=1,IM TRIM 88
31 STRCD (I,N)=STRCD(I,N)*(1.+5*STRCD(I,N)/6371221.3) TRIM 89
909 FORMAT(=RCD=,10F9.2) TRIM 90
29 IF(JVSR.EQ.0) GO TO 27 TRIM 91
PRINT 910,JVSR TRIM 92
910 FORMAT(=INTENSITY VERSUS RANGE PLOT WILL BE MADE=,13) TRIM 93
IF(IVSR.NE.0) PRINT 911 TRIM 94
911 FORMAT(5H =,=CAUTION=, . ONLY THE LAST I VS R PLOT WILL BE MADE=) TRIM 95
IVSR=JVSR TRIM 96
NVSR=N TRIM 97
27 IF(IRP.EQ,0) GO TO 28 TRIM 98
NTPLT=15 TRIM 99
ZMAX=0. TRIM 100
DRPLT=1. TRIM 101
RLPLT=1.E6 TRIM 102
PRINT 915 TRIM 103
28 IF(IRD(N),NE.0) PRINT 912 TRIM 104
IF(IRT(N),NE.0) PRINT 913 TRIM 105
915 FORMAT (=GRAY PLOT WILL BE MADE=) TRIM 106
912 FORMAT (=GRAY DEPTH DISTRIBUTION WILL BE MADE=) TRIM 107
913 FORMAT (=GRAY TAPE WILL BE MADE=) TRIM 108
GO TO 40 TRIM 109
30 IF(IRP.EQ,0) GO TO 33 TRIM 110
NTPLT=STRCD(1,N)+.1 TRIM 111
IF(NTPLT.LT.1) NTPLT=15 TRIM 112

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	ZMAX=STRCD(2,N)	TRIM 113
	DRPLT=DR(N)	TRIM 114
	RLST=R2(N)	TRIM 115
	RLPLT=RLST	TRIM 116
	PRINT 915	TRIM 117
	PRINT 914,R1(N),DR(N),R2(N)	TRIM 118
33	IF((IRD(N)+IRT(N).EQ.0) GO TO 35	TRIM 119
	PRINT 914,R1(N),DR(N),R2(N)	TRIM 120
914	FORMAT(=00OUTPUT RANGES=,3F10.4)	TRIM 121
	IF((IRD(N).NE.0) PRINT 912	TRIM 122
	IF((IRT(N).NE.0) PRINT 913	TRIM 123
	GO TO 40	TRIM 124
35	N=N-1	TRIM 125
40	IF(IC.EQ.0) GO TO 45	TRIM 126
	N=N+1	TRIM 127
	IF (N.GT.10)41,20	TRIM 128
41	PRINT 42	TRIM 129
42	FORMAT(1M0,=NUMBER OF BUTPUT CONTROL CARDS EXCEEDS 10, PROGRAM	TRIM 130
	1ABORTED=)	TRIM 131
	CALL BYEBYE	TRIM 132
45	NR=N \$ IF (LA.EG.1.0P,IP.EQ.1) REWIND 4	TRIM 133
	JRT=0	TRIM 134
	RMAX1=0.	TRIM 135
	D=1.0 \$ D1=DRPLT \$ DELTM=0.0 \$ ICA=0 \$DELTA=0.0	TRIM 136
	DO 47 I=1,NR	TRIM 137
	IF (DR(I).LT.D) D=DR(I) \$ IF (DR(I).LT.D1) D1=DR(I)	TRIM 138
	IF (R2(I).GT.RLST) RLST=R2(I)	TRIM 139
	IF (IT(2,I).EQ.0) GO TO 47	TRIM 140
	IF (R2(I).GT.RMAX1) RMAX1=R2(I)	TRIM 141
47	JRT=JRT+IRT(I)	TRIM 142
	D=D/2.0	TRIM 143
	CALL INIT	TRIM 144
	CALL NEWPROF(ZM)	TRIM 145
	CALL NEWPROF	TRIM 146
	CALL CONNECT	TRIM 147
	IF(ZMAX.EQ.0.) ZMAX=ZM	TRIM 148
	RPLT=1.E6	TRIM 149
	IF(NTPLT.EQ.0) GO TO 49	TRIM 150
	RPLT=DRPLT	TRIM 151
	CALL RAYPLBT(NTPLT,ZMAX)	TRIM 152
49	IF(JRT.EQ.0) GO TO 51	TRIM 153
	CALL RAYTAPE	TRIM 154
51	NOLD=-10	TRIM 155
	J=0	TRIM 156
	NINT=1	TRIM 157
C	IF ALL THE INTENSITY CALCULATIONS HAVE THE SAME RCDS	TRIM 158
C	A TABULAR FORMAT WILL BE USED	TRIM 159
	DO 55 I=1,NR	TRIM 160
	IF(INT(I).EQ.0) GO TO 55	TRIM 161
	IF(J.EQ.0) J=1	TRIM 162
	IF(J.EQ.1) GO TO 55	TRIM 163
	IF(JNRC(I).NE.JNRC(J)) GO TO 54	TRIM 164
	K=JNRC(I)	TRIM 165
	DO 53 L=1,K	TRIM 166
	IF(ABS(STRCD(L,I)-STRCD(L,J)).GT.1) GO TO 54	TRIM 167
53	CONTINUE	TRIM 168

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	GO TO 55	TRIM 169
54	NINT=2	TRIM 170
	GO TO 95	TRIM 171
55	CONTINUE	TRIM 172
95	RMAX=0.	TRIM 173
100	RN=1.E6	TRIM 174
	DO 103 I=1,NR	TRIM 175
	IF (R1(I).LT,RN) RN=R1(I)	TRIM 176
103	CONTINUE	TRIM 177
	RSTART=RMAX	TRIM 178
	RMAX=AMIN(1.001*RTW0,RPLT,RN)*1000.	TRIM 179
	RT=.001*(RMAX+1.)	TRIM 180
	IF (RT.GT.RLST+D) GO TO 140	TRIM 181
	IF (I0PT.NE.0) GO TO 104	TRIM 182
	TILT=TILT	TRIM 183
	TILT=TIMELEFT(1)	TRIM 184
	DELT=TILT-TILT	TRIM 185
	IF (DELT.LT.0.0) GO TO 108	TRIM 186
	ICA=ICA+1	TRIM 187
	FICA=FICA	TRIM 188
	DELT=DELT+DELT	TRIM 189
	DELT=DELT/FICA	TRIM 190
108	RER=(RLST-(RSTART/1000.0))/D1	TRIM 191
	TOTIME=RER*DELT*2.0	TRIM 192
	TOTIMM=TOTIME/60.0	TRIM 193
	IF (TILT.LE.90.0*DELT.AND.TOTIME.GE.30.0*DELT) 107,104	TRIM 194
107	IF (JRT.NE.0) BACKSPACE 1 \$ CALL DUMP	TRIM 195
	PRINT ,05,TILT,TOTIMM	TRIM 196
105	FORMAT(1H0,PROGRAM ABORTED, INSUFFICIENT RUN TIME, TIME REMAINING	TRIM 197
	1G=,F10.3, SECONDS,5X,ESTIMATED TIME TO FINISH RUN=,F10.3,	TRIM 198
	2 MINUTES)	TRIM 199
	PRINT 101,RTW0M	TRIM 200
101	FORMAT (1H0,REMOVE DATA DECK THROUGH PROFILE AT RANGE=,F10.3, KM	TRIM 201
	1 BEFORE RESTARTING CASE=,)	TRIM 202
	IF (IFE.EQ.1) PRINT 106	TRIM 203
	IF (IS.EQ.1.AND.IFE.EQ.0) PRINT 112	TRIM 204
112	FORMAT (1H0,INSERT BLANK CARD AFTER RESTART CARD, FOLLOWED BY A	TRIM 205
	1ARD WITH WORD START IN COLUMNS 1-8, FOLLOWED BY REMAINING DATA=,)	TRIM 206
106	FORMAT (1H0,INSERT END OF FILE CARD AFTER RESTART CARD BEFORE RESTR	TRIM 207
	1TARTING CASE=,)	TRIM 208
	IF (IFE.EQ.1) GO TO 111	TRIM 209
109	READ 900,JUNK	TRIM 210
	IF (EOF.60)111,109	TRIM 211
111	CALL WYEBYE	TRIM 212
104	IF (I0PT.NE.0) GO TO 102	TRIM 213
	IF (I0PT.EQ.0) CALL RESTART \$ CALL CLOSEIOP	TRIM 214
	PRINT 90,IITLE \$ DO 113 J=1,10	TRIM 215
113	JUNK(J)=IITLE(J) \$ READ (19)IITLE	TRIM 216
	REWIND 19	TRIM 217
	IF (IITLE(1).EQ.0)RESTART ,AND.IS.EQ.1.AND.IFE.EQ.0) CALL RETRY	TRIM 218
	I0PT1=IITLE(2)	TRIM 219
	IF (I0PT1.EQ.0) I0PT=I0PT1 \$ DO 114 J=1,10	TRIM 220
114	IITLE(J)=JUNK(J) \$ IF (JRT.EQ.0) GO TO 102 \$ DO 121 J=1,IFSK	TRIM 221
121	CALL SKIPFILE (1) \$ DO 123 J=1,IRES	TRIM 222
123	READ (1)	TRIM 223
102	CALL ADVANCE SIF(RMAX*.1.LT,RTW0) GO TO 110 \$ CALL NEWPROF	TRIM 224

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	CALL CONNECT	TRIM 225
110	IF(RT,LT,RPLT) GO TO 115 S CALL RAYPLOT	TRIM 226
	RPLT=RPLT*DRPLT	TRIM 227
	IF(RPLT.GT.RLPLT*.1) RPLT=1.E6	TRIM 228
115	IF(RT,LT,RN) GO TO 135	TRIM 229
	DO 130 I=1,NR	TRIM 230
	IF(R1(I).GT.RT) GO TO 130	TRIM 231
	IF(INT(I).EQ.0) GO TO 125	TRIM 232
	IF(I.EQ.NOLD) GO TO 120	TRIM 233
	LNRC=JNRC(I)	TRIM 234
	DO 117 J=1,LNRC	TRIM 235
117	RCD(J)=STRCD(J,I)	TRIM 236
	DO 119 J=1,6	TRIM 237
119	ISCEQ(J)=IT(J,I)	TRIM 238
120	CALL INTENSTY	TRIM 239
	CALL INTPRINT(NINT)	TRIM 240
	IF(I.EQ.NVSR) CALL IVSRPLOT(IVSR)	TRIM 241
	NOLD=I	TRIM 242
125	IF(IRD(I).NE.0) CALL RAYZDIST (NTPLT)	TRIM 243
	IF(IRT(I).NE.0) CALL RAYTAPE	TRIM 244
	IF(DR(I).LT.0.) GO TO 126	TRIM 245
	R1(I)=R1(I)+DR(I)	TRIM 246
	GO TO 127	TRIM 247
126	R1(I)=R1(I)-DR(I)	TRIM 248
127	IF(R1(I).GT.R2(I)+.001) R1(I)=1.56	TRIM 249
130	CONTINUE	TRIM 250
135	IF(RT,GT,RB) CALL NWRBRT(RB)	TRIM 251
	GO TO 100	TRIM 252
140	IF(JRT.EQ.0) GO TO 150	TRIM 253
	ENDFILE LTRT	TRIM 254
	ENDFILE LTRT	TRIM 255
	BACKSPACE LTRT	TRIM 256
150	IF (INCR.GT.1.AND.INCR.LE.16) 151,153	TRIM 257
151	INCR=INCR+1	TRIM 258
	WRITE (36,919) (PLACHDR(II),II=1,INCR)	TRIM 259
919	FORMAT (16F5.1)	TRIM 260
153	IF (IFE.EQ.1) GO TO 154	TRIM 261
	IF (LA.EQ.1.OR.IS.EQ.1) GO TO 160	TRIM 262
157	READ 900,JUNK	TRIM 263
	IF (EOF,60) 158,157	TRIM 264
160	IF (LA.EQ.1.OR.IS.EQ.0.AND.LA.EQ.0) LPM=60	TRIM 265
	IF (IS.EQ.1) LPM=6	TRIM 266
176	IF(LPM.EQ.60)READ (LPM,1903) NCUR,RB,TI	TRIM 267
	IF(LPM.EQ.6)READ (LPM) NCUR,RB,TI	TRIM 268
	IF(EOF,LPM) 177,178	TRIM 269
177	IF (LA.EQ.1) ENDFILE 6	TRIM 270
	REWIND 6	TRIM 271
	GO TO 158	TRIM 272
178	IL=1 S IF (LA.EQ.1) WRITE (6) NCUR,RB,TI	TRIM 273
179	IM=IL+4	TRIM 274
	IF(LPM.EQ.60)READ(LPM,1900)(Z(2,I),V(2,I),I=IL,IM)	TRIM 275
	IF(LPM.EQ.6)READ(LPM) (Z(2,I),V(2,I),I=IL,IM)	TRIM 276
	IF(LA.EQ.1)WRITE (6) (Z(2,I),V(2,I),I=IL,IM)	TRIM 277
	IF(V(2,IM).LE.0.) GO TO 176	TRIM 278
	IL=IL+5	TRIM 279
	GO TO 179	TRIM 280

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1503	FORMAT(11,F7.3,9A8)	TRIM	281
1500	FORMAT(10F8.4)	TRIM	282
1508	IFPR1=IFPR \$ IF (IFPR.NE.1) IFPR=1 \$ IF (IPFL.EQ.0) GO TO 159	TRIM	283
	IF (IFPR1.EQ.0.AND.IPFL.EQ.1) CALL PROFPLT (2.0,5,1)	TRIM	284
	IF (IPFL.EQ.2.AND.IFPR1.EQ.0) CALL PROFPLT (2.0,5,1)	TRIM	285
159	IFE=1 \$ IFT1=IFT1 \$ IF (IS.EQ.0) GO TO 1	TRIM	286
161	READ 900,JUNK \$ IF (EMF.60) 1,161	TRIM	287
152	IF (IPC0.NE.0) CALL STOPPLT	TRIM	288
	CALL BYEBYE	TRIM	289
	END	TRIM	290

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5.4DS TRIMAIN

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ED

		IDENT	TRIMAIN
PROGRAM LENGTH		04624	
ENTRY POINTS	TRIMAIN	01572	
ALOCK NAMES			
	MIRRORS	00621	
	INFO	00024	
	PROFIL	00316	
	LOUDNESS	00765	
	PRO	00006	
	PATTERN	00004	
	PIDEF	00003	
	LIMITS	00036	
	TLE	00012	
	ABC	00026	
	IFC	00007	
	RANST	00004	
EXTERNAL SYMBOLS			
	QBENTRY		
	THEND.		
	Q2007111		
	Q1010100		
	QBODICT.		
	INITRAYS		
	BRLTRD		
	RYE8YE		
	INIT		
	NEWPROF		
	CONNECT		
	RAYPLOT		
	RAYTAPE		
	TIMELFT		
	DUMP		
	RESTART		
	CLOSEIOP		
	RETRY		
	SKIPFILE		
	ADVANCE		
	INTENSTY		
	ITNPRINT		
	IVSRPLOT		
	RAYZDIST		
	NWBRLT		
	PROFPLOT		
	PROFPLIT		
	STOPPLOT		
	POWRP		
	MINIF		
	ATANF		
	COOIFEOF		
	EFT.		
	BSP.		
	REW.		
	TSM.		
	TSB.		
	STW.		
	STB.		
	SLE.		
	SLI.		
	ONSINGL.		

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CLOSEIOP				07/12/73	ED 00000	PAGE NO.	1
PROGRAM LENGTH			IDENT	CLOSEIOP		CICP	1
ENTRY POINTS		CLOSEIOP	00012				
INTERNAL SYMBOLS			00006				
		IOP.					
			ENTRY	CLOSEIOP		CICP	2
00000			EXT	IOP.		CICP	3
00002	50	1	SAVEAQ	2		CICP	4
	50	0	SAVEI2	00.1		CICP	5
00003	77	2		SAVEAQ		CICP	6
	12	0	DLDA				
00004	00	0	CLOSEIOP	OCT	0	CICP	7
	00	0					
00005	77	2	DSTA	(*)SAVEAQ		CICP	8
	20	0					
00006	56	1	SIU	SAVEI2.1		CICP	9
	50	1	ENI	15.1		CICP	10
00007	04	1	ENG	35.1		CICP	11
	50	0					
00010	63	0	63	310		CICP	12
	03	0	93	(5) IOP.		CICP	13
00011	55	1	IJP	0-2.1		CICP	14
	75	0	UJP	SAVEI2		CICP	15
			END			CICP	16

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	SUBROUTINE RETRY	RETY	1
	DIMENSION TITLE (9),ZIL(2,90),VIL(2,50)	RETY	2
15	READ 1,10	RETY	3
	1 FORMAT (A8)	RETY	4
	IF (EOF,NO) 15,14	RETY	5
14	IF (IL,EO,CONSTANT) GO TO 75	RETY	6
	GO TO 19	RETY	7
75	LEN=60	RETY	8
76	IF (LEN,EO,60)READ (LEN ,903) NCUR,RB,TITLE	RETY	9
	IF (EOF,LEN) 77,78	RETY	10
77	ENDFILE 6	RETY	11
	REWIND 6	RETY	12
	GO TO 72	RETY	13
78	IL=1 5 WRITE (6) NCUR,RB,TITLE	RETY	14
79	IL=IL+4	RETY	15
	IF (LEN,EO,60)READ (LEN ,900) (ZIL(2,1),VIL(2,1),I=IL,IH)	RETY	16
	WRITE (6) (ZIL(2,1),VIL(2,1),I=IL,IH)	RETY	17
	IF (VIL(2,IH),LE,0.) GO TO 76	RETY	18
	IL=IL+5	RETY	19
	GO TO 79	RETY	20
900	FORMAT(10F8,4)	RETY	21
903	FORMAT (11,F7,3,9A8)	RETY	22
62	RETURN	RETY	23
	END	RETY	24

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DS RETRY

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ED 0

PROGRAM LENGTH		00346	IDENT	RETRY
ENTRY POINTS	RETRY	00340		
EXTERNAL SYMBOLS				

THEND,
QBCCICT,
QBCCIFEP,
EFT,
REW,
TSM,
STR,
SLC,
SLI,
ONSINGL.

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SUBROUTINE INTRAYS                                INIT  1
DIMENSION VBP(91)                                INIT  2
COMMON /PATTERN/ SE,ITP,DATE,SEPLEV             INIT  3
COMMON /P/DEF/ N1,CTR,TRP1                       INIT  4
COMMON /RAYS/ NRAY,TGAM(1000),ZZ(1000),SS(1000),TIME(1000),
1  NCTR(1000),PHASE(1000)                         INIT  5
COMMON /IFC/ IFE,IA,IB,IP,IC,IS,LA              INIT  7
NRAY=0                                             INIT  8
GG=1000                                           INIT  9
PRINT 905                                         INIT 10
905  FORMAT ( * GAMLD GAMDD DGAMD IC SL PHASE * ) INIT 11
IF (IA,EG,0,AND,LA,EG,C,ER,LA,EG,1,OR,IA,EG,2) LPC=60 INIT 12
IF (IA,EG,1,OR,IA,EG,3) LPC=2                    INIT 13
10  IF (LPC,EG,60)READ (LFC,900)GAMLD,GAMDD,DGAMD,IC,SL,PH INIT 14
IF (LPC,EG,2)READ (LFC) GAMLD,GAMDD,DGAMD,IC,SL,PH INIT 15
IF (LA,EG,1)WRITE ( 2) GAMLD,GAMDD,DGAMD,IC,SL,PH INIT 16
PRINT 906,GAMLD,GAMDD,DGAMD,IC,SL,PH            INIT 17
906  FORMAT (1H0, 3F10,4, 15, 2F7,2 )           INIT 18
SL=10,*(,1*(SL*SEPLEV))                          INIT 19
IFF=1                                             INIT 20
IF (ARS(OG*GAMDD),LT,.001) GO TO 20              INIT 21
IF (NRAY,EG,C) GO TO 15                           INIT 22
NRAY=NRAY+1                                       INIT 23
SS(NRAY)=0.                                       INIT 24
15  GG=DGAMD*GAMDD                                 INIT 25
SEG=S/(OG/DTR)                                    INIT 26
IFF=0                                             INIT 27
20  G=GG*DGAMD                                     INIT 28
S=S/(G/DTR)                                       INIT 29
NRAY=NRAY+1                                       INIT 30
IF (NRAY,GT,1000) GO TO 100                       INIT 31
TGAM(NRAY)=S/SCRT(1,=S*S)                         INIT 32
ZZ(NRAY)=SD                                       INIT 33
TIME(NRAY)=C,                                     INIT 34
NCTR(NRAY)=C,                                     INIT 35
PHASE(NRAY)=PH/DTR                                INIT 36
SS(NRAY)=SL*.5*ARS(S-SEG)                          INIT 37
IF (IFF,NE,0) SS(NRAY+1)=SS(NRAY+1)*SL*.5*ARS(S-SEG) INIT 38
IFF=1                                             INIT 39
GG=G                                              INIT 40
SEG=S                                             INIT 41
IF ( (G * .000001) ,LT, GAMLD ) GO TO 20         INIT 42
IF (IC,NE,0) GO TO 10                             INIT 43
23  IF (ITP,EG,0) GO TO 35                         INIT 44
IL=1                                             INIT 45
25  I=IL+1V                                       INIT 46
IF (IA,EG,0,AND,LA,EG,C,ER,LA,EG,1,OR,IA,EG,1) LP =60 INIT 47
IF (IA,EG,2) LP=7                                  INIT 48
IF (LP,EG,60)READ(LF ,901)(VBP(I),I=IL,IH)        INIT 49
IF (LP,EG,7)READ(LF ) (VBP(I),I=IL,IH)           INIT 50
IF (LA,EG,1)WRITE( 7) (VBP(I),I=IL,IH)           INIT 51
PRINT 907,(VBP(I),I=IL,IH)                       INIT 52
907  FORMAT(=OVBP =,20)S,1)                      INIT 53
IF (VBP(IH),EG,0,) GO TO 27                      INIT 54
IL=IL+2U                                         INIT 55
GO TO 25                                         INIT 56

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27	I=I+1	INIT 57
	IF(IH,EW,1) GO TO 28	INIT 58
	IF(VBP(IH),EG,0,) GO TO 27	INIT 59
28	GO 29 I=IH,90	INIT 60
29	VBP(I+1)=VBP(IH)	INIT 61
	GO 31 I=1,NRAY	INIT 62
	D=ABS(DI*ROTAN(TGAM(I))*DATD)	INIT 63
	D=D	INIT 64
	D=D+D	INIT 65
	D=(1,D)*VBP(N+1)+C*VBP(N+2)	INIT 66
31	SS(I)=SS(I)+IC,*(+1,E-1+D)	INIT 67
35	PRINT VU2	INIT 68
	PRINT 903,(I,TGAM(I),SS(I),PHASE(I),I=1,NRAY)	INIT 69
	IF(LA,EO,1,CH,IA,EG,1,WR,IA,EG,3) REWIND 2	INIT 70
	IF(LA,EO,1,CH,IA,EG,2) REWIND 7	INIT 71
	RETURN	INIT 72
100	IF(IC,EW,0) GO TO 25	INIT 73
	READ 904,IC	INIT 74
	GO TO 100	INIT 75
900	FORMAT(3F10,4,15,2F5,2)	INIT 76
901	FORMAT(20F4,1)	INIT 77
902	FORMAT('0 INITIAL TAN GAMMA, SIGNAL LEVEL, AND PHASE//')	INIT 78
903	FORMAT(' 2(110,3F15,5)')	INIT 79
904	FORMAT(18X,12)	INIT 80
	END	INIT 81

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3 INTRAYS

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ED 0

		ICENT	INTRAYS
PROGRAM LENGTH		01026	
ENTRY POINTS	INTRAYS	00220	
BLOCK NAMES			
	PATTERN	00004	
	PICF	00003	
	RAVS	13561	
	IFC	00007	
EXTERNAL SYMBOLS			
	TMEND,		
	Q2C07111		
	Q1C10100		
	Q1C03100		
	Q0LC1CT,		
	SURTF		
	SIAF		
	ATANF		
	HEW,		
	TSM,		
	TSA,		
	STM,		
	STR,		
	ONSINGL,		

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SUBROUTINE BRLTRD(AB) & COMMON /PIDEF/ PI,DTR,INOP/
COMMON /INFO/ IDUM(2),OMEGA,ICMH(17)
COMMON /MIRNORS/ IERL,ENLT(200),BPST(200)
DIMENSION DB(50),LG(50),DTSTR(600),BR(91,4),BP(91,4),ISW(4),
1  MHL(50),ICL(50),DYM(600)
COMMON/ABC/PLNCHDB(16),INCR,NBRS,NSRS,ALIM,IFT,IFT1
COMMON /IIC/ IFE,IA,IJ,IP,IC,IS,LA
EQUIVALENCE (LR,DTSTR(551)),(DG,DTSTR(501)),(ICL,DTSTR(451)),
1  (RBL,DTSTR(401)),(ISW,DTSTR(397)),(RR,DTSTR), (ISCP,DTSTR(396)),
2  (IE,DTSTR(395)),(IB,DTSTR(394)),(K,DTSTR(393)),
3  (IL,DTSTR(392)),(IH,DTSTR(391)),(IC,DTSTR(390))
EQUIVALENCE (N,DTSTR(389)),(Y,DTSTR(388)),(F,DTSTR(387)),(PHI,
1  DTSTR(386)),(ULB,DTSTR(385)),(R,DTSTR(384)),
2  (RN,DTSTR(383)) & EQUIVALENCE (BP,DTSTR(183))
DATA (DTSTR(I),I=501,600)=
1  19., 35., 40., 52., 6(90.),
2  19., 25., 35., 45., 55., 5(90.),
3  11., 20., 25., 35., 45., 56., 4(90.),
4  11., 20., 30., 40., 55., 5(90.),
5  5., 7.5, 16.5, 17.5, 19., 20., 21., 22.5, 2(90.),
1  0., 3.7, 4.5, 7(6.),
2  0., 2.3, 4.6, 6.5, 6(8.),
3  0., 3., 4.4, 6.7, 8.5, 5(10.),
4  2., 5.2, 7.7, 9.8, 6(12.),
5  4., 5.7, 12., 12.8, 13.4, 13.7, 13.9, 3(14.)
DATA ((DTSTR(I),I=401,500)=
1  18., 30., 40., 50., 55., 5(90.),
2  17., 20., 30., 40., 50., 55., 4(90.),
3  13., 20., 35., 45., 52.5, 5(90.),
4  7.5, 11., 20., 25., 30., 34., 4(90.),
5  2.5, 5., 7.5, 15., 17.5, 20., 22., 3(90.),
1  0., 2.6, 4.4, 5.6, 6(6.),
2  0., 1.3, 4.6, 7., 8.5, 5(9.),
3  3., 5.3, 8.7, 10.3, 6(11.),
4  3., 4., 10.4, 12.7, 13.7, 5(14.),
5  8., 11.7, 10., 14.1, 15., 15.8, 4(16.)
DATA ((DTSTR(I),I=301,400)=
1  19., 25., 35., 45., 51., 5(90.),
2  18., 25., 35., 45., 55., 5(90.),
3  14., 20., 30., 40., 50., 53., 4(90.),
4  8., 12., 20., 22.5, 26., 5(90.),
5  2.5, 4.5, 7.5, 10., 14.5, 17.5, 20., 23., 2(90.),
1  0., 1.5, 3.5, 5.1, 6(6.),
2  0., 2.8, 5.6, 7.6, 6(9.),
3  3., 5., 7.5, 9.4, 10.8, 5(11.),
4  5., 6.1, 12.2, 13.2, 6(14.),
5  9., 10., 12., 13.9, 16., 17.1, 17.7, 3(18.)
DATA ((DTSTR(I),I=201,300)=
1  18., 23., 30., 40., 50., 55., 4(90.),
2  17., 20., 25., 30., 35., 45., 55., 3(90.),
3  13., 25., 30., 35., 42.5, 45., 50., 3(90.),
4  9., 12.5, 20., 22.5, 27., 5(90.),
5  2.5, 4.5, 7.5, 10., 14.5, 17.5, 20., 23., 2(90.),
1  0., 4., 4., 6., 7.4, 5(8.),
2  0., 1.7, 3.5, 5.6, 6.8, 8.8, 4(10.),
3  3., 6.6, 8., 9.1, 10.4, 10.7, 4(12.)

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4 7., 8., 12., 13., 6(14.), BLAD 97
5 9., 10., 12., 13., 16., 17., 17., 3(18.) ) BLAD 98
DATA ((DTSTR(I),I=101,200)*) BLAD 99
1 2,5, 10., 12., 15., 20., 25., 30., 35., 40., 90., BLAD 60
2 2,5, 7,5, 12,3, 20., 25., 32,5, 37,5, 42,5, 2(90.), BLAD 61
3 2,5, 5., 7,5, 12,5, 17,5, 22,5, 27,5, 32,5, 2(90.), BLAD 62
4 2,5, 7,5, 10., 11,5, 13., 15., 20., 24., 2(90.), BLAD 63
5 2,5, 5., 8,5, 10., 12,5, 15., 20., 22,5, 27,5, 90., BLAD 64
1 3,5, 5,4, 6., 6,6, 7,7, 8,6, 9,4, 9,8, 2(10.), BLAD 65
2 6,5, 8., 9,5, 11., 11,9, 13., 13,4, 3(13,5), BLAD 66
3 7., 9,4, 11,5, 14., 14,7, 15,1, 15,4, 3(15,5), BLAD 67
4 9., 13,5, 15,2, 16., 16,6, 17., 17,4, 3(17,5), BLAD 68
5 11., 13,6, 16., 17., 18,1, 18,8, 19,6, 19,8, 2(20.) ) BLAD 69
DATA ((UTSTR(I),I=1,100)*) BLAD 70
1 7,5, 11., 13,5, 15., 17,5, 20., 25., 27,5, 2(90.), BLAD 71
2 7,5, 10., 11,5, 14., 15., 17,5, 20., 25., 29,5, 90., BLAD 72
3 7,5, 12., 15., 18., 20., 22,5, 25., 27., 90., 90., BLAD 73
4 7,5, 10., 14,5, 17,5, 20., 22,5, 25., 28., 90., 90., BLAD 74
5 2,5, 5,5, 8., 10., 15., 17,5, 20., 23., 90., 90., BLAD 75
1 6,5, 8,6, 9,8, 10,8, 11., 11,7, 12,7, 3(13.), BLAD 76
2 7., 8,8, 10., 10,6, 11,1, 11,9, 12,5, 13,4, 2(14.), BLAD 77
3 8., 11., 12,8, 14., 14,8, 15,4, 15,8, 3(16.), BLAD 78
4 9., 11., 13,5, 14,8, 15,6, 16,2, 16,6, 3(17.), BLAD 79
5 10., 13., 15., 16., 17,8, 18,4, 18,7, 3(19.) ) BLAD 80
IF (IFT,EW,1) GO TO 2 BLAD 81
DE 1 J=1,600 BLAD 82
1 DTH(J)=DTSTR(J) BLAD 83
IFT=1 BLAD 84
GO TO 3 BLAD 85
2 DE 4 J=1,600 BLAD 86
4 DTSTR(J)=DTH(J) & IE=0 BLAD 87
3 FH=OMEGA/TWOP & IF(FR,LT,300,) GO TO 25 BLAD 88
IF(FR,GT,1500,) GO TO 10 & IF(FR,LT,750,) GO TO 5 & IQ=301 BLAD 89
GO TO 20 BLAD 90
5 IC=401 & GO TO 20 BLAD 91
10 IF(FR,LT,2750,) GO TO 15 & IC=101 & IF(FR,GT,6000,) IQ=1 BLAD 92
GO TO 20 BLAD 93
15 IC=201 BLAD 94
20 DE 24 I=5(1,500 & DTSTR(I)=DTSTR(IQ) BLAD 95
24 IC=IC+1 BLAD 96
25 DE 30 I=1,500 BLAD 97
30 DTSTR(I)=0, & ISCP=HE BLAD 98
IF (I,=EQ,0,AGE,LA,EG,C,ER,LA,EG,1,BR,IJ,EQ,2) LPB=60 BLAD 99
IF (I,=EQ,1,ER,IJ,EG,3) LPB=9 BLAD 100
40 IB=IB+1 & IF(LPB,EG,60)READ (LPB,900)RBL(IB),ICL(IB) BLAD 101
IF(LPB,EG,9)READ (LPB) RBL(IB),ICL(IB) BLAD 102
IF(LA,EG,1)WRITE ( 9) RBL(IB),ICL(IB) & IF(RBL(IB)) 41,41,42 BLAD 103
41 RBL(IB)=1,EJ0 BLAD 104
42 IF(ICL(IB)) 43,43,44 BLAD 105
43 ICL(IB)=0 & GO TO 60 BLAD 106
44 IF(ICL(IB)=9) 46,46,45 BLAD 107
45 ICL(IB)=ICL(IB)/10 BLAD 108
46 IF(ICL(IB)=5) 60,60,47 BLAD 109
47 K=ICL(IB)=5 & IF(ISW(K)) 48,48,60 BLAD 110
48 ISW(K)=1 & IL=1 BLAD 111
49 IH=IL+1 & IF(LPB,EG,60)READ (LPB,901)(BR(I,K),I=IL,IH) BLAD 112

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IF (LPP,EO,9)HEAD (LPG)(BR (I,K),I=IL,IM)          BLRD 113
IF (LA,EO,1)WRITE ( 9, (BR(I,K),I=IL,IM)  $ IL=IL+20  BLRD 114
IF (BR(IM,K)) 51,51,49                               BLRD 115
90 IF (BR(IM,K)) 51,51,53                             BLRD 116
91 IM=IM+1 $ IF (IM) 52,52,50                         BLRD 117
92 IM=1                                                BLRD 118
93 DO 94 I=IM,90                                       BLRD 119
94 BR(I+1,K)=BR(IM,K) $ IL=1 $ IF (ISCP) 60,60,55    BLRD 120
95 IM=IL+1 $ IF (IJ,EC,C,AND,LA,EC,D,OR,LA,EO,1,OR,IJ,EO,1) LPP=60  BLRD 121
IF (IJ,GE,2) LPP=63 $ IF (LPP,EC,60)READ (LPP,901) (BP(I,K),I=IL,IM)BLRD 122
IF (LPP,EO,M) READ (LPP) (BP(I,K),I=IL,IM)          BLRD 123
IF (LA,EO,1) WRITE(8) (BP(I,K),I=IL,IM)  $ IL=IL+20  BLRD 124
IF (BP(IM,K)) 55,60,55                               BLRD 125
60 IF (RBL(IB),LT,1,E15) GE TO 40 $ DO 65 K=6,9      BLRD 126
IF (IS=(K=5)) 65,65,61                               BLRD 127
61 PRINT 902,K $ PRINT 903,(I,BR(I+1,K=5),BP(I+1,K=5),I=IE,90)  BLRD 128
65 CONTINUE $ PRINT 900 $ DP 70 I=2,IB $ RN=RBL(I=1)  BLRD 129
PRINT 904,M,RN,ICL(I=1)                               BLRD 130
70 R=RN $ PRINT 905,M,ICL(IM) $ IE=1                BLRD 131
75 IC=ICL(IE) $ IF (IC) 76,76,80                    BLRD 132
76 DO 77 I=1,200 $ HHLT(I)=1.                       BLRD 133
77 BPST(I)=0, $ GO TO 100                            BLRD 134
80 DO 99 I=1,200 $ T=CTR=ATAN(.01*(I-1)) $ K=IC-5 $ IF (K) 81,81,95  BLRD 135
81 IL=10+IC $ IF (DG(IL=9),GE,T) GO TO 93           BLRD 136
82 IF (DG(IL=8),GE,T) GO TO 92 $ IL=IL+1 $ GO TO 82  BLRD 137
92 DCB=CB(IL=9)*(T-DG(IL=9))*(DB(IL=8)-DB(IL=9))/(DG(IL=8)-DG(IL=9))  BLRD 138
GE TO 94                                              BLRD 139
93 DCB=CB(IL=9)                                       BLRD 140
94 PHI=0, $ GO TO 9M                                  BLRD 141
95 N=I $ F=TN $ C=ER(N+1,K)+F*(BR(N+2,K)-BR(N+1,K)) $ PHI=0,  BLRD 142
IF (ISCP,NE,0) PHI=EP(N+1,K)+F*(BP(N+2,K)-BP(N+1,K))  BLRD 143
98 BPST(I)=PHI                                        BLRD 144
99 BR(I)=10,*(I-1)*CCE                               BLRD 145
100 RB=RBL(IE) $ RETURN $ ENTRY AWRRT $ IE=IE+1      BLRD 146
IF (IC=ICL(IE)) 75,100,75                            BLRD 147
900 FORMAT(78,4,12)                                   BLRD 148
901 FORMAT(20F4,2)                                    BLRD 149
902 FORMAT(38HUSER SUPPLIED BOTTOM LOSS TABLE CLASS ,15/1X  BLRD 150
1 3(2H0A,6X,2HCB,7X,3HFI,10X))                     BLRD 151
903 FORMAT(3(13,F10,3,FB,3,YX))                     BLRD 152
904 FORMAT(5H FHP,F10,2,3H TO,F10,2,16H KM BOTTOM CLASS,15)  BLRD 153
905 FORMAT(5H FHP,F10,2,3H TO,3X,23HEND OF RUN BOTTOM CLASS,15)  BLRD 154
END                                                  BLRD 155

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BRLTRC

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ED 0

		IDENT	BRLTRD
PROGRAM LENGTH		03503	
ENTRY POINTS	BRLTRD	02361	
	AWRHLT	03321	
BLOCK NAMES			
	PIREF	00003	
	INFC	00024	
	MIRORS	00021	
	ABC	00026	
	IFC	00007	
EXTERNAL SYMBOLS			
	Q1C1010U		
	THEAD,		
	Q1C0310U		
	Q2C07111		
	QBCLICT,		
	ATANE		
	TSP,		
	TSP,		
	SIW,		
	STB,		
	ONSINGL,		

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SUBROUTINE WORD SIZE                                WORD 1
COMMON /RAYS/ NRAY, TGAM(1000), ZZ(1000), SS(1000), TIME(1000),    WORD 2
1 NCOUNT(1000), PHASE(1000)                                WORD 3
COMMON /INFO/ RSTART, RMAX, CMEGA, ATT, IPRAY, ITN, ITN2, ITN3, IBIG,    WORD 4
1 ISCP, IT1, IT2, IT3, IPER, IFTIME, LTRT, LTER, LTRP, LPIN, IATT    WORD 5
COMMON /TRIANG/ AP(100,2), BP(100,2), AL(100), BL(100), ZZERO(100),    WORD 6
1 RZERO(100), AA(100), BW(100), SST(100), CCT(100), NTRI          WORD 7
COMMON /TLE/ STITLE (10)                                     WORD 8
COMMON /ABC/ PLNCHDB (16), INCR, NBR5, NSRS, ALIM, IFT, IFT1      WORD 9
COMMON /RANST/ RDUM, IREC, IFSK, SDUM                        WORD 10
DATA (JBIG=37777777777777777777), (IENT=0), (IFSK=-1)        WORD 11
ENTRY INI                                                    WORD 12
IF (IFT1, EQ, 0) GO TO 2                                     WORD 13
JBIG=37777777777777777777      3 IENT=0                    WORD 14
2 ITNSQR1(SORT(JBIG/4,))                                     WORD 15
ITN2=ITN*2                                                 WORD 16
ITN3=ITN2*ITN                                             WORD 17
IBIG=ITN3*ITN                                             WORD 18
RETURN                                                    WORD 19
ENTRY RAY TAPE                                             WORD 20
ZB=AL(NIRI)*BL(NTRI)*RMAX                                  WORD 21
IF (IENT, NE, 0) GO TO 1                                    WORD 22
WRITE (LTRT) STITLE, ALIM, NBR5, NSRS, ITN                WORD 23
IENT=1      3 IREC=1      3 IFSK=IFSK+1                  WORD 24
1 WRITE (LTRT) NRAY, RMAX, ZB, (TGAM(I), I=1, NRAY), (ZZ(I), I=1, NRAY),    WORD 25
1 (SS(I), I=1, NRAY), (NCOUNT(I), I=1, NRAY), (TIME(I), I=1, NRAY),    WORD 26
2 (PHASE(I), I=1, NRAY)      3 IREC=IREC+1              WORD 27
RETURN                                                    WORD 28
END                                                        WORD 29

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S WORDSIZE

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ED 0

	IDENT	WORDSIZE
PROGRAM LENGTH	00217	
ENTRY POINTS	INIT 00012	
	RAYTYPE 00044	
	WORDSIZE 00005	
BLOCK NAMES		
	RAVS 13561	
	INFO 00024	
	TRIANG 02261	
	TLE 00012	
	ABC 00026	
	RANST 00004	
EXTERNAL SYMBOLS		
	01010100	
	THEND,	
	000C1CT,	
	SQRTP	
	STB,	
	SLE,	
	ONSINQL,	

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SUBROUTINE NEWPROF(ZMAX)                                NEWP  1
COMMON /INFO/ RSTART,RMAX,OMEGA,ATT,IPRAY,ITN,ITN2,ITN3,IBIG, NEWP  2
1  ISCP,IT1,IT2,IT3,IPER,IFTIMS,LTRY,LTER,LTRP,LPIN,IATT NEWP  3
COMMON /PROFIL/ R1,N1,Z1(50),V1(50),R2,N2,Z2(50),V2(50),IBOTC,IPFLNEWP  4
COMMON/INPUT/ RBOT(250),ZBOT(250),ZIL(2,50),VIL(2,50),NN(2),ICON(2NEWP  5
1,50)                                                    NEWP  6
COMMON /TLE/STITLE (10)                                NEWP  7
COMMON /PRO/ IPROP,IKNM,PLTL,RM,IPCO,IPPR              NEWP  8
DIMENSION TITL(9),PM(3),LIN (114)                     NEWP  9
COMMON/ABC/PUNCHDB (16),INCR,NBRS,NSRS,ALIP,IFT,IFT1 NEWP 10
COMMON /IPC/ IFE,IA,IB,IK,ID,IS,LA                    NEWP 11
COMMON /RANSY/ RS,IDUM,IDUMH,SDS                       NEWP 12
DATA (NBPT=0),(IFE=0),(LIN=114(1M)),(IFT2=0),(IRH=0) NEWP 13
IFE=IFE=0 S IF (IFT,EQ,IFT2) GO TO 952 S IWM=0 S IFT2=IFT NEWP 14
952 IF (IFT,EQ,0,OR,IWM,EQ,1) GO TO 950 S NBPT=0 S IFE=0 S IFE=IFE=0 NEWP 15
IWM=1 S A2=0 S R2=0.0 S N1=0 S R1=0.0 S IPPR=0        NEWP 16
DO 951 J=1,114                                          NEWP 17
951 LIN(J)=1M                                           NEWP 18
950 IF(NBPT.GT.0) GO TO 20                               NEWP 19
C FIRST ENTRY, READ IN BOTTOM TRACK                     NEWP 20
IL=1 S IF (ID,EQ,0,AND,LA,EQ,0,OR,LA,EQ,1) LPI=60S IF (ID,EQ,1) LPI=5 NEWP 21
2 IM=IL+4                                               NEWP 22
IF(LPI,EQ,60)READ (LPI,900) (RBOT(I),ZBOT(I),I=IL,IM) NEWP 23
IF(LPI,EQ,5)READ (LPI) (RBOT(I),ZBOT(I),I=IL,IM)      NEWP 24
IF(LA,EQ,1)WRITE (5) (RBOT(I),ZBOT(I),I=IL,IM)       NEWP 25
IF(RBOT(IM),LE,0.) GO TO 3 S IL=IL+5 S GO TO 2        NEWP 26
3 IM=IM+1 S IF(RBOT(IM),LE,0.) GO TO 3 S NBPT=IM      NEWP 27
IF (LA,EQ,1,OR,ID,EQ,1) REWIND 5                       NEWP 28
PRINT 901,(RBOT(I),ZBOT(I),I=1,NBPT) S IF (IBOTC,LE,0) GO TO 1 NEWP 29
DO 5 J=1,NBPT                                           NEWP 30
5 ZBOT(I)=ZBOT(I)+(1.-.5-ZBOT(I))/637.221.3           NEWP 31
1 CONTINUE S WRITE (35,611),STITLE,(RBOT(J),ZBOT(J),J=1,NBPT) NEWP 32
611 FORMAT (10A8,/,/(10F8.3))                          NEWP 33
611 FORMAT (10F8.3)                                      NEWP 34
ZMAX=0, SD0 4 J=1,NBPT                                  NEWP 35
IF(ZBOT(I).GT,ZMAX) ZMAX=ZBOT(I)                       NEWP 36
4 CONTINUE                                              NEWP 37
IBPT=0 S IF (IS,EQ,0,AND,LA,EQ,0,OR,LA,EQ,1) LPN=60 NEWP 38
NN(2)=0 S IF (IS,EQ,1) LPN=6                           NEWP 39
DO 55 I=1,2                                             NEWP 40
DO 55 J=1,50                                           NEWP 41
ZIL(I,J)=0.0                                           NEWP 42
VIL(I,J)=0.0                                           NEWP 43
55 ICON(I,J)=0                                         NEWP 44
NN(1)=0                                                NEWP 45
NIB=0                                                  NEWP 46
DO 56 J=1,50                                           NEWP 47
Z1(J)=0.0                                              NEWP 48
V1(J)=0.0                                              NEWP 49
Z2(J)=0.0                                              NEWP 50
V2(J)=0.0                                              NEWP 51
56 ASSIGN 6 TO IRET                                     NEWP 52
GO TO 70                                               NEWP 53
C AT 70 IS THE READIN AND CONNECT ROUTINE, RETURN IS TO IRET NEWP 54
6 ASSIGN 20 TO IRET                                     NEWP 55
GO TO 70                                               NEWP 56

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20	IBPT=IBPT+1	NEWP 57
	IF (IBPT.LE.NBPT) GO TO 21	NEWP 58
	RBV=.001*R2+100.	NEWP 59
	IFPR=1	NEWP 60
	GO TO 22	NEWP 61
21	RBT=RBOT(IBPT)	NEWP 62
	ZBT=ZBOT(IBPT)	NEWP 63
	IF (RM.LE.RBT.AND.(FE0F.EQ.1.AND.RS.NE.0.0) IFPR=1	NEWP 64
22	IF (RBT.LE.RB) GO TO 25	NEWP 65
C	GET NEW INPUT PROFILE	NEWP 66
	ASSIGN 23 TO IRET	NEWP 67
	GO TO 70	NEWP 68
23	IF (IBPT.GT.NBPT) GO TO 25	NEWP 69
	IBPT=IBPT+1	NEWP 70
	ZBT=ZBT+(RA-RBT)*(ZBT-ZBOT(IBPT))/(RBT-RBOT(IBPT))	NEWP 71
C	THIS IS THE BOTTOM DEPTH AT PROFILE RANGE	NEWP 72
	RBT=RA	NEWP 73
25	R1=R2	NEWP 74
	N1=N2	NEWP 75
C	MOVE PROFILE 2 TO PROFILE 1	NEWP 76
	DO 27 I=1,N2	NEWP 77
	Z1(I)=Z2(I)	NEWP 78
27	V1(I)=V2(I)	NEWP 79
	R2=1000.*RBT	NEWP 80
	FA=(RB-RBT)/(RB-RA)	NEWP 81
	FB=1.-FA	NEWP 82
	N2=1	NEWP 83
29	IF (ICON(1,N2).GT.NN(1)) ICON(1,N2)=NN(1)	NEWP 84
	IF (ICON(2,N2).GT.NN(2)) ICON(2,N2)=NN(2)	NEWP 85
	Z=FA*Z1L(1,ICON(1,N2))+FB*Z1L(2,ICON(2,N2))	NEWP 86
	V=FA*V1L(1,ICON(1,N2))+FB*V1L(2,ICON(2,N2))	NEWP 87
	IF (N2.GT.1.AND.Z.LT.Z?(N2-1)) 125,126	NEWP 88
125	Z=Z?(N2-1)	NEWP 89
	V=V?(N2-1)	NEWP 90
126	IF (Z.GT.ZBT) GO TO 35	NEWP 91
	Z2(N2)=Z	NEWP 92
	V2(N2)=V	NEWP 93
	N2=N2+1	NEWP 94
	IF (N2.LE.NIB) GO TO 29	NEWP 95
C	EXTRAPOLATION TO BOTTOM	NEWP 96
	Z2(N2)=ZBT	NEWP 97
	M=N2-1	NEWP 98
31	M=M-1	NEWP 99
	Z=Z2(M)	NEWP 100
	IF (ABS(Z-Z2(N2-1)).LT.1.E-5*Z) GO TO 31	NEWP 101
	V=V2(M)	NEWP 102
	V2(N2)=V2(M) + (ZBT-Z) * (V-V2(N2-1)) / (Z-Z2(N2-1)-Z)	NEWP 103
	GO TO 40	NEWP 104
35	Z2(N2)=ZBT	NEWP 105
	V2(N2)=V2(N2-1) + (ZBT-Z?(N2-1)) * (V-V2(N2-1)) / (Z-Z2(N2-1))	NEWP 106
C	REMOVE DUPLICATE POINTS	NEWP 107
40	M=2	NEWP 108
	IDC=0	NEWP 109
42	IF (Z2(M).GT.Z2(M-1)+0.0001) GO TO 45	NEWP 110
	IDC=1	NEWP 111
	N2=N2+1	NEWP 112

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	DO 44 I=M,N2	NEWP 113
	Z2(I)=Z2(I+1)	NEWP 114
44	V2(I)=V2(I+1)	NEWP 115
45	M=M+1	NEWP 116
	IF (M.LE.N2) GO TO 42	NEWP 117
	IF (IDC.GT.0) GO TO 40	NEWP 118
	IF (Z2(N2+1).EQ.0.0) GO TO 46	NEWP 119
	N5=N2+1	NEWP 120
	DO 47 I=N5,50	NEWP 121
	Z2(I)=0.0	NEWP 122
47	V2(I)=0.0	NEWP 123
46	IF (IPROP.EQ.0.OR.IPROP.EQ.1) GO TO 54	NEWP 124
	PRINT 902,R2	NEWP 125
	PRINT 914	NEWP 126
	DO 7 J=1,N2	NEWP 127
	NV=V2(J)-1455.5	NEWP 128
	IF (NV.LT.4.OR.NV.GT.114) GO TO 48	NEWP 129
	LIN(NV)=1M	NEWP 130
	PRINT 915,Z2(J),V2(J),LIN	NEWP 131
	LIN(NV)=1M	NEWP 132
	GO TO 7	NEWP 133
48	PRINT 915,Z2(J),V2(J)	NEWP 134
	7 CONTINUE	NEWP 135
54	IF (IPFL.EQ.1) CALL PROFPLOTT (RB,N3,INPF)	NEWP 136
	IF (IPFL.EQ.2) CALL PROFPLIT (RB,N3,INPF)	NEWP 137
	IF (RS.GE.RBOT(2).OR.IFEQ.EQ.1) RETURN \$ PRINT 275 \$ CALL BYEYE	NEWP 138
275	FORMAT (5X,'PROGRAM ABORTED, TWO SOUND SPEED PROFILES INPUT BEFORE	NEWP 139
	1 SECOND BOTTOM POINT')	NEWP 140
70	IF (NN(2).EQ.0) GO TO 75 \$ NB=NN(2) \$ DO 71 I=1,NB	NEWP 141
	ZIL(I,1)=ZIL(2,1)	NEWP 142
71	VIL(I,1)=VIL(2,1)	NEWP 143
	RA=RB	NEWP 144
75	NN(1)=NN(2)	NEWP 145
	IF (IFEQ.EQ.0) GO TO 76	NEWP 146
	RB=RB+.E6	NEWP 147
	GO TO 82	NEWP 148
76	IF (LPN.EQ.60) READ (LPN,903) NCUR,RB,TITLE	NEWP 149
	IF (LPN.EQ.6) READ (LPN) NCUR,RB,TITLE	NEWP 150
	IF (EOF.LPN) 77,78	NEWP 151
77	IFEQ=1 \$ IFEQ=IFEQ	NEWP 152
	RB=RA+.E6 \$ IF (LA.EQ.1) ENDFILE 6	NEWP 153
	IF (LA.EQ.1.OR.IS.EQ.1) REWIND 6 \$ GO TO 82	NEWP 154
78	IL=1 \$ IF (LA.EQ.1) WRITE (6) NCUR,RB,TITLE \$ RS=RB	NEWP 155
79	IM=IL+4	NEWP 156
	IF (LPN.EQ.60) READ (LPN,900) (ZIL(2,1),VIL(2,1),I=IL,IM)	NEWP 157
	IF (LPN.EQ.6) READ (LPN) (ZIL(2,1),VIL(2,1),I=IL,IM)	NEWP 158
	IF (LA.EQ.1) WRITE (6) (ZIL(2,1),VIL(2,1),I=IL,IM)	NEWP 159
	IF (VIL(2,IM).LE.0.) GO TO 81	NEWP 160
	IL=IL+5	NEWP 161
	GO TO 79	NEWP 162
81	IM=IM+1	NEWP 163
	IF (VIL(2,IM).LE.0.) GO TO 81	NEWP 164
	NN(2)=IM	NEWP 165
	N3=IM	NEWP 166
	INPF=0	NEWP 167
	IF (IPROP.EQ.0) GO TO 74	NEWP 168

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PRINT 904, RB, TITLE                                NEWP 169
PRINT 914                                            NEWP 170
74 DO 20 I=1, IM                                     NEWP 171
   IF (VIL(2,I).LT.1400.07OR,VIL(2,I).GT.1650.0) 58,57 NEWP 172
58 PRINT 920, RB, ZIL(2,I), VIL(2,I)                NEWP 173
920 FORMAT(1H,5X,'INPLY ERROR IN PROFILE AT RANGE',F10.4,5X,'VALUE AT NEWP 174
1 DEPTH',F10.3,'M',F10.3,' M/SEC')                 NEWP 175
   CALL BYEBYE                                       NEWP 176
57 IF (ZIL(2,I).NE.SDS) GO TO 257 $ PRINT 258,ZIL(2,I),RSCALL BYEBYENEWP 177
258 FORMAT (5X,'PROGRAM ABORTED, INPUT PROFILE DEPTH',F10.3,1X,'=SOURCNEWP 178
1E DEPTH, AT RANGE',F10.3,' KM')                   NEWP 179
257 IF (I.EQ.1) GO TO 157 $IF (ZIL(2,I).LT.ZIL(2,I-1)) GO TO 90 NEWP 180
157 IF (IPROP.EQ.0) GO TO 28 $NV=VIL(2,I)-.455.5    NEWP 181
   IF (NV.LT.4.0R,NV.GT.114) GO TO 38 $ L[N(NV)]=1MV NEWP 182
   PRINT 915,ZIL(2,I),VIL(2,I),LIN                 NEWP 183
   LIN(NV)=1H                                       NEWP 184
   GO TO 29                                          NEWP 185
38 PRINT 915,ZIL(2,I),VIL(2,I)                       NEWP 186
29 CONTINUE                                         NEWP 187
   IF (NCUR.GT.0) GO TO 80                           NEWP 188
   DO 80 I=1,IM                                     NEWP 189
     V.L(2,I)=VIL(2,I)*(1.+7IL(2,I)/6371221.3)     NEWP 190
     ZIL(2,I)=ZIL(2,I)*(1.+5*ZIL(2,I)/6371221.3)   NEWP 191
     IF (IPFL.EQ.1) CALL PROFPLT (RB,N3,INPF)       NEWP 192
     IF (IPFL.EQ.2) CALL PROFPLT (RB,N3,INPF)       NEWP 193
     IF (NN(1).EQ.0) GO TO IRET,(6,20,23)           NEWP 194
82 ICON(1,1)=1                                       NEWP 195
   ICON(2,1)=1                                       NEWP 196
   NA=2                                              NEWP 197
   NB=2                                              NEWP 198
   NR=2                                              NEWP 199
83 IF (ZIL(2,NB).EQ.ZIL(1,NB)) GO TO 92            NEWP 200
   IF (NB.LE.NN(2)) GO TO 84                         NEWP 201
   IP=2                                              NEWP 202
   GO TO 88                                          NEWP 203
84 IF (NA.LE.NN(1)) GO TO 85                         NEWP 204
   IP=1                                              NEWP 205
   GO TO 88                                          NEWP 206
85 DVMA=VIL(1,NA)-VIL(1,NA-1)                       NEWP 207
   DVLA=DVMA                                         NEWP 208
   DVMA=DVMA                                         NEWP 209
   IF (NA.GT.2) DVLA=VIL(1,NA-1)-VIL(1,NA-2)       NEWP 210
   IF (NA.LT.NN(1)) DVMA=VIL(1,NA+1)-VIL(1,NA)     NEWP 211
   DVMB=VIL(2,NB)-VIL(2,NB-1)                       NEWP 212
   DVLB=DVMB                                         NEWP 213
   DVMB=DVMB                                         NEWP 214
   IF (NB.GT.2) DVLB=VIL(2,NB-1)-VIL(2,NB-2)       NEWP 215
   IF (NB.LT.NN(2)) DVMB=VIL(2,NB+1)-VIL(2,NB)     NEWP 216
   PH(1)=ABS(ZIL(1,NA-1)-ZIL(2,NB))                 NEWP 217
   IF (DVLA=DVMB,GE.0,.AND.DVMA=DVMB,GE.0,) PH(1)=PH(1)-250. NEWP 218
   PH(2)=ABS(ZIL(1,NA)-ZIL(2,NB-1))                 NEWP 219
   IF (DVMA=DVLB,GE.0,.AND.DVMA=DVMB,GE.0,) PH(2)=PH(2)-250. NEWP 220
   PH(3)=ABS(ZIL(1,NA)-ZIL(2,NB))                   NEWP 221
   IF (DVMA=DVMB,GE.0,.AND.DVMA=DVMB,GE.0,) PH(3)=PH(3)-250. NEWP 222
   BP=PH(1)                                          NEWP 223
   IP=1                                              NEWP 224

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	DO 87 I=2,3	NEWP 225
	IF (PM(I).GE,8P) GO TO 87	NEWP 226
	IP=I	NEWP 227
	BP=PM(I)	NEWP 228
87	CONTINUE	NEWP 229
88	GO TO (90,91,92),IP	NEWP 230
90	ICON(1,NIB)=NA-1	NEWP 231
	ICON(2,NIB)=NB	NEWP 232
	NB=NB+1	NEWP 233
	GO TO 93	NEWP 234
91	ICON(1,NIB)=NA	NEWP 235
	ICON(2,NIB)=NB-1	NEWP 236
	NA=NA+1	NEWP 237
	GO TO 93	NEWP 238
92	ICON(1,NIB)=NA	NEWP 239
	ICON(2,NIB)=NB	NEWP 240
	NA=NA+1	NEWP 241
	NB=NB+1	NEWP 242
93	IF (NA.GT,NN(1).AND,NB.GT,NN(2)) GO TO IRET,(6,20,23)	NEWP 243
	NIB=NIB+1	NEWP 244
	IF (NIB.LE,50) GO TO 83	NEWP 245
	PRINT 905	NEWP 246
	CALL WYEBYE	NEWP 247
908	FORMAT(10F6,4)	NEWP 248
901	FORMAT(24H0LISTING OF BOTTOM TRACK/3M0,4X,9(6H R(KM)),6X,4HZ(M),4X)	NEWP 249
	1 // (1X,10F10,3)	NEWP 250
902	FORMAT(30H0INTERPOLATED PROFILE AT RANGE,F10.0,2M H//)	NEWP 251
903	FORMAT(11,F7,3,9A8)	NEWP 252
904	FORMAT(23H0INPUT PROFILE AT RANGE,F11.3,3M KM,5X,9A8//)	NEWP 253
914	FORMAT(3X,0DEPTH (M),2X,0VELOCITY,01400.0X,01470.0X,01480.0X,	NEWP 254
	101490.0X,01500.0X,01510.0X,01520.0X,01530.0X,01540.0X,01550.0X,	NEWP 255
	2,6X,01560.0X,01570.0X//)	NEWP 256
915	FORMAT(1X,F11.4,F10.4,11A1)	NEWP 257
905	FORMAT(29H000 MANY POINTS INTERPOLATED)	NEWP 258
	END	NEWP 259

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DS NEWPROF

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ED 0

	IDENT	NEWPROF
PROGRAM LENGTH	03072	
ENTRY POINTS	00471	
BLOCK NAMES		
INFO	00024	
PROFIL	00316	
INPUT	01442	
TLB	00012	
PRO	00006	
ABC	00026	
IFC	00007	
RANST	00004	

EXTERNAL SYMBOLS

THEND,
Q1Q1Q100
Q0DICT,
PROFLOT
PROFLIT
BYEBYE
Q0CIFE0F
EFT,
REW,
TSH,
TSB,
STM,
STB,
SLO,
SLI,
QNSINGL.

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	SUBROUTINE CONNECT	CONN 1
	COMMON /PROFIL/ R1,N1,Z1(50),V1(50),R2,N2,Z2(50),V2(50),IBOTC,IPFL	CONN 2
	COMMON /TRIANG/ AP(100,2),BP(100,2),AL(100),BL(100),ZZERO(100),	CONN 3
1	RZERO(100),AA(100),EB(100),SST(100),CCT(100),NTRI	CONN 4
	NA=NB*1	CONN 5
	NTRI=0	CONN 6
	IADD=0	CONN 7
10	NTRI=NTRI+1	CONN 8
	IF(NB,EQ,N2) GO TO 12	CONN 9
	IF (IADD,EQ,1,PR,NA,EQ,V1) GO TO 30	CONN 10
12	RZERO(NTRI)=R2	CONN 11
	ZZERO(NTRI)=Z2(NH)	CONN 12
	AL(NTRI)=Z1(NA*1)	CONN 13
	BL(NTRI)=(Z2(NB)+Z1(NA*1))/(R2-R1)	CONN 14
	AA(NTRI)=1./V2(NH)**2	CONN 15
	RZ=(1,DU/V1(NA)**2+1,DC/V1(NA*1)**2)/(Z1(NA)+Z1(NA*1))	CONN 16
	RB=(1,DU/V2(NB)**2+1,DC/V1(NA)**2-BZ*(Z2(NB)+Z1(NA)))/(R2-R1)	CONN 17
	NA=NA*1	CONN 18
	IADD=1	CONN 19
	GO TO 40	CONN 20
30	RZERO(NTRI)=R1	CONN 21
	ZZERO(NTRI)=Z1(NA)	CONN 22
	AL(NTRI)=Z1(NA)	CONN 23
	BL(NTRI)=(Z1(NA)+Z2(NB*1))/(R1-R2)	CONN 24
	AA(NTRI)=1./V1(NA)**2	CONN 25
	RZ=(1,DU/V2(NB)**2+1,DC/V2(NB*1)**2)/(Z2(NB)+Z2(NB*1))	CONN 26
	RB=(1,DU/V1(NA)**2+1,DC/V2(NB)**2-BZ*(Z1(NA)+Z2(NB)))/(R1-R2)	CONN 27
	NA=NB*1	CONN 28
	IADD=0	CONN 29
	GO TO 40	CONN 30
40	RB(NTRI)=S1*(SQRT(BZ**2+dB**2),BZ)	CONN 31
	IF(BB(NTRI),EQ,0.) GO TO 41	CONN 32
	SST(NTRI)=BR/BB(NTRI)	CONN 33
	CCT(NTRI)=HZ/BB(NTRI)	CONN 34
	GO TO 42	CONN 35
41	CCT(NTRI)=1,	CONN 36
	SST(NTRI)=0,	CONN 37
42	AL(NTRI)=AL(NTR)*BL(NTRI)*R1	CONN 38
	TANT=SST(NTRI)/AMAX1(CCT(NTRI),1,E=100)	CONN 39
	BP(NTRI,2)=(AL(NTRI)*TANT)/(1,-BL(NTRI)*TANT)	CONN 40
	R=AL(NTRI)*1	CONN 41
	IF(NTRI,EQ,1) R=0	CONN 42
	RP(NTRI,1)=(R*TANT)/(1,-B*TANT)	CONN 43
	AP(NTRI,1)=AP(NTRI,2)*C,	CONN 44
	IF(NA,LI,N1,PR,N2,LI,N2) GO TO 10	CONN 45
	RETURN	CONN 46
	END	CONN 47

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DS CONNECT

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ED

0

	ICENT	CONNECT
PROGRAM LENGTH	00414	
ENTRY POINTS	CONNECT	00003
BLOCK NAMES		
	PROFIL	00316
	TRIANG	02261
EXTERNAL SYMBOLS		
	0101021J	
	0100421J	
	0000101J	
	SURTF	
	MAXIF	

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SUBROUTINE PR0FPL0T (R1,N3,INPF)                                PLOT 1
COMMON /PROFIL/ R1,N1,Z1(50),V1(50),R2,N2,Z2(50),V2(50),IBOTC,IPFLPLOT 2
DIMENSION XT(10),X(4),XP(50),Y(50),PLTARRAY(254),ZDEPTH(250),XRANGPLOT 3
1E(250),XL(50),YL(400),YP(10)                                PLOT 4
COMMON /INPUT/ R00T(250),Z00T(250),ZIL(2,50),VIL(2,50),NN(2),ICON(2)PLOT 5
1,5n)                                                         PLOT 6
COMMON /LIMITS/R0(10),DR(10),R02(10)                        PLOT 7
COMMON /PRO/ IPROP,IKNM,PLTL,RM,IPCO,IFPR                    PLOT 8
COMMON /TLE/STITLE(10)                                       PLOT 9
COMMON /ABC/PUNCHDB(16),INCR,NBRS,NSRS,ALIM,IFT1,IFT2      PLOT 10
DATA (IPL0T=0),(IST=0),(IFT2=0),(IRN=0),(IJ=0)              PLOT 11
IF (IPCO.EQ.1.AND.IPL0T.EQ.0.OR,IST.EQ.1) GO TO 10n         PLOT 12
IF (IPL0T.EQ.1) GO TO 1 $ CALL PLOTS (PLTARRAY,254,3)       PLOT 13
100 IF (IFT1.EQ.IFT2) GO TO 95 $ IBM=0 $ IFT2=IFT1          PLOT 14
52 IF (IFT1.EQ.0.AND.IJ.EQ.1.OR,IRN.EQ.1) RETURN           PLOT 15
IBM=1 $ IPL0T=1 $ IPCO=1 $ IST=0 $ IJ=1                     PLOT 16
RM= MAX1F(R02(1),R02(2),R02(3),R02(4),R02(5),R02(6),R02(7),R02(8),PLOT 17
R02(9),R02(10)) $ IDI=n $ K=0                                PLOT 18
20 K=K+1 $ IF (RM.GT.R00T(K)) 20,21                          PLOT 19
21 ZMAX=Z00T(1)                                               PLOT 20
DO 22 J=2,K                                                  PLOT 21
22 ZMAX= MAX1F(Z00T(J),ZMAX)                                  PLOT 22
IF (ZMAX.LE. 250.0.AND,ZMAX.GT. 0.0 ) ZMAX= 250.0         PLOT 23
IF (ZMAX.LE. 500.0.AND,ZMAX.GT. 250.0 ) ZMAX= 500.0       PLOT 24
IF (ZMAX.LE. 1000.0.AND,ZMAX.GT. 500.0 ) ZMAX= 1000.0     PLOT 25
IF (ZMAX.LE. 2000.0.AND,ZMAX.GT.1000.0 ) ZMAX= 2000.0     PLOT 26
IF (ZMAX.LE. 4000.0.AND,ZMAX.GT.2000.0 ) ZMAX= 4000.0     PLOT 27
IF (ZMAX.LE. 5000.0.AND,ZMAX.GT.4000.0 ) ZMAX= 5000.0     PLOT 28
IF (ZMAX.LE.10000.0.AND,ZMAX.GT.5000.0 ) ZMAX=10000.0     PLOT 29
DO 25 J=1,11                                                PLOT 30
A=(ZMAX/10.0)*(J-1)                                          PLOT 31
IF (J.EQ.6) CALL SYMROL (-1.00,5.0,0.14,9HDEPTH (M),00.0,9) PLOT 32
XL(J)=0.0                                                    PLOT 33
Y(J)=(11-J)                                                 PLOT 34
25 CALL NUMBER(-0.80,Y(J),0.140,A,0.0,4HF5.0)              PLOT 35
CALL LINE (XL,Y,11,1.3,0.105,1)                            PLOT 36
DO 26 J=1,250                                               PLOT 37
26 YL(J)=0.0                                                PLOT 38
IF (PLTL.GT.156.0) CALL BYEBYE                              PLOT 39
RSCALE=PLTL/RM                                              PLOT 40
NTM=AMIN1(PLTL*1.,40.5)                                     PLOT 41
RT=1.                                                         PLOT 42
RMAN=RM                                                       PLOT 43
IF (IKNM.GT.0) RMAN=RM /1.852                                PLOT 44
56 NT=RMAN/RT                                                PLOT 45
IF (NT,LE.NTM) GO TO 57                                     PLOT 46
RT=2.*RT                                                      PLOT 47
NT=RMAN/RT                                                  PLOT 48
IF (NT,LE.NTM) GO TO 57                                     PLOT 49
RT=2.5*RT                                                    PLOT 50
NT=RMAN/RT                                                  PLOT 51
IF (NT,LE.NTM) GO TO 57                                     PLOT 52
RT=2.*RT                                                      PLOT 53
GO TO 56                                                      PLOT 54
C PLOT SURFACE AXIS                                         PLOT 55
57 CALL PLOT(0., 0.,3)                                       PLOT 56

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XN=0.
RSCALE1=RSCALE
IF (IKNM.GT.0) RSCALE1=1.892*RSCALE
DX=RT*RSCALE1
R=0.
IF=0
58 CALL PLOT(XN,0.,2)
CALL PLOT(XN,-0.05,2)
RK=R
CALL NUMBER(XN=.48,-0.19,1.4E-1,RK,0.,4HF4.0)
IF (R.LT.RMAN/2.) GO TO 59
IF (IF.EQ.1) GO TO 59
IF (IKNM.EQ.0) 4,7
7 CALL SYMBGL(XN=0.30,-0.40,0.14,10HRANGE (NM),0.,10)
GO TO 8
4 CALL SYMBGL(XN=0.30,-0.40,0.14,10HRANGE (KM),0.,10)
8 CALL SYMBGL (XN=7.20,10,15,0.21,STITLE,0.,80)
IF=1
59 CALL PLOT(XN,0.,3)
IF (R.GE.RMAN) GO TO 60
XN=XN+DX
R=R+RT
GO TO 58
60 IDP=0
1 IF (IFPR.EQ.1) GO TO 5
X(3)=(R2/1000.0)*RSCALE
IF (INPF.EQ.0) X(3)=R1*RSCALE
X(1)=X(3)*1.5
IF (INPF.EQ.1) GO TO 2 $ IF (X(3).GT.PLYL) GO TO 35
DO 5 J=1,N3
15 XP(J)=((0.5*VIL(2,J)-735.0)*0.1)*X(3)
IDI=IDI+1
XL(IDI)=X(3)
IF (IDI.GE.2) GO TO 50
CALL SYMBGL (X(1)*0.02,10,27,0.10,16HVELOCITY (M/SEC),0.0,16)
TX=0.5
50 N=2
DO 55 J=1,N
XT(J)=X(1)*(J-1)*TX
YP(J)=10.02
XM=1500.0
DX=10.0
PL=XM*(J-1)*DX
IF (IDI.EQ.1) CALL NUMBER(XT(J)-0.07,10,10.,.105,PL,0.0,4HF4.0)
55 CONTINUE
IF (X(3).LE.PLYL) CALL LINE (XT,YP,N,1,13,0,07,1)
IF (INPF.EQ.1) GO TO 2
DO 3 I=1,N3 SY(I)=10.0*(1.0-(ZIL(2,I)/ZMAX))
3 IF (Y(I).LT.0.0) Y(I)=0.0
IF (X(3).LE.PLYL) CALL LINE (XP,Y,N3,1,-2,0,0,0)
35 INPF=1
GO TO 5
2 DO 6 I=1,N2 SY(I)=10.0*(1.0-(Z2(I)/ZMAX))
6 IF (Y(I).LT.0.0) Y(I)=0.0
IDP=IDP+1
ZDEPTH(IDP)=Y(N2)
XRANGE (IDP)=X(3)
9 IF (IFPR.EQ.0) GO TO 30
CALL LINE (XRANGE,ZDEPTH,IDP,1,1,0,0,0)
CALL LINE (XL, YL,IDI, 1,3,0,140,91)
CALL PLOTS (0,0) $ CALL PLOT (PLYL*10.0*0.1-3) $ IST=1
30 RETURN
END
PLOT 97
PLOT 98
PLOT 99
PLOT 100
PLOT 101
PLOT 102
PLOT 103
PLOT 104
PLOT 105
PLOT 106
PLOT 107
PLOT 108
PLOT 109
PLOT 110
PLOT 111
PLOT 112
PLOT 113
PLOT 114
PLOT 115
PLOT 116
PLOT 117
PLOT 118
PLOT 119

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DS PROFLOT

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	IDENT	PROFLOT
PROGRAM LENGTH	03700	
ENTRY POINTS	02503	
BLOCK NAMES		
PROFIL	00316	
INPUT	01442	
LIMITS	00036	
PRO	00006	
TLE	00012	
ABC	00026	
EXTERNAL SYMBOLS		
01010100		
000DICT,		
PLOTS		
SYMBOL		
NUMBER		
LINE		
BYEBYE		
PLOT		
MINIF		
MAXIF		

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SUBROUTINE PROFPLT (RI,N3,INPF) PLIT 1
COMMON /PROFIL/ R1,N1,Z1(50),V1(50),R2,N2,Z2(50),V2(50),IBOTC,IPFLPLIT 2
DIMENSION XT(10),X(4),XP(50),Y(50),PLTARRAY(254),ZDEPTH(250),XRANGPLIT 3
1E(250),XL(50),YL(400),YP(10),XJ(100) PLIT 4
COMMON /INPUT/ RBOT(250),ZBOT(250),ZIL(2,50),VIL(2,50),NN(2),ICBN(2PLIT 5
1,50) PLIT 6
COMMON /LIMITS/R0(10),DR(10),R02(10) PLIT 7
COMMON /PRO/ IPROP,IKNM,PLTL,RM,IPCO,IFPR PLIT 8
COMMON /TLE/STITLE(10) PLIT 9
COMMON /ABC/PUNCHDB(16),INCR,NBRS,NSRS,ALIM,IFT,IFT1 PLIT 10
DATA (IPL0T=0),(IST=0),(IFT2=0),(IBW=0),(IJ=0) PLIT 11
IF (IPCO.EQ.1.AND,IPL0T.EQ.0.OR,IST.EQ.1) GO TO 100 PLIT 12
IF (IPL0T.EQ.1) GO TO 1 S CALL PLOTS (PLTARRAY,254,3) PLIT 13
100 IF (IFT1.EQ,IFT2) GO TO 952 $IBW=0 $ IFT2=IFT1 PLIT 14
952 IF (IFT1.EQ,0.AND,IJ.EQ,1.OR,IBW.EQ,1) RETURN PLIT 15
IBW=1 $ IPL0T=1 $ IPCO=1 $ IST=0 $ IJ=1 PLIT 16
RM= MAX1F(R02(1),R02(2),R02(3),R02(4),R02(5),R02(6),R02(7),R02(8),PLIT 17
1R02(9),R02(10)) $ K=0 $ IDI=0 $ IYLA0 PLIT 18
20 K=K+1 PLIT 19
IF (RM.GT,RBOT(K)) 20,21 PLIT 20
21 ZMAX=ZBOT(1) PLIT 21
DO 22 J=2,K PLIT 22
22 ZMAX= MAX1F(ZBOT(J),ZMAX) PLIT 23
IF (ZMAX.LE, 250.0.AND,ZMAX.GT, 0.0 ) ZMAX= 250.0 PLIT 24
IF (ZMAX.LE, 500.0.AND,ZMAX.GT, 250.0 ) ZMAX= 500.0 PLIT 25
IF (ZMAX.LE, 1000.0.AND,ZMAX.GT, 500.0 ) ZMAX= 1000.0 PLIT 26
IF (ZMAX.LE, 2000.0.AND,ZMAX.GT,1000.0 ) ZMAX= 2000.0 PLIT 27
IF (ZMAX.LE, 4000.0.AND,ZMAX.GT,2000.0 ) ZMAX= 4000.0 PLIT 28
IF (ZMAX.LE, 5000.0.AND,ZMAX.GT,4000.0 ) ZMAX= 5000.0 PLIT 29
IF (ZMAX.LE,10000.0.AND,ZMAX.GT,5000.0 ) ZMAX=10000.0 PLIT 30
DO 25 J=1,11 $ A=(ZMAX/10.0)*(J-1) PLIT 31
IF (J.EQ.6) CALL SYMBOL (-1,40,5,0,0.14,9HDEPTH (M),90,0,9) PLIT 32
Y(J)=(11-J) $ XL(J)=-0.4 PLIT 33
25 CALL NUMBER(1.20,Y(J),0.140,A,0,0,4HF5,0) PLIT 34
CALL LINE (XL,Y,11,1,3,0,105,1) $ RSCALE=PLTL/RM $ RJ=RM*RSCALE PLIT 35
IF (PLTL.GT,150.0) CALL BYEBYE $ DO 26 J=1,250 PLIT 36
26 YL(J)=-0.0525 $ IDP=0 PLIT 37
CALL SYMBOL (1,02,10,20,0,10,16HVELOCITY (M/SEC),0,0,16) PLIT 38
1 IF (IFPR.EQ,1) GO TO 5 $ X(3)=(R2/1000.0)*RSCALE PLIT 39
X(1)=X(3)*.1 $ X(2)=-0.94 PLIT 40
X(4)=R2/1000.0 PLIT 41
IF (IKNM.GT,0) X(4)=X(4)/1.852 PLIT 42
IF (INPF.EQ,0) GO TO 60 PLIT 43
DO 15 J=1,N2 PLIT 44
15 XP(J)=V2(J) PLIT 45
CALL SCALE (XP,N2,1,0,XM,DX,1,7X) PLIT 46
DO 30 J=1,N2 PLIT 47
30 XP(J)=XP(J)*X(1) PLIT 48
50 N=1.0/TX+0.50 PLIT 49
N=N+1 PLIT 50
DO 55 J=1,N PLIT 51
XT(J)=X(1)*(J-1)*TX PLIT 52
YP(J)=10.02 PLIT 53
PL=XM*(J-1)*DX PLIT 54
IF (PL.GE,1600.0.AND,PL.LE,1650.0) PL=PL-1600.0 PLIT 55
IF (PL.GE,1500.0.AND,PL.LE,1600.0) PL=PL-1500.0 PLIT 56

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IF (PL.GE,1400.0.AND.PL.LE,1500.0) PL=PL-1400.0          PLIT 57
55 CALL NUMBER (XT(J)-0.07,10.10,0.07,PL,0.0,4HF2.0)      PLIT 58
   CALL LINE (XT,YF,N,1,13,0.07,1)                       PLIT 59
   IF (INPF.EQ,1) GO TO 2                                PLIT 60
60 INPF=1                                                PLIT 61
   IDI=IDI+1                                             PLIT 62
   XI(IDI)=X(3)                                         PLIT 63
   IF (X(3).GE,RJ/4.0.AND.ITAL.EQ,0) 35,5              PLIT 64
35 ITAL=1                                               PLIT 65
   IF (IKNM.EQ,0) CALL SYMBOL (RJ/2.0-0.6,-0.40,0.14,10HRANGE (KM),0, PLIT 66
10,10)                                                  PLIT 67
   IF (IKNM.GT,0) CALL SYMBOL (R /2.0-0.6,-0.40,0.14,10HRANGE (NM),0, PLIT 68
10,10)                                                  PLIT 69
   CALL SYMBOL (RJ/2.0=4.8,10.20,0.14,STITLE,0.0,80)    PLIT 70
   GO TO 5                                              PLIT 71
2 DO 6 I=1,N2                                           PLIT 72
  Y(I)=10.0*(1.0-(Z2(I)/ZMAX)) SIF(Y(I).LT,0.0) Y(I)=0.0 PLIT 73
  XL(I)=X(3)                                           PLIT 74
6 CALL NUMBER (X(2)*X(1),Y(I),0.07,Z2(I),0.0,4HF4.0)    PLIT 75
  CALL LINE (XL,Y,N2,1,3,0.07,1)                       PLIT 76
  CALL LINE (XP,Y,N2,1,1,0.07,1)                       PLIT 77
  CALL NUMBER (X(3)=0.30,=0.25,0.105,X(4),0.0,4HF4.0)  PLIT 78
  IDP=IDP+1                                             PLIT 79
  ZDEPTH(IDP)=Y(N2)                                    PLIT 80
  XRANGE (IDP)=X(3)                                    PLIT 81
  IF (X(3).GE,RJ/4.0.AND.ITAL.EQ,0) 45,5              PLIT 82
45 ITAL=1                                               PLIT 83
   IF (IKNM.EQ,0) CALL SYMBOL (RJ/2.0-0.6,-0.40,0.14,10HRANGE (KM),0, PLIT 84
10,10)                                                  PLIT 85
   IF (IKNM.GT,0) CALL SYMBOL (RJ/2.0-0.6,-0.40,0.14,10HRANGE (NM),0, PLIT 86
10,10)                                                  PLIT 87
   CALL SYMBOL (RJ/2.0=0.6,10.20,0.14,STITLE,0.0,48)   PLIT 88
5 IF (IFPR.EQ,0) GO TO 130                              PLIT 89
  CALL LINE (XRANGE,ZDEPTH,IDP,1,1,0.0,0)              PLIT 90
  CALL LINE (XRANGE,YL,IDP,1,3,0,105,1)               PLIT 91
  CALL LINE (XI,YL,IDI,1,3,0,2,1)                     PLIT 92
  CALL PLOTS (0,0) S CALL PLOT (PLTL=10.0,0.0,-3) S IST=1 PLIT 93
130 RETURN                                             PLIT 94
   END                                                 PLIT 95

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S PRGFPLIT

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	IDENT	PRGFPLIT
PROGRAM LENGTH	03745	
ENTRY POINTS	02654	PRGFPLIT
BLOCK NAMES		
	PROFIL	00316
	INPUT	01442
	LIMITS	00036
	PRO	00006
	TLE	00012
	ABC	00026
EXTERNAL SYMBOLS		
	Q1010100	
	PREDICT,	
	PLTS	
	SYMBOL	
	NUMBER	
	LINE	
	BYEBYE	
	SCALE	
	PLOT	
	MAXIF	

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SUBROUTINE ADVANCE
COMMON /THIANG/ AP(100,2),BP(100,2),AL(100),RL(100),ZZERO(100),
1  HZERO(100),AA(100),BB(100),SST(100),CCT(100),NTR
COMMON /RAYS/ NRAY,TGAP(1000),ZZ(1000),SS(1000),TIME(1000),
1  NCGUNT(1000),PHASE(1000)
COMMON /INFO/ RSTART,RMAX,EMEGA,ATT,IPRAY,ITN,ITN2,ITN3,IBIG,
1  ISCH,IT1,IT2,IT3,IPEH,IFTIMS,LTRT,LTER,LTRP,LPIN,IATT
COMMON /PDEF/ PI,CTR,TWCP
COMMON /MIRORS/ JL,BRLT(200),BPST(200)
COMMON /ARC/PUNCMDB (16),INCR,NBRS,NSRS,ALIM,IFT,IFT1
DIMENSION RNEW(4),RNEW(4),ZNEW(4),ZPNEW(4)
LEGJCAL BNUP,6NLW
TANSUM(A,B)=(A+B)/(1,-A*B)
CELT(CR,T,S)=ABS(CR)*SCHT(CM[S]*(1,(T*(T+S)+S*S)/3,))
C      LOOP OVER ALL THE RAYS
DO 100 IRAY=1,NRAY      I IMIST=0      S SSR=SS(IRAY)
IF (NBRS,EQ,2500,AND,NSHS,EQ,2500) GO TO 10
NN=NCGUNT(IRAY) SM=NN/ITN SNNE=NN/ITN SNR=M*NN/ITN SM=NN/ITN SNRR=MADVA0017
10 IF (ABS(SSH),LT,ALIM,OR,NBR,GT,NBRS,OR,NSR,GT,NSRS) GO TO 100
ZR=ZZ(IRAY)      S HR=RSTART
TGR=TGAP(IRAY)
TRAY=TIME(IRAY)
NR=PHASE(IRAY)
NCTR=NCGUNT(IRAY)
DO 20 I=1,NTRI
C      FIND CORRECT LAYER
P=ZR-AL(I)-BL(I)*HR
IF (P,0001,GT,0,) GO TO 20
NTRR=I
IF (ABS(P),GT,.0001,OR,TGR,GT,-BL(I)) GO TO 30
20 CONTINUE
GO TO 80
30 CT=CCT(NTRR)
IF (IPRAY,NE,3) PRINT 666,IRAY,NTRR,ZR,RR,TGR,NCTR
ST=SST(NTRR)
Z0=ZZERO(NTRR)
C      TRANSFORM TO PRIMED COORDINATES
R0=RZERO(NTRR)
ZRP=CT*(ZR-Z0)+ST*(HR-R0)
RRP=CT*(RR-R0)+ST*(ZR-Z0)
CIS=AA(NTRR)+BB(NTRR)*ZRP
TANT=ST/AMAX1(CT,1,E=300)
TGRP=TANSUM(TANT,*TGR)
CMIS=CIS/(1,*TGRP**2)
C      CALCULATE PARABOLIC RAY PATH, ALPHA IS THE CURVATURE
ALP=AB,25*BB(NTRR)/CMIS
TA=2,*ALPHA
C      FIND INTERSECTIONS WITH UPPER AND LOWER LAYER BOUNDARIES
DO 40 I=1,2
APNTR=AP(NTRR,I)
BPNTR=BP(NTRR,I)
C=APNTR*BPNTR-RRP*ZRP
P=BPNTR*TGRP
IF (ABS(ALPHA),GT,1,E=25) GO TO 303
C      RAY PATH IS LINEAR FOR THESE STATEMENTS
CHP=-C/P
ADVA0000
ADVA0001
ADVA0002
ADVA0003
ADVA0004
ADVA0005
ADVA0006
ADVA0007
ADVA0008
ADVA0009
ADVA0010
ADVA0011
ADVA0012
ADVA0013
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ADVA0040
ADVA0041
ADVA0042
ADVA0043
ADVA0044
ADVA0045
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ADVA0048
ADVA0049
ADVA0050
ADVA0051
ADVA0052
ADVA0053
ADVA0054
ADVA0055

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K=2*J=1
RPNEW(K)=RRP+CRP
ZPNEW(K)=ZRP+TGRP+CRP
ZNEW(K)=CT*ZPNEW(K)+ST*HPNEW(K)+Z0
RNEW(K)=CT*RPNEW(K)+ST*ZPNEW(K)+R0
ZNEW(K+1)=1,E300
ZPNEW(K+1)=1,E300
RNEW(K+1)=1,E300
RPNEW(K+1)=1,E300
GO TO 40
C      SOLVE QUADRATIC EQUATION FOR PARABOLIC RAY PATH
303  DISC=P*P+4*ALPHA*C
      IF(DISC<LT,0,0) GO TO 32
      DISC=SQRT(DISC)
      DE 31 J=1,2
      K=2*J=2
      S=2*J=3
      F=P+S*DISC
      DRP=F/TA
C      ITERATION TO IMPROVE ACCURACY FOR SMALL CURVATURE RAYS
      IF(ABS(DR),LT,.1*ABS(F)) DRP=(ALPHA*((ALPHA+DRP**2-C)/P)**2-C)/P
305  RPNEW(K)=RRP+CRP
      ZPNEW(K)=ZRP+CRP+(TGRP+ALPHA*CRP)
      ZNEW(K)=CT*ZPNEW(K)+ST*RPNEW(K)+Z0
31   RNEW(K)=CT*HPNEW(K)+ST*ZPNEW(K)+R0
      GO TO 40
32   DE 33 J=1,2
      K=2*J=2
33   RNEW(K)=1,E300
40   CONTINUE
      ENLW=ABS(ZR-AL(NTRR)-BL(NTRR)*RR),LT,.01,AND,TGR,GT,-BL(NTRR)
C      SELECT CORRECT INTERSECTION AS NEXT POSITION
      IF(NTRR<EQ,1) GO TO 405
      CNUP=ABS(AL(NTRR-1)*EL(NTRR-1)*RR-ZH),LT,.01
      AND TGR,LT,-BL(NTRR-1)
      GO TO 41
405  CNUP=ABS(ZR),LT,.01,AND,TGR,LT,0,
41   ILP=IDN=1
      IF(NGT,CNUP) GO TO 411
      ILP=1
      IF(ABS(HR*RNNEW(1)),LT,ABS(RR*RNNEW(2))) IUP=2
      IF(RNEW(IUP),LT,RH,GR,RNEW(ILP),GT,HMAX) IUP=0
411  IF(NOT,HNLW) GO TO 412
      ICN=3
      IF(ABS(HR*RNNEW(3)),LT,ABS(RR*RNNEW(4))) IDN=4
      IF(RNEW(IDN),LT,RH,GR,RNEW(ICN),GT,HMAX) IDN=0
412  IF(ILP,GE,0) GO TO 414
      ILP=0
      RTRY=HMAX
      DE 413 I=1,2
      IF(RNEW(I),LT,RR,GR,RNEW(I),GT,RTRY) GO TO 413
      RTRY=RNEW(I)
      ILP=I
413  CONTINUE
414  IF(IDN,GE,0) GO TO 416
      ICN=0
ADVA0056
ADVA0057
ADVA0058
ADVA0059
ADVA0060
ADVA0061
ADVA0062
ADVA0063
ADVA0064
ADVA0065
ADVA0066
ADVA0067
ADVA0068
ADVA0069
ADVA0070
ADVA0071
ADVA0072
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ADVA0111

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RTRY=HMAX
DE 415 I=3,4
IF (HNEW(I),LT,RR,GR,HNEW(I),GT,RTRY) GO TO 415
ICN=I
RTRY=HNEW(I)
415 CONTINUE
416 IF (IDN,EQ,0) GO TO 420
IF (IUP,NE,0) GO TO 418
417 ITRY=IDN
RTRY=HNEW(IDN)
GO TO 429
418 IF (HNEW(IUP),GE,HNEW(ICN)) GO TO 417
419 ITRY=IUP
RTRY=HNEW(IUP)
GO TO 429
420 IF (IUP,EQ,0) GO TO 50
GO TO 419
429 TGRPN=TA*(RPNW(ITRY)-RHP)+TGRP
THAY=THAY+DEL(RPNW(ITRY)-RHP,TGRP,TGRPN)
TGRN=TANSUM(TGRPN,+TANT)
R=HTRY
Z=ZNEW(ITRY)
C CHECK FOR SURFACE AND BOTTOM HITS, TURNS AND TURNUNDERS
IF (TGR=IGHN,GE,0) GO TO 44
IF (TGR,GT,0) GO TO 43
NCTR=NCIR+ITN2
GO TO 44
43 NCTR=NCIR+1
44 IF (ITRY,GT,2) GO TO 45
NTRH=NTRH+1
IF (NTR,GT,0) GO TO 46
NTRH=1
SSR=SSH+SL
PHR=PHR+P
NCTR=NCIR+ITN3
TGR=TGRN
GO TO 30
45 NTR=NTRH+1
IF (NTR,LE,NTH) GO TO 46
NTR=NTH
NCTR=NCIR+ITN3
TGRAZE=TANSUM(TGRN,DL(NTR))
S=100,ABS(TGRAZE)+1,
N=S
S=S+N
IF (N,GT,199) N=199
SSR=SSH*((1,-S)+HMLT(N)+S*RLT(N+1))
PHR=PHR*((1,-S)+HPST(N)+S*RPST(N+1))
TGR=TANSUM(TGRAZE,HL(NTR))
IF (TGR,LT,-JL(NTH)) GO TO 30
46 TGR=TGRN
GO TO 30
C CALCULATE HAY INTERSECTION WITH VERTICAL BOUNDARY, RORMAX
50 IF (ABS(ST),LT,2,E=4) GO TO 60
BV=CT/ST
AV=(RMAX+R0)/ST

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ADVA0112
ADVA0113
ADVA0114
ADVA0115
ADVA0116
ADVA0117
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RAY=RRP*BV-ZRP                                ADVA0168
PHI=TGRP                                        ADVA0169
IF (ABS(ALPHA),GT,1,E-25) GO TO 501            ADVA0170
C      LINEAR RAYS                               ADVA0171
RPNEW(1)=RRP*Q/P                               ADVA0172
RPNEW(2)=1,E100                                ADVA0173
GO TO 505                                       ADVA0174
C      PARABOLIC RAYS                           ADVA0175
501  DISC=PHI*4,ALPHA*C                         ADVA0176
      IF (DISC,LT,0,) GO TO 80                 ADVA0177
      DISC=SQRT(DISC)                           ADVA0178
      S=1                                         ADVA0179
      GO 503 I=1,2                               ADVA0180
      F=PHI*DISC                                 ADVA0181
      DRP=F/TA                                    ADVA0182
      IF (ABS(F),LT,1*ABS(F)) DRP=(ALPHA*(ALPHA*DRP*2=C)/P)**2=C/P ADVA0183
      RPNEW(1)=RRP*LRP                           ADVA0184
503  S=-S                                         ADVA0185
505  GO 51 I=1,2                                  ADVA0186
      ZNEW(1)=ZRP*(RPNEW(1)-RRP)*(TGRP+ALPHA*(RPNEW(1)-RRP)) ADVA0187
51  ZNEW(1)=CT*(ZNEW(1)+ST*RPNEW(1))*Z0        ADVA0188
      I=2                                         ADVA0189
C      SELECT CORRECT INTERSECTION              ADVA0190
      IF (ABS(ZNEW(1)-ZR),LT,ABS(ZNEW(2)-ZR)) I=1 ADVA0191
      TGRPA=TA*(RPNEW(1)-RRP)*TGRP              ADVA0192
      TRAY=TRAY+DELTA*(RPNEW(1)-RRP,TGRP,TGRPA) ADVA0193
      TGRN=TAN(SUM(TGRPA,TA*TA))                 ADVA0194
C      CHECK FOR TURNERS AND TURNERS           ADVA0195
52  IF (TGRN<TGRN,GE,0,) GO TO 54              ADVA0196
      IF (TGRN,LT,0,) GO TO 53                 ADVA0197
      NCTR=NCTR+1                                ADVA0198
      GO TO 54                                   ADVA0199
53  NCTR=NCTR+1*2                                ADVA0200
54  TGRN=(TRAY)*TGRN                             ADVA0201
      IF (NTRN,LE,1) GO TO 545                 ADVA0202
C      CHECK THAT RAY IS WITHIN THE PROPER LIMITS ADVA0203
      IF (ZNEW(1),LT,AL(NTRN-1)+BL(NTRN+1)*RMAX,1) GO TO 80 ADVA0204
545  IF (ZNEW(1),GT,AL(NTRN)+HI(NTRN)*RMAX,1) GO TO 80 ADVA0205
C      THROW IN VOLUME ATTENUATION              ADVA0206
      IF (IATT,NE,0) SSR=SSR*10,**(0,0001*ATT*(TRAY*TIME([RAY])/SQRT(CIS)) ADVA0207
55  SS([RAY])=SSR                                ADVA0208
      Z([RAY])=ZNEW(1)                           ADVA0209
      TIME([RAY])=TRAY                            ADVA0210
      COUNT([RAY])=NCTR                          ADVA0211
      PHASE([RAY])=PHR                           ADVA0212
      GO TO 100                                   ADVA0213
60  I=1:60                                       ADVA0214
C      WHEN SMALL OR ZERO HORIZONTAL GRADIENTS, EQUATION FOR SECTION ADVA0215
C      50 IS SINGULAR; THIS IS AN ITERATIVE SOLUTION FOR SUCH A CASE ADVA0216
C      GUESS VALUE FOR ITERATION                ADVA0217
      ZN=ZR+IGH*(RMAX*HR)                        ADVA0218
66  DO 67 I=1,7                                   ADVA0219
      RPN=C*(RMAX-R0)+ST*(ZN+Z0)                ADVA0220
      DRP=RPN-RRP                                ADVA0221
      TGRPA=TGRP*ALPHA*[HR]                     ADVA0222
      ZP=DRP*TGRPA                               ADVA0223

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	ZPNW=ZRP*DZP	ADVA0224
	ZNW2=CT*ZPNW-ST*RPW*ZC	ADVA0225
	D=ABS(ZNW2-ZN)	ADVA0226
	IF (I,EO,3) DD=D	ADVA0227
47	ZNW=ZNW2	ADVA0228
C	CHECK FOR CONVERGENCE	ADVA0229
	IF (D,LT,1,01) GO TO 6E	ADVA0230
	IF (D,LT,1,5*DD) GO TO 6E	ADVA0231
	IMIST=53	ADVA0232
	GO TO 8U	ADVA0233
68	RPNEW(1)=RPNEW(2)*RPW	ADVA0234
	GO TO 5U5	ADVA0235
C	PRINT ERROR MESSAGE	ADVA0236
80	SJR=0,	ADVA0237
	PRINT 81,IRAY,IMIST,RR,ZR,TGR	ADVA0238
	PRINT 82, RMAX,ZNEW(1),TGRA	ADVA0239
666	FORMAT('RAY',I5,' IN LAYER',I5,' Z=',F10,2,' R=',F10,2,' TGR=',F10,2,' NCTR=',I6)	ADVA0240
1	10,5,' TERMINATED',5X,' IMIST',12,5X,' STARTING RANGE',F12,2,5X,' RAY DEPTH',F12,2,5X,' STARTING TANGENT',F12,6)	ADVA0241
81	FORMAT('RAY',I5,' TERMINATED',5X,' IMIST',12,5X,' STARTING RANGE',F12,2,5X,' RAY DEPTH',F12,2,5X,' STARTING TANGENT',F12,6)	ADVA0242
82	FORMAT('MAXIMUM RANGE',F12,2,5X,' NEW RAY DEPTH',F10,2,5X,' FIN',F12,6)	ADVA0243
	GO TO 55	ADVA0244
100	CONTINUE	ADVA0245
	RETURN	ADVA0246
	END	ADVA0247

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DS ADVANCE

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ED 0

	IDENT	ADVANCE
PROGRAM LENGTH	01720	
ENTRY POINTS	ADVANCE	00125
BLOCK NAMES		
TRIANG	02261	
RAYS	13561	
INFG	00024	
PDEF	00003	
MIRRORS	00621	
ABC	00026	
EXTERNAL SYMBOLS		
THEAD,		
QJC10140		
QJC00040		
Q1C10100		
Q1C03100		
Q2C07111		
Q80DICT,		
SURT		
MAX1P		
STM,		
ONSINGL,		

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	SUBROUTINE CHANNEL(ZR,Y,ZT,ZTU)	CHAN0000
	COMMON /VBLPRF/ N,Z(100),C(100)	CHAN0001
	CALL VBLCALC	CHAN0002
20	DO 25 I=1,N	CHAN0003
	IF(ZR,GT,Z(I)) GO TO 25	CHAN0004
	I=I	CHAN0005
	F=(ZR-Z(I+1))/(Z(I)-Z(I+1))	CHAN0006
	CH=SQRT(1+(Y+1)*(F+C(I))*(1-F)+C(I+1))	CHAN0007
	GO TO 30	CHAN0008
25	CONTINUE	CHAN0009
	ZTU=Z(I)-1.	CHAN0010
	RETURN	CHAN0011
30	I=I+1	CHAN0012
31	IF(C(I),GT,CH) GO TO 35	CHAN0013
	I=I+1	CHAN0014
	IF(I,N,0) GO TO 31	CHAN0015
	ZT=0.	CHAN0016
	GO TO 40	CHAN0017
35	F=(CH-C(I+1))/(C(I)-C(I+1))	CHAN0018
	ZT=F*Z(I+1)+(1-F)*Z(I+1)	CHAN0019
40	I=I	CHAN0020
41	IF(C(I),GT,CH) GO TO 45	CHAN0021
	I=I+1	CHAN0022
	IF(I,N,0) GO TO 41	CHAN0023
	ZTU=Z(I)	CHAN0024
	RETURN	CHAN0025
45	F=(CH-C(I+1))/(C(I)-C(I+1))	CHAN0026
	ZTU=F*Z(I+1)+(1-F)*Z(I+1)	CHAN0027
	RETURN	CHAN0028
	ENTRY RCALC	CHAN0029
	IF(ZT,GT,.9) GO TO 50	CHAN0030
	RCYCLE=1.53	CHAN0031
	RETURN	CHAN0032
50	I=1	CHAN0033
	RCYCLE=0.	CHAN0034
	TG2=0.	CHAN0035
	DO 60 I=1,N	CHAN0036
	IF(Z(I),GT,ZT,LT,ZTU) GO TO 55	CHAN0037
	IF(I,N,0) GO TO 50	CHAN0038
	RCYCLE=RCYCLE+(ZTU-Z(I+1))/(.5+TG1)	CHAN0039
	RETURN	CHAN0040
55	TG1=SQRT((CH/C(I))*2-1.)	CHAN0041
	IF(I,EQ,1) GO TO 56	CHAN0042
	IF(I,N,0) GO TO 56	CHAN0043
	DR=(Z(I)-Z(I+1))/(.5+(TG1+TG2))	CHAN0044
	GO TO 57	CHAN0045
56	DR=(Z(I)-ZT)/(.5+TG1)	CHAN0046
57	RCYCLE=RCYCLE+DR	CHAN0047
59	TG2=TG1	CHAN0048
	I=I+1	CHAN0049
60	CONTINUE	CHAN0050
	RETURN	CHAN0051
	ENTRY WUENS	CHAN0052
	IF(RCYCLE,GT,1.E100) GO TO 71	CHAN0053
	I=I	CHAN0054
65	IF(Z(I),GT,ZR) GO TO 70	CHAN0055

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IF(Z(IN+1),GT,ZR) GO TO 75
IN=IN+1
IF(IN,GE,N) GO TO 71
GO TO 69
70 IF(Z(IN+1),LE,ZR) GO TO 74
IN=IN+1
IF(IN,GE,3) GO TO 65
71 T=0
RETURN
74 IN=IN+1
75 V=C(IN)*(C(IN+1)-C(IN))*(ZR-Z(IN))/(Z(IN+1)-Z(IN))
T=T+(SURT((CM/V)**2-1))*RCYCLE
RETURN
END
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CHAN0096
CHAN0097
CHAN0098
CHAN0099
CHAN0040
CHAN0061
CHAN0062
CHAN0063
CHAN0064
CHAN0065
CHAN0066
CHAN0067
CHAN0068
CHAN0069
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S CHANNEL

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ED 0

	IDENT	CHANNEL
PROGRAM LENGTH	00906	
ENTRY POINTS	00003	CHANNEL
	00191	RCALC
	00297	WDENS
BLOCK NAMES		
	00311	VELPRF
EXTERNAL SYMBOLS		
		080DICT,
		VELCALC
		SORTF

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	SUBROUTINE VELCALC	VELC	1
	COMMON /INFO/ DDDUC,RMAX,DDDCDD(18)	VELC	2
	COMMON /VELPRF/ N,Z(100),C(100)	VELC	3
	COMMON /THIANG/ AP(100,2),BP(100,2),AL(100),BL(100),ZZERO(100),	VELC	4
1	RZERU(100),AA(100),RW(100),SST(100),CCT(100),NTRI	VELC	5
	COMMON/ABQ/PLNCHD(16),INCR,NBRS,NSRS,ALIM,IFT,IFT1	VELC	6
	DATA (RGLD=-1,EJ00),(IFT2=0),(IBH=0)	VELC	7
	IF (IFT1,EO,IFT2) GO TO 13	VELC	8
	IBH=0	VELC	9
	IFT2=IFT1	VELC	10
13	IF (IFT1,EO,0,GR,IBH,EC,1) GO TO 3	VELC	11
	RGLD=-1,EJ00	VELC	12
	IBH=1	VELC	13
3	IF (ABS(RMAX-RGLD),LT,1,) GO TO 20	VELC	14
	RGLD=RMAX	VELC	15
	N=NTRI+1	VELC	16
	DE 10 :=1,N	VELC	17
	IF (I,EO,1) GO TO 1	VELC	18
	J=I+1	VELC	19
	ZZ=AL(J)+BL(J)+RMAX	VELC	20
	GO TO 2	VELC	21
1	J=1	VELC	22
	ZZ=0,	VELC	23
2	ZP=CCT(J)*(ZZ-ZZENE(J))+SST(J)*(RMAX-RZERU(J))	VELC	24
	C(I)=1./SQRT(AA(J)+BB(J)+ZP)	VELC	25
10	Z(I)=ZZ	VELC	26
20	RETLRN	VELC	27
	END	VELC	28

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JS VELCALC

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ED 0

	IDENT	VELCALC
PROGRAM LENGTH	00132	
ENTRY POINTS	00006	
BLOCK NAMES		
INFO	00024	
VELPRF	00311	
YPIANG	02261	
ABC	00026	
EXTERNAL SYMBOLS		
QBDDICT,		
SQRTF		

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SUBROUTINE INTENSTY
C      JUNE 14, 1971 LLOYDS MIRROR ADDED FOR ALL RECEIVERS AND TYPES
C      UNUSED SWITCH IF TMS IS NOW LLMR, 0 FOR NO LLOYDS MIRROR, AND
C      NON-ZERO FOR LLOYDS MIRROR. THIS SWITCH IS THE COLUMN AFTER
C      IPER ON THE INPUT CARDS
      6/15/71 RECEIVERS BELOW BOTTOM FIXED
COMMON /LOUDNESS/ LNRG, RCD(100), TYPEISC(100), TYPEIRP(100),
1  TYPEII(100), TYPEIII(100)
COMMON /TLE/STITLE (18)
COMMON /RAYS/ NRAY, IGAM(1000), ZZ(1000), SS(1000), TIME(1000),
1  NCOUNT(1000), PHASE(1000)
COMMON /INFO/ RSTART, RMAX, OMEGA, ATT, IPRAY, ITN, ITN2, ITN3, IBIG,
1  ISCP, IT1, IT2, IT3, IPER, LLMR, LTRT, LTER, LTRP, LFIN, IATT
COMMON /PIDEF/ PI, DTR, TWOPI
COMMON /VELPRF/ MN, Z(100), C(100)
COMMON /TMPSTR/ DUD(102)
DIMENSION QUAD(100), IMP(100), SINT(100,4), SSL(100), QUS(100), TYP(10
10)
EQUIVALENCE (QUAD,DDD)
COMMON/ABC/PUNCHDU (10), INCR, NBR, NSRS, ALIM, IFT, IFT1
DATA (IENT=0), (IFT2=0), (IBH=0), (IMP=0)(0)
SEC(T)=FVA*SQRT(1.*T)
IF (IFT1.EQ.0) GO TO 2 $ IBH=0 $ IFT2=IFT1
2 IF (IFT1.EQ.0.OR.IBH.EQ.1) GO TO 3 $ IENT=0 $ IBH=1
3 FVA=1.
IF (IATT.EQ.0.AND.ATT.NE.0.) FVA=10.**(-.0001*ATT*RMAX)
CALL VELCALG SWAVEL=TWOPI*C(1)/OMEGA $ AK=TWOPI/WAVEL $ FLM=1.
DO 5 I=1, LNRC
5  TYPEISC(I)=TYPEIRP(I)*TYPEII(I)*TYPEIII(I)*QUAD(I)*0.
IF (IT1.EQ.0.AND.IT2.EQ.0) GO TO 60
SW=0.
SDZ=0.
DO 10 I=2, NRAY
W=AMIN1(SS(I), SS(I-1))
SDZ=SDZ+W*ABS(ZZ(I)-ZZ(I-1))
10 SW=SW+W
DZBAR=SDZ/SW
IF (DZBAR.LT.WAVEL) DZBAR=WAVEL
CALL CHANNEL(1., 1000., ZS, ZB)
DZM=ZB/SQRT(FLOAT(NRAY))
IF (DZBAR.GT.DZM) DZBAR=DZM
IF (IT1.EQ.0) GO TO 25
DO 20 I=1, NRAY
N=NCOUNT(I)
M=N/ITN
NTO=N-M*ITN
N=M/ITN
NSR=M-N*ITN
M=N/ITN
NTU=N-M*ITN
NBR=M
IF (I.EQ.1) GO TO 19
NOTUO=IABS(NTO-NTUO)*IABS(NTU-NTUO)
NDSBR=IABS(NSR-NSRO)*IABS(NBR-NBRO)
ID=NDSBR
ID=ID*NOTUO
INTE 1
INTE 2
INTE 3
INTE 4
INTE 5
INTE 6
INTE 7
INTE 8
INTE 9
INTE 10
INTE 11
INTE 12
INTE 13
INTE 14
INTE 15
INTE 16
INTE 17
INTE 18
INTE 19
INTE 20
INTE 21
INTE 22
INTE 23
INTE 24
INTE 25
INTE 26
INTE 27
INTE 28
INTE 29
INTE 30
INTE 31
INTE 32
INTE 33
INTE 34
INTE 35
INTE 36
INTE 37
INTE 38
INTE 39
INTE 40
INTE 41
INTE 42
INTE 43
INTE 44
INTE 45
INTE 46
INTE 47
INTE 48
INTE 49
INTE 50
INTE 51
INTE 52
INTE 53
INTE 54
INTE 55
INTE 56

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IF (IU.GT.3) ID=3
W=AMI*(SS(I),SS(I-1))
IF (W.LE.ALIM.OR.NBR.GT.NBRS.OR.NSR.GT.NSR5) ID=3
NCOUNT(I)=NCOUNT(I)+ID*IBIG
19 NSRO=NSR
   NGR0=NGR
   NTU0=NTU
   NTO0=NTO
20 CONTINUE      S DO 21 I=1, LNRC
   SS(I)=0.0
   QUS(I)=0.0
   TYP5(I)=0.0
21 IMP(I)=0      S IPR=0
   INW=NCOUNT(2)/IBIG
   DC 30 I=2, NRAY
   NCOUNT(I)=NCOUNT(I)+INW*IBIG
   INXT=NCOUNT(I+1)/IBIG      S IF (I*2.LE.NRAY) INXTT=NCOUNT(I+2)/IBIG
   IF (INW.GE.2) GO TO 29
   IQ1=0      S IQ2=0      S IQ3=0
   ZI=ZZ(I-1)
   S1=SEC(TGAM(I-1))*SS(I-1)
   OS=SEC(TGAM(I))*SS(I)-S1
   T1=TIME(I-1)
   DT=TIME(I)-T1
   TG1=TGAM(I-1)
   UTG=TGAM(I)-TG1
   DZ=ZZ(I)-Z1      S DO 25 J=1, LNRC      S IQ1=0      S IQ2=0      S IQ3=0
   ZR=ZCD(J)      S IF (ZR.GT.38) GO TO 25
   F=(ZR-Z1)/DZ      S DZ1=ZZ(I+1)-ZZ(I)      S F1=(ZR-ZZ(I))/DZ1
   IF (F.LT.=0.5.OR.F.GT.1.5) GO TO 25
   IF (INW.EQ.0.AND.F.LE.1.0.AND.F.GE.0..AND.IMP(J).EQ.0) 23,24
23 IQ1=1
   GO TO 26
24 IF (F.GT.1.0.AND.INW.EQ.0 .AND.INXT.NE.INW.AND.IMP(J).EQ.0) 31,32
31 IQ2=1
   GO TO 26
32 IF (F.LT.0.0.AND.IPR.NE.INW.AND.INW.EQ.0) 33,34
33 IQ3=1
   GO TO 26
34 IQ1=0      S IQ2=0      S IQ3=0
   GO TO 25
26 SL=(S1+F*OS)/(RMAX*ABS(DZ))
   IF (SL.LE.0.0) GO TO 25      S IF (ABS(DZ).LT.0.001) GO TO 25
   TG=TG1+F*DTG      S IF (IQ1.EQ.1) IM(J)=1
   TH=DTG*ATANF(TG)      S IF (INW.GE.1.AND.INXT.GE.1) GO TO 25
   IF (LLMR.NE.0) FLM=2.*SIN(ZR*AK*TG/SQRT(1.+TG**2))**
   T=T1+F*DT
   IF (IQ1.EQ.1.AND.SINT(J,1).EQ.0.0) SINT(J,4)=FLM
   IF (IQ1.EQ.1.AND.SINT(J,1).EQ.0.0) SINT(J,1)=SL
   IF (IQ2.EQ.1.AND.SINT(J,1).EQ.0.0.AND.SINT(J,2).EQ.0.0.AND.SINT(J,
13).EQ.0.0) SINT(J,4)=FLM
   IF (IQ2.EQ.1.AND.SINT(J,1).EQ.0.0.AND.SINT(J,2).EQ.0.0.AND.SINT(J,
13).EQ.0.0) SINT(J,2)=SL
   IF (IQ3.EQ.1.AND.SINT(J,1).EQ.0.0.AND.SINT(J,2).EQ.0.0.AND.SINT(J,
13).EQ.0.0) SINT(J,4)=FLM
   IF (IQ3.EQ.1.AND.SINT(J,1).EQ.0.0.AND.SINT(J,2).EQ.0.0.AND.SINT(J,

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13).EQ.0.0) SINT(J,3)=SL
IF(IPER.EQ.0) GO TO 23
IF (IENT.EQ.0) WRITE(LTER,1099),STITLE
IF (IENT.EQ.0) WRITE( 49,1879),STITLE
1879 FORMAT (10A8)
1399 FORMAT (1M1.00 EIGENRAY SET *10A8)
IF (IENT.EQ.0) WRITE(LTER,499)
PR=10.0*ALOG10(SL)
N=NCOUNT(I)
IENT=1
M=N/ITN
NTO=N-4*ITN
NM=ITN
NSR=M-4*ITN
MN=ITN
NTU=N-4*ITN
NBR=M
IF (IQ3.EQ.1) IQUAL=3
IF (IQ2.EQ.1) IQUAL=2
IF (IQ1.EQ.1) IQUAL=1
IREM=1
IF (IQ3.EQ.1.AND.SINT(J,3).NE.0.0) IREM=2H0
IF (SINT(J,3).NE.0.0.AND.IQ1.EQ.1) IREM=2H00
WRITE(LTER,900) I,NBR,NTU,NSR,NTO,RMAX,ZR,TH,T,PR,IQUAL,IREM
RMKM=RMAX/1000.0
WRITE(49,1878) I,NBR,NTU,NSR,NTO,RMKM,ZR,TH,T,PR
1878 FORMAT (5I5,F10.4,F10.4,F10.4,F15.5,F10.1)
899 FORMAT(=ONRAY NBR NTU NSR NTO,10X,=RANGE DEPTH THETA
1 TIME=, 9X,=SL(DB),5X,=IQUAL,4X,=REM=)
900 FORMAT(5I5,F15.0,F10.0,F10.4,F13.5,F10.1,6X,15,5X,A2)
22 FLM=SINT(J,4)
IF (SINT(J,1).NE.0.1) SL=SINT(J,1)
IF (SINT(J,2).NE.0.4) D=SINT(J,1).EQ.0.0) SL=SINT(J,2)
IF (SINT(J,3).NE.0.4) D=SINT(J,1).EQ.0.0) SL=SINT(J,3)
IF (SINT(J,3).EQ.0.0) GO TO 27
IF (IQ1.EQ.1.AND.SINT(J,1).NE.0.0) 71,72
71 TYPEIRP(J)=SSL(J)
IF (ISCP.EQ.0) GO TO 27
TYPEISC(J)=TYPSP(J)
QUAD(J)=QUS(J)
GO TO 27
72 SSL(J)=TYPEIRP(J)
27 TYPEIRP(J)=TYPEIRP(J)+SL*FLM
IF (ISCP.EQ.0) GO TO 23
PR=SQRT(SL)
P=OMEGA*T+PHASE(I)
IF (IQ3.EQ.1.AND.IQ1.EQ.0) QUS(J)=QUAD(J)
QUAD(J)=QUAD(J)+PR*SIN(P)
IF (IQ3.EQ.1.AND.IQ1.EQ.0) TYPSP(J)=TYPEISC(J)
TYPEISC(J)=TYPEISC(J)+PR*COS(P)
25 IF (INX.GE.1.OR.IPR.NE.INW.AND.INW.NE.INAT) IHP(J)=0
29 IPR=INW
INW=INXT
IF (INW.EQ.0.OR.INW.LT.1.AND.INXT.LT.1) GO TO 30
DO 28 LL=1,LNRC
SINT(LL,1)=0.0
INTE 113
INTE 114
INTE 115
INTE 116
INTE 117
INTE 118
INTE 119
INTE 120
INTE 121
INTE 122
INTE 123
INTE 124
INTE 125
INTE 126
INTE 127
INTE 128
INTE 129
INTE 130
INTE 131
INTE 132
INTE 133
INTE 134
INTE 135
INTE 136
INTE 137
INTE 138
INTE 139
INTE 140
INTE 141
INTE 142
INTE 143
INTE 144
INTE 145
INTE 146
INTE 147
INTE 148
INTE 149
INTE 150
INTE 151
INTE 152
INTE 153
INTE 154
INTE 155
INTE 156
INTE 157
INTE 158
INTE 159
INTE 160
INTE 161
INTE 162
INTE 163
INTE 164
INTE 165
INTE 166
INTE 167
INTE 168

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	SINT(LL,2)=0.0	INTE 169
	SINT(LL,3)=0.0	INTE 170
	SINT(LL,4)=0.0	INTE 171
28	CONTINJE	INTE 172
30	CONTINJE	INTE 173
35	DO 37 I=1, LNRC	INTE 174
	TYPEISC(I)=TYPEISC(I)**2+QUAD(I)**2	INTE 175
37	QUAD(I)=EXP(-RCD(I)/DZBAR)	INTE 176
	IF(IT2.EQ.0) GO TO 60	INTE 177
	F=2.*RMAX*DZBAR	INTE 178
	EB=EXP(-ZB/DZBAR)	INTE 179
	DO 50 I=1, NRAY	INTE 180
	IF (ABS(SS(I)).LT.ALEM) GO TO 50	INTE 181
	EZ=EXP(-ZZ(I)/DZBAR)	INTE 182
	SL=SEC(TGAM(I)).*BS(I)/F	INTE 183
	SGK=TGAM(I)*AK/SQRT(1.+TGAM(I)**2)	INTE 184
	SL=SL/(1.-S*(EB/EZ+E4))	INTE 185
	DO 40 J=1, LNRC	INTE 186
	IF(RCD(J).GT.ZB) GO TO 50	INTE 187
	ER=QUAD(J)	INTE 188
	IF(LLMR.NE.0) FLM=2.*SIN(RCD(J)*SGK)**2	INTE 189
	IF(ER.GT.EZ) GO TO 79	INTE 190
	S=SL*ER/EZ	INTE 191
	GO TO 60	INTE 192
39	S=SL*EZ/ER	INTE 193
40	TYPEII(J)=TYPEII(J)+S*FLM	INTE 194
50	CONTINJE	INTE 195
60	IF(IT3.EQ.0) RETURN	INTE 196
	DO 70 I=1, NRAY	INTE 197
	CALL CHANNEL(ZZ(I), TGAM(I), ZTO, ZTU)	INTE 198
	CALL RCALC	INTE 199
	IF(LLMR.NE.0) CALL WDENS(ZZ(I), CTRR)	INTE 200
	SL=FVA*SS(I)/RMAX	INTE 201
	DO 65 J=1, LNRC	INTE 202
	IF(RCD(J).GT.ZTU) GO TO 70	INTE 203
	IF(RCD(J).LT.ZTO) GO TO 65	INTE 204
	CALL WJENS(RCD(J), S)	INTE 205
	IF(LLMR.EQ.0) GO TO 64	INTE 206
	TG=TGAM(I)*CTRR/S	INTE 207
	FLM=2.*SIN(AK*RCD(J)*TG/SQRT(1.+TG**2))**2	INTE 208
	S=S*FLM	INTE 209
64	TYPEIII(J)=TYPEIII(J)+S*SL	INTE 210
65	CONTINJE	INTE 211
70	CONTINJE	INTE 212
	RETURN	INTE 213
	END	INTE 214

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5.40S INTENSTY

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ED 0

		IDENT	INTENSTY
PROGRAM LENGTH		Q3451	
ENTRY POINTS	INTENSTY	Q1540	
BLOCK NAMES			
	LOUDNESS	00765	
	TLE	00012	
	RAVS	13561	
	INPO	00024	
	PIDEF	00003	
	VELPRF	00311	
	TMPSTR	00266	
	ABC	00026	
EXTERNAL SYMBOLS			
	Q2007111		
	TMEND.		
	Q800ICT.		
	VELCALC		
	CHANNEL		
	RCALC		
	WDENS		
	ALOG10		
	SORTF		
	SINF		
	MINIF		
	EXPF		
	COSF		
	ATANF		
	STM.		
	SLO.		
	QNSINGL.		

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SUBROUTINE ITNPRINT (NINT)
COMMON /INFO/ RSTART,RMAX,PMEGA,ATT,IPRAY,ITN,ITN2,ITNS,IBIG,
1  ISCP,IT1,IT2,IT3,IPER,IFTIMS,LTRT,LTER,LTRP,LPIN,IATT
COMMON /TMPATH/ DLE(182)
COMMON /LIM/ J/ R1 (10), CR (10), R2 (10)
COMMON /ABC/PUNCHD (16),INCR,NBRS,NSRS,ALIM,IFT,IFT1
COMMON /TLE/STITLE (10)
DATA (INCR=1)
DIMENSION LINE(90),DE(4),FMT(6),AAL(400),IS(4),ABDDD(182)
EQUIVALENCE (LINE,CDC)
COMMON /LBOUNDNESS/ LNRC,RCD(100),AL(100,4)
EQUIVALENCE (AL,AAL)
DATA (HA6=3HA7,),(HFC=5HF7,1,),(B=1M),(IS=1MS,1MR,1H2,1H3)
DATA (FMT(1)=6H(F8,3),(FMT(6)=8H6X,90A1))
DIMENSION ITT(4)
EQUIVALENCE (ISCP,ITT)
DATA (IENT=0),(IFT2=0),(IBH=0)
IF (IFT1.EQ.0,IFT2) GO TO 3 $ IBH=0 $ IFT2=IFT1
3 IF (IFT1.EQ.0,CR,LEM,EC,1) GO TO 2 $ INCR=1 $ IENT=0 $ HA6=3HA7,
HF6=5HF7,1, $ B=1M $ IS(1)=1MS $ IS(2)=1MR $ IS(3)=1H2 $ IS(4)=1H3
FMT(1)=6H(F8,3, $ FMT(6)=8H6X,90A1) $ IBH=1
2 IF (NINT,EW,1) GO TO 40 $ AM=0, $ DB=10 $ I=1,400
IF (AAL(I),GT,AM) A=AAL(I)
10 CONTINUE $ DBM=10, $ AINT(ALEG10(AM)) $ DBL=DBM*90,
RK=001*HRMAX
ISK=0
IF (IENT,EQ,0) WRITE (39,1) STITLE
IF (LNRC,GE,35) ISK=1
WRITE (39,900),ISK,RK,CBL,CBM
DE 30 J=1,LNRC
DE 15 J=1,90
15 LINE(J)=1M
DE 25 J=1,4
IF (AL(I,J),LT,ALIM) GO TO 20
FMT(J+1)=HF6
DB(J)=10, $ ALEG10(AL(I,J))
IL=(DB(J)=DBL)*1,3
IF (IL,LE,0,OR,IL,GT,90) GO TO 25
LINE(IL)=IS(J)
GO TO 25
20 FMT(J+1)=HA6
DB(J)=B
25 CONTINUE
30 WRITE (39,FMT) RCD(I),DB,LINE $ IENT=1
RETURN
40 IF (IENT,NE,0) GO TO 41
WRITE(39,1),STITLE
1 FERMAT (1M,10AB)
WRITE (36,920),STITLE,LNRC,ITT(1),ITT(2),ITT(3),ITT(4)
IF (IENT,EQ,0) WRITE (35,941) STITLE,(RCD(J),J=1,19)
941 FERMAT (10AB,/,10F8,3)
IF (IENT,EQ,0,AND,ITT(1),GT,0) WRITE (45,912) ,STITLE
912 FERMAT ( ' COHERENT PHASE VALLES',/,10AB)
IF (IENT,EQ,0,AND,ITT(2),GT,0) WRITE (46,913),STITLE
913 FERMAT ( ' RANDOM PHASE VALLES',/,10AB)
IF (IENT,EQ,0,AND,ITT(3),GT,0) WRITE (47,914),STITLE

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914	FORMAT (TYPE 2 VALLES,/,10A8)	ITNP	97
	IF (IEN1,EO,3,AND,IT1(4),GT,0) WRITE (48,915) ,STITLE	ITNP	98
915	FORMAT (TYPE 3 VALLES,/,10A8)	ITNP	99
	IEN1=1	ITNP	100
	WRITE(39,905) (MCD(1),I=1,LNRC)	ITNP	101
	WRITE (39,908)	ITNP	102
900	FORMAT(11=INTENSITIES AT*,F10,3,* KM, */=0 DEPTH ISC IRP	ITNP	103
	1 I1 I11 *,F6,1,84X,F6,1)	ITNP	104
905	FORMAT(*OBSERVED INTENSITY VS RANGE*,15X,*AT DEPTHS*/	ITNP	105
	1 *O R(KM) TYPE *,13F9,3,/,19X,13F9,3)	ITNP	106
908	FORMAT(1X)	ITNP	107
41	RK=RMAX/1000,	ITNP	108
	IP=0	ITNP	109
	DE 50 I=1,4	ITNP	110
	IF (IT1(1),EQ,0) GO TO 50	ITNP	111
	DE 45 J=1,LNRC	ITNP	112
	DLU(J)= 10.*ALEG10(AMAX1(ALIM ,AL(J,I)))	ITNP	113
	PUNCHDB(INCR)=ABS(DCD(J))	ITNP	114
	ABDDD(J)=PUNCHDB(INCR)	ITNP	115
	INCR=INCR+1	ITNP	116
	IF (INCR,LT,17) GO TO 45	ITNP	117
	INCR=1	ITNP	118
	WRITE (36,909) (PUNCH-DE(I),I=1,16)	ITNP	119
45	CONTINUE	ITNP	120
	IF (I,EO,1,AND,IT1(1),GT,0) WRITE (45,911) (ABDDD(J),J=1,19)	ITNP	121
	IF (I,EO,2,AND,IT1(2),GT,0) WRITE (46,911) (ABDDD(J),J=1,19)	ITNP	122
	IF (I,EO,3,AND,IT1(3),GT,0) WRITE (47,911) (ABDDD(J),J=1,19)	ITNP	123
	IF (I,EO,4,AND,IT1(4),GT,0) WRITE (48,911) (ABDDD(J),J=1,19)	ITNP	124
	IF (IP,EO,0) GO TO 46	ITNP	125
	WRITE (39,906) IS(1),(DCD(J),J=1,LNRC)	ITNP	126
906	FORMAT(16X,A1,2X,13F9,1,/,19X,13F9,1)	ITNP	127
	GO TO 50	ITNP	128
46	IP=1	ITNP	129
	WRITE(39,907) RK,IS(1),(DCD(J),J=1,LNRC)	ITNP	130
907	FORMAT(19,3,7X,A1,2X,13F9,1,/,19X,13F9,1)	ITNP	131
	50 CONTINUE	ITNP	132
909	FORMAT (10F5,1)	ITNP	133
911	FORMAT (10F8,3)	ITNP	134
920	FORMAT (10A8,/,515)	ITNP	135
	RETURN	ITNP	136
	END	ITNP	137

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S ITPRINT

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ED 0

	ICENT	ITPRINT
PROGRAM LENGTH	01980	
ENTRY POINTS	00911	
BLOCK NAMES		
INFO	00024	
TMPSTR	00266	
LIMITS	00026	
ABC	00026	
TLE	00012	
LOUDNESS	00765	
EXTERNAL SYMBOLS		
TMEND,		
D1Q1010U		
Q0CCICT,		
AL0G10		
MAXIF		
STW,		
SL0,		
QNSINGL,		

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SUBROUTINE IVSRPL6T(ITF)
COMMON /INFU/ RSTART,RMAX,OMEGA,ATT,IPRAY,ITN,ITN2,ITN3,IBIG,
1  ISCH,IT1,IT2,IT3,IPER,IFTIMS,LTRT,LTER,LTRP,LPIN,IATT
COMMON /LOUDNESS/ LNRC,MCD(100),AL(100,4)
COMMON /TMPSTH/ DDC(102)
COMMON /TLE/STITLE(10)
COMMON /ABC/PLACHDB(16),INCR,NBRS,NSRS,ALIM,IFT,IFT1
DATA (IENT=0),(IFT2=0),(IBH=0)
DIMENSION LINE(100)
EQUIVALENCE (LINE,DDC)
IF (IFT1.EQ.0,IFT2) GO TO 13
IBH=0
IFT2=IFT1
13 IF (IFT1.EQ.0,PH,IBH,EQ.1) GO TO 3
IENT=0
IBH=1
3 IF (IENT.NE.0) GO TO 10
WRITE (38,1),STITLE
1 FERMAT (1H1,1JAB)
IENT=1
IT=ITP+1
IF (IT.EQ.5) IT=1
CG 2 I=1,11
2 LINE(I)=-170+10*I
AM=ND(LNRC,9)
WRITE (38,900) (MCD(I),I,I=1,A)
WRITE (38,901) (LINE(I),I=1,11)
CG 25 I=1,11
25 LINE(I)=1H*
WRITE (38,903) (LINE(I),I=1,11)
900 FERMAT(00,15A,0RECEIVED INTENSITY VS RANGE/0RECEIVER AT DEPTH P
1LGTS AS// (F10,3,I9))
901 FERMAT(00 R(KM)0,5X,11I10)
903 FERMAT (14X,11(9X,A1))
10 IF (IT,LE,0,OR,IT,GT,4) RETURN
CG 15 I=1,105
15 LINE(I)=48
CG 20 I=1,N
DB=10,ALOG10(AMAX1(1,E-25,AL(I,IT)))
IP=161,0+DB
IF (IP,LE,0,OR,IP,GT,105) GO TO 20
LINE(IP)=I
20 CONTINUE
RK=RMAX/1000,
WRITE(38,902) RK,LINE
902 FERMAT(9,3,14X,105H1)
RETURN
END
IVSR 1
IVSR 2
IVSR 3
IVSR 4
IVSR 5
IVSR 6
IVSR 7
IVSR 8
IVSR 9
IVSR 10
IVSR 11
IVSR 12
IVSR 13
IVSR 14
IVSR 15
IVSR 16
IVSR 17
IVSR 18
IVSR 19
IVSR 20
IVSR 21
IVSR 22
IVSR 23
IVSR 24
IVSR 25
IVSR 26
IVSR 27
IVSR 28
IVSR 29
IVSR 30
IVSR 31
IVSR 32
IVSR 33
IVSR 34
IVSR 35
IVSR 36
IVSR 37
IVSR 38
IVSR 39
IVSR 40
IVSR 41
IVSR 42
IVSR 43
IVSR 44
IVSR 45
IVSR 46
IVSR 47
IVSR 48

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IVSRPLOT

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ED

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	ICENT	IVSRPLOT
PROGRAM LENGTH	00432	
ENTRY POINTS	00064	
BLOCK NAMES		
INFG	00024	
L0UCNESS	00765	
TMPSTR	00266	
YLE	00012	
ABC	00026	
EXTERNAL SYMBOLS		
THEAD,		
D1G1010U		
D0C01CT,		
ALEG10		
XMINOF		
MAXIF		
STH,		
SL0,		
ONSINGL,		

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SUBROUTINE RAY PLOT(NP,ZMAX)                                RAYP  1
COMMON /INFO/ RSTART,RMAX,OMEGA,ATT,IPRAY,ITN,ITN2,ITN3,IBIG, RAYP  2
1  ISCP,IT1,IT2,IT3,IPER,IFTIMS,LTRT,LTER,LTRP,LPIN,IATT   RAYP  3
COMMON /RAYS/ NRAY,TCAP(1000),ZZ(1000),SS(1000),TIME(1000), RAYP  4
1  NCCUNT(1000),PHASE(1000)                                RAYP  5
COMMON /TMPSTR/ DDE(102)                                    RAYP  6
COMMON/ABC/PUNCHDW (16),INCR,NBRS,NSRS,ALIM,IFT,IFT1      RAYP  7
DIMENSION IR(25),ISYM(25),LINE(115),INUM(9)              RAYP  8
COMMON /TRIANG/ AP(100,2),BP(100,2),AL(100),BL(100),ZZERO(100), RAYP  9
1  RZEHU(100),AA(100),BB(100),SST(100),CCT(100),NTR;    RAYP 10
EQUIVALENCE (LINE,CDC)                                     RAYP 11
DATA (ISYM=1HA,1HC,1HD,1HE,1HF,1HG,1HH,1HI,1HJ,1HK,1HL,1HM,1HN,1HO) RAYP 12
1  ,1HP,1HQ,1HR,1HT,1HL,1MV,1HW,1HX,1HY,1HZ,1H*)         RAYP 13
COMMON /TITLE/STITLE (10)                                 RAYP 14
DATA (IENT=0),(IBLAK=1F ),(IHB=1HB),(IS=1HS),(IFT2=0),(IBH=0) RAYP 15
DATA (INUM=1H2,1H3,1H4,1H5,1H6,1H7,1H8,1H9,1H9)         RAYP 16
IF (IFT1.EQ.0) GO TO 2                                     RAYP 17
IBH=0                                                       RAYP 18
IFT2=IFT1                                                  RAYP 19
2 IF (IFT1.EQ.0.OR.IBH.EC.1) GO TO 3                       RAYP 20
IENT=0 5  IBH=1                                            RAYP 21
3 IF (IENT.NE.0) GO TO 10                                  RAYP 22
WRITE (LTRP,1),STITLE                                     RAYP 23
IENT=1                                                     RAYP 24
ANP=FLOAT(NRAY)/FLOAT(NP)                                  RAYP 25
DO 5 I=1,NP                                               RAYP 26
ANP=(FLOAT(I)-.5)*1,                                       RAYP 27
IR(I)=A-                                                  RAYP 28
IF (IR(I).GT.NRAY) IR(I)=NRAY                             RAYP 29
5 CONTINUE                                                RAYP 30
SZ=ZMAX/114,                                             RAYP 31
WRITE (LTRP,900) SZ                                       RAYP 32
10 ZB=AL(NIR)+BL(NTR)*RMAX                                RAYP 33
RKM=,001*RMAX                                           RAYP 34
IB=(ZMAX-ZB)/SZ+1,5                                       RAYP 35
IB1=1                                                     RAYP 36
IF (IB.LE.0) GO TO 12                                     RAYP 37
IF (IB.GT.115) IB=115                                     RAYP 38
DO 11 I=1,IB                                             RAYP 39
11 LINE(I)=IHB                                           RAYP 40
IB1=IB+1                                                 RAYP 41
DO 15 I=IB1,114                                          RAYP 42
15 LINE(I)=IBLAK                                         RAYP 43
LINE(115)=IS                                             RAYP 44
DO 20 I=1,NP                                             RAYP 45
K=IR(I)                                                  RAYP 46
IF (NBRS.EQ.2500.AND.NSRS.EQ.2500) GO TO 17            RAYP 47
NN=NCCUNT(K)  SM=NN/ITN  SN=NP/ITN  SNR=MM=NN*ITN  SM=NN/ITN  SNBR=MM RAYP 48
17 IF (ABS(S(K)).LT.ALIM.OR.NBR.GT.NBRS.OR.NSR.GT.NSRS) GO TO 20 RAYP 49
ZR=ZZ(K)                                                 RAYP 50
IP=(ZMAX-ZR)/SZ+1,5                                       RAYP 51
IF (IP.GT.115) IP=115                                     RAYP 52
IF (IP.LE.0) GO TO 20                                     RAYP 53
IF (LINE(IP).EQ.IBLAK.OR.LINE(IP).EQ.IS.OR.LINE(IP).EQ.IHR) GO TO 19 RAYP 54
DO 16 J=1,8                                             RAYP 55
IF (LINE(IP).NE.INUM(J)) GO TO 16                       RAYP 56

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	LINE(I,P)=NUM(J+1)	RAYP 57
	GO TO 20	RAYP 58
16	CONTINUE	RAYP 59
	LINE(I,P)=NUM(I)	RAYP 60
	GO TO 20	RAYP 61
19	LINE(I,P)=SYM(I)	RAYP 62
20	CONTINUE	RAYP 63
	WRITE (LTP,901) NKM,LINE	RAYP 64
1	FORMAT (1H1,10A0)	RAYP 65
900	FORMAT(27HOPLST OF RAY PATHS SCALE,F8,2.2X,10MM/POSITION/ 1 10MORANGE(KM),3X,114(1HX),1HS)	RAYP 66
901	FORMAT(11.3.2X,115A1)	RAYP 67
	RETURN	RAYP 68
	END	RAYP 69

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IS RAYPLOT

06/04/73

ED 0

	ICENT	RAYPLOT
PROGRAM LENGTH	00609	
ENTRY POINTS	RAYPLOT	00145
BLOCK NAMES		
INFO	00024	
RAYS	13961	
TMPSTR	00266	
ABC	00026	
TRIANG	02261	
TLE	00012	
EXTERNAL SYMBOLS		
THEAD,		
01010100		
0000101,		
STM,		
SLO,		
0NSINGL,		

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SUBROUTINE RAYZDIST (NP)                                RAYZ  1
COMMON /RAYS/ NRAY, TGAM(1000), ZZ(1000), SS(1000), TIME(1000), RAYZ  2
1 NCOUNT(1000), PHASE(1000)                          RAYZ  3
COMMON /INFO/ RSTART, RMAX, OMEGA, ATY, IPRAY, ITN, ITN2, ITN3, IBIG, RAYZ  4
1 ISCP, IT1, IT2, IT3, IPEK, IFTIMS, LTRT, LTER, LTRP, LPIN, IATT RAYZ  5
COMMON /TMPS*/ DUC(102)                                RAYZ  6
COMMON /TLE/STITLE(10)                                RAYZ  7
DIMENSION LINE(71)                                     RAYZ  8
DIMENSION ISYM(29), IR(29)                             RAYZ  9
COMMON /PDEF/ PI, ETR, THEPI                           RAYZ 10
EQUIVALENCE (LINE, CDC)                                RAYZ 11
COMMON /ABC/PUNCHDW (16), INCR, NBR5, NSRS, ALIM, IFT, IFT1 RAYZ 12
DATA (IENT=0), (IFT2=0), (IBH=0)                      RAYZ 13
DATA (ISYM=1HA, 1HC, 1HD, 1HE, 1HF, 1HG, 1HH, 1HI, 1HJ, 1HK, 1HL, 1HM, 1HN, 1HO) RAYZ 14
1 , 1HP, 1HO, 1HR, 1HT, 1HL, 1HV, 1HW, 1HX, 1HY, 1HZ, 1H*) RAYZ 15
IF (IFT1.EQ.0) GO TO 7                                  RAYZ 16
IBH=0                                                    RAYZ 17
IFT2=IFT1                                               RAYZ 18
7 IF (IFT1.EQ.0.OR.IBH.EC.1) GO TO 6                   RAYZ 19
IENT=0                                                  RAYZ 20
IBH=1                                                    RAYZ 21
6 IF (IENT.EQ.1) GO TO 3                                RAYZ 22
LTRD=37                                                 RAYZ 23
ANP=FLOAT(NRAY)/FLEAT(NP)                              RAYZ 24
DO 4 I=1, NP                                            RAYZ 25
ANP=FLOAT(I),.5)*1,                                    RAYZ 26
IR(I)=ANP                                              RAYZ 27
IF (IR(I).GT.NRAY) IR(I)=NRAY                         RAYZ 28
4 CONTINUE                                             RAYZ 29
IENT=1                                                 RAYZ 30
3 WRITE (LTRD,2), STITLE                               RAYZ 31
INC=1                                                  RAYZ 32
1 CALL CHANNEL(1,,1000,,ZS,ZB)                         RAYZ 33
DO 5 I=1,71                                            RAYZ 34
LINE(I)=1MX                                           RAYZ 35
RK=RMAX/1000,                                         RAYZ 36
SCALE=ZB/71,0                                         RAYZ 37
WRITE(LTRD,900) HK,ZB,SCALE,LINE                     RAYZ 38
DO 8 I=1,71                                            RAYZ 39
8 LINE(I)=1M                                           RAYZ 40
DO 40 I=1,NRAY                                         RAYZ 41
S=SS(I)                                               RAYZ 42
IF (NBR5.EQ.2500.AND.NSRS.EC.2500) GO TO 35          RAYZ 43
N=NCOUNT(I)                                           RAYZ 44
M=N/ITN                                               RAYZ 45
N=M/ITN                                               RAYZ 46
NSR=M*N*ITN                                           RAYZ 47
M=N/ITN                                               RAYZ 48
NBR=M                                                 RAYZ 49
35 IF (S.GT.ALIM.AND.NBR.LE.NBR5.AND.NSR.LE.NSRS) GO TO 12 RAYZ 50
IF (I.EQ.1R(INC))10,15                                RAYZ 51
10 WRITE (LTRD,1901), ISYM(INC), I                   RAYZ 52
INC=INC+1                                             RAYZ 53
GO TO 40                                              RAYZ 54
15 WRITE(LTRD,901) I                                   RAYZ 55
900 FORMAT(26HCRAY DEPTH DISTRIBUTION AT,F10,4.4M KM.,,10X,=BOTTOM DEP) RAYZ 56

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1M=F10,J,M,1UX,SCALE=F10,J,M/POSITION,/,29HOLD NRAY RAYZ 97
2NBR NTU NSR NT6,3X,5HCEPT,5X,5HTETA,6X,4HTIME,1X,6HLOSSES,1X, RAYZ 98
371A1) RAYZ 99
901 FERMAT(4X,14,10X,11HTERMINATED,) RAYZ 60
1901 FERMAT(2X,A1,1X,14,10X,11HTERMINATED,) RAYZ 61
GE TO 40 RAYZ 62
12 TH=10,ALOG10(S) RAYZ 63
TIME(I) RAYZ 64
Z=ZZ(I) RAYZ 65
N=NCUNI(I) RAYZ 66
M=N/ITN RAYZ 67
NT0=N*M/ITN RAYZ 68
N=M/ITN RAYZ 69
NSH=M*N/ITN RAYZ 70
P=N/ITN RAYZ 71
NTU=N*M/ITN RAYZ 72
NBR=M RAYZ 73
LINE(1)=1M RAYZ 74
LINE(71)=1M RAYZ 75
CALL CHANNEL(2,TGAM(I),ZT0,ZT1) RAYZ 76
IZP=70,*(1,-ZT0/Z0)+1,5 RAYZ 77
IF (IZP,GT,71,OR,IZP,LT,1) GE TO 45 RAYZ 78
LINE(IZP)=1M RAYZ 79
45 IZM=70,*(1,-ZT0/Z0)+1,5 RAYZ 80
IF (IZM,GT,71,OR,IZM,LT,1) GE TO 55 RAYZ 81
LINE(IZM)=1M RAYZ 82
55 IZR=70,*(1,-Z/Z0)+1,5 RAYZ 83
IF (IZR,GT,71,OR,IZR,LT,1) GE TO 60 RAYZ 84
LINE(IZR)=1M RAYZ 85
60 TH=CTR=ATAN(TGAM(I)) RAYZ 86
IF (1,EG,IR(INC))20,25 RAYZ 87
20 WRITE (LTHD,902) ISYM(INC), I,NBR,NTU,NSR,NT6,Z,TH,T,DB,LINE RAYZ 88
INC=INC+1 RAYZ 89
GE TO 30 RAYZ 90
902 FERMAT(2X,A1,1X,515, F8,2,F10,5,F10,3,F7,1,1X,71A1) RAYZ 91
25 WRITE (LTHD,1902) I,NBR,NTU,NSR,NT6,Z,TH,T,DB,LINE RAYZ 92
1902 FERMAT(4X,515, F8,2,F10,5,F10,3,F7,1,1X,71A1) RAYZ 93
30 IF (IZP,LE,71,AND,IZP,GE,1) LINE(IZP)=1M RAYZ 94
IF (IZM,LE,71,AND,IZM,GE,1) LINE(IZM)=1M RAYZ 95
IF (IZR,LE,71,AND,IZR,GE,1) LINE(IZR)=1M RAYZ 96
40 CONTINUE RAYZ 97
2 FERMAT(1M1,10A8,/) RAYZ 98
RETURN RAYZ 99
END RAYZ 100

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DS RAYZDIST

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ED 0

	ICENT	RAYZDIST
PROGRAM LENGTH	01094	
ENTRY POINTS	RAYZDIST	00234
BLOCK NAMES		
PAYS	13561	
INFS	00024	
TMPSTR	00266	
TLE	00012	
PICF	00003	
ABC	00026	
EXTERNAL SYMBOLS		
G1C1010U		
THEAD,		
C0C0ICT,		
CHANNEL		
ALEG10		
ATANF		
STW,		
SLC,		
ONSINGL,		

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```
SUBROUTINE DYEBYE  
DIMENSION LEAVE(1)  
J=1  
LEAVE(J)=63000000003000000  
END
```

```
BYBY 1  
BYBY 2  
BYBY 3  
BYBY 4  
BYBY 5
```


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S BYE BYE

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ED 0

PROGRAM LENGTH
ENTRY POINTS BYE BYE
EXTERNAL SYMBOLS
DBCCICT,

ICENT BYE BYE
00017
00004

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IDS RECOVERY                                08/02/72      EN      0      PAGE NO.      1
PROGRAM LENGTH                               00120  IDENT RECOVERY                                00001
ENTRY POINTS  DUMP                           00000
                RESTART                       00007
                ASTATUS                       MACHN
                ST                            STATUS M1
                                                (M1) 00002
                                                00070ST 00003
                                                00000ST 00004
                                                00000ST 00004
                ENUM
    
```

```

TITLE == DUMP AND RESTART FACILITY 00008
IDENT NAME == Q-NML-RECOVERY 00009
IDENT NUMBER == 00001000 00010
LANGUAGE == COMPAQ S.3 00011
COMPUTER == CDC 3800 00012
CONTRIBUTOR == ANNA BYRD MAYS, CODE 7017.1 00013
                DOUGLAS P. SHANNON, CODE 7017.3 00014
                RESEARCH COMPUTATION CENTER 00015
                MATH. AND INFO. SCIENCES DIVISION 00016
DATE == JUNE 1970 00017
PURPOSE == ALLOWS PROGRAMS WITH A LONG RUN-TIME TO 00018
                HAVE A RESTART CAPABILITY 00019
    
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                ENTRY DUMP+RESTART 00021
00017 M1 EQU 15 ALWAYS INPUT TAPE, FIRST OUTPUT TAPE 00022
00004 TRIS EQU 5=1 PARITY RE-TRY COUNTEN 00023
50000 LORCME EQU 50000B OCTAL NUMBER ON DEMAND CARD 00024
00052 PARITY EQU 42 PARITY STATUS BIT 00025
00000 UNLOADM EQU 0 1 IF UNLOAD TAPE AFTER USE. LAH SMITH 00026
00000 PWA EQU 0 00027
    
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NS	RECOVERY				08/02/72	En	0	PAGE NO.	2
00000	03 0 00000	DUMP	U+JP	00					00020
00001	00 0 77777								
	77 2 04000		U+TA	(0)SAVEAU	SAVE REGISTERS TO DUMP ON TAPE				00030
	20 0 00010								
00007	00 7 40053		NAT	D+A					00031
	20 0 00012		SIA	SAVE0					00032
00003	90 1 00013		SIU	SAVE12,1					00033
	97 2 00013		SIL	SAVE12,2					00034
00004	90 3 00014		SIU	SAVE13,1					00035
	97 4 00014		SIL	SAVE13,2					00036
00005	90 5 00015		SIU	SAVE16,1					00037
	97 6 00015		SIL	SAVE16,2					00038
00006	50 1 00017		END	HT1,1					00039
	50 0 00000								
00007		MOUL	MODE	((0,1),0)BIN,LO)	MODE TAPE 200 BPI				00040
00012	50 0 00000		END	TR15,0	SET ME-TNY COUNTER				00041
00013		HEW,1	HEWIND	((0,1),0)					00042
00014			WRITE	((0,1),0)CWA,0)					00043
00021			ASTATUS	((0,1),0)					00044
00024	03 0 30052		ZHJP	0,PARITY,CONT,1	JUMP IF NO PARITY ERROR				00045
	04 0 00050								
00024			HEWIND	((0,1),0)					00046
00031			HEAD	((0,1),0)HDR(PCW,0)	MAKE SURE OF PARITY ERROR				00047
00031			ASTATUS	((0,1),0)					00048
00040	03 0 30052		ZHJP	0,PARITY,CONT,1	JUMP IF NO PARITY ERROR				00049
	04 0 00050								
00041	55 0 00013		IJP	RE=1,0					00050
	51 1 00001		INI	1,1					00051
00042			RELEASE	((=1,1),0)					00052
									00053
00044	02 0 00022		HJJP,NE	0,MT,0,3,MOUL	TAPE -- TNY ANOTHER UNIT				00054
	30 1 00007				JUMP IF NOT OVER TAPE UNIT LIMIT				
00045	12 1 00012		LUA	ERROR=1,1,1,1	ARMED MESSAGE				00055
	20 0 00007		SIA	0,1,1					00056
00046			ANORI	00	KILL JOB				00057
			IPZ	UNLOAD,1,2					00058
00046	02 0 00017	CONT,1	HJJP,NE	0,MT,1,0,3	JUMP IF NOT FIRST TAPE				00059
	30 1 00045								00060
00046			HEWIND	((0,1),0)	MEMORUM FREE REWIND				00061
00054	52 1 00013		IPN	UNLOAD,MT					00062
	53 0 00015		LIU	SAVE12,1	RELOAD USED INDEX NEG.				00073
00055	77 2 00000		LIL	SAVE16,0					00074
	12 0 00010		ULDA	SAVE0	RESTORE A AND Q				00075
00046	75 0 00000		UJP	DUMP	EXIT				00076
	50 0 00000								

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ANS	RECOVERY					04/02/72	Ln	0	PAGE NO.	3
00057	00	0	00000	NESTANT	UCT		0			00078
	00	0	00000							
00060	77	1	00000		END		0			
00061	50	0	00006		END			REGISTERS NEED NOT BE SAVED		00079
00064				NEW.2	MODE			SET ME-TMY COUNTER		00080
00067					HEAD			SET MODE TO 200 BPI		00081
00072					ASTATUS					00082
00076	63	0	30052		ZHJP			MEINCANNATE COMP		00083
	64	0	000102							00084
00077	55	0	00006		IJP					00085
					ABONT					00086
00102	17	0	00012	CONT.2	LUA			KILL JOB IF TAPE UNREADABLE		00087
	00	7	00055		NAT			REVITALIZE MACHINE REGISTERS		00088
00103	77	2	00000		ULDA					00089
	12	0	000110							00091
00104	52	1	00013		LJU					
	53	2	00013		LIL			SAVE12.1		00092
00105	52	3	00014		LJU			SAVE12.2		00093
	53	4	00014		LIL			SAVE14.3		00094
00106	52	5	00015		LJU			SAVE14.4		00095
	53	6	00015		LIL			SAVE16.5		00096
					IPN			SAVE16.6		00097
00107	75	0	00057		UJP			UNLOAD.1		00099
	50	0	00000		NESTANT					00101

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NO	RECOVERY	DATA	CODE	UNIT	DESCRIPTION	PAGE NO.	NO.	
00110			SAVEAU	W3S			00103	
00112			SAVEU	W3S			00104	
00113	00	U	00000	SAVE12	UCT	0	00105	
	00	U	00000					
00114	00	U	00000	SAVE34	UCT	0	00104	
	00	U	00000					
00114	00	U	00000	SAVE56	UCT	0	00107	
	00	U	00000					
00114	50	U	7777	WCA	IUTW=C	(11)00000,7777H	ALL OF BANK ONE	00104
	00	1	00000					
00117	50	J	P50000		IUTW=C		BANK ZERO FROM LOWEN HOUND TO RECOVERY = 1	00110
	00	0	27776				77776H=LOWEN,FWA=77776H=LOWEN=1	00111
00120	10	U	00006		IUTW	(0)SAVEAU,A	SPACE FOR INDEZ REGISTERS	00112
	00	0	P00110					
			P00116	WCA	WCA			00113
00121	20	0	7777	MSRIPCW	IJSM	00,00		00114
	00	0	7777					
00122	22	2	12000	ENRCH	WCU	1,0ADW 15		00115
	51	6	00105					
00123	22	2	12000		WCU	1,0ADW 16		00116
	51	6	00106					
00124	22	2	12000		WCU	1,0ADW 17		00117
	51	6	00107					
				IPN		UNLOADMT,1		00118
				END				00121

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PROGRAM TRIPLT                                TPLY  1
C THIS VERSION IS COMPATIBLE WITH 4-9-72 VERSION OF TRIMAIN TPLY  2
C DISK VERSION OF TRIPLT                      TPLY  3
C IF INFO WILL FIT IN CORE DISK IS NOT OPENED TPLY  4
C THIS DETERMINED BY NRMAX AND THE NUMBER OF RAYS TO PLOT TPLY  5
C                                              TPLY  6
COMMON /INFO/ ID,NR,NRMAX,ZMAX,NSCALE,AL,RR(2000),ZBOT(2000),IKNM TPLY  7
DIMENSION TITLE(10),BUF(254),NRPL0T(512),ZR(1000),YR(1000),SR(1000) TPLY  8
1),NCRUNT(1000)                                TPLY  9
COMMON /1/ ZSTOR(16384)                        TPLY 10
COMMON /2/ TSTOR(16384)                        TPLY 11
900 FORMAT(10A8)                                TPLY 12
901 FORMAT(28M1CALCOMP PLOT FROM RAY TAPE ,10A8) TPLY 13
902 FORMAT(2F8.3,14.615,F10.3)                 TPLY 14
903 FORMAT(8MLENGTH=,F10.2,3X,10HMAX DEPTH=,F12.1,3X,14HNO. OF RECORD TPLY 15
1S,110,5X,=IKNM=,13,5X,=IFMC=,13,5X,=NFSK=,13,5X,=ITTR=,13,/, TPLY 16
21X,=DB LIMIT=,18,3,5X,=MAXIMUM NUMBER OF SURFACE REFLECTIONS=, TPLY 17
313,5X,=MAXIMUM NUMBER OF BOTTOM REFLECTIONS=,15) TPLY 18
904 FORMAT(20I4)                                TPLY 19
905 FORMAT(5HUNRAY,20I5)                        TPLY 20
906 FORMAT(11HNO OF RAYS,16,3X,10HLENGTH OF BLOCK,16,3X,12HNO OF BLOCK TPLY 21
1KS,16)                                         TPLY 22
9039 FORMAT(24HOPACITY ERROR IN RECORD ,16)    TPLY 23
IDF0=0 $ IC0=0 SREAD 4,ITNC $HEWIND 1         TPLY 24
4 FORMAT (I2)                                   TPLY 25
CALL PLOTS(BUF,254,10)                         TPLY 26
2 READ 902, AL,ZMAX,NRMAX,IKNM,IFMC,NFSK,ITTR,NSR1,NBR1,ALIM1 TPLY 27
IF (EOF,60)2,7                                  TPLY 28
7 IL=IL+1                                       TPLY 29
DO J J=1,NFSK                                   TPLY 30
3 CALL SKIPFILE (1)                             TPLY 31
READ (1),TITLE,ALIM,NBRS,NSRS,ITNSIF(ITTR,LT,0)READ 900,TITLE TPLY 32
IF (ALIM1.NE.0.0.AND.ALIM1.GT.ALIM) ALIM=POWRF(10,0,(=ALIM1/10.0)) TPLY 33
IF (ALIM1.EQ.0.0) ALIM1=-10.0=ALOG10(ALIM) $ PRINT 901,TITLE TPLY 34
IF (NSR1.NE.0.AND.NSR1.LT.NSRS) NSRS=NSR1     TPLY 35
IF (NBR1.NE.0.AND.NBR1.LT.NBRS) NBRS=NBR1     TPLY 36
PRINT 903,AL,ZMAX,NRMAX,IKNM,IFMC,NFSK,ITTR,ALIM1,NSRS,NBRS TPLY 37
IF (AL.LE.0.0.OR.AL.GT.120.) STOP $ IF (ZMAX.LE.0.) STOP $ IL=1 TPLY 38
IF (NRMAX.LE.0.0R.NRMAX.GT.2000) STOP        TPLY 39
5 IM=IL+19                                      TPLY 40
IF (IM.GT.511) STOP                             TPLY 41
READ 904,(NRPL0T(I),I=IL,IM)                   TPLY 42
PRINT 905,(NRPL0T(I),I=IL,IM)                 TPLY 43
IF (EOF,60) 10,15                              TPLY 44
10 IM=IL-1                                       TPLY 45
GO TO 25                                        TPLY 46
15 IF (NRPL0T(IM).EQ.0) GO TO 20                TPLY 47
IL=IL+20                                        TPLY 48
GO TO 5                                         TPLY 49
20 IM=IM-1                                       TPLY 50
IF (NRPL0T(IM).NE.0) GO TO 25                 TPLY 51
IF (IM.GT.0) GO TO 20                         TPLY 52
25 NI0PLT IM                                    TPLY 53
IF (IM,LE.0) STOP                              TPLY 54
L0LK=32*(512/NI0PLT)                          TPLY 55
M0LK=(NRMAX-1)/L0LK+1                         TPLY 56

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PHINT 906,NTOPLT,LBLK,MBLK          TPLT 57
NDISK=MBLK*LRLK*NTOPLT+2           TPLT 58
IF (NDISK.GT.2**20) STOP            TPLT 59
IF (MBLK.EQ.1.OR.IDF0.EQ.1) GO TO 30 TPLT 60
IDF0=1                               TPLT 61
CALL UKOPEN(2,3HRRAN,0)             TPLT 62
C   PLOT TITLE AND Z-AXIS           TPLT 63
30  CALL SYMBOL(1,,0,,.14,TITLE,90,,80) TPLT 64
    CALL SYMBOL(2,8,9,9J,.14,IMC,0,,1) TPLT 65
    Z=0                               TPLT 66
    DO 31 I=1,10                     TPLT 67
    CALL PLOT(3,,11,-1,3)            TPLT 68
    CALL PLOT(3,,10,-1,2)           TPLT 69
    CALL PLOT(3,05,10,-1,2)         TPLT 70
    CALL PLOT(2,95,10,-1,4)         TPLT 71
    Z=Z+ZMAX/10                     TPLT 72
    CALL NUMBER(2,32,9,93-I,.14,2,0,,4HF5,0) TPLT 73
    IF (I.EQ.5.AND.IFMC.GE.0) CALL SYMBOL (2.,4.5.,.14,9HDEPTH (M),00., TPLT 74
19)                                  TPLT 75
    IF (I.EQ.5.AND.IFMC.LT.0) CALL SYMBOL (2.,4.5.,.14,10HDEPTH (FT), TPLT 76
190.,10)                             TPLT 77
31  CONTINUE                          TPLT 78
    IF (IFMC.LT.0) ZMAX=ZMAX+0.3048  TPLT 79
    NH=NRMAX                           TPLT 80
    M=1                                 TPLT 81
    IREC=0                              TPLT 82
32  DO 50 IR=1,LBLK                   TPLT 83
    IREC=IREC+1 $ IFEF=0              TPLT 84
    READ(1) NHAY,NR(IREC),7HOR(IREC),(TR(I),I=1,NRAY),(ZR(I),I=1,NRAY) TPLT 85
1, (SS(I),I=1,NRAY),(NCOUNT(I),I=1,NRAY) TPLT 86
    IF (EOP,1) 36,38                  TPLT 87
33  IFEF=1                             TPLT 88
    IF (NRMAX.LT. IREC-1) GO TO 32    TPLT 89
    NHMAX=IREC-1                      TPLT 90
    NK=NRMAX                           TPLT 91
    GO TO 32                           TPLT 92
34  IF (IOCHECK,1) 39,40              TPLT 93
35  PHINT 9039,IREC                   TPLT 94
40  DO 45 I=1,NTOPLT $ K=NRPLBT(I) $J=LBLK*(I-1)+IR $ 7STOR(J)=ZR(K) TPLT 95
    IF (NSRS.EQ.2500.AND.NRSR.EQ.2500) GO TO 41 TPLT 96
    NN=NCOUNT (K)$MM=NN/$IN$NN=$M/$IN$NRSR=$M-NN/$IN$NBR=$M TPLT 97
41  IF (SS(K).LE.ALIM.ON.NSW.GE.NRSR.OR.NBR.GE.NRSR) ZSTOR(J)=-ZR(K) TPLT 98
    IF (Z(K).LT.0.0) ZSTOR(J)=ZR(K)  TPLT 99
    ZSTOR(J)=-TR(K)                   TPLT 100
42  CONTINUE                          TPLT 101
50  IF (MBLK.EQ.1) GO TO 60 $ IDEL=MBLK*LRLK TPLT 102
    MDISK=(M-1)*LRLK                 TPLT 103
    DO 55 I=1,NTOPLT                 TPLT 104
    CALL UKLOCATE(MDISK)              TPLT 105
    J=(I-1)*LRLK+1                   TPLT 106
    K=J+LRLK-1                       TPLT 107
    CALL UKWRITE(ZSTOR(J),7STOR(K))  TPLT 108
    MDISK=MDISK+IDEL                 TPLT 109
    CALL UKLOCATE(MDISK)              TPLT 110
    CALL UKWRITE(7STOR(J),7STOR(K)) TPLT 111
55  MDISK=MDISK+IDEL                 TPLT 112

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60	IF (M.EQ.MBLK.OP.IFEF.EQ.1) GO TO 65	TPLT 113
	M=M+1	TPLT 114
	GO TO 35	TPLT 115
65	NREC=J2*((RMAX-1)/J2+1)	TPLT 116
	RMAX=NR(NR)	TPLT 117
	RSCALE=AL/RMAX	TPLT 118
	CALL PLOTPT	TPLT 119
	IF (MBLK.EQ.1) GO TO 80	TPLT 120
	ID=1	TPLT 121
	MDISK=0	TPLT 122
	DO 70 I=1,NTPLT	TPLT 123
	CALL UNLOCATE(MDISK)	TPLT 124
	CALL LKREAD(TSTOR(1),ZSTOR(NREC))	TPLT 125
	MDISK=MDISK+1EFL	TPLT 126
	CALL UNLOCATE(MDISK)	TPLT 127
	CALL LKREAD(TSTOR(1),ISTOR(NREC))	TPLT 128
	MDISK=MDISK+1DFL	TPLT 129
	CALL MAYPLOT(ZSTOR,TSIPK)	TPLT 130
70	ID=-ID	TPLT 131
	GO TO 90	TPLT 132
80	ID=1	TPLT 133
	DO 85 I=1,NTPLT	TPLT 134
	L=(I-1)*LBLK+1	TPLT 135
	CALL MAYPLOT(ZSTOR(L),TSTOR(L))	TPLT 136
85	ID=-ID	TPLT 137
90	CALL PLOT(AL*10.,U.,-3)	TPLT 138
	IF (IFEF.EQ.1) GO TO 91 & IREC=0	TPLT 139
92	IREC=IREC+1	TPLT 140
	READ(1) NRAY,RR(IREC),7BOT(IREC),(TR(I),I=1,NRAY),(ZR(I),I=1,NRAY)	TPLT 141
	L=ISS(I),I=1,NRAY),(NQUINT(I),I=1,NRAY)	TPLT 142
	IF (EQF,1) 91,92	TPLT 143
91	IF (ICO.LT.ITAC) GO TO 2	TPLT 144
	CALL STOPPLOT	TPLT 145
	STOP	TPLT 146
	END	TPLT 147

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TRIPLT

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ED 0

		IDENT	TRIPLT
PROGRAM LENGTH		12771	
ENTRY POINTS	TRIPLT	11432	
BLK NAMES			
	INFO	07647	
	1	40000	
	2	40000	

EXTERNAL SYMBOLS

QBENTRY
 TEND,
 QBSTOPS
 Q2007000
 Q1203100
 QBODICT,
 PLOTS
 SKIPFILE
 DKOPEN
 SYMBOL
 PLOT
 NUMBER
 DKLOCATE
 DKWRITE
 PLOTBOT
 DKREAD
 RAYPLOT
 STEPLOT
 ALG10
 PGNF
 QBQIF0F
 QBQIF10C
 RW.
 TSW.
 TSB.
 STM.
 SL0.
 SLI.
 QNSINGL.

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	SUBROUTINE PLOTBOT	TPLT 148
	COMMON /INFO/ ID,RR,RMAX,ZMAX,RSCALE,AL,PR(2000),ZBOT(2000),IKNM	TPLT 149
	NIM=AMINI(AL+1.,40.5)	TPLT 150
	RI=1.	TPLT 151
	RMAN=RMAX	TPLT 152
	IF (IKNM.LT.0) RMAN=RMAX/1.052	TPLT 153
50	NI=RMAN/RT	TPLT 154
	IF (NT,LE,NTM) GO TO 5/	TPLT 155
	RI=2.*RT	TPLT 156
	NI=RMAN/RT	TPLT 157
	IF (NT,LE,NTM) GO TO 5/	TPLT 158
	RI=2.*RT	TPLT 159
	NI=RMAN/RT	TPLT 160
	IF (NT,LE,NTM) GO TO 5/	TPLT 161
	RI=2.*RT	TPLT 162
	GO TO 56	TPLT 163
C	PLOT SURFACE AXIS	TPLT 164
5/	CALL PLOT(3.,10.,3)	TPLT 165
	X=3.	TPLT 166
	RSCALE1=RSCALE	TPLT 167
	IF (IKNM.LT.0) RSCALE1=1.052*RSCALE	TPLT 168
	DX=RT*RSCALE1	TPLT 169
	R=0.	TPLT 170
	IF=0	TPLT 171
50	CALL PLOT(X,10.,2)	TPLT 172
	CALL PLOT(X,9.95,2)	TPLT 173
	RK=R/1000.	TPLT 174
	CALL NUMBER(X-.24,10.05,1.4E-1,RK,0.,4WF4,0)	TPLT 175
	IF (R.LT.RMAN/2.) GO TO 59	TPLT 176
	IF (IF,EQ.1) GO TO 59	TPLT 177
	IF (IKNM.LT.0) CALL SYMBOL(X-.30,10.25,,14,10HRANGE (NM),0.,10)	TPLT 178
	IF (IKNM.GE.0) CALL SYMBOL(X-.30,10.25,,14,10HRANGE (KM),0.,10)	TPLT 179
	IF=1	TPLT 180
59	CALL PLOT(X,10.,3)	TPLT 181
	IF (R.GE.RMAN) GO TO 60	TPLT 182
	X=X+DX	TPLT 183
	R=R+RT	TPLT 184
	GO TO 58	TPLT 185
C	PLOT BOTTOM CONTOUR	TPLT 186
60	DO 63 I=1,NM	TPLT 187
	K=NR+1-I	TPLT 188
	Y=10.*(1.-ZBOT(K)/ZMAX)	TPLT 189
	X=RR(K)*RSCALE+3.	TPLT 190
	IP=2	TPLT 191
	IF (I.EQ.1) IP=3	TPLT 192
	IF (Y.GE.0.) GO TO 63	TPLT 193
	IP=3	TPLT 194
	Y=0.	TPLT 195
63	CALL PLOT(X,,IP)	TPLT 196
	RETURN	TPLT 197
	END	TPLT 198

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5 PLOTBOT

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ED 0

	IDENT	PLOTBOT
PROGRAM LENGTH	U0309	
ENTRY POINTS	J0010	
BLOCK NAMES		
INFO	U7647	
EXTERNAL SYMBOLS		
01010100		
000DICT,		
PLOT		
NUMBER		
SYMBOL		
MINIF		

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SUBROUTINE RAYPLOT(ZSTOR,ISTOR)
DIMENSION ZSTOR(2000),TSTOR(2000)
DIMENSION Z(25),R(25)
COMMON /INFO/ ID,NR,RMAX,ZMAX,RSCALE,AL,RH(2000),ZROT(2000),IKNM
NID=1 $ IRH=0 $ IPR=0 $ IHT=0 $ SIRI=0 $ IST=0 $ IJT=0
IF (ID,LT,0) NID=NR $ IF (NID,NE,1) IPR=1
Z0=ABS(ZSTOR(NID)) $ IF (ZSTOR(1),LT,0.0) RETURN
T0=TSTOR(NID)
R0=RR(NID)
Z00=ZROT(NID)
X=R0*RSCALE $ IF (Z0,GT,290) Z0=290
Y=10.*(1.-Z0/ZMAX)
IF (Y,LT,0.) Y=0.
CALL PLOT(X+3.,Y,3)
DO 90 LL=2,NR
IF (ID,GT,0) GO TO 73
L=NR-LL+1
GO TO 74
73
L=LL
74
ZN=ABS(ZSTOR(L)) $ TN=TSTOR(L) $ RN=RR(L) $ ZBN=ZROT(L) $ DR=RN-R0
IF (ZN,GT,ZBN) ZN=ZBN $ IF (ZSTOR(L),LT,0.0,AND,IPR,EQ,1) 91,93
93 IF (NID,NE,1,AND,IRH,EQ,0) 94,95
94 X=R0*RSCALE $ Y=10.*(1.-Z0/ZMAX) $ IF (Y,LT,0.) Y=0.0
CALL PLOT (X+3.,Y,3) $ IRH=1 $ IPR=0 $ SIRI=1 $ IF (ZSTOR(L+1),GE,0.) IST=1
95
ZN0=ZN-DR*TN
Z00=Z0+DR*T0
IF (ZN0,GE,0.) GO TO 75
IF (Z0N,GE,0.) GO TO 75
Z00=-Z0N
T00=-T0
75
Td=(Z0N-Z00)/DR
IF (Z0N,LE,Z00) GO TO 76
IF (Z0N,LE,Z0N) GO TO 76
IF (TR,EQ,0.) GO TO 76
DZ=Z0-Z00
Z0=Z0+2.*DZ/(1.+Td**2)
R0=R0-2.*DZ/(TR+1./TP)
T0=(T0-TR)/(1.+T0*Td)
T00=(T0-TG)/(1.+TG*Td)
GO TO 77
76
Z0=2.*Z00-Z0
T0=-T0
77
DR=RN-R0
Z0N=Z0+DR*T0
ZN0=ZN-DR*TN
78
DX=ABS(DR*RSCALE)
N=DX/.02+2.
C
INTERPELATION TO FIFTIETHS WILL BE DONE
IF (N,GT,25) N=25
I1=1
DF=1./(N-1)
F=0.
C
SPLINE FIT BY CONTINUED LINEAR INTERPELATION
DZ=ZN-Z0
DZ0=Z0N-Z0

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TPLT 199
TPLT 200
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	DZ=ZN-ZNW	TPLT 255
79	Z1=Z0+F*DZ	TPLT 256
	Z2=Z0+F*DZ0	TPLT 257
	Z3=ZNW+F*DZN	TPLT 258
	G=1.-F	TPLT 259
	Z4=G*Z2+F*Z1	TPLT 260
	Z5=G*Z1+F*Z3	TPLT 261
	Z(II)=G*Z4+F*Z5	TPLT 262
	R(II)=H0+F*DR	TPLT 263
	II=II+1	TPLT 264
	F=F*DF	TPLT 265
	IF(II,LE,N) GO TO 79	TPLT 266
	DF 89 II=1,N	TPLT 267
	IN=0	TPLT 268
	IF(Z(II).LT.0.) IN=1	TPLT 269
	IF(Z(II).GT.ZBN*(R(II)-RN)*TB) IN=-1	TPLT 270
	IF(II,EQ,1) GO TO 82	TPLT 271
	IF(IN,EQ,10) GO TO 82	TPLT 272
	IF(IN,NE,1.AND,10,NE,1) GO TO 80	TPLT 273
	RHIT=1*(H(II)+4*(II-1)*(R(II)-R(II-1))+(Z(II)+Z(II-1))/(Z(II-1)-Z(II-1)))	TPLT 274
	X=RHIT*RSCALE\$IP=3\$IF(1BT,EQ,1,OR,NID,EQ,1,OR,IST,EQ,1)IP=2\$IFRT=1	TPLT 275
	CALL PLOT(X*3.,10.,IP)\$IF(7STOR(L).GE.0,0) GO TO 82 5 IPR=1	TPLT 276
	GO TO 91	TPLT 277
80	D=(Z(II)-Z(II-1))/(H(II)-H(II-1))-TB	TPLT 278
	RHIT=(Z(II-1)-ZBN*(H(II-1)-RN)*TB)/D*R(II-1)	TPLT 279
	F=(RHIT-R(II-1))/(R(II)-R(II-1))	TPLT 280
	IF(F.GT.1.) GO TO 82	TPLT 281
	IF(F.LT.0.) GO TO 82	TPLT 282
	X=RHIT*RSCALE\$IP=3\$IF(1BT,EQ,1,OR,NID,EQ,1,OR,IST,EQ,1)IP=2	TPLT 283
	1BT=1	TPLT 284
	Y=10.*(1.-(ZBN*(RHIT-RN)*TB)/ZMAX)\$IF(7STOR(L).LT.0,0) IPR=1	TPLT 285
	IF(Y.GT.0.) GO TO 81	TPLT 286
	Y=0.	TPLT 287
	IP=3	TPLT 288
81	CALL PLOT(X*3.,Y,IP)	TPLT 289
82	IF(Z(II).GT.0.) GO TO 83	TPLT 290
	Y=10.*(1.+Z(II)/ZMAX)	TPLT 291
	X=R(II)*RSCALE\$IF(Z(II).EQ.0,0,AND,IRI,EQ,1)IJT=1	TPLT 292
	IF(Z(II).EQ.0,0,AND,ZSTOR(L).LT.0,0) IPR=1 GO TO 86	TPLT 293
83	IF(Z(II).GT,ZBN*(H(II)-RN)*TB) GO TO 84	TPLT 294
	Y=10.*(1.-Z(II)/ZMAX)\$IF(Z(II).EQ,ZBN*(R(II)-RN)*TB,AND,ZSTOR(L).LT.0,0) IPR=1	TPLT 295
	X=R(II)*RSCALE\$IF(Z(II).EQ,ZBN*(R(II)-RN)*TB,AND,IRI,EQ,1)IJT=1	TPLT 296
	GO TO 86	TPLT 297
84	CZ=Z(II)-(ZBN*(H(II)-RN)*TB)	TPLT 298
	ZP=Z(II)-2.*DZ/(1.+TB**2) \$ R=H(II)	TPLT 299
	IF(TB,NE,0.) RP=RP+2.*DZ/(TB+1./TB) \$Y=10.*(1.-ZP/ZMAX)	TPLT 300
	IF(ZP,EQ,ZBN*(RP-RN)*TB,AND,ZSTOR(L).LT.0.) IPR=1	TPLT 301
	IF(ZP,EQ,ZBN*(RP-RN)*TB,AND,IRI,EQ,1) IJT=1 \$X=RP*RSCALE	TPLT 302
	IF(1BT,EQ,1.AND,NID,NE,1,OR,IST,EQ,1) GO TO 86	TPLT 303
	IF(NID,NE,1) GO TO 107	TPLT 304
	IF(IPR,EQ,1,OR,ZSTOR(L).GE.0,0) GO TO 86	TPLT 305
107	IF(II,EQ,N) GO TO 108	TPLT 306
	DZS=Z(II+1)-(ZBN*(R(II+1)-RN)*TB)	TPLT 307
	ZPS=Z(II+1)-2.*DZS/(1.+TB**2)	TPLT 308
		TPLT 309
		TPLT 310

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	IF (ZP.GE,ZPS.AND,NID.EQ.1.UR.DZS.LE.0.0.AND,NID.EQ.1) IPR=1	TPLT 311
	IF (ZP.GE,ZPS.AND,NID.NE.1.UR.DZS.LE.0.0.AND,NID.NE.1) IJT=1	TPLT 312
	GO TO 86	TPLT 313
106	IF (IPR.EQ.0.AND,ZSTOK(L).LT.0.0) IPR=1	TPLT 314
	IF (IMT.EQ.0.AND,ZSTOK(L+1).LT.0.0.AND,NID.NE.1) IJT=1	TPLT 315
86	IP=2	TPLT 316
	IF (Y.LT.10.,AND,Y.GT.0.) GO TO 87	TPLT 317
	IP=3	TPLT 318
	Y=AMINI(10.,AMAX1(Y,0.))	TPLT 319
87	IF (X.LT.AL+1.,AND,X.GE.-.01) GO TO 88	TPLT 320
	IP=3	TPLT 321
	X=AMINI(AL+1.,AMAX1(X,0.))	TPLT 322
88	IF (IMT.EQ.0.AND,IRI.EQ.1.AND,IST.EQ.0) IP=3 & CALL PLOT(X+3.,Y,IP)	TPLT 323
	IG=IN \$ IF (IJT.EQ.1) IRT=1 & IF (IPR.EQ.1) GO TO 91	TPLT 324
89	CONTINUE	TPLT 325
91	ZM9=ZM9 & ZB=ZN	TPLT 326
	TO=TN	TPLT 327
90	RU=RN	TPLT 328
	RETURN	TPLT 329
	END	TPLT 330

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3 RAYPLOT

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ED 0

		IDENT	RAYPLOT
PROGRAM LENGTH		01377	
ENTRY POINTS	RAYPLOT	UC06D	
BLOCK NAMES	INFO	07647	
EXTERNAL SYMBOLS			
	0101010U		
	000UIC.		
	PLST		
	MINIF		
	MAXIF		

Appendix B

COMPARISON OF CALCULATED AND EXPERIMENTAL RESULTS

A comparison was made between the calculated results from TRIMAIN and some experimental data which was furnished by Cdr. P.R. Tatro of the Maury Center for Ocean Science. The input parameters for TRIMAIN were: a frequency of 100 hertz and no volume attenuation, a fan of rays between $\pm 60^\circ$ in 1° steps, a bottom loss of MGS class IV for the entire track, type II intensity calculations, a source depth of 152.4 meters and a receiver depth of 762.0 meters. Figs. B1a, B1b, and B1c are print plots of input sound-speed profiles, Fig. B2 is a Calcomp plot of profiles and the bottom track, Fig. B3a is a list of calculated intensity values, Fig. B3b is a list of experimental intensity values, Fig. B4 is a Calcomp plot of selected rays which were traced (one ray every 15°), and Fig. B5 is a Calcomp comparison of experimental and calculated intensity values. Good agreement exists between the two sets of values.

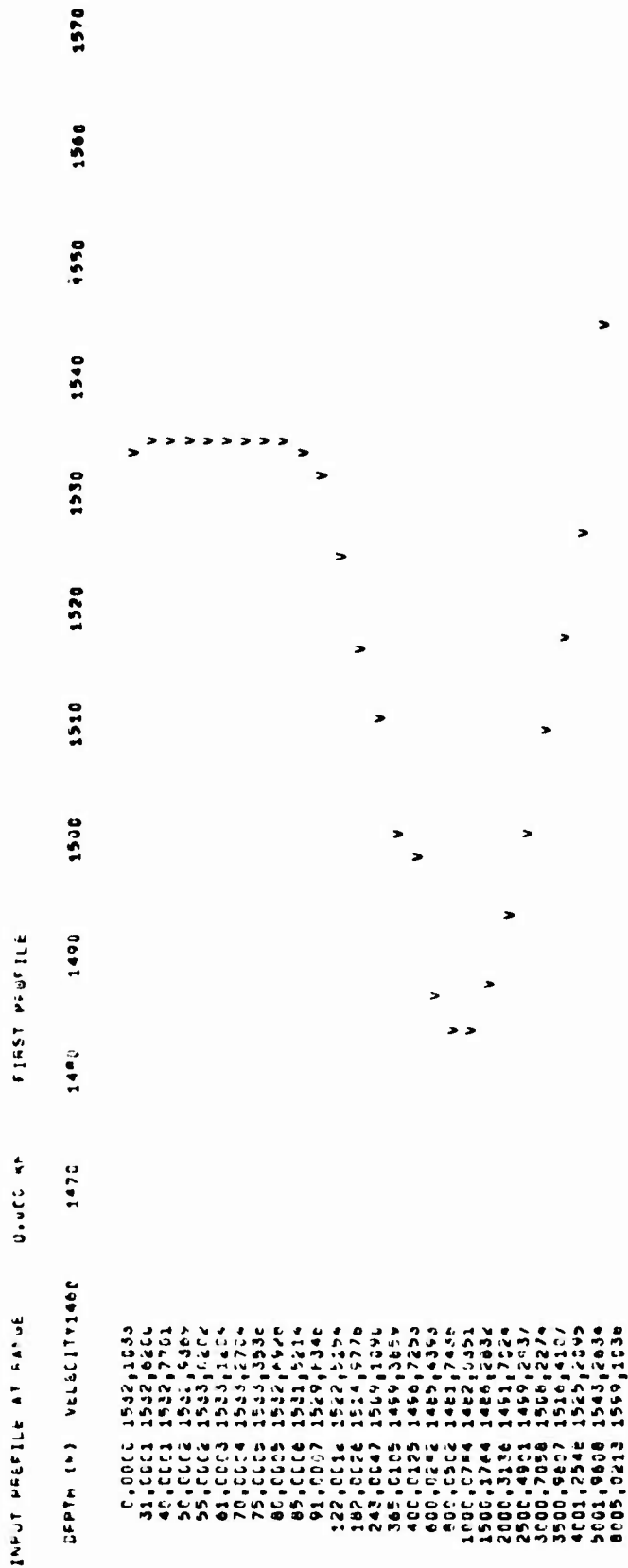


Fig. B1a — Input profile at 0 km

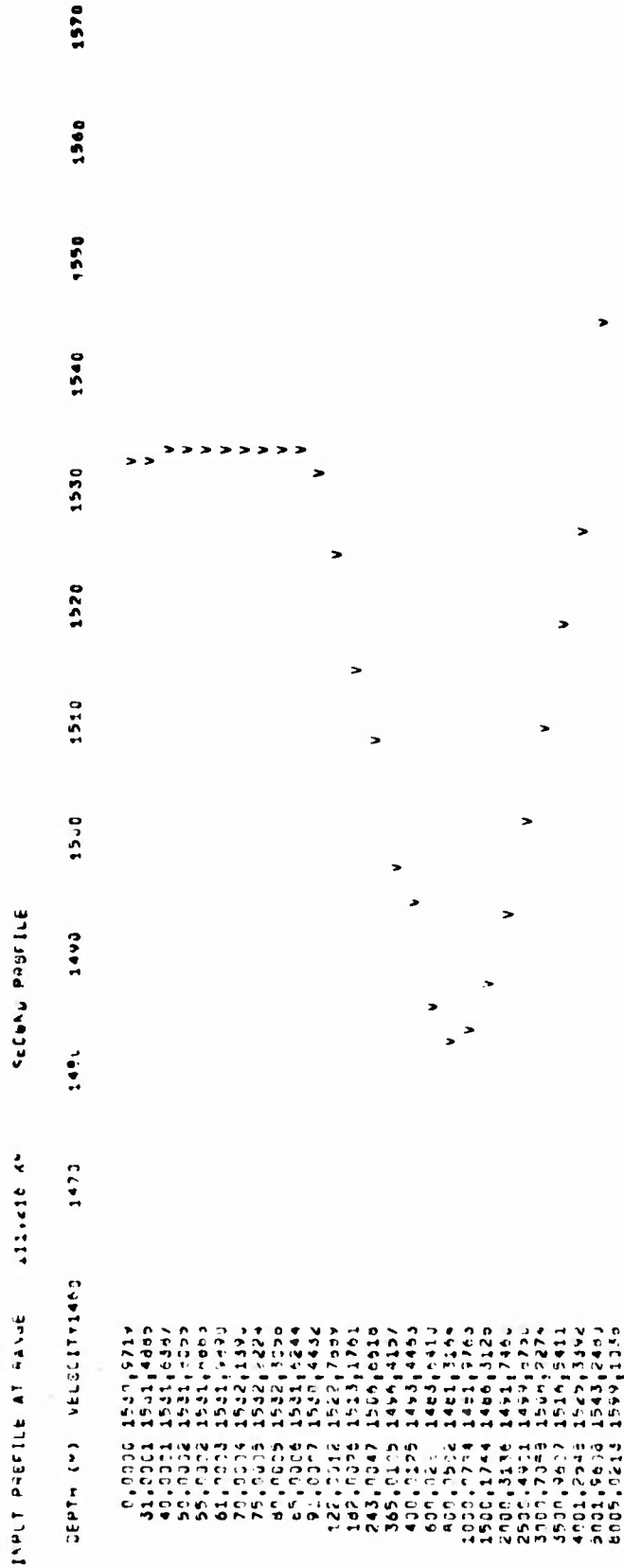


Fig. Bib — Input profile at 111.216 km

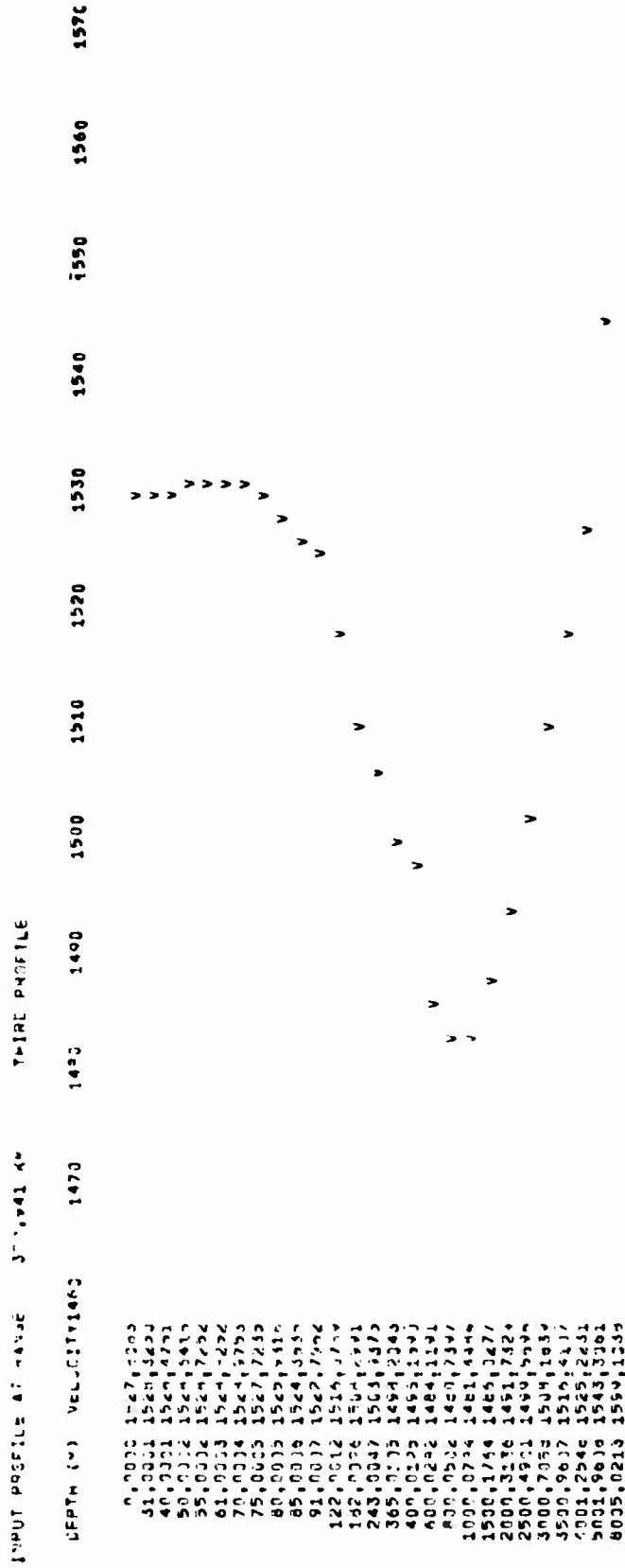


Fig. B1c — Inpvt Profile at 329.941 km

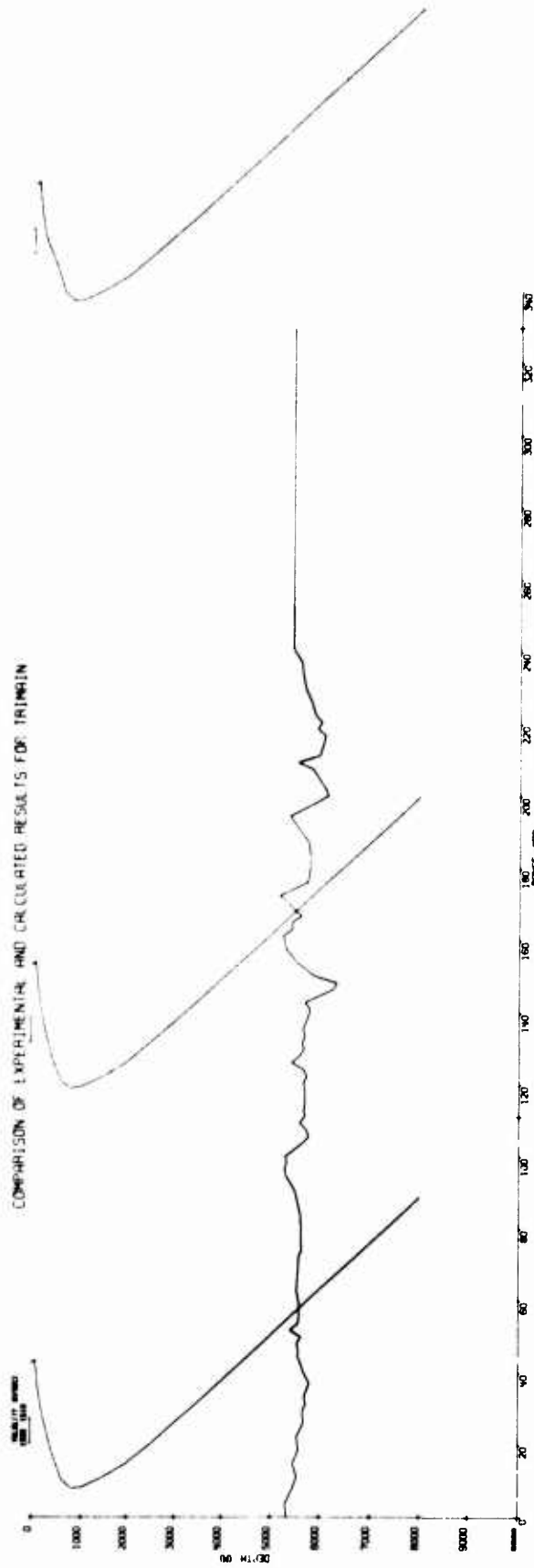


Fig. B2 — Profiles and Bottom Track

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CALCULATED RESULTS RANGE LOSSES		00,000	01,000	02,000	03,000	04,000	05,000	06,000	07,000	08,000	09,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	26,000	27,000	28,000	29,000	30,000	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000	41,000	42,000	43,000	44,000	45,000	46,000	47,000	48,000	49,000	50,000	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000	61,000	62,000	63,000	64,000	65,000	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000	81,000	82,000	83,000	84,000	85,000	86,000	87,000	88,000	89,000	90,000	91,000	92,000	93,000	94,000	95,000	96,000	97,000	98,000	99,000	100,000
1,000	58,000	00,000	01,000	02,000	03,000	04,000	05,000	06,000	07,000	08,000	09,000	10,000	11,000	12,000	13,000	14,000	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	26,000	27,000	28,000	29,000	30,000	31,000	32,000	33,000	34,000	35,000	36,000	37,000	38,000	39,000	40,000	41,000	42,000	43,000	44,000	45,000	46,000	47,000	48,000	49,000	50,000	51,000	52,000	53,000	54,000	55,000	56,000	57,000	58,000	59,000	60,000	61,000	62,000	63,000	64,000	65,000	66,000	67,000	68,000	69,000	70,000	71,000	72,000	73,000	74,000	75,000	76,000	77,000	78,000	79,000	80,000	81,000	82,000	83,000	84,000	85,000	86,000	87,000	88,000	89,000	90,000	91,000	92,000	93,000	94,000	95,000	96,000	97,000	98,000	99,000	100,000

Fig. B3a — Calculated intensity values

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EXPERIMENTAL RESULTS RANGE		LOSSES	
2.515	50,630	98,527	62,750
3.126	42,250	99,198	64,120
5.258	42,120	102,441	66,500
6.429	43,130	104,113	66,870
6.701	40,630	105,305	66,620
6.773	41,480	106,706	68,270
10.744	43,370	108,128	61,880
12.114	46,000	109,499	67,500
13.427	45,370	110,871	63,620
14.859	42,620	112,243	62,000
16.201	46,500	113,614	61,250
19.460	46,750	114,986	61,120
21.731	44,870	116,357	69,500
22.463	47,750	117,939	67,120
23.774	48,250	119,210	65,000
25.146	47,000	120,962	62,870
26.518	48,000	121,954	68,870
27.889	49,500	123,325	63,370
29.261	51,120	124,497	64,260
30.632	48,870	126,468	106,120
32.004	48,250	127,440	108,870
33.376	47,750	128,912	111,120
36.576	46,720	131,103	113,120
37.248	48,370	131,555	112,620
39.319	50,880	132,507	114,377
41.451	50,750	136,246	110,750
42.762	51,500	137,417	110,500
43.434	52,250	138,909	109,620
46.177	52,500	140,360	112,250
47.549	51,750	141,732	111,500
48.920	47,620	143,104	112,120
52.721	51,120	144,475	111,750
55.093	50,000	145,847	111,500
56.464	52,000	147,218	110,370
57.836	53,500	149,276	107,500
62.746	48,750	150,447	105,750
64.118	44,380	152,019	101,870
65.489	48,620	153,391	99,750
66.770	46,000	154,762	66,120
68.203	44,120	157,505	63,370
69.723	45,370	158,977	66,000
71.095	47,370	160,249	63,130
72.466	47,370	161,420	63,250
75.209	48,370	162,942	63,500
76.581	48,370	166,378	65,120
77.953	45,120	168,250	66,120
79.324	46,880	170,093	63,250
80.696	48,000	172,304	62,500
82.067	47,870	173,736	62,620
83.439	48,130	175,108	64,120
86.182	48,000	176,479	67,870
87.554	46,880	177,951	63,500
88.925	46,800	179,222	65,120
90.297	48,130	180,594	69,380
91.669	48,500	183,794	68,130
93.040	49,500	185,166	63,130
94.412	48,620	186,538	68,500
95.783	46,800	198,535	102,500
97.155	48,750	199,906	102,620
		201,278	102,620
		202,449	101,620
		204,021	102,500
		205,393	68,370
		206,764	66,880
		208,136	65,870
		209,507	65,500
			210,979
			213,512
			216,256
			217,427
			218,999
			220,370
			221,742
			223,114
			224,485
			225,857
			227,228
			230,260
			231,572
			232,943
			234,315
			235,687
			237,058
			238,430
			239,801
			241,173
			242,545
			243,916
			246,888
			249,431
			251,003
			252,374
			253,746
			255,118
			256,489
			257,861
			259,232
			260,604
			262,490
			264,262
			265,633
			267,005
			268,376
			269,748
			271,120
			272,491
			273,863
			275,234
			276,606
			283,117
			284,488
			285,860
			287,231
			288,612
			289,975
			291,346
			292,718
			294,089
			295,461
			298,700
			300,152
			301,523
			302,895
			304,267
			305,638
			307,010
			95,370
			94,500
			96,500
			95,750
			97,620
			97,620
			98,620
			96,620
			96,500
			98,500
			100,120
			96,120
			94,870
			97,000
			96,620
			97,750
			102,250
			102,370
			98,620
			104,500
			99,380
			97,750
			97,750
			101,620
			102,000
			102,250
			101,250
			99,120
			97,370
			97,700
			98,370
			98,500
			99,250
			99,500
			99,500
			99,500
			98,130
			99,380
			99,500
			99,500
			97,120
			97,000
			99,370
			100,250
			96,750
			96,120
			99,380
			99,500
			98,620
			101,870
			103,500
			101,750
			99,500
			97,750
			102,120
			106,120
			102,870
			98,250
			96,250
			99,870
			100,620

Fig. B3b -- Experimental intensity values

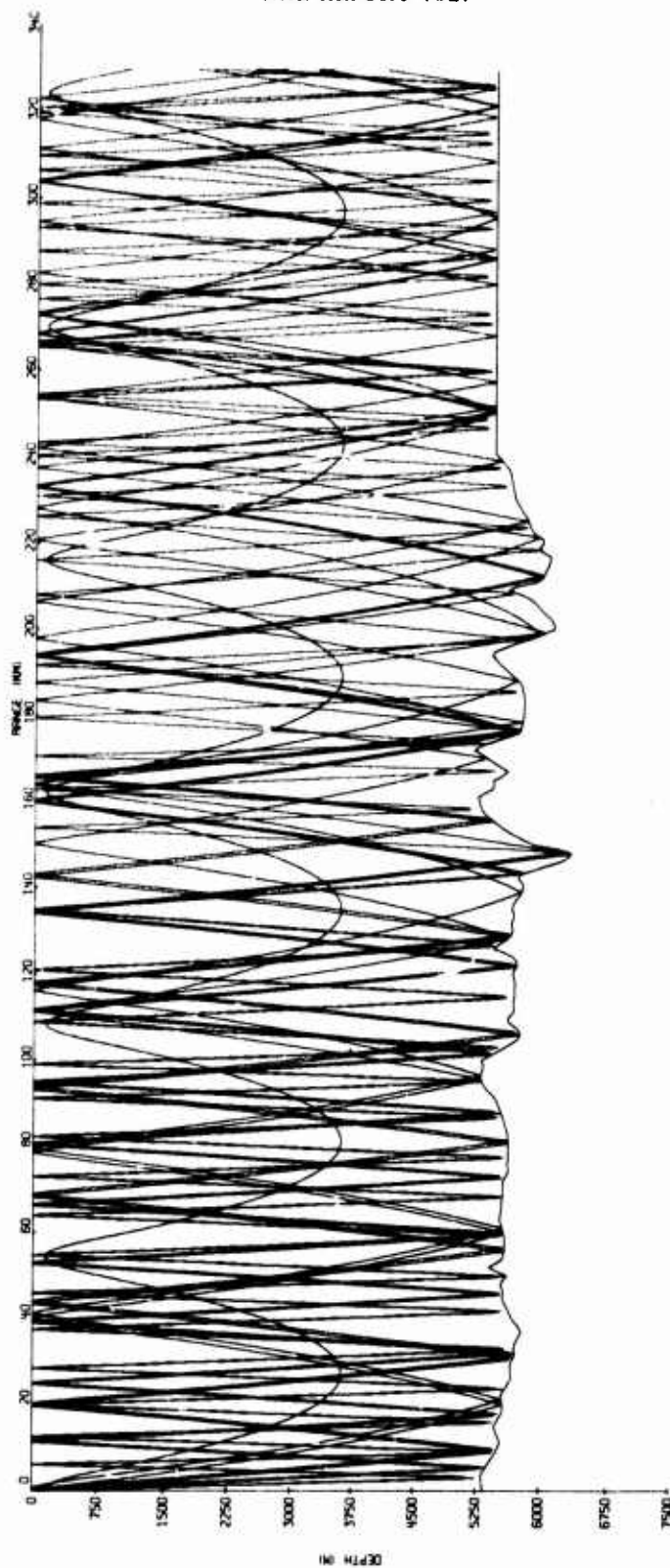


Fig. B4 - Selected rays which were traced (one ray every 15°)

COMPARISON OF EXPERIMENTAL AND CALCULATED RESULTS FOR TRAINING

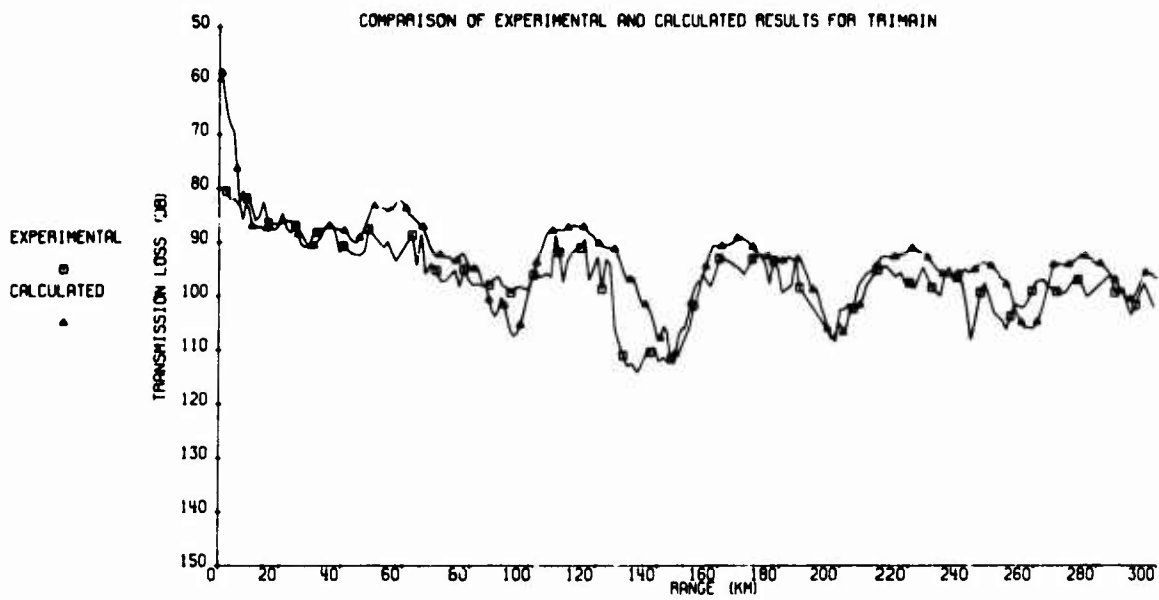


Fig. B5 — Comparison of experimental and calculated intensity values