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SIPT—A seismic refraction inverse modeling program for timeshare terminal computer systems

by

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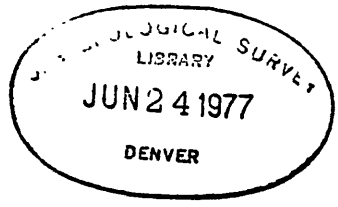

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

SIPT--A seismic refraction inverse modeling program for timeshare terminal computer systems

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Abstract

SIPT is an interactive Fortran computer program that was developed for use with a timeshare computer system with program control information submitted from a remote terminal, and output data displayed on the terminal or printed on a line printer. The program is an upgraded version of FSIP1 (Scott, Tibbetts, and Burdick, 1972) with several major improvements in addition to its adaptation to timeshare operation. The most significant improvement was made in the procedure for handling data from in-line offset shotpoints beyond the end shotpoints of the geophone spread. The changes and improvements are described, user's instructions are outlined, examples of input and output data for a test problem are presented, and the Fortran program is listed in this report.

An upgraded batch-mode program, SIPB, is available for users who do not have a timeshare computer system available (Scott, 1977).

Introduction

SIPT is an interactive Fortran-4 computer program for inverse modeling of seismic refraction data. Output of the program is presented in tables and as a plotted vertical cross section representing velocity layering beneath a line of seismic spreads. SIPT evolved from FSIP1, a batch-mode Fortran program developed and described by Scott, Tibbetts, and Burdick (1972) and by Scott (1973). SIPT has been developed and tested on a DEC-1070 computer with an ANSI Standard Fortran Compiler, and should be operable with only minor modification on any time-share machine with a virtual memory and a similar compiler.

This report describes the salient features of SIPT with emphasis on the changes and improvements that have been made over its predecessor FSIP1. An outline of user's instructions and examples of input and output data are presented along with a complete listing of the program.

Salient features of SIPT

The following basic assumptions apply to the inverse modeling procedure used in SIPT:

1. Layers are continuous and extend from one end of the line of refraction spreads to the other.
2. Layer velocity increases with layer depth.
3. Horizontal velocity is equal to or greater than vertical velocity for any given layer.
4. Although vertical and horizontal velocity for a given layer

may be different from one another, both velocities are constant from one end of a spread to the other. Vertical and horizontal velocities may vary from one spread to another.

5. The program user determines and specifies the refraction layer that is represented by each arrival time entered as input data. If a refraction layer is not specified, that arrival time is not used in computing the depth model.
6. The program user determines and specifies the position (in 3-D space) of each shotpoint and geophone for which arrival times are entered as input data.
7. Limits of input data:

   Number of layers in a problem: 2-5.

   Number of geophone spreads in a problem: 1-5.

   Number of shotpoints per spread: 1-7.

   Number of geophones per spread: 2-25.

   Number of problems per job: no limit.

The following changes and improvements over FSIP1 were made in developing SIPT:

1. SIPT is designed to be operated by remote terminal rather than by batch processing procedures.
2. Input data for SIPT are placed in a disk file in either of two modes: (1) formatted according to the card formats specified for FSIP1, or (2) free field for more convenient entry by remote terminal. (See examples under INPUT DATA.)

The first option makes it possible to use card decks previously punched for use with FSIP1.

3. Output options of SIPT are: terminal only, line printer only, or both terminal and printer. The volume of output data displayed on the terminal can be selectively reduced by use of type-out suppression options designated by keyboard entry in response to prompts typed out on the terminal during program execution.

4. Shotpoint explosive charges can be located in any layer in SIPT. In FSIP1 all shots were assumed to be in layer 1 which sometimes caused this layer to be distorted near the shotpoint when shots were located in deep holes.

5. In FSIP1 the refraction horizons were extrapolated beyond the end geophones of the end spreads using the dip that was determined for the horizon between the two end geophones. This procedure sometimes produced erroneous projections of refraction horizons, resulting in an unreasonable model, particularly when option JOFF=1 was selected, which caused rays to be traced from distant in-line offset shotpoints along projected refraction horizons. In SIPT, under the JOFF=1 option, refraction horizons are extended beyond the spread ends to the actual entry point of the ray traced from the offset shotpoint into the refraction horizon during the previous iteration of ray tracing. Under the JOFF=0 option the refraction horizon is projected using

the dip obtained by linear regression of depth points occurring under the half of the geophone spread in question. This procedure usually projects the refraction horizon at a much gentler and more reasonable dip. However, in cases where this approach still produces an unreasonable result, a new option called IDIP can be selected by placing a 1 (rather than zero or blank) in column 80 of the second control cord, or in the case of free field data, by inserting a 1 (rather than zero) as the 18th (and last) variable entry on the second input data record. This option (IDIP=1) causes the ray-tracing subroutine RAYUP to use the average slope of the ground surface along the geophone spread(s) in place of the computed dip of the refraction horizons in tracing a ray from a refractor to a target geophone or shotpoint, which is equivalent to making the assumption that the directions taken by rays entering and emerging from the refraction horizon are those that would occur if all layers were parallel with the ground surface. The model layers are not forced to be parallel with the surface by this option. However, the selection of this option cannot result in a completely valid model unless the refraction horizons are actually parallel with the ground surface, and it should not be used except as a last resort to obtain a reasonable model when large and uncorrectable errors are associated with input data. The

IDIP option of SIPT replaces the IFILL option of FSIP1, an option that was seldom used and never needed since it merely changed the selection of characters used in producing the printer plot of the vertical cross-sectional model. Removal of the IFILL option has simplified subroutine PLOT, resulting in more efficient operation.

6. The option JOFF=0, obtained by putting a blank or zero in column 79 of the second control card in FSIP1, has been improved significantly in SIPT. The objective of this option is to reference the arrival times associated with offset shotpoints (beyond the spread end shotpoints) to the arrival times of the end shotpoints and then to trace the rays from the end shotpoints to the target geophones rather than from the offset shotpoints to the target geophones. This approach has the advantage of avoiding the need for an error-prone extrapolation of the refraction horizon beyond the end shotpoints (as described in item 5 above). However, one of the limitations of selecting this option with the old FSIP1 program was that the offset shotpoint arrival times could not be referenced to the end shotpoint times for a given layer unless at least one of the geophones received refraction arrivals (representing the layer in question) from both the offset shotpoint and the end shotpoint. In the new program SIPT, if the arrival times from the two shotpoints from the refractor do not overlap, two lines are

fitted (by least squares) to the arrival times that are recorded from the two shotpoints for the refraction horizon, and the reference time correction (which is later subtracted from the offset shotpoint arrival times) is taken as the time difference between the two fitted lines at a point midway between the two inner geophones, one receiving an arrival from the offset shotpoint, the other from the end shotpoint.

7. As an extension of item 6 (above), in FSIP1 if no arrivals from the deepest refraction horizon were obtained by shooting the end shotpoint, then there was no way of referencing the arrivals obtained from the offset shotpoint to those obtained from the end shotpoint for the option JOFF=0, and the option JOFF=1 had to be used to obtain an interpretation down to the deepest layer. In SIPT, this problem is overcome by determining a reference correction time under the assumption that the two deepest layers are parallel. If this assumption is made, the times representing the deepest layer can be referenced to the arrivals representing the next shallower layer (obtained from the same shotpoint) by subtracting

$$\Delta t_{i+1} = \frac{V_i}{V_{i+1}} \cdot \Delta t_i$$

from the arrivals representing the deepest layer. In the above formula Δt_i represents the reference correction time

for referencing the arrivals from the offset shotpoint to the end shotpoint for the next shallower layer i (Δt_i is obtained by the technique described in item 6 above). V_i and V_{i+1} represent the apparent velocities for the deepest layer i+1 and the next shallower layer i, and are determined by fitting lines (by least squares) to the arrival times representing the two layers.

8. A new option called XTRUE is available in SIPT. Its normal (default) value is zero (obtained by placing a zero or blank in column 20 of the spread control card, or as the 5th word of the equivalent record in a free-field data file). The purpose of the option is to correct for the slope of the ground surface and to compute new inline coordinate values (x) for geophone and shotpoint locations for XTRUE=0. If the inline coordinate values for shotpoints and geophones are corrected for surface slope prior to entry into input data files, then the option XTRUE=1 should be selected to skip the correction. When the slope correction option XTRUE=0 is selected, the position of geophone number 1 is left unchanged and all other shotpoints and geophones are referenced to it. Users should be aware that the XSHIFT option (4th word on spread control card or record) is not affected by this new option (XSHIFT is not corrected for slope of the ground surface when XTRUE=0) and it is the user's responsibility to correct XSHIFT for surface slope before it is entered into the input data file.

User's instructions

The following instructions are divided into two sections: (1) Preparation of data files, and (2) Executing SIPT by remote terminal.

1. Preparation of data files:

   A. Card input

      1. Data cards may be prepared using formats described by Scott, Tibbets and Burdick (1972) (Appendix A, p. 27-32) except that the new control variable IDIP replaces IFILL in column 80 of the second control card. (See item 5 on p. 4-6 of this report.) The new variable XTRUE is available for correcting x-distances for the slope of the ground surface (see item 8, p. 8).

      2. Card image files are entered into the computer disk storage system and are assigned discrete names with a separate file with a discrete name for each problem.

   B. Free field input

      1. When data files are entered directly from the terminal it is more convenient to enter them in free field form than in card formatted form. This is accomplished by typing commas between adjacent numeric data values rather than placing them in specific columns or fields. Alphanumeric characters

representing spread symbols and shotpoint symbols occupy only one space (column) of the record, and are followed immediately by the next data value without separation by a comma or a space (see example). Data for each problem are entered as a discrete file and each problem is given a unique file name. The "END" card (END punched in columns 1-3) that is required as the last card in an input data file for FSIP1 is not needed in a data file to be used with SIPT, although its presence will do no harm.

2. Executing SIPT by remote terminal:

   A. Log in and give the proper system commands to compile and execute SIPT.

   B. Respond to program-generated prompts as indicated below.

      1. "ENTER DATA FILE NAME (OR <CR> TO EXIT):" The proper response to this prompt is to type in the discrete name of the disk file containing input data for the problem to be processed, followed by a carriage return. If all problems in the job have been processed, press the carriage return key without preceding it with any other keyboard entry. This will stop execution of the program and exit from it so that the user may log off the terminal or enter some other job.

2. "ENTER INPUT FMT TYPE: C=CARD, F=FREE FIELD:"
   If the input data file is formatted according to the card formats specified for FSIP1, type in "C" followed by a carriage return. If the input file is prepared in free field format, type in "F" followed by a carriage return.
3. "ENTER OUTPUT UNIT: P=LPT, T=TERMNL, B=BOTH:"
   Type "P" for output on the line printer, "T" for output on the terminal, and "B" for output on both the line printer and the terminal. Follow the character typed with a carriage return. If either the "T" or "B" options are selected, the prompts marked with asterisks below will be typed during execution of SIPT; if the "P" option is selected, these prompts will not be typed.
4. "ENTER NEW EXIT, -6 THRU +6 or <CR> FOR OLD:" If you want to change the exit number from the one specified in the input data file, enter the desired exit number (preceded by a minus sign for brief output or by a plus sign or no sign for full output), and then type a carriage return. If you do not wish to change the exit number, simply press the carriage return key without a prior entry. If the exit number is negative and "P" was selected in response to the prompt in item 3 above, the

program will complete computation of the problem, print results on the line printer, and cycle back to the first prompt which calls for entry of a new input data file.

*5. "TABLE OF SP & GEO DATA? ENTER TO TO TYPE, <CR> TO SUPPRESS:" Type "T" followed by a carriage return if you want the input data file containing shotpoint, geophone, and arrival time data typed back out on the terminal. If you want this information suppressed, press the carriage return key without a prior entry. If the "B" output option was selected in item 3 above, the table of shotpoint and geophone data will be printed on the line printer regardless of the response to this prompt. If the "P" option was selected, the prompt is skipped and no response is needed.

6. "T-D PLOT: 1=RAW, 2=DATUM, 3=PRE-D, 4=L1 REMOVED:" This prompt will be suppressed (because it is not applicable) if the exit number selected in item 4 is negative, or if it is negative on the original data file if a new exit is not selected in response to the item 4 prompt. In the case of a negative exit number the T-D (time-distance) plot is omitted from both printer and terminal output. If the

* This prompt is skipped for output option "P" (See item 3 of this section.)

prompt is typed, the proper response is to type a "1" to obtain a T-D plot of the raw arrival times, "2" for a T-D plot with arrival times corrected to the datum plane, "3" for a T-D plot showing arrival times as they exist just prior to depth computation of layer 1. This plot will show the arrival times from offset shotpoints referenced to those from end shotpoints if the option JOFF=0 is selected. Type "4" to obtain a T-D plot with layer 1 stripped away. After the desired number is typed, press the carriage return key. Only one number (and one T-D plot) may be selected for any given problem run. The T-D plot is made on the line printer or on the terminal, not on an x-y plotting device. If option "T" or "B" was selected in item 3 above, the following prompts are typed out. If "P" was selected the program cycles back to the first prompt which calls for entry of another input data file.

*7. "ENTER T TO TYPE, <CR> TO SUPPRESS: If you want the T-D plot typed out on the terminal, type in "T" followed by a carriage return. If you want it suppressed, press the carriage return key without

---

* This prompt is skipped for output option "P". (See item 3 of this section.)

a prior entry. If option "B" was selected in item 3 above, the T-D plot will be printed on the line printer regardless of the response to this prompt.

*8. "TABLE OF RAY END POINTS? T TO TYPE, <CR> TO SUPPRESS:" Type in a "T" followed by a carriage return to have a table of elevations and x-coordinate distances typed out for all points of entry and emergence of critically refracted rays into and out of refracting horizons. Press the carriage return key without a prior entry to suppress this table on the terminal. The table will be printed on the line printer if the "B" option was selected in item 3 above regardless of the response to this prompt.

*9. "DEPTH BENEATH SPS-GEOS? T TO TYPE, <CR> TO TO SUPPRESS:" Type in a "T" followed by a carriage return to type out this table of depths and elevations of refracting horizons beneath each shotpoint and geophone. Press the carriage return key without a prior entry to suppress this type out. The table will be printed on the line printer regardless of the response to this prompt if the "B" option was selected in item 3 above.

* This prompt is skipped for output option "P". (See item 3 of this section.)

*10. "DEPTH PLOT? ENTER T TO TYPE, <CR> TO SUPPRESS:"
Type "T" followed by a carriage return to obtain a typed plot with reduced depth scale of the cross section representing the interpreted two-dimensional model. To suppress this plot, press the carriage return key without a prior entry. The depth plot will be plotted on the line printer if option "B" was selected in 3 above, regardless of the response to this prompt.

After a response is made to this prompt the program cycles back to the first prompt which calls for entry of a new input data file.

* This prompt is skipped for output option "P". (See item 3 of this section.)

References

Scott, J. H., Tibbetts, B. L., and Burdick, R. G., 1972, Computer analysis of seismic refraction data: USBM R.I. 7595, 95 p.

Scott, J. H., 1973, Seismic refraction modeling by computer: Geophysics, v. 38, no. 2, p. 271-284.

Scott, J. H., 1977, SIPB--a seismic refraction inverse modeling program for batch computer systems: U.S. Geol. Survey Open-File Rept. 77-366, 108 p.

APPENDIX A. -- Input data examples

Card input data

Input data in card format for the test problem SIPTST.J06 is listed below. Output is listed in Appendix B.

```
SIPTST.J06  SPREADS S AND $      DEMONSTRATION OF EXIT 6
2 6 4 4  2.5    00
1  1520
2  5900
3  9500
4 15000
S  3 12              1
S  A  24869   -29             2
S  C  24930   400             2
S  B  25075   900             2
S  1  24856     0            13  2  69  3  97  4
S  2  24841    75            24  2  57  3  93  4
S  3  24840   150            36  2  47  3  87  4
S  4  24873   225           485  2  43  2 865  4
S  5  24902   300            62  3  37  2  86  4
S  6  24843   375            66  3  19  2  75  4
S  7  25010   450            78  3  25  2  75  4
S  8  24911   497            73  3  24  2  64  3
S  9  24987   600            81  4  43  2  60  3
S 10  25132   675            93  4  65  3  56  2
S 11  25005   775            91  4  69  3  34  2
S 12  25059   875            99  4  78  3  18  2
$  4 12       675  1
$  L  24869  -704             2
$  A  24987  - 75             2
$  C  25117   275             2
$  B  25499   563             2
$  1  25132     0            92  4 275  2  65  3  87  4
$  2  25003    50            86  4 275  2  50  3  74  4
$  3  25005   100            88  4  37  2  44  3  71  4
$  4  25024   150            96  4 485  2  40  2  72  4
$  5  25059   200            99  4  56  2  30  2 685  4
$  6  25096   250           995  4  57  4  19  2  62  4
$  7  25137   300           105  4  62  4  20  2  59  4
$  8  25174   350           107  4 645  4  30  2  55  4
$  9  25207   400           108  4  65  4  39  2  49  4
$ 10  25293   450           113  4  70  4  50  2  47  4
$ 11  25381   500          1165  4  74  4  55  3  45  2
$ 12  25445   525           119  4  77  4  60  3  46  1
END
```

Free field input data

Input data in free field form for the test SIPTST.TTY is listed below. Output is listed in Appendix B.

```
SIPTST.TTY  SPREADS S AND $      DEMO OF EXIT 6
2,6,4,4,2.5,16.66667,0,0,0,0,0,0,0,0,0,0,0,0
1,1520
2,5900
3,9500
4,15000
S3,12,0,1
SA2486.9,-29,0,2
SC2493.0,400,0,2
SB2507.5,900,0,2
S1,2485.6,0,0,13,2,69,3,97,4
S2,2484.1,75,0,24,2,57,3,93,4
S3,2484.0,150,0,36,2,47,3,87,4
S4,2487.3,225,0,48.5,2,43,2,86.5,4
S5,2490.2,300,0,62.3,37,2,86,4
S6,2484.3,375,0,66,3,19,2,75,4
S7,2501.0,450,0,78,3,25,2,75,4
S8,2491.1,497,0,73,3,24,2,64,3
S9,2498.7,600,0,81,4,43,2,60,3
S10,2513.2,675,0,93,4,65,3,56,2
S11,2500.5,775,0,91,4,69,3,34,2
S12,2505.9,875,0,99,4,78,3,18,2
$4,12,675,1
$L2486.9,-704,0,2
$A2498.7,-75,0,2
$C2511.7,275,0,2
$B2549.9,563,0,2
$1,2513.2,0,0,92,4,27.5,2,65,3,87,4
$2,2500.3,50,0,86,4,27.5,2,50,3,74,4
$3,2500.5,100,0,88,4,37,2,44,3,71,4
$4,2502.4,150,0,96,4,48.5,2,40,2,72,4
$5,2505.9,200,0,99,4,56,2,30,2,68,5,4
$6,2509.6,250,0,99.5,4,57,4,19,2,62,4
$7,2513.7,300,0,105,4,62,4,20,2,59,4
$8,2517.4,350,0,107,4,64.5,4,30,2,55,4
$9,2520.7,400,0,108,4,65,4,39,2,49,4
$10,2529.3,450,0,113,4,70,4,50,2,47,4
$11,2538.1,500,0,116.5,4,74,4,55,3,45,2
$12,2544.5,525,0,119,4,77,4,60,3,46,1
```

APPENDIX B. -- Output data examples

Terminal output

Terminal output for the test problem SIPTST.JO6 is given on the following pages. Output for compiling and loading the program on DEC-10 computer system is given below.

```
.EX SIPT.FOR
FORTRAN: SIPT
MAIN.
RAYUP
TERP
KENDS
REGPES
REGV
HOEV
EXTRP
ELCOR
DIP
AVG
ADMIG
RAYCOR
FILLIN
PLOT
SETIP
HTIME
TIE
LINK:    Loading
[LNKXCT SIPT Execution]
```

```
.EX SIPT.REL
LINK:   LOADING
[LINKXCT SIPT Execution]

ENTER DATA FILE NAME (OR <CR> TO EXIT):       SIPTST.TTY
 ENTER INPUT FMT TYPE: C=CARD, F=FREE FIELD: F
 ENTER OUTPUT UNIT: P=LPT, T=TERMNL, B=BOTH: T
 ENTER NEW EXIT, -6 THRU +6 OR <CR> FOR OLD:

                                SIPT REV 20

SIPTST.TTY  SPREADS C AND $      DEMO OF EXIT 6

CONTROL CARD DATA

$ X L V  FT/C  FT/R  MS/C EDAT1/2 XDAT1/2 SLOPE INTCP BLIM  TLIM T D D
2 6 4 4   2.5  16.7   1.0     0.0     0.0 .0000   0.0 0.50  10.0 0 0 0
                              0.0     0.0

VELOCITY CARDS

      SPREAD 1       SPREAD 2       SPREAD
L     VV     VH      VV     VH
1   1520.    0.      0.     0.
2   5900.    0.      0.     0.
3   9500.    0.      0.     0.
4  15000.    0.      0.     0.

TABLE OF SP & GEO DATA? T TO TYPE, <CR> TO SUPPRESS: T

SHOTPOINT AND GEOPHONE DATA

 SPREAD C, 3 SHOTPOINTS, 12 GEOPHONES, XSHIFT =      0.0, XTRUE = 1

 SP    ELEV     X LOC     Y LOC     DEPTH   UPHOLE T  FUDGE T  END SP
 --  -------  --------  --------  --------  --------  --------  ------
  A  2486.9     -29.0       0.0       2.0       0.0       0.0       0
  C  2493.0     400.0       0.0       2.0       0.0       0.0       0
  B  2507.5     900.0       0.0       2.0       0.0       0.0       0

            ARRIVAL TIMES + FUDGE T AND LAYERS REPRESENTED

 G   ELEV      X       Y     SP A    SP C    SP B    SP
 -  -----   -----   -----   -----   -----   -----
 1  2486.      0.      0.   13. 2   69. 3   97. 4
 2  2484.     75.      0.   24. 2   57. 3   93. 4
 3  2484.    150.      0.   36. 2   47. 3   87. 4
 4  2487.    225.      0.   49. 2   43. 2   87. 4
 5  2490.    300.      0.   62. 3   37. 2   86. 4
 6  2484.    375.      0.   66. 3   19. 2   75. 4
 7  2501.    450.      0.   78. 3   25. 2   75. 4
 8  2491.    497.      0.   73. 3   24. 2   64. 3
 9  2499.    600.      0.   81. 4   43. 2   60. 3
10  2513.    675.      0.   93. 4   65. 3   56. 2
11  2501.    775.      0.   91. 4   69. 3   34. 2
12  2506.    875.      0.   99. 4   78. 3   18. 2

SHOTPOINT AND GEOPHONE DATA

 SPREAD $, 4 SHOTPOINTS, 12 GEOPHONES, XSHIFT =    675.0, XTRUE = 1

 SP    ELEV     X LOC     Y LOC     DEPTH   UPHOLE T  FUDGE T  END SP
 --  -------  --------  --------  --------  --------  --------  ------
  L  2486.9    -704.0       0.0       2.0       0.0       0.0       0
  A  2498.7     -75.0       0.0       2.0       0.0       0.0       0
  C  2511.7     275.0       0.0       2.0       0.0       0.0       0
  B  2549.9     563.0       0.0       2.0       0.0       0.0       0

            ARRIVAL TIMES + FUDGE T AND LAYERS REPRESENTED

 G   ELEV      X       Y     SP L    SP A    SP C    SP B    SP
 -  -----   -----   -----   -----   -----   -----   -----
 1  2513.      0.      0.   92. 4   28. 2   65. 3   87. 4
 2  2500.     50.      0.   86. 4   28. 2   50. 3   74. 4
 3  2501.    100.      0.   88. 4   37. 2   44. 3   71. 4
 4  2502.    150.      0.   96. 4   49. 2   40. 2   72. 4
 5  2506.    200.      0.   99. 4   56. 2   30. 2   69. 4
 6  2510.    250.      0.  100. 4   57. 4   19. 2   62. 4
 7  2514.    300.      0.  105. 4   62. 4   20. 2   59. 4
 8  2517.    350.      0.  107. 4   65. 4   30. 2   55. 4
 9  2521.    400.      0.  108. 4   65. 4   39. 2   49. 4
10  2529.    450.      0.  113. 4   70. 4   50. 2   47. 4
11  2538.    500.      0.  117. 4   74. 4   55. 3   45. 2
12  2545.    525.      0.  119. 4   77. 4   60. 3   46. 1
```

```
T-D PLOT: 1=RAW, 2=DATUM, 3=PRE-D, 4=LI PENVD: 3
ENTER T TO TYPE, <CR> TO SUPPRESS: T

OVERRIDE V1 =   1520.
OVERRIDE V2 =   5900.
OVERRIDE V3 =   8500.
OVERRIDE V4 =  15000.
```

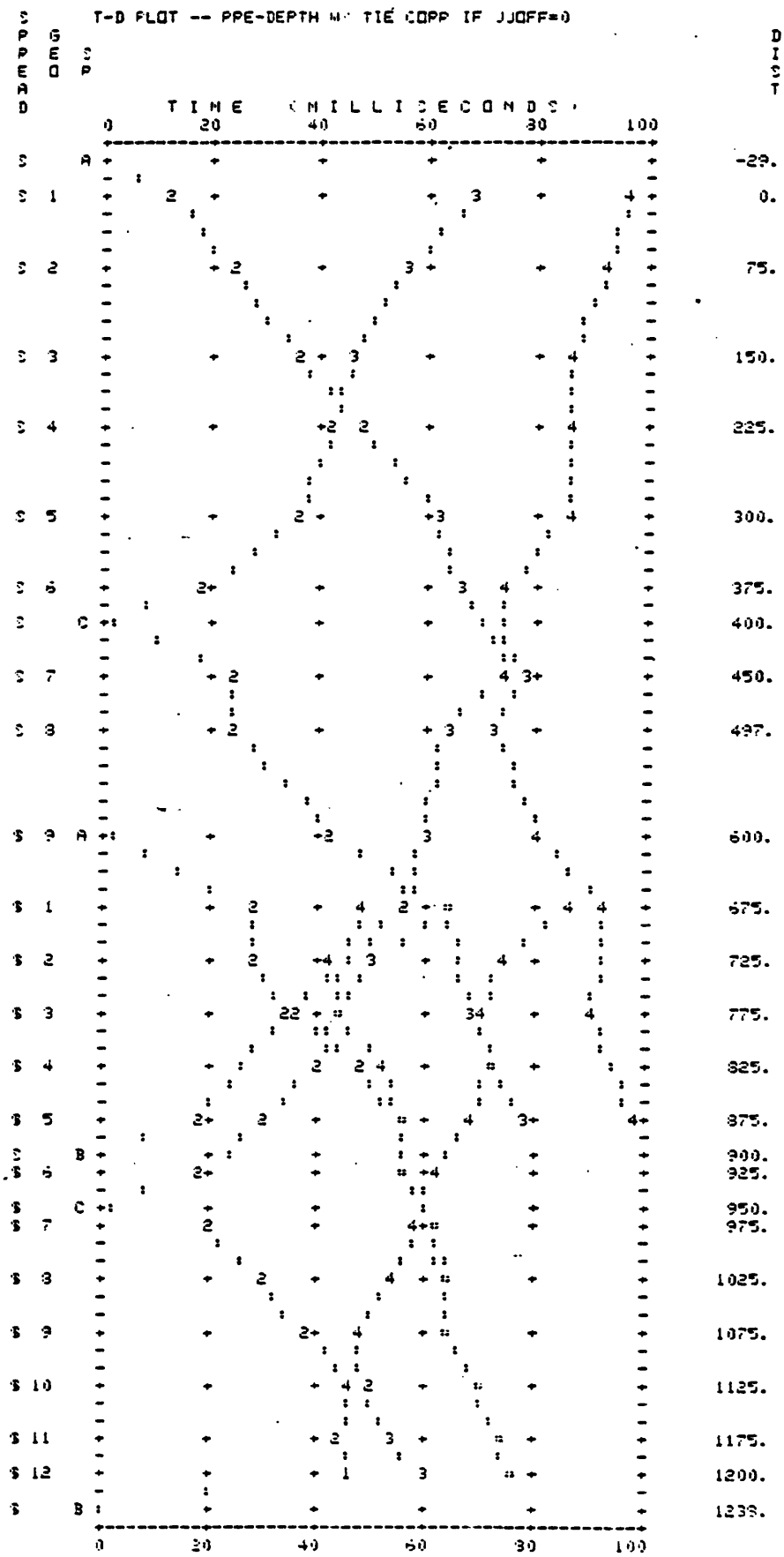


TABLE OF PAY END PTS? T TO TYPE, <CR> TO SUPPRESS: T

SPREAD 3 PAY END PTS BENEATH GEOPHONES

G		SP A	SP C	SP B	SP
1	X	-2. 2	69. 3	38. 4	
	EL	2476.1	2408.8	2391.8	
2	X	72. 2	129. 3	130. 4	
	EL	2474.9	2426.2	2372.6	
3	X	149. 2	204. 3	213. 4	
	EL	2479.9	2429.4	2354.4	
4	X	224. 2	226. 2	297. 4	
	EL	2482.4	2482.4	2324.2	
5	X	278. 3	304. 2	443. 4	
	EL	2446.5	2476.0	2314.0	
6	X	351. 3	377. 2	554. 4	
	EL	2445.2	2478.5	2327.5	
7	X	435. 3	447. 2	603. 4	
	EL	2464.0	2484.1	2350.7	
8	X	481. 3	496. 2	517. 3	
	EL	2469.9	2488.3	2452.4	
9	X	534. 4	599. 2	646. 3	
	EL	2346.8	2493.5	2425.5	
10	X	618. 4	597. 3	680. 2	
	EL	2372.8	2415.2	2493.7	
11	X	722. 4	714. 3	777. 2	
	EL	2388.8	2412.2	2490.7	
12	X	826. 4	831. 3	880. 2	
	EL	2396.5	2431.0	2492.6	

PAY END POINTS BENEATH SHOTPOINTS

L2 PT X	-26.	403.	0.	
EL	2475.9	2480.6	0.0	
L2 LF X	0.	398.	898.	
EL	0.0	2480.2	2494.2	
L3 PT X	32.	442.	0.	
EL	2415.8	2439.9	0.0	
L3 LF X	0.	379.	857.	
EL	0.0	2449.5	2434.0	
L4 PT X	8.	0.	0.	
EL	2392.1	0.0	0.0	
L4 LF X	0.	0.	839.	
EL	0.0	0.0	2379.6	

SPREAD 1 PAY END PTS BENEATH GEOPHONES

G		SP L	SP A	SP C	SP B	SP
1	X	615.4	670.2	732.3	750.4	
	EL	2366.5	2493.8	2428.7	2384.7	
2	X	671.4	724.2	778.3	793.4	
	EL	2381.7	2493.4	2435.4	2394.0	
3	X	725.4	772.2	818.3	841.4	
	EL	2393.2	2491.9	2444.2	2399.3	
4	X	768.4	819.2	831.2	905.4	
	EL	2382.7	2487.4	2487.5	2392.0	
5	X	819.4	873.2	880.2	964.4	
	EL	2384.1	2492.0	2492.6	2392.9	
6	X	881.4	880.4	929.2	1008.4	
	EL	2402.3	2402.1	2496.8	2418.0	
7	X	925.4	927.4	972.2	1066.4	
	EL	2395.3	2398.2	2499.4	2428.1	
8	X	993.4	993.4	1022.2	1109.4	
	EL	2413.2	2413.0	2501.6	2442.7	
9	X	1057.4	1058.4	1071.2	1136.4	
	EL	2437.9	2440.7	2504.4	2465.7	
10	X	1113.4	1114.4	1122.2	1171.4	
	EL	2456.0	2458.8	2508.9	2480.1	
11	X	1173.4	1173.4	1164.3	1183.2	
	EL	2487.9	2488.0	2494.5	2514.6	
12	X	1200.4	1199.4	1190.3	0.1	
	EL	2504.6	2501.9	2500.5	0.0	

PAY END POINTS BENEATH SHOTPOINTS

L2 RT X	0.	601.	954.	0.	
EL	0.0	2493.5	2498.3	0.0	
L2 LF X	0.	0.	948.	1238.	
EL	0.0	0.0	2497.9	2518.2	
L3 RT X	0.	640.	992.	0.	
EL	0.0	2433.9	2462.7	0.0	
L3 LF X	0.	0.	930.	1232.	
EL	0.0	0.0	2453.6	2509.8	
L4 RT X	669.	669.	0.	0.	
EL	2389.3	2389.3	0.0	0.0	
L4 LF X	0.	0.	0.	1236.	
EL	0.0	0.0	0.0	2505.8	

```
DEPTH BENEATH SPS-GEOS? T TO TYPE, <CR> TO SUPPRESS: T

SPREAD 3   DEPTHS BENEATH SPS & GEOS

                              LAYER 2        LAYER 3        LAYER 4        LAYER
SP     X       EL      DEPTH  ELEV    DEPTH  ELEV    DEPTH  ELEV
--   ---     ----    ------------    ------------    ------------
 A   -29.  2486.9    11.3 2475.6    81.6 2405.3    95.3 2391.6
 C   400.  2493.0    12.2 2480.8    42.0 2451.0   143.8 2349.2
 B   900.  2507.5    13.3 2494.2    58.9 2448.6   109.5 2398.0

GEO
---
 1     0.  2485.6     9.8 2475.8    77.1 2408.5    98.1 2387.5
 2    75.  2484.1     9.0 2475.1    67.8 2416.3   101.9 2382.2
 3   150.  2484.0     4.1 2479.9    57.9 2426.1   118.0 2366.0
 4   225.  2487.3     4.9 2482.4    51.8 2435.5   139.6 2347.7
 5   300.  2490.2    13.8 2476.4    46.8 2443.4   153.3 2336.9
 6   375.  2484.3     5.3 2479.0    35.8 2448.5   141.1 2343.2
 7   450.  2501.0    16.6 2484.4    45.1 2455.9   139.8 2361.2
 8   497.  2491.1     2.7 2488.4    38.6 2452.5   133.1 2358.0
 9   600.  2498.7     5.2 2493.5    65.7 2433.0   139.0 2359.7
10   675.  2513.2    19.6 2493.6    87.7 2425.5   135.3 2377.9
11   775.  2500.5     9.9 2490.6    68.9 2431.6   111.8 2388.7
12   875.  2505.9    14.0 2491.9    61.2 2444.7   110.2 2395.7

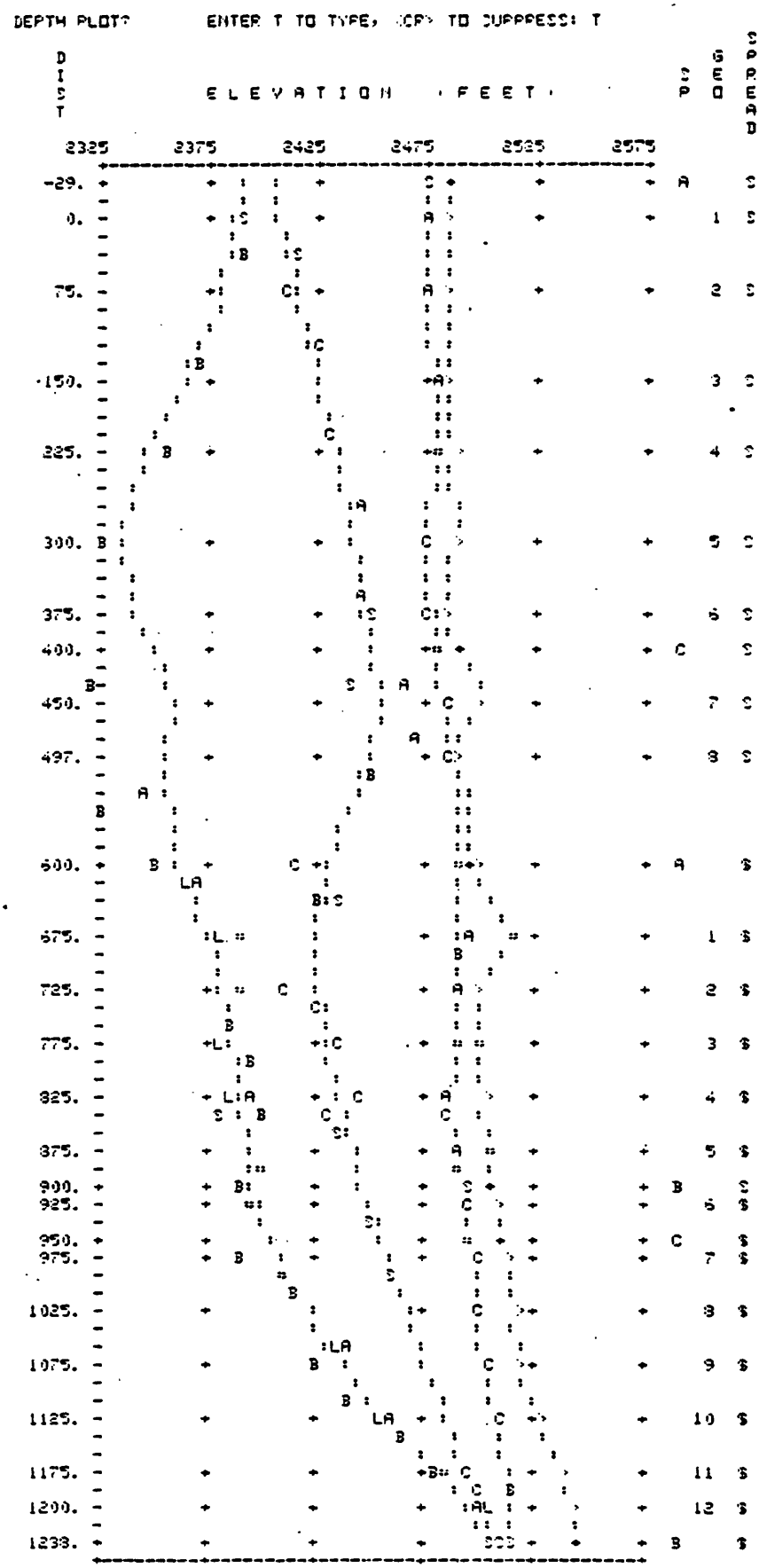
VELOCITIES USED
          LAYER 1        LAYER 2        LAYER 3        LAYER 4        LAYER
VERTICAL   1520.          5900.          9500.
HORIZONTAL                5900.          9500.         15000.

SPREAD 5   DEPTHS BENEATH SPS & GEOS

                              LAYER 2        LAYER 3        LAYER 4        LAYER
SP     X       EL      DEPTH  ELEV    DEPTH  ELEV    DEPTH  ELEV
--   ---     ----    ------------    ------------    ------------
 A   600.  2498.7     5.2 2493.5    65.7 2433.0   139.0 2359.7
 C   950.  2511.7    13.8 2497.9    55.4 2456.3   106.9 2404.8
 B  1238.  2549.9    31.5 2518.4    41.4 2508.5    41.4 2508.5

GEO
---
 1   675.  2513.2    19.5 2493.7    87.7 2425.5   135.3 2377.9
 2   725.  2500.3     6.9 2493.4    71.8 2428.5   117.0 2383.3
 3   775.  2500.5     9.2 2491.3    68.9 2431.6   111.9 2388.7
 4   825.  2502.4    14.9 2487.5    64.3 2438.1   110.2 2392.2
 5   875.  2505.9    13.8 2492.1    61.2 2444.7   110.2 2395.7
 6   925.  2509.6    13.3 2496.3    57.2 2452.4   109.4 2400.2
 7   975.  2513.7    14.3 2499.4    53.5 2460.2   104.3 2409.4
 8  1025.  2517.4    15.6 2501.8    47.9 2469.5    93.6 2423.8
 9  1075.  2520.7    16.0 2504.7    42.1 2478.6    80.3 2440.4
10  1125.  2529.3    20.1 2509.2    41.5 2487.8    69.5 2459.8
11  1175.  2538.1    24.3 2513.8    41.1 2497.0    50.3 2487.8
12  1200.  2544.5    28.9 2515.6    43.0 2501.5    48.1 2496.4

VELOCITIES USED
          LAYER 1        LAYER 2        LAYER 3        LAYER 4        LAYER
VERTICAL   1520.          5900.          9500.
HORIZONTAL                5900.          9500.         15000.
```


DEPTH PLOT? ENTER T TO TYPE, <CR> TO SUPPRESS: T
DIST
ELEVATION (FEET)
SP
GEO
SPREAD
2325
2375
2425
2475
2525
2575
-29.
0.
75.
150.
225.
300.
375.
400.
450.
497.
600.
675.
725.
775.
825.
875.
900.
925.
950.
975.
1025.
1075.
1125.
1175.
1200.
1238.

Line printer output

Printer output for the test problem SIPTST.J06 is on the following pages. Note that the selection of exit -6 (instead of 6 given in the example of terminal output) reduces the amount of output information printed. Terminal output for executing the program is given below.

```
ENTER DATA FILE NAME (OR <CR> TO EXIT):        SIPTST.J06
 ENTER INPUT FMT TYPE: C=CARD, F=FREE FIELD: C
 ENTER OUTPUT UNIT: P=LPT, T=TERMNL, B=BOTH: P
 ENTER NEW EXIT, -6 THRU +6 OR <CR> FOR OLD: -6

ENTER DATA FILE NAME (OR <CR> TO EXIT):
STOP

END OF EXECUTION
CPU TIME: 52.85 ELAPSED TIME: 19:7.45
EXIT
[59.76  556 108]
```

SIPTST.J06 SPREADS 3 AND 4 DEMONSTRATION OF EXIT 6

CONTROL CARD DATA

				PLOT SCALES			DATUM OVERRIDE VALUES									
				ELEV	HORIZ	TIME	POINT 1		POINT 2							
SPRDS	EXIT	LAYERS	VCARDS	FT/COL	FT/ROW	MS/COL	ELEV	X POS	ELEV	X POS	SLOPE	INTCPT	BLIM	TLIM	TRACE	OFF	DIP
2	-6	4	4	2.5	8.3	1.0	0.0	0.0	0.0	0.0	0.0000	0.0	0.50	10.0	0	0	0

VELOCITY CARDS

	SPREAD 1		SPREAD 2		SPREAD
LAYER	VV	VH	VV	VH	
1	1520.	0.	0.	0.	
2	5900.	0.	0.	0.	
3	9500.	0.	0.	0.	
4	15000.	0.	0.	0.	

SHOTPOINT AND GEOPHONE DATA

SPREAD 3, 3 SHOTPOINTS, 12 GEOPHONES, XSHIFT = 0.0, XTRUE = 1

SP	ELEV	X LOC	Y LOC	DEPTH	UPHOLE T	FUDGE T	END SP
A	2486.9	-29.0	0.0	2.0	0.0	0.0	0
C	2493.0	400.0	0.0	2.0	0.0	0.0	0
B	2507.5	900.0	0.0	2.0	0.0	0.0	0

				ARRIVAL TIMES + FUDGE T AND LAYERS REPRESENTED						SP
GEO	ELEV	X LOC	Y LOC	SP A		SP C		SP B		
1	2485.6	0.0	0.0	13.0	2	69.0	3	97.0	4	
2	2484.1	75.0	0.0	24.0	2	57.0	3	93.0	4	
3	2484.0	150.0	0.0	36.0	2	47.0	3	87.0	4	
4	2487.3	225.0	0.0	48.5	2	43.0	2	86.5	4	
5	2490.2	300.0	0.0	62.0	3	37.0	2	86.0	4	
6	2484.3	375.0	0.0	66.0	3	19.0	2	75.0	4	
7	2501.0	450.0	0.0	78.0	3	25.0	2	75.0	4	
8	2491.1	497.0	0.0	73.0	3	24.0	2	64.0	3	
9	2498.7	600.0	0.0	81.0	4	43.0	2	60.0	3	
10	2513.2	675.0	0.0	93.0	4	65.0	3	56.0	2	
11	2500.5	775.0	0.0	91.0	4	69.0	3	34.0	2	
12	2505.9	875.0	0.0	99.0	4	78.0	3	18.0	2	

SIPTST,J06 SPREADS 8 AND 8 DEMONSTRATION OF EXIT 6

SHOTPOINT AND GEOPHONE DATA

SPREAD 8, 4 SHOTPOINTS, 12 GEOPHONES, XSHIFT = 675.0, XTRUE = 1

SP	ELEV	X LOC	Y LOC	DEPTH	UPHOLE T	FUDGE T	END SP
L	2486.9	-704.0	0.0	2.0	0.0	0.0	0
A	2498.7	-75.0	0.0	2.0	0.0	0.0	0
C	2511.7	275.0	0.0	2.0	0.0	0.0	0
B	2549.9	563.0	0.0	2.0	0.0	0.0	0

GEO	ELEV	X LOC	Y LOC	ARRIVAL TIMES + FUDGE T AND LAYERS REPRESENTED SP L	SP A	SP C	SP B
1	2513.2	0.0	0.0	92.0 4	27.5 2	65.0 3	87.0 4
2	2500.3	50.0	0.0	86.0 4	27.5 2	50.0 3	74.0 4
3	2500.5	100.0	0.0	88.0 4	37.0 2	44.0 3	71.0 4
4	2502.4	150.0	0.0	96.0 4	48.5 2	40.0 2	72.0 4
5	2505.9	200.0	0.0	99.0 4	56.0 2	30.0 2	68.5 4
6	2509.6	250.0	0.0	99.5 4	57.0 4	19.0 2	62.0 4
7	2513.7	300.0	0.0	105.0 4	62.0 4	20.0 2	59.0 4
8	2517.4	350.0	0.0	107.0 4	64.5 4	30.0 2	55.0 4
9	2520.7	400.0	0.0	108.0 4	65.0 4	39.0 2	49.0 4
10	2529.3	450.0	0.0	113.0 4	70.0 4	50.0 2	47.0 4
11	2538.1	500.0	0.0	116.5 4	74.0 4	55.0 3	45.0 2
12	2544.5	525.0	0.0	119.0 4	77.0 4	60.0 3	46.0 1

$IPTST,J06 SPREADS 5 AND 6   DEMONSTRATION OF EXIT 6

SPREAD 5 RAY END POINTS BENEATH GEOPHONES

GEO		SP A	L=	SP C	L=	SP B	L=	SP
1	POS	-2,2	2	68,5	3	38,0	4	
	ELEV	2476,1		2408,8		2391,8		
2	POS	72,4	2	128,8	3	129,7	4	
	ELEV	2474,9		2426,2		2372,6		
3	POS	149,1	2	204,1	3	212,8	4	
	ELEV	2479,9		2429,4		2354,4		
4	POS	224,0	2	226,0	2	296,7	4	
	ELEV	2482,4		2482,4		2324,2		
5	POS	277,9	3	304,4	2	443,4	4	
	ELEV	2446,5		2476,0		2314,0		
6	POS	350,9	3	376,9	2	553,6	4	
	ELEV	2445,2		2478,5		2327,5		
7	POS	435,5	3	446,9	2	602,9	4	
	ELEV	2464,0		2484,1		2350,7		
8	POS	481,0	3	496,2	2	516,6	3	
	ELEV	2469,9		2488,3		2452,4		
9	POS	534,4	4	598,7	2	645,7	3	
	ELEV	2346,8		2493,5		2425,5		
10	POS	617,8	4	597,0	3	679,6	2	
	ELEV	2372,8		2415,2		2493,7		
11	POS	722,0	4	713,9	3	777,4	2	
	ELEV	2388,8		2412,2		2490,7		
12	POS	826,4	4	830,5	3	879,8	2	
	ELEV	2396,5		2431,0		2492,6		

RAY END POINTS BENEATH SHOTPOINTS

L=2	RIGHT	POS	-26,4	403,2	0,0
		ELEV	2475,9	2480,6	0,0
L=2	LEFT	POS	0,0	398,0	898,0
		ELEV	0,0	2480,2	2494,2
L=3	RIGHT	POS	32,4	442,0	0,0
		ELEV	2415,8	2439,9	0,0
L=3	LEFT	POS	0,0	378,9	857,1
		ELEV	0,0	2449,5	2434,0
L=4	RIGHT	POS	8,4	0,0	0,0
		ELEV	2392,1	0,0	0,0
L=4	LEFT	POS	0,0	0,0	838,9
		ELEV	0,0	0,0	2379,6

SIPTST,J06 SPREADS 5 AND 8 DEMONSTRATION OF EXIT 6

SPREAD 8 RAY END POINTS BENEATH GEOPHONES

GEO		Sp L	L	Sp A	L	Sp C	L	Sp B	L	SP
1	POS	614.6	4	669.9	2	732.1	3	749.5	4	
	ELEV	2366.5		2493.8		2428.7		2384.7		
2	POS	671.4	4	723.5	2	777.9	3	792.5	4	
	ELEV	2381.7		2493.4		2435.4		2394.0		
3	POS	724.9	4	772.4	2	818.2	3	841.0	4	
	ELEV	2393.2		2491.9		2444.2		2399.3		
4	POS	767.7	4	819.4	2	830.7	2	905.3	4	
	ELEV	2382.7		2487.4		2487.5		2392.0		
5	POS	818.5	4	872.8	2	879.8	2	963.6	4	
	ELEV	2384.1		2492.0		2492.6		2392.9		
6	POS	880.6	4	880.4	4	929.1	2	1007.8	4	
	ELEV	2402.3		2402.1		2496.8		2418.0		
7	POS	925.0	4	926.7	4	972.0	2	1065.7	4	
	ELEV	2395.3		2398.2		2499.4		2428.1		
8	POS	992.9	4	992.8	4	1021.5	2	1107.7	4	
	ELEV	2413.2		2413.0		2501.6		2442.7		
9	POS	1057.3	4	1058.3	4	1071.3	2	1136.3	4	
	ELEV	2437.9		2440.7		2504.4		2465.7		
10	POS	1112.9	4	1113.8	4	1121.5	2	1171.3	4	
	ELEV	2456.0		2458.8		2508.9		2480.1		
11	POS	1172.7	4	1172.7	4	1163.7	3	1183.0	2	
	ELEV	2487.9		2488.0		2494.5		2514.6		
12	POS	1199.7	4	1198.7	4	1190.5	3	0.0	1	
	ELEV	2504.6		2501.9		2500.5		0.0		

RAY END POINTS BENEATH SHOTPOINTS

L=2 RIGHT	POS	0.0	601.0	953.6	0.0	
	ELEV	0.0	2493.5	2498.3	0.0	
L=2 LEFT	POS	0.0	0.0	947.8	1232.4	
	ELEV	0.0	0.0	2497.9	2518.2	
L=3 RIGHT	POS	0.0	639.7	991.7	0.0	
	ELEV	0.0 *	2433.9	2462.7	0.0	
L=3 LEFT	POS	0.0	0.0	930.2	1231.7	
	ELEV	0.0	0.0	2453.6	2509.8	
L=4 RIGHT	POS	669.3	669.3	0.0	0.0	
	ELEV	2389.3 *	2389.3	0.0	0.0	
L=4 LEFT	POS	0.0	0.0	0.0	1236.2	
	ELEV	0.0	0.0	0.0	2505.8	

SIPTST,J06 SPREADS 8 AND 9 DEMONSTRATION OF EXIT 6

SPREAD 8 SMOOTHED POSITION OF LAYERS BENEATH SHOTPOINTS AND GEOPHONES

			LAYER 2		LAYER 3		LAYER 4		LAYER
SP	POSITION	SURF ELEV	DEPTH	ELEV	DEPTH	ELEV	DEPTH	ELEV	
A	-29.0	2486.9	11.3	2475.6	81.6	2405.3	95.3	2391.6	
C	400.0	2493.0	12.2	2480.8	42.0	2451.0	143.8	2349.2	
B	900.0	2507.5	13.3	2494.2	58.9	2448.6	109.5	2398.0	
GEO									
1	0.0	2485.6	9.8	2475.8	77.1	2408.5	98.1	2387.5	
2	75.0	2484.1	9.0	2475.1	67.8	2416.3	101.9	2382.2	
3	150.0	2484.0	4.1	2479.9	57.9	2426.1	118.0	2366.0	
4	225.0	2487.3	4.9	2482.4	51.8	2435.5	139.6	2347.7	
5	300.0	2490.2	13.8	2476.4	46.8	2443.4	153.3	2336.9	
6	375.0	2484.3	5.3	2479.0	35.8	2448.5	141.1	2343.2	
7	450.0	2501.0	16.6	2484.4	45.1	2455.9	139.8	2361.2	
8	497.0	2491.1	2.7	2488.4	38.6	2452.5	133.1	2358.0	
9	600.0	2498.7	5.2	2493.5	65.7	2433.0	139.0	2359.7	
10	675.0	2513.2	19.6	2493.6	87.7	2425.5	135.3	2377.9	
11	775.0	2500.5	9.9	2490.6	68.9	2431.6	111.8	2388.7	
12	875.0	2505.9	14.0	2491.9	61.2	2444.7	110.2	2395.7	

VELOCITIES USED:

	LAYER 1	LAYER 2	LAYER 3	LAYER 4	LAYER
VERTICAL	1520.	5900.	9500.		
HORIZONTAL		5900.	9500.	15000.	

SIPTST.J06 SPREADS 8 AND 9 DEMONSTRATION OF EXIT 6

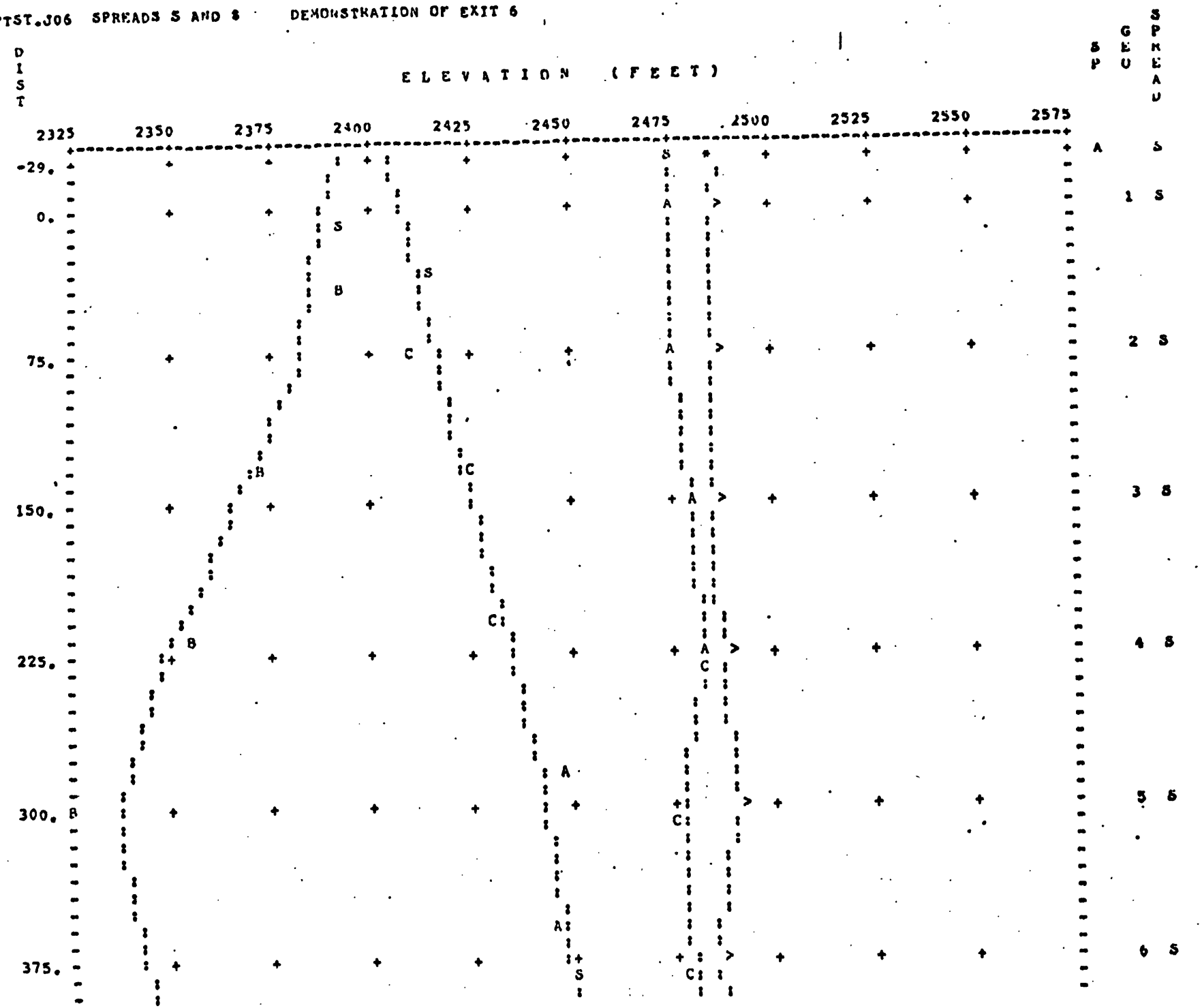
SPREAD 9 SMOOTHED POSITION OF LAYERS BENEATH SHOTPOINTS AND GEOPHONES

			LAYER 2		LAYER 3		LAYER 4		LAYER
SP	POSITION	SURF ELEV	DEPTH	ELEV	DEPTH	ELEV	DEPTH	ELEV	
A	600.0	2498.7	5.2	2493.5	65.7	2433.0	139.0	2359.7	
C	950.0	2511.7	13.8	2497.9	55.4	2456.3	106.9	2404.8	
B	1238.0	2549.9	31.5	2518.4	41.4	2508.5	41.4	2508.5	
GEO									
1	675.0	2513.2	19.5	2493.7	87.7	2425.5	135.3	2377.9	
2	725.0	2500.3	6.9	2493.4	71.8	2428.5	117.0	2383.3	
3	775.0	2500.5	9.2	2491.3	68.9	2431.6	111.8	2388.7	
4	825.0	2502.4	14.9	2487.5	64.3	2438.1	110.2	2392.2	
5	875.0	2505.9	13.8	2492.1	61.2	2444.7	110.2	2395.7	
6	925.0	2509.6	13.3	2496.3	57.2	2452.4	109.4	2400.2	
7	975.0	2513.7	14.3	2499.4	53.5	2460.2	104.3	2409.4	
8	1025.0	2517.4	15.6	2501.8	47.9	2469.5	93.6	2423.8	
9	1075.0	2520.7	16.0	2504.7	42.1	2478.6	80.3	2440.4	
10	1125.0	2529.3	20.1	2509.2	41.5	2487.8	69.5	2459.8	
11	1175.0	2538.1	24.3	2513.8	41.1	2497.0	50.3	2487.8	
12	1200.0	2544.5	28.9	2515.6	43.0	2501.5	48.1	2496.4	

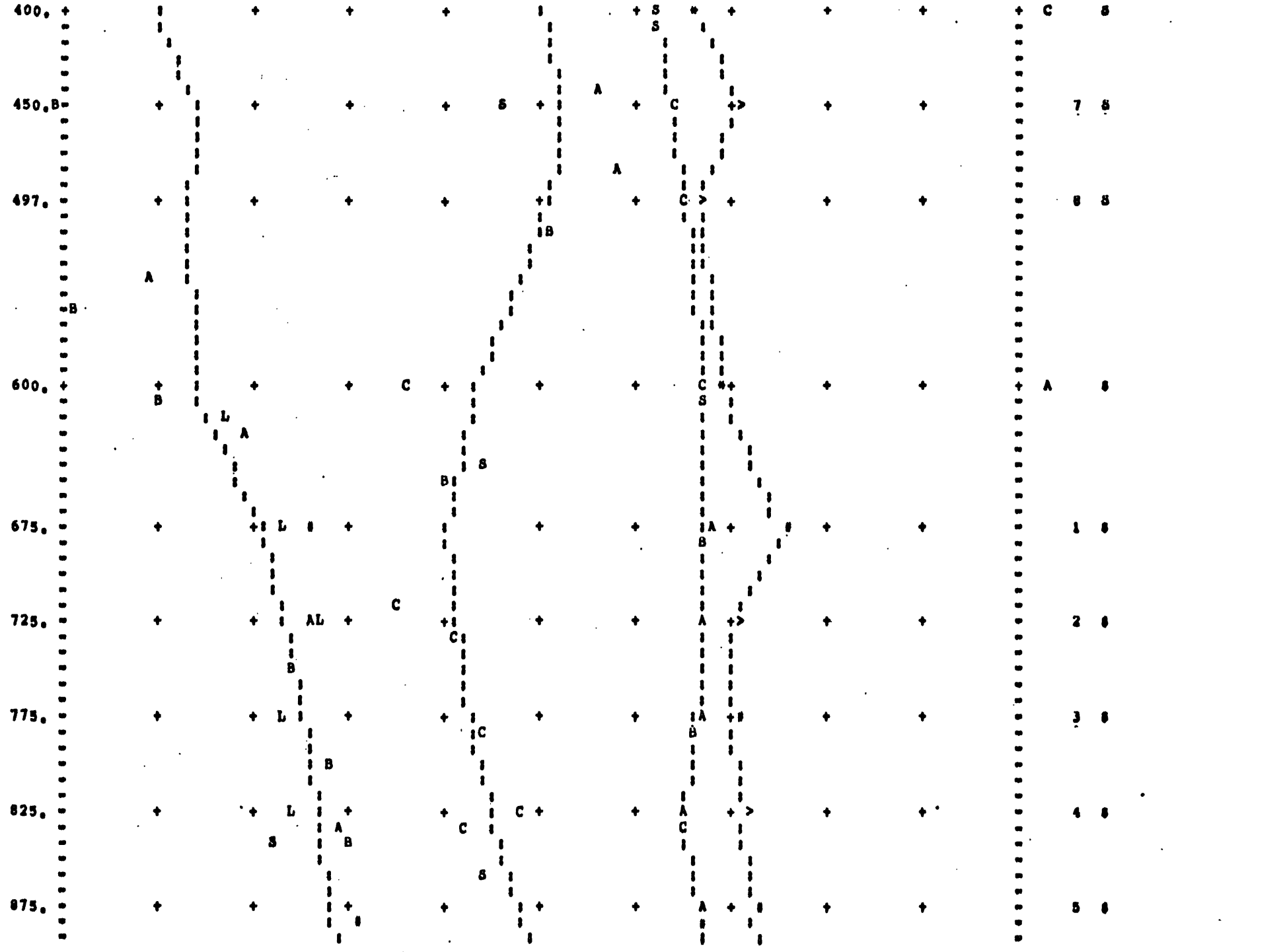
VELOCITIES USED:

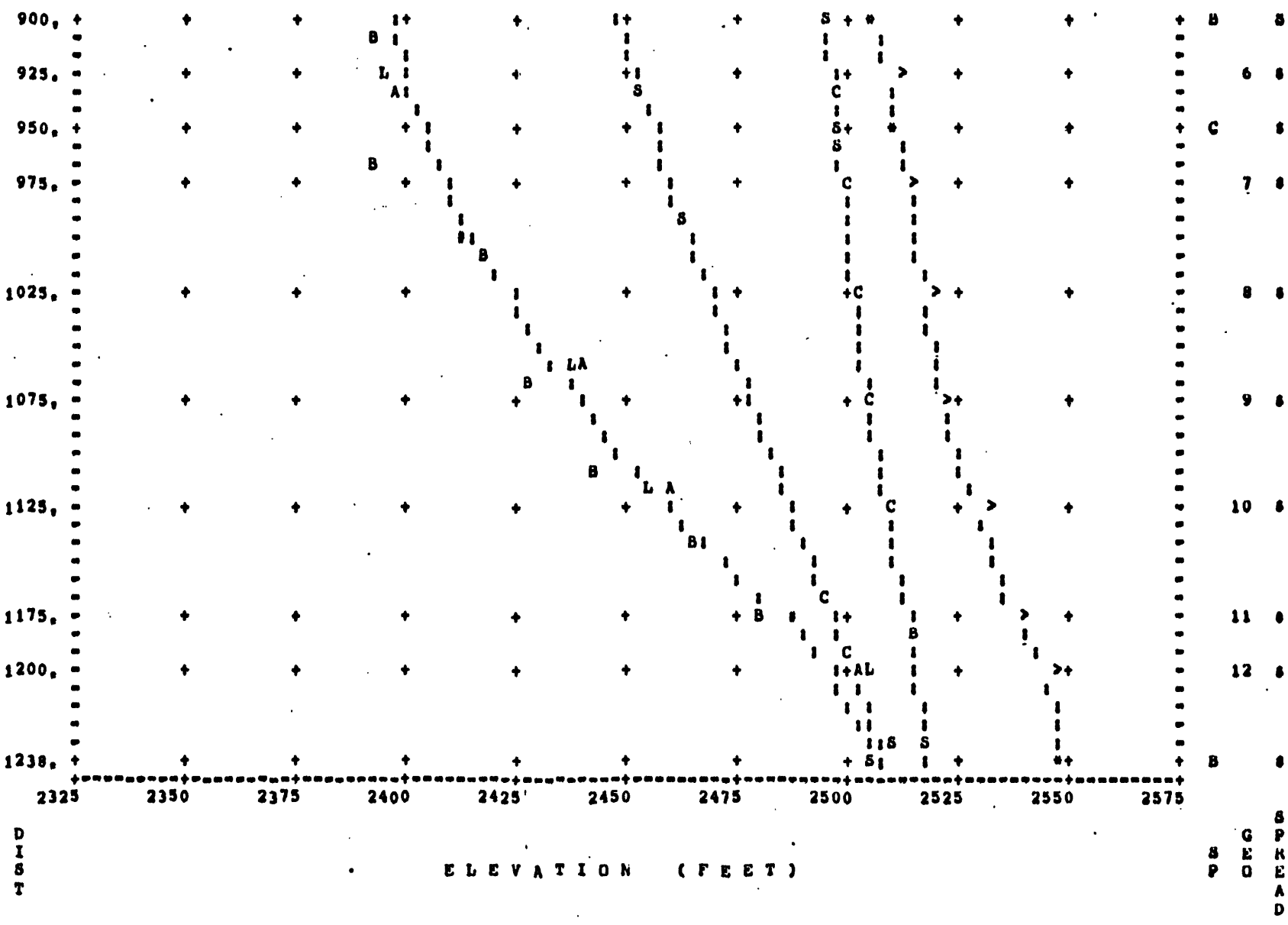
	LAYER 1	LAYER 2	LAYER 3	LAYER 4	LAYER
VERTICAL	1520.	5900.	9500.		
HORIZONTAL		5900.	9500.	15000.	

SIPTST.J06 SPREADS S AND 8 DEMONSTRATION OF EXIT 6



32-a


400.
450.
497.
600.
675.
725.
775.
825.
875.


900.
925.
950.
975.
1025.
1075.
1125.
1175.
1200.
1238.
2325
2350
2375
2400
2425
2450
2475
2500
2525
2550
2575
DIST
ELEVATION (FEET)
SP
GEO
SPEED

APPENDIX C. -- Fortran program listing

The Fortran program for SIPT.FOR is given on the following pages.

```
C PROGRAM  SIPT  REV 20  1-19-77   DEC-10 (USGS DENVER)                          0
C                                                                              100
C THIS PROGRAM INTERPRETS REFRACTION SEISMIC DATA FOR UP TO 5 SPREADS          200
C OF UP TO 25 GEOS AND 7 SPS EACH, AND FOR 2 TO 5 LAYERS.                      300
C                                                                              400
C PART 1 COMPUTES ELEVATION CORRECTIONS AND PLOTS CORRECTED T-D GRAPH.          500
C                                                                              600
C PART 2 COMPUTES VELOCITIES, MAKES WEATH CORR, AND REPLOTS T-D GRAPH.         700
C                                                                              800
C PART 3 COMPUTES MIGRATED DEPTHS AND MAKES SMOOTHED DEPTH INTERP.             900
C                                                                             1000
      DOUBLE PRECISION DIN                                                    1100
C                                                                             1200
C UNLABLED COMMON                                                             1300
C                                                                             1400
      COMMON IBL,IQUES,IP,IT,ICOLN,IPLUS,ISQ,IDASH,IS,IAST,IDEE,IL,NL,        1500
     1LN,P,TSCALE,XSCALE,XSCO2,ESCALE,XLIM1,XLIM2,IPLOT,IDENT                 1600
C                                                                             1700
C LABLED COMMON                                                               1800
C                                                                             1900
      COMMON/BLK0/LG                                                          2000
     1       /BLK1/NM,NJ,NK,JTRL,JPRT,ITY                                     2100
     2       /BLK2/XG,ERP,SLOPE,IDIP                                          2200
     3       /BLK3/TA,TR,DSG                                                  2300
     4       /BLK4/VVA,VHA                                                    2400
     5       /BLK5/IDSPR,IDSP,KL,KR,D                                         2500
     6       /BLK6/TRP,JJOFF                                                  2600
     7       /BLK7/JA,JB,TRS,ERS,XSP,ESP,LS                                   2700
     8       /BLK8/PRG,ERG,KRG,PRS2,ERS2,KRS2,ZRSP,ZRG                        2800
     9       /BLK9/EG,ES                                                      2900
     9       /BLK10/BLIM,ITRACE,TANSG                                         3000
     9       /BLK11/VREG,PREG                                                 3100
     9       /BLK12/VHOB,PHOB                                                 3200
C                                                                             3300
      DIMENSION IDENT(16),IP(103),IT(53),                                     3400
     1 IL(5),VREG(5),VHOB(5),PREG(5),PHOB(5),ZSG(4),                          3500
     2 IDSPR(5),NJ(5),NK(5),XSHIFT(5),JA(5),JB(5),BL(5),                      3600
     2 VVA(5,5),VHA(5,5),                                                     3700
     3 TVS(7),AVVDD(7),ZRSP(7),                                               3800
     4 IDSP(7,5),ESP(7,5),XSP(7,5),YSP(7,5),ZSP(7,5),TUH(7,5),EDSP(7,5),      3900
     4 TFUDGE(7,5),ES(7,5),KL(7,5),KR(7,5),SPTC(7,5),SPPT(7,5),LS(7,5),       4000
     4 ZRG(25,7),                                                             4100
     4 PS2(7,5,2),ES2(7,5,2),TRS2(7,5,2),                                     4200
     5 ERS(7,5,4),TRS(7,5,4),                                                 4300
     5 ERS2(7,5,4,2),PRS2(7,5,4,2),KRS2(7,5,4,2),                             4400
     6 TVG(25),XVG(25),DSG(25),PRP(25),XS(25),ERX(25),                        4500
     6 PRG2(25,2),ERG2(25,2),TRG2(25,2),                                      4600
     7 TCG(25,2),XCG(25,2),XINTG(25,2),EINTG(25,2),                           4700
     8 EDG(25,5),EG(25,5),XG(25,5),YG(25,5),                                  4800
     8 GTC(25,5),GPT(25,5),                                                   4900
     8 PG2(25,5,2),EG2(25,5,2),TG2(25,5,2),                                   5000
     9 ERP(25,5,4),TRP(25,5,4),                                               5100
     9 TA(25,7,5),TR(25,7,5),LG(25,7,5),D(25,7,5),VDD(25,7,5),P(25,7,5),      5200
     9 PRG(25,7,5),ERG(25,7,5),TRG(25,7,5),KRG(25,7,5)                        5300
C                                                                             5400
C CONSTANTS                                                                   5500
C                                                                             5600
      DATA IEND,IBL,IS,ISQ,IAST,IPLUS,IDASH,ICOLN,IDEE,IQUES,ICEE,ITEE        5700
     1,IPEE,IBEE,IX/'END  ',' ',    'S    ','#    ','*    ','+    ',         5800
     2'-    ',':    ',')    ','?    ','C    ','T    ','P    ','B    ',      5900
```

```
     3'X    '/                                                              6000
      DATA IL/'1   ','2   ','3   ','4   ','5   '/                          6100
      DATA MM,MJ,MK,ML,ML1,IZ,I1,IN1,BIG/5,7,25,5,4,0,1,10,9999999./       6200
C                                                                           6300
C*************************************************************************  6400
C PART 1                                                                    6500
C*************************************************************************  6600
C                                                                           6700
C INITIALIZE                                                                6800
C                                                                           6900
    1 TYPE 10000                                                            7000
10000 FORMAT(/' ENTER DATA FILE NAME (OR <CR> TO EXIT):',6X,$)              7100
      ACCEPT 10002, DIN                                                     7200
10002 FORMAT(A10)                                                           7300
      IF(DIN.EQ.10H          ) STOP                                         7400
      OPEN(UNIT=IN1,DEVICE='DSK',ACCESS='SEQIN',MODE='ASCII',FILE=DIN)      7500
      IFTYPE=IBL                                                            7600
      TYPE 10004                                                            7700
10004 FORMAT('  ENTER INPUT FMT TYPE: C=CARD, F=FREE FIELD: ',$)            7800
      ACCEPT 10006, IFTYPE                                                  7900
10006 FORMAT(A5)                                                            8000
      IF(IFTYPE.NE.ICEE) IFTYPE=ITEE                                        8100
      TYPE 10007                                                            8200
10007 FORMAT('  ENTER OUTPUT UNIT: P=LPT, T=TERMNL, B=BOTH: ',$)            8300
      JPRT=IX                                                               8400
      JTRL=IBL                                                              8500
      ACCEPT 10006, JOUT                                                    8600
      IF(JOUT.NE.ITEE.AND.JOUT.NE.IBEE) GO TO 10008                         8700
      JTRL=IX                                                               8800
      IF(JOUT.EQ.ITEE) JPRT=IBL                                             8900
10008 DO 2 K=1,MK                                                           9000
      TVG(K)=0.                                                             9100
      XVG(K)=0.                                                             9200
      DSG(K)=0.                                                             9300
      PRP(K)=0.                                                             9400
      XS(K)=0.                                                              9500
      DO 2 LR=1,2                                                           9600
      PRG2(K,LR)=0.                                                         9700
      ERG2(K,LR)=0.                                                         9800
      TRG2(K,LR)=0.                                                         9900
      TCG(K,LR)=0.                                                         10000
      XCG(K,LR)=0.                                                         10100
      XINTG(K,LR)=0.                                                       10200
    2 EINTG(K,LR)=0.                                                       10300
      DO 5 J=1,MJ                                                          10400
      AVVDD(J)=0.                                                          10500
      DO 5 M=1,MM                                                          10600
      IDSP(J,M)=IBL                                                        10700
      SPTC(J,M)=0.0                                                        10800
      SPPT(J,M)=0.0                                                        10900
      LS(J,M)=1                                                            11000
      ESP(J,M)=0.                                                          11100
      XSP(J,M)=0.                                                          11200
      YSP(J,M)=0.                                                          11300
      ZSP(J,M)=0.                                                          11400
      TUH(J,M)=0.                                                          11500
      EDSP(J,M)=0.                                                         11600
      TFUDGE(J,M)=0.                                                       11700
      ES(J,M)=0.                                                           11800
      KL(J,M)=0                                                            11900
```

```
      KR(J,M)=0                                                          12000
      DO 3 LR=1,2                                                        12100
      PS2(J,M,LR)=0.                                                     12200
      ES2(J,M,LR)=0.                                                     12300
    3 TR(J,M,LR)=0.                                                      12400
      DO 4 L=1,ML1                                                       12500
      ERS(J,M,L)=0.0                                                     12600
      TRS(J,M,L)=0.0                                                     12700
      DO 4 LR=1,2                                                        12800
      ERS2(J,M,L,LR)=0.0                                                 12900
      PRS2(J,M,L,LR)=0.0                                                 13000
      KRS2(J,M,L,LR)=IBL                                                 13100
    4 CONTINUE                                                           13200
      DO 5 K=1,MK                                                        13300
      PRG(K,J,M)=0.0                                                     13400
      ERG(K,J,M)=0.0                                                     13500
      TRG(K,J,M)=0.0                                                     13600
      KRG(K,J,M)=IBL                                                     13700
      VDD(K,J,M)=0.0                                                     13800
      D(K,J,M)=0.0                                                       13900
      LG(K,J,M)=0                                                        14000
      TR(K,J,M)=0.                                                       14100
      TA(K,J,M)=0.                                                       14200
      P(K,J,M)=0.                                                        14300
    5 CONTINUE                                                           14400
      DO 6 M=1,MM                                                        14500
      DO 6 L=1,ML                                                        14600
      VVA(M,L)=0.0                                                       14700
      VHA(M,L)=0.0                                                       14800
    6 CONTINUE                                                           14900
      DO 8 M=1,MM                                                        15000
      JA(M)=0                                                            15100
      JB(M)=0                                                            15200
      NJ(M)=0                                                            15300
      NK(M)=0                                                            15400
      XSHIFT(M)=0.                                                       15500
      DO 8 K=1,MK                                                        15600
      GTC(K,M)=0.0                                                       15700
      GPT(K,M)=0.0                                                       15800
      DO 7 LR=1,2                                                        15900
      PG2(K,M,LR)=0.                                                     16000
      EG2(K,M,LR)=0.                                                     16100
    7 TG2(K,M,LR)=0.                                                     16200
      DO 8 L=1,ML1                                                       16300
      ERP(K,M,L)=0.0                                                     16400
      TRP(K,M,L)=0.0                                                     16500
    8 CONTINUE                                                           16600
      IXTRUE=0                                                           16700
      IREP=0                                                             16800
      DMY0=0.                                                            16900
      DMY1=0.                                                            17000
      DMY2=0.                                                            17100
      DMY3=0.                                                            17200
C                                                                        17300
C READ INPUT CARDS AND PRINT INPUT DATA                                  17400
C                                                                        17500
      READ(IN1,9) IDENT                                                  17600
    9 FORMAT (16A5)                                                      17700
      IF (IDENT(1).EQ.IEND) GO TO 1                                      17800
      IF(IFTYPE.EQ.ICEE)READ(IN1,11)NM,IEXIT,NL,NV,ESCALE,XSCALE,TSCALE, 17900
```

```
     1 EDAT1,XDAT1,EDAT2,XDAT2,SLOPE,A,BLIM,TLIM,ITRACE,JJOFF,IDIP          18000
   11 FORMAT (I1,I2,2(1X,I1),1X,3(F4.0,1X),4F7.1,F7.4,F7.1,F7.2,F4.1,1X,   18100
     1 3I1)                                                                18200
      IF(IFTYPE.EQ.ITEE)READ(IN1,12)NM,IEXIT,NL,NV,ESCALE,XSCALE,TSCALE,   18300
     1EDAT1,XDAT1,EDAT2,XDAT2,SLOPE,A,BLIM,TLIM,ITRACE,JJOFF,IDIP          18400
   12 FORMAT(4I,11F,3I)                                                    18500
      IXIT=0                                                               18600
      IF (IABS(IEXIT).LE.6) IXIT=IEXIT                                     18700
      IF (NL.LE.1) NL=2                                                    18800
      IF (NM.EQ.0) NM=1                                                    18900
      IF (BLIM.EQ.0.0) BLIM=0.5                                            19000
      IF (ESCALE.EQ.0.) ESCALE=5.0                                         19100
      IF (XSCALE.EQ.0.) XSCALE=8.33333333                                  19200
      IF (TSCALE.EQ.0.) TSCALE=1.0                                         19300
      IF (TLIM.EQ.0.0) TLIM=10.0                                           19400
      LN=NL-1                                                              19500
C                                                                          19600
C EXIT OVERRIDE SELECTION FROM TERMINAL                                    19700
C                                                                          19800
      TYPE 10012                                                           19900
10012 FORMAT('  ENTER NEW EXIT, -6 THRU +6 OR <CR> FOR OLD; ',$)          20000
      JEXIT=0                                                              20100
      ACCEPT 10201, JEXIT                                                  20200
      IF(JEXIT.NE.0.AND.IABS(JEXIT).LE.6) IXIT=JEXIT                       20300
      IF(JPRT.NE.IBL)PRINT 13,IDENT,NM,IXIT,NL,NV,ESCALE,XSCALE,TSCALE     20400
     1,EDAT1,XDAT1,EDAT2,XDAT2,SLOPE,A,BLIM,TLIM,ITRACE,JJOFF,IDIP         20500
   13 FORMAT (1H1,50X,12H SIPT REV 20/1HO,16A5/1HO,17HCONTROL CARD DATA,   20600
     1 13X,20HP L O T  S C A L E S,5X,9HO A T U M,4X,15HO V E R R I D E,   20700
     2 4X,11HV A L U E S/1HO,30X,4HELEV,4X,5HHORIZ,                        20800
     3 3X,4HTIME,4X,29HP O I N T   1   P O I N T   2/1H ,5HSPRDS,2X,       20900
     4 44HEXIT  LAYERS  VCARDS  FT/COL  FT/ROW  MS/COL,                   21000
     5 2(3X,4HELEV,4X,5HX POS),3X,28HSLOPE  INTCPT   BLIM    TLIM,3X      21100
     6 13HTRACE OFF DIP/1H ,5H-----,2X,4H----,13(2X,6H------),2X,          21200
     7 13H----- --- ---/1H ,I3,2I7,I8,2X,7F8.1,F8.4,F7.1,F8.2,F8.1,I6,     21300
     8 I5,I4)                                                              21400
      IF(JTRL.NE.IBL)TYPE 10013,IDENT,NM,IXIT,NL,NV,ESCALE,XSCALE,         21500
     1TSCALE,EDAT1,XDAT2,SLOPE,A,BLIM,TLIM,ITRACE,JJOFF,IDIP,EDAT2,XDAT2   21600
10013 FORMAT(/30X,'SIPT REV 20'//1X,14A5/1X,2A5/' CONTROL CARD DATA'//     21700
     1' S X L V  FT/C  FT/R  MS/C EDAT1/2 XDAT1/2 SLOPE INTCP BLIM  TLIM   21800
     2 T O D'/1X,I1,3I2,3F6.1,2F8.1,F6.4,F6.1,F5.2,F6.1,3I2/26X,2F8.1)     21900
      NIXIT=0                                                              22000
      IF(IXIT.GE.0) GO TO 14                                               22100
      IXIT=IABS(IXIT)                                                      22200
      NIXIT=1                                                              22300
   14 IF (NV.EQ.0) GO TO 24                                                22400
      IF(JPRT.EQ.IBL) GO TO 11015                                          22500
      PRINT 15, (M,M=1,NM)                                                 22600
   15 FORMAT (1HO,14HVELOCITY CARDS/4X,5(6X,'SPREAD',I2))                  22700
      PRINT 10014, (IBL,M=1,NM)                                            22800
10014 FORMAT(2X,'LAYER',5(A3,'VV     VH  '))                             22900
      PRINT 11014, (IBL,M=1,NM)                                            23000
11014 FORMAT(2X,'-----',5(A1,'------ ------'))                             23100
11015 IF(JTRL.EQ.IBL) GO TO 10016                                          23200
      TYPE 10015,(M,M=1,NM)                                                23300
10015 FORMAT(' VELOCITY CARDS'//5(6X,'SPREAD',I2))                         23400
      TYPE 11016, (IBL,M=1,NM)                                             23500
11016 FORMAT(1X,'L ',5(A3,'VV     VH  '))                                  23600
10016 DO 20 I=1,NV                                                         23700
      IF(IFTYPE.EQ.ICEE)READ(IN1,17) L,(VVA(M,L),VHA(M,L),M=1,NM)          23800
   17 FORMAT (I1,10F6.0)                                                   23900
```

```
      IF(IFTYPE.EQ.ITEE)READ(IN1,10017)L,(VVA(M,L),VHA(M,L),M=1,NM)          24000
10017 FORMAT(I,10F)                                                         24100
      IF(JPRT.NE.IBL)PRINT 19,L,(VVA(M,L),VHA(M,L),M=1,NM)                  24200
   19 FORMAT (4X,I1,2X,10F7.0)                                              24300
      IF(JTRL.NE.IBL)TYPE 10019,L,(VVA(M,L),VHA(M,L),M=1,NM)                24400
10019 FORMAT(1X,I1,10F7.0)                                                  24500
      DO 20 M=1,NM                                                          24600
      VVA(M,L)=VVA(M,L)/1000.                                               24700
      VHA(M,L)=VHA(M,L)/1000.                                               24800
   20 CONTINUE                                                              24900
   24 ITY=IBL                                                               25000
      IF(JTRL.EQ.IBL) GO TO 25                                              25100
      TYPE 22                                                               25200
   22 FORMAT(/' TABLE OF SP & GEO DATA? T TO TYPE, <CR> TO SUPPRESS: '      25300
     1,$)                                                                   25400
      ACCEPT 10006,ITY                                                      25500
   25 DO 60 M=1,NM                                                          25600
      IF(IFTYPE.EQ.ICEE)READ(IN1,27) IDSPR(M),NJ(M),NK(M),XSHIFT(M)         25700
     1,IXTRUE                                                               25800
   27 FORMAT (A1,2I3,F11.1,1X,I1)                                           25900
      IF(IFTYPE.EQ.ITEE)READ(IN1,10027)IDSPR(M),NJ(M),NK(M),XSHIFT(M)       26000
     1,IXTRUE                                                               26100
10027 FORMAT(A1,2I,F,I)                                                     26200
      IF(JPRT.NE.IBL)PRINT 29, IDSPR(M),NJ(M),NK(M),XSHIFT(M),IXTRUE        26300
   29 FORMAT (/28H SHOTPOINT AND GEOPHONE DATA//2X,6HSPREAD,1X,A1,1H,,      26400
     1I2,1X,11HSHOTPOINTS,,I3,1X,19HGEOPHONES, XSHIFT =,F8.1,', XTRUE ='    26500
     2,I2//2X,55HSP    ELEV     X LOC     Y LOC     DEPTH  UPHOLE T  FUDGE T  26600
     3,2X,6HEND SP/2X,10H-- -------,6(1X,8H--------))                       26700
      IF(JTRL.NE.IBL.AND.ITY.NE.IBL)TYPE 29,IDSPR(M),NJ(M),NK(M),           26800
     1XSHIFT(M),IXTRUE                                                      26900
      XLAST=-BIG                                                            27000
      JN=NJ(M)                                                              27100
      DO 35 J=1,JN                                                          27200
      IF(IFTYPE.EQ.ICEE)READ(IN1,31) IDTEST,IDSP(J,M),ESP(J,M),XSP(J,M)     27300
     1,YSP(J,M),ZSP(J,M),TUH(J,M),TFUDGE(J,M),JC                            27400
   31 FORMAT (A1,2X,A1,3F7.1,3F5.1,1X,I1)                                   27500
      IF(IFTYPE.EQ.ITEE)READ(IN1,10031)IDTEST,IDSP(J,M),ESP(J,M)            27600
     1,XSP(J,M),YSP(J,M),ZSP(J,M),TUH(J,M),TFUDGE(J,M),JC                   27700
10031 FORMAT(2A1,6F,I)                                                      27800
      IF (IDTEST.NE.IDSPR(M).OR.XSP(J,M).LT.XLAST) GO TO 9990               27900
      IF(JPRT.NE.IBL)PRINT 33, IDSP(J,M),ESP(J,M),XSP(J,M),YSP(J,M)         28000
     1,ZSP(J,M),TUH(J,M),TFUDGE(J,M),JC                                     28100
   33 FORMAT (1H ,2X,A1,F8.1,5F9.1,I6)                                      28200
      IF(JTRL.NE.IBL.AND.ITY.NE.IBL)TYPE 33,IDSP(J,M),ESP(J,M),XSP(J,M)     28300
     1,YSP(J,M),ZSP(J,M),TUH(J,M),TFUDGE(J,M),JC                            28400
      ES(J,M)=ESP(J,M)-ZSP(J,M)                                             28500
      IF (JC.EQ.1) JA(M)=J                                                  28600
      IF (JC.EQ.2) JB(M)=J                                                  28700
      XLAST=XSP(J,M)                                                        28800
   35 CONTINUE                                                              28900
      IF(JPRT.EQ.IBL) GO TO 10040                                           29000
      PRINT 41, (IDSP(J,M),J=1,JN)                                          29100
   41 FORMAT (1HO,33X,46HARRIVAL TIMES + FUDGE T AND LAYERS REPRESENTED/    29200
     129H  GEO  ELEV     X LOC     Y LOC,2X,7(5X,'SP ',A1))                 29300
      PRINT 42, (IBL,J=1,JN)                                                29400
   42 FORMAT('  --- ------',2(' --------'),2X,7(A2,'-------'))              29500
10040 IF(JTRL.EQ.IBL.OR.ITY.EQ.IBL) GO TO 10043                             29600
      TYPE 10041,(IDSP(J,M),J=1,JN)                                         29700
10041 FORMAT(/13X,'ARRIVAL TIMES + FUDGE T AND LAYERS REPRESENTED'//1X,     29800
     1' G  ELEV     X      Y ',7(3X,'SP 'A1))                               29900
```

```
      TYPE 10042, (IBL,J=1,JN)                                          30000
10042 FORMAT('  - ----- ----- -----  ',7(A1,'----- '))                  30100
10043 XLAST=-BIG                                                        30200
      KN=NK(M)                                                          30300
      DO 55 K=1,KN                                                      30400
      IF(IFTYPE.EQ.ICEE)READ(IN1,43)IDTEST,KTEST,EG(K,M),XG(K,M),YG(K,M) 30500
     1,(TA(K,J,M),LG(K,J,M),J=1,JN)                                     30600
   43 FORMAT (A1,I3,3F7.1,7(F5.1,1X,I1))                                30700
      IF(IFTYPE.EQ.ITEE)READ(IN1,10044)IDTEST,KTEST,EG(K,M),XG(K,M)     30800
     1,YG(K,M),(TA(K,J,M),LG(K,J,M),J=1,JN)                             30900
10044 FORMAT(A1,I,3F,7(F,I))                                            31000
      IF (IDTEST.NE.IDSPR(M).OR.KTEST.NE.K.OR.XG(K,M).LT.XLAST)         31100
     1 GO TO 9990                                                       31200
      DO 44 J=1,JN                                                      31300
      IF (TA(K,J,M).NE.0.0) TA(K,J,M)=TA(K,J,M)+TFUDGE(J,M)             31400
      IF (TA(K,J,M).LE.0.) LG(K,J,M)=0                                  31500
      TR(K,J,M)=TA(K,J,M)                                               31600
   44 CONTINUE                                                          31700
      IF(JPRT.NE.IBL)PRINT 45, K,EG(K,M),XG(K,M),YG(K,M),               31800
     1 (TA(K,J,M),LG(K,J,M),J=1,JN)                                     31900
   45 FORMAT (2X,I2,F8.1,2F9.1,2X,7(F7.1,I2))                           32000
      IF(JTRL.NE.IBL.AND.ITY.NE.IBL)TYPE 10045,K,EG(K,M),XG(K,M),YG(K,M) 32100
     1,(TA(K,J,M),LG(K,J,M),J=1,JN)                                     32200
10045 FORMAT(1X,I2,3F6.0,1X,7(F5.0,I2))                                 32300
      XLAST=XG(K,M)                                                     32400
   55 CONTINUE                                                          32500
      IF((M.NE.NM.OR.NIXIT.EQ.0).AND.JPRT.NE.IBL)PRINT 57, IDENT        32600
   57 FORMAT (1H1,16A5)                                                 32700
   60 CONTINUE                                                          32800
C                                                                       32900
C IF IXTRUE=0, CORRECT X-DISTANCES. IXTRUE=0 IMPLIES THAT X-DISTANCES   33000
C FOR SPS & GEOS ARE MEASURED ALONG GROUND SURFACE AND NO CORRECTION HAS 33100
C BEEN MADE FOR SLOPE.                                                  33200
C                                                                       33300
      IF(IXTRUE.NE.0) GO TO 95                                          33400
      DO 90 M=1,NM                                                      33500
      JN=NJ(M)                                                          33600
      KN=NK(M)                                                          33700
      XS(1)=XG(1,M)                                                     33800
      DO 62 K=2,KN                                                      33900
      XS(K)=XS(K-1)+SQRT((XG(K,M)-XG(K-1,M))**2-(EG(K,M)-EG(K-1,M))**2) 34000
   62 CONTINUE                                                          34100
      DO 64 J=1,JN                                                      34200
      IF(XSP(J,M).GT.XG(1,M)) GO TO 66                                  34300
   64 CONTINUE                                                          34400
      J=JN+1                                                            34500
   66 J1=J-1                                                            34600
      IF(J1.EQ.0) GO TO 70                                              34700
      XTIE=XS(1)                                                        34800
      XREF=XG(1,M)                                                      34900
      EREF=EG(1,M)                                                      35000
      DO 68 J=1,J1                                                      35100
      JR=J1-J+1                                                         35200
      XTIE=XTIE-SQRT((XREF-XSP(JR,M))**2-(EREF-ESP(JR,M))**2)           35300
      XREF=XSP(JR,M)                                                    35400
      EREF=ESP(JR,M)                                                    35500
      XSP(JR,M)=XTIE                                                    35600
   68 CONTINUE                                                          35700
   70 J1=J1+1                                                           35800
      DO 72 J=J1,JN                                                     35900
```

```
      IF(XSP(J,M).GT.XG(KN,M)) GO TO 74                                 36000
      DO 71 K=2,KN                                                      36100
      IF(XG(K,M).LT.XSP(J,M)) GO TO 72                                  36200
      XSP(J,M)=XS(K-1)+(XS(K)-XS(K-1))*(XSP(J,M)-XG(<-1,M))/            36300
     1(XG(K,M)-XG(K-1,M))                                               36400
   71 CONTINUE                                                          36500
   72 CONTINUE                                                          36600
      GO TO 78                                                          36700
   74 J1=J                                                              36800
      XTIE=XS(KN)                                                       36900
      XREF=XG(KN,M)                                                     37000
      EREF=EG(KN,M)                                                     37100
      DO 76 J=J1,JN                                                     37200
      XTIE=XTIE+SQRT((XSP(J,M)-XREF)**2-(ESP(J,M)-EREF)**2)             37300
      XREF=XSP(J,M)                                                     37400
      EREF=ESP(J,M)                                                     37500
      XSP(J,M)=XTIE                                                     37600
   76 CONTINUE                                                          37700
   78 DO 80 K=1,KN                                                      37800
   80 XG(K,M)=XS(K)                                                     37900
   90 CONTINUE                                                          38000
C                                                                       38100
C  COMPUTE V1 USING DIRECT DIST DD FROM SHOT TO GEOS FOR WHICH LG=1      38200
C                                                                       38300
   95 IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 100                         38400
  100 FORMAT (1HO,1X,42HV1 FOR DIRECT RAYS AND DIRECT DISTANCES DD)     38500
      SUM1=0.0                                                          38600
      PTS1=0.0                                                          38700
      DO 150 M=1,NM                                                     38800
      SUM2=0.0                                                          38900
      PTS2=0.0                                                          39000
      JN=NJ(M)                                                          39100
      DO 120 J=1,JN                                                     39200
      SUM3=0.0                                                          39300
      PTS3=0.0                                                          39400
      KN=NK(M)                                                          39500
      DO 110 K=1,KN                                                     39600
      IF (LG(K,J,M).NE.1) GO TO 110                                     39700
      D(K,J,M)=SQRT ((EG(K,M)-ES(J,M))**2+(XG(K,M)-XSP(J,M))**2+(YG(K,M) 39800
     1-YSP(J,M))**2)                                                    39900
      VDD(K,J,M)=D(K,J,M)/TA(K,J,M)                                     40000
      PTS3=PTS3+1.0                                                     40100
      SUM3=SUM3+VDD(K,J,M)                                              40200
      PTS2=PTS2+1.0                                                     40300
      SUM2=SUM2+VDD(K,J,M)                                              40400
      PTS1=PTS1+1.0                                                     40500
      SUM1=SUM1+VDD(K,J,M)                                              40600
  110 CONTINUE                                                          40700
      IF (PTS3.EQ.0.) GO TO 115                                         40800
      AVVDD(J)=SUM3/PTS3                                                40900
      GO TO 120                                                         41000
  115 AVVDD(J)=0.0                                                      41100
  120 CONTINUE                                                          41200
      IF (PTS2.EQ.0.) GO TO 126                                         41300
      SUM2=SUM2/PTS2                                                    41400
  126 IF (NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 150                          41500
      PRINT 130,IDSPR(M)                                                41600
  130 FORMAT(/2X,'SPREAD',1X,A1,5X,'SP  GEO    DD        V1   AVG V1'/  41700
     115X,'--  ---',3('  ------'))                                      41800
      DO 140 J=1,JN                                                     41900
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      DO 134 K=1,KN                                                     42000
      IF(VDD(K,J,M).EQ.0.) GO TO 134                                    42100
      PRINT 132, IDSP(J,M),K,D(K,J,M),VDD(K,J,M)                        42200
  132 FORMAT(16X,A1,I5,F8.1,3PF8.0)                                     42300
  134 CONTINUE                                                          42400
      IF(AVVDD(J).NE.0.) PRINT 136, AVVDD(J)                            42500
  136 FORMAT(38X,3PF8.0)                                                42600
  140 CONTINUE                                                          42700
  150 CONTINUE                                                          42800
      IF (PTS1.EQ.0.) GO TO 152                                         42900
      SUM1=SUM1/PTS1                                                    43000
  152 VREG(1)=SUM1                                                      43100
      IF (VREG(1).LE.0.0) VREG(1)=1.5                                   43200
  156 IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 157, SUM1                   43300
  157 FORMAT (1HO,10HAVG OF ALL,3PF7.0)                                 43400
C                                                                       43500
C APPLY XSHIFT TO XSP AND XG ARRAYS                                     43600
C  ALSO COMPUTE DIR DIST BETWEEN (XSP,YSP,ESP) AND (XG,YG,EG) IF LG.NE.1 43700
C  AND COMPUTE PLOT POSITIONS P                                         43800
C                                                                       43900
      DO 180 M=1,NM                                                     44000
      JN=NJ(M)                                                          44100
      KN=NK(M)                                                          44200
      DO 165 K=1,KN                                                     44300
      XG(K,M)=XG(K,M)+XSHIFT(M)                                         44400
  165 CONTINUE                                                          44500
      DO 175 J=1,JN                                                     44600
      XSP(J,M)=XSP(J,M)+XSHIFT(M)                                       44700
      DO 170 K=1,KN                                                     44800
      IF (LG(K,J,M).NE.1) D(K,J,M)=SQRT((XG(K,M)-XSP(J,M))**2+(YG(K,M)- 44900
     1 YSP(J,M))**2+(EG(K,M)-ESP(J,M))**2)                              45000
      IF (XG(K,M)-XSP(J,M)) 168,166,167                                 45100
  166 IF (K.EQ.KN) GO TO 168                                            45200
  167 P(K,J,M)=XSP(J,M)+D(K,J,M)                                        45300
      GO TO 170                                                         45400
  168 P(K,J,M)=XSP(J,M)-D(K,J,M)                                        45500
  170 CONTINUE                                                          45600
  175 CONTINUE                                                          45700
  180 CONTINUE                                                          45800
C                                                                       45900
C FIND NUMBER OF GEO TO THE LEFT, KL(J,M), AND RIGHT, KR(J,M) OF EACH SP 46000
C      IF NONE, KL OR KR SET TO ZERO.                                   46100
C                                                                       46200
      DO 188 M=1,NM                                                     46300
      JN=NJ(M)                                                          46400
      KN=NK(M)                                                          46500
      DO 186 J=1,JN                                                     46600
      IF (XSP(J,M).LE.XG(1,M)) GO TO 183                                46700
      IF (XSP(J,M).GE.XG(KN,M)) GO TO 184                               46800
      DO 181 K=2,KN                                                     46900
      IF (XG(K,M).GT.XSP(J,M)) GO TO 182                                47000
  181 CONTINUE                                                          47100
  182 KL(J,M)=K-1                                                       47200
      KR(J,M)=K                                                         47300
      GO TO 186                                                         47400
  183 KL(J,M)=0                                                         47500
      KR(J,M)=1                                                         47600
      GO TO 186                                                         47700
  184 KL(J,M)=KN                                                        47800
      KR(J,M)=0                                                         47900
```

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  186 CONTINUE                                                          48000
  188 CONTINUE                                                          48100
C                                                                       48200
C FIND END SPS FOR EACH SPREAD AND SET LIMITS OF X AXIS FOR T-D GRAPH   48300
C                                                                       48400
      XSC02=XSCALE/2.0                                                  48500
      DO 200 M=1,NM                                                     48600
      JN=NJ(M)                                                          48700
      KN=NK(M)                                                          48800
      IF (JA(M).NE.0) GO TO 192                                         48900
      DO 190 J=1,JN                                                     49000
      IF (XSP(J,M).LE.XG(1,M)) GO TO 190                                49100
      JA(M)=J-1                                                         49200
      IF (J.GT.1) GO TO 192                                             49300
      JA(M)=1                                                           49400
      IF (M.EQ.1) XLIM1=XG(1,1)                                         49500
      GO TO 194                                                         49600
  190 CONTINUE                                                          49700
      JA(M)=JN                                                          49800
  192 IF (M.NE.1) GO TO 195                                             49900
      J=JA(M)                                                           50000
      XLIM1=AMIN1(XSP(J,1),XG(1,1))                                     50100
  194 XLIM1=XLIM1+XSC02                                                 50200
  195 IF (JB(M).NE.0) GO TO 197                                         50300
      DO 196 J=1,JN                                                     50400
      IF (XSP(J,M).LT.XG(KN,M)) GO TO 196                               50500
      JB(M)=J                                                           50600
      GO TO 197                                                         50700
  196 CONTINUE                                                          50800
      JB(M)=JN                                                          50900
      IF (M.NE.NM) GO TO 200                                            51000
      XLIM2=XG(KN,NM)                                                   51100
      GO TO 200                                                         51200
  197 IF (M.NE.NM) GO TO 200                                            51300
      J=JB(M)                                                           51400
      XLIM2=AMAX1(XSP(J,NM),XG(KN,NM))                                  51500
  200 CONTINUE                                                          51600
C                                                                       51700
C T-D PLOT SELECTION FROM TERMINAL                                      51800
C                                                                       51900
      IF(NIXIT.EQ.0) GO TO 10199                                        52000
      IPLOT=0                                                           52100
      GO TO 204                                                         52200
10199 TYPE 10200                                                        52300
10200 FORMAT(/' T-D PLOT: 1=RAW, 2=DATUM, 3=PRE-D, 4=L1 REMVD: ',$)     52400
      ACCEPT 10201, IPLOT                                               52500
10201 FORMAT(I)                                                         52600
      IF(IPLOT.LT.1.OR.IPLOT.GT.4) IPLOT=1                              52700
      ITY=JTRL                                                          52800
      IF(JTRL.EQ.IBL) GO TO 10204                                       52900
      ITY=IBL                                                           53000
      TYPE 10202                                                        53100
10202 FORMAT(' ENTER T TO TYPE, <CR> TO SUPPRESS: ',$)                  53200
      ACCEPT 10006, ITY                                                 53300
C                                                                       53400
C TEST FOR DOING RAW TIME T-D PLOT                                      53500
C                                                                       53600
10204 IF(IPLOT.EQ.1) CALL PLOT(1)                                       53700
  204 IF (IXIT.EQ.0) GO TO 1                                            53800
C                                                                       53900
```

```
C FIT STRAIGHT LINE THRU GEO ELEVATIONS                                 54000
C                                                                       54100
  205 IF (SLOPE.NE.0.0.OR.A.NE.0.0) GO TO 225                           54200
      IF (XDAT1.NE.0.0.OR.XDAT2.NE.0.0) GO TO 220                       54300
      SUM1=0.0                                                          54400
      SUM2=0.0                                                          54500
      PTS=0.0                                                           54600
      DO 212 M=1,NM                                                     54700
      KN=NK(M)                                                          54800
      DO 210 K=1,KN                                                     54900
      SUM1=SUM1+XG(K,M)                                                 55000
      SUM2=SUM2+EG(K,M)                                                 55100
      PTS=PTS+1.0                                                       55200
  210 CONTINUE                                                          55300
  212 CONTINUE                                                          55400
      XBAR=SUM1/PTS                                                     55500
      EBAR=SUM2/PTS                                                     55600
      SUM1=0.0                                                          55700
      SUM2=0.0                                                          55800
      DO 216 M=1,NM                                                     55900
      KN=NK(M)                                                          56000
      DO 214 K=1,KN                                                     56100
      DIFF=XG(K,M)-XBAR                                                 56200
      SUM1=SUM1+DIFF*EG(K,M)                                            56300
      SUM2=SUM2+DIFF**2                                                 56400
  214 CONTINUE                                                          56500
  216 CONTINUE                                                          56600
      SLOPE=SUM1/SUM2                                                   56700
      A=EBAR-SLOPE*XBAR                                                 56800
      GO TO 225                                                         56900
  220 SLOPE=(EDAT2-EDAT1)/(XDAT2-XDAT1)                                 57000
      A=EDAT1-SLOPE*XDAT1                                               57100
  225 DO 230 M=1,NM                                                     57200
      KN=NK(M)                                                          57300
      DO 226 K=1,KN                                                     57400
      EDG(K,M)=A+SLOPE*XG(K,M).                                         57500
  226 CONTINUE                                                          57600
      JN=NJ(M)                                                          57700
      DO 227 J=1,JN                                                     57800
  227 EDSP(J,M)=ES(J,M)                                                 57900
      J1=JA(M)                                                          58000
      J2=JB(M)                                                          58100
      DO 228 J=J1,J2                                                    58200
      EDSP(J,M)=A+SLOPE*XSP(J,M)                                        58300
  228 CONTINUE                                                          58400
  230 CONTINUE                                                          58500
C                                                                       58600
C VELOCITY OVERRIDE CARD ANALYSIS -- SET ANY ZERO VH=VV IF VV NONZERO   58700
C                                                                       58800
      IOVER=0                                                           58900
      IF (VVA(1,1).NE.0.0) GO TO 242                                    59000
      DO 240 M=1,NM                                                     59100
      VVA(M,1)=VREG(1)                                                  59200
  240 CONTINUE                                                          59300
      GO TO 246                                                         59400
  242 IOVER=1                                                           59500
      IF (NM.LE.1) GO TO 246                                            59600
      DO 244 M=2,NM                                                     59700
      IF (VVA(M,1).EQ.0.0) VVA(M,1)=VVA(1,1)                            59800
  244 CONTINUE                                                          59900
```

```
  246 DO 250 L=2,NL                                                    60000
      IF (VVA(1,L).EQ.0.0) GO TO 250                                   60100
      IF (VHA(1,L).EQ.0.0) VHA(1,L)=VVA(1,L)                           60200
      IF (NM.LE.1) GO TO 250                                           60300
      DO 248 M=2,NM                                                    60400
      IF (VVA(M,L).EQ.0.0) VVA(M,L)=VVA(1,L)                           60500
      IF (VHA(M,L).EQ.0.0) VHA(M,L)=VHA(1,L)                           60600
  248 CONTINUE                                                         60700
  250 CONTINUE                                                         60800
C                                                                      60900
C COMPUTE AND APPLY VERTICAL TIME CORRECTIONS TO DATUM -- PRINT RESULTS 61000
C                                                                      61100
  300 IF(NIXIT.EQ.1) GO TO 303                                         61200
      IF(JTRL.EQ.IBL) GO TO 301                                        61300
      IF(IOVER.EQ.0) TYPE 10303,VREG(1)                                61400
10303 FORMAT(/1X,'COMPUTED V1 =',3PF8.0)                               61500
      IF(IOVER.EQ.1) TYPE 10304,VVA(1,1)                               61600
10304 FORMAT(/1X,'OVERRIDE V1 =',3PF8.0)                               61700
  301 IF(JPRT.EQ.IBL) GO TO 303                                        61800
      PRINT 57, IDENT                                                  61900
      PRINT 302, A, SLOPE                                              62000
  302 FORMAT (1H0,46HARRIVAL TIMES CORRECTED TO DATUM (DATUM ELEV =,F8.1 62100
     1,4H + (,F8.4,25H)X), AND PLOT POSITIONS D)                       62200
  303 DO 400 M=1,NM                                                    62300
      VV=VVA(M,1)                                                      62400
      JN=NJ(M)                                                         62500
      KN=NK(M)                                                         62600
C FIRST PRECOMPUTE GEO TIME CORR                                       62700
      DO 304 K=1,KN                                                    62800
      TVG(K)=(EDG(K,M)-EG(K,M))/VV                                     62900
  304 CONTINUE                                                         63000
C THEN COMPUTE SP TIME CORR                                            63100
      DO 306 J=1,JN                                                    63200
      TVS(J)=0.                                                        63300
      IF (J.LT.JA(M).OR.J.GT.JB(M)) GO TO 306                          63400
      TVS(J)=(EDSP(J,M)-ES(J,M))/VV                                    63500
      IF (TUH(J,M).NE.0.0) TVS(J)=TVS(J)*TUH(J,M)*VV/ZSP(J,M)          63600
  306 CONTINUE                                                         63700
C APPLY DATUM CORRECTIONS                                              63800
  312 DO 332 J=1,JN                                                    63900
      DO 330 K=1,KN                                                    64000
      IF (LG(K,J,M).NE.1.AND.TR(K,J,M).NE.0.0) TA(K,J,M)=TR(K,J,M) +   64100
     1 TVS(J) + TVG(K)                                                 64200
  330 CONTINUE                                                         64300
  332 CONTINUE                                                         64400
C PRINT RESULTS                                                        64500
      IF (NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 400                         64600
      PRINT 383, IDSPR(M),(IDSP(J,M),J=1,JN)                           64700
  383 FORMAT (1H0,1X,7HSPREAD ,A1,7X,7(10X,'SP ',A1))                  64800
      PRINT 384, (EDSP(J,M),J=1,JN)                                    64900
  384 FORMAT(/7X,'ELEV . . . . .',7(F10.1,4X))                         65000
      PRINT 385, (TVS(J),J=1,JN)                                       65100
  385 FORMAT (9X,1H./9X,1H.,3X,6HCORR T,7(F12.1,2X))                   65200
      PRINT 387, (IBL,J=1,JN)                                          65300
  387 FORMAT (' GEO      .',10X,7(A1,'---T-----D---'))                 65400
      DO 390 K=1,KN                                                    65500
      PRINT 389, K,EDG(K,M),TVG(K),(TA(K,J,M),P(K,J,M),J=1,JN)         65600
  389 FORMAT (1X,I2,2F8.1,1X,14F7.1)                                   65700
  390 CONTINUE                                                         65800
  400 CONTINUE                                                         65900
```

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C                                                                       66000
C EXIT POINT TEST AND BRANCH                                            66100
C                                                                       66200
C PLOT T-D GRAPH                                                        66300
C                                                                       66400
  450 IF(IPLOT.EQ.2) CALL PLOT(1)                                       66500
C                                                                       66600
      IF (IXIT.EQ.1) GO TO 1                                            66700
C                                                                       66800
C***********************************************************************66900
C PART 2                                                                67000
C***********************************************************************67100
C                                                                       67200
C DO REGRESSION VELOCITY COMPUTATION FOR TOP OF LAYER 2                 67300
C                                                                       67400
 1000 IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 57, IDENT                   67500
      L1=1                                                              67600
      L2=2                                                              67700
      CALL REGV(L2,NIXIT)                                               67800
      IF(PREG(2).GT.0.0) GO TO 1005                                     67900
      IF (VVA(1,2).GT.0.0) GO TO 1020                                   68000
 1001 IF (NIXIT.NE.0) GO TO 1                                           68100
      IF(JPRT.NE.IBL) PRINT 1002, L2                                    68200
 1002 FORMAT (/1X,46HNOT ENOUGH POINTS TO DEFINE VELOCITY FOR LAYER,I2, 68300
     118H USE OVERRIDE CARD)                                            68400
      IF(JTRL.NE.IBL) TYPE 1002, L2                                     68500
      GO TO 1                                                           68600
C                                                                       68700
C DO HOBSON-OVERTON VEL COMPUTATION FOR TOP OF LAYER 2                  68800
C                                                                       68900
 1005 CALL HOBV(L2,NIXIT)                                               69000
C                                                                       69100
      IF (VVA(1,2).NE.0.0) GO TO 1020                                   69200
      VV=(VREG(2)*PREG(2)+2.0*VHOB(2)*PHOB(2))/(PREG(2)+2.0*PHOB(2))    69300
      DO 1008 M=1,NM                                                    69400
      VVA(M,2)=VV                                                       69500
      VHA(M,2)=VV                                                       69600
 1008 CONTINUE                                                          69700
C                                                                       69800
      IF(NIXIT.NE.0) GO TO 1094                                         69900
      IF(JPRT.NE.IBL)PRINT 1011,L2,VV                                   70000
 1011 FORMAT('0WTD AVG VELOCITY FOR LAYER',I2,2H =,3PF7.0/' -'          70100
     1,6('------'))                                                     70200
      IF(JTRL.NE.IBL)TYPE 11011,L2,VV                                   70300
11011 FORMAT(1X,'COMPUTED V',I1,' =',3PF8.0)                            70400
      GO TO 1094                                                        70500
C                                                                       70600
 1020 IF(NIXIT.NE.0) GO TO 1094                                         70700
      IF(JPRT.NE.IBL) PRINT 1021, L2,VVA(1,L2)                          70800
 1021 FORMAT (1X,'OVERRIDE V',I1,' =',3PF8.0)                           70900
      IF(JTRL.NE.IBL) TYPE 1021, L2,VVA(1,L2)                           71000
C                                                                       71100
C COMPUTE VELOCITIES FOR DEEPER LAYERS BY REGRESSION AND HOBSON METHOD  71200
C                                                                       71300
 1094 DO 1100 L=3,NL                                                    71400
      IF(NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 57, IDENT                    71500
      LCALL=L                                                           71600
      CALL REGV(LCALL,NIXIT)                                            71700
      IF (PREG(L).GT.0.) GO TO 1096                                     71800
      IF(VVA(1,L).GT.0.) GO TO 1100                                     71900
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      L2=L                                                                  72000
      GO TO 1001                                                            72100
 1096 LCALL=L                                                               72200
      CALL HOBV(LCALL,NIXIT)                                                72300
      IF(VVA(1,L).NE.0.) GO TO 1098                                         72400
      VV=(VREG(L)*PREG(L)+2.*VHOB(L)*PHOB(L))/(PREG(L)+2.*PHOB(L))          72500
      DO 1097 M=1,NM                                                        72600
      VVA(M,L)=VV                                                           72700
      VHA(M,L)=VV                                                           72800
 1097 CONTINUE                                                              72900
      IF(NIXIT.NE.0) GO TO 1100                                             73000
      IF(JPRT.NE.IBL) PRINT 1011, L,VV                                      73100
      IF(JTRL.NE.IBL) TYPE 11011, L,VV                                      73200
      GO TO 1100                                                            73300
C                                                                           73400
 1098 IF(NIXIT.NE.0) GO TO 1100                                             73500
      IF(JPRT.NE.IBL) PRINT 1021, L,VVA(1,L)                                73600
      IF(JTRL.NE.IBL) TYPE 1021, L,VVA(1,L)                                 73700
 1100 CONTINUE                                                              73800
C                                                                           73900
C MAKE TIE CORRECTION IF JJOFF.EQ.0                                         74000
C                                                                           74100
      IF(JJOFF.NE.0) GO TO 1150                                             74200
      DO 1145 M=1,NM                                                        74300
      MCALL=M                                                               74400
      KN=NK(M)                                                              74500
      J=JA(M)                                                               74600
      IF(XG(1,M).GE.XSP(J,M)) GO TO 1120                                    74700
C SET D NEGATIVE FOR GEOS LEFT OF LEFT END SP                               74800
      K2=KL(J,M)                                                            74900
      DO 1118 K=1,K2                                                        75000
      D(K,J,M)=-D(K,J,M)                                                    75100
 1118 CONTINUE                                                              75200
 1120 JJ=J-1                                                                75300
      IF(JJ.LT.1) GO TO 1130                                                75400
      JJTIE=0                                                               75500
      DO 1125 L=2,NL                                                        75600
      LCALL=L                                                               75700
      CALL KENDS(LCALL,MCALL,JJ,KR(JJ,M),KN,K11,K22)                        75800
      IF(K11.EQ.0) GO TO 1125                                               75900
      KT1=KR(J,M)                                                           76000
      IF(KT1.EQ.0) GO TO 1125                                               76100
      CALL TIE(LCALL,MCALL,J,JJ,K11,K22,KT1,KN,KN,1,JJTIE)                  76200
 1125 CONTINUE                                                              76300
      J=J-1                                                                 76400
      GO TO 1120                                                            76500
 1130 J=JB(M)                                                               76600
      JN=NJ(M)                                                              76700
      IF(XG(KN,M).LE.XSP(J,M)) GO TO 1135                                   76800
C SET D NEGATIVE FOR GEOS RIGHT OF RIGHT END SP                             76900
      K1=KR(J,M)                                                            77000
      DO 1132 K=K1,KN                                                       77100
      D(K,J,M)=-D(K,J,M)                                                    77200
 1132 CONTINUE                                                              77300
 1135 JJ=J+1                                                                77400
      IF(JJ.GT.JN) GO TO 1145                                               77500
      JJTIE=0                                                               77600
      DO 1140 L=2,NL                                                        77700
      LCALL=L                                                               77800
      CALL KENDS(LCALL,MCALL,JJ,1,KL(JJ,M),K11,K22)                         77900
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      IF(K11.EQ.0) GO TO 1140                                          78000
      KT2=KL(J,M)                                                      78100
      IF(KT2.EQ.0) GO TO 1140                                          78200
      CALL TIE(LCALL,MCALL,J,JJ,K11,K22,1,KT2,KN,2,JJTIE)              78300
 1140 CONTINUE                                                         78400
      J=J+1                                                            78500
      GO TO 1135                                                       78600
 1145 CONTINUE                                                         78700
C                                                                      78800
C PLOT T-D GRAPH OF PRE-DEPTH TIME VALUES                              78900
C                                                                      79000
 1150 DO 1160 M=1,NM                                                   79100
      JN=NJ(M)                                                         79200
      KN=NK(M)                                                         79300
      DO 1160 J=1,JN                                                   79400
      DO 1160 K=1,KN                                                   79500
 1160 TA(K,J,M)=TR(K,J,M)                                              79600
C                                                                      79700
      IF(IPLOT.EQ.3) CALL PLOT(1)                                      79800
C                                                                      79900
C COMPUTE DEPTH PTS AT BASE OF LAYER 1 (FOR IREP=1,IFLAG=0)            80000
C (IREP.GE.2 IS DONE IN PART 3)                                        80100
C                                                                      80200
C SPREAD LOOP STARTS HERE----------------------------LOOP ENDS AT 1060  80300
C                                                                      80400
 1025 IF (ITRACE.NE.0.AND.IXIT.GE.4.AND.JPRT.NE.IBL) PRINT 1027, L2    80500
 1027 FORMAT (1H1,45HINTERMEDIATE RESULTS OF RAY TRACING FOR LAYER,I2) 80600
      IFLAG=0                                                          80700
      RADS=SQRT(1.+SLOPE**2)                                           80800
      DO 1060 M=1,NM                                                   80900
      JN=NJ(M)                                                         81000
      KN=NK(M)                                                         81100
      VV=VVA(M,L1)                                                     81200
      HV=VHA(M,L2)                                                     81300
      IF (HV.LE.VV) GO TO 9992                                         81400
      RAD=SQRT(HV**2-VV**2)                                            81500
      TANSG=VV/RAD                                                     81600
      VOCOSG=TANSG*HV                                                  81700
      VVCOSG=VV*RAD/HV                                                 81800
      DENEX=HV*RADS                                                    81900
      IF (JJOFF.NE.0) GO TO 1029                                       82000
      J1=JA(M)                                                         82100
      J2=JB(M)                                                         82200
      GO TO 1030                                                       82300
 1029 J1=1                                                             82400
      J2=NJ(M)                                                         82500
C                                                                      82600
C PRECOMPUTE DATUM ELEV CORR FOR ALL GEOS AND STORE V AND TRIG CONSTS  82700
 1030 DO 1034 K=1,KN                                                   82800
C I=1 FOR RIGHT-GOING RAYS, 2 FOR LEFT-GOING                           82900
      DO 1033 I=1,2                                                    83000
      ICALL=I                                                          83100
      CALL ELCOR(TANSG,VV,HV,XG(K,M),EG(K,M),A,SLOPE,ICALL,TCG(K,I),   83200
     1 XCG(K,I),XINTG(K,I),EINTG(K,I))                                 83300
 1033 CONTINUE                                                         83400
 1034 CONTINUE                                                         83500
C                                                                      83600
C SHOT POINT LOOP STARTS HERE------------------------LOOP ENDS AT 1049 83700
C                                                                      83800
      DO 1049 J=J1,J2                                                  83900
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      JJ=J                                                                  84000
C                                                                           84100
C INITIALIZE FOR RIGHT-GOING RAYS                                           84200
C                                                                           84300
      I=1                                                                   84400
      II=2                                                                  84500
      K1=KR(J,M)                                                            84600
      IF (K1.EQ.0) GO TO 1046                                               84700
      K2=KN                                                                 84800
C                                                                           84900
C COMPUTE ELEV TIME CORR AND DIRECT DISTS                                   85000
C                                                                           85100
 1036 MCALL=M                                                               85200
      JCALL=J                                                               85300
      CALL KENDS(2,MCALL,JCALL,K1,K2,K11,K22)                               85400
      IF (K11.EQ.0) GO TO (1046,1049),I                                     85500
      CALL ELCOR(TANSG,VV,HV,XSP(J,M),ES(J,M),A,SLOPE,II,TC,XC,XINT,EINT    85600
     1)                                                                     85700
C                                                                           85800
C RE-ENTRY POINT FOR OUTLYING SHOTPOINTS                                    85900
C                                                                           86000
 1037 DO 1038 K=K11,K22                                                     86100
      IF (LG(K,JJ,M).NE.2) GO TO 1038                                       86200
      TA(K,JJ,M)=TR(K,JJ,M)+TC+TCG(K,I)                                     86300
      DSG(K)=D(K,J,M)+XC+XCG(K,I)                                           86400
 1038 CONTINUE                                                              86500
C                                                                           86600
C EXTRAP TIME AT SP AND COMPUTE COORD OF END PT OF RAY BENEATH SP           86700
C                                                                           86800
      MCALL=M                                                               86900
      CALL REGRES(K11,K22,JJ,MCALL,2,V,T,PT,0)                              87000
      IF (PT.EQ.0.) GO TO (1046,1049),I                                     87100
      Z=T*VOCOSG                                                            87200
      TS=Z/VVCOSG                                                           87300
      ZTAN=Z*TANSG                                                          87400
      RAY=SQRT(Z**2+ZTAN**2)                                                87500
      B=SLOPE                                                               87600
      IF(I.EQ.1) B=-B                                                       87700
      XTRU=RAY*(VV-B*RAD)/DENEX                                             87800
      ZTRU=RAY*(RAD+VV*B)/DENEX                                             87900
      IF(I.EQ.2) XTRU=-XTRU                                                 88000
 1039 PRS2(JJ,M,1,I)=XINT+XTRU                                              88100
      IF(I.EQ.2) ZTAN=-ZTAN                                                 88200
      PRSH=XINT+ZTAN/RADS                                                   88300
      ERS2(JJ,M,1,I)=EINT-ZTRU                                              88400
      TRS2(JJ,M,I)=TS                                                       88500
      PS2(JJ,M,1)=XSP(J,M)                                                  88600
      ES2(JJ,M,I)=ES(J,M)                                                   88700
      IF (TRS2(JJ,M,I).GE.0.) GO TO 1041                                    88800
      TS=0.                                                                 88900
      Z=0.                                                                  89000
      TRS2(JJ,M,I)=0.                                                       89100
      ERS2(JJ,M,1,I)=ES(J,M)                                                89200
      PRS2(JJ,M,1,I)=XSP(J,M)                                               89300
      PRSH=XSP(J,M)                                                         89400
C                                                                           89500
C COMPUTE COORD OF RAY END PTS AT GEOS                                      89600
C                                                                           89700
 1041 ZRSP(JJ)=Z                                                            89800
      DO 1043 K=K11,K22                                                     89900
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      IF (LG(K,JJ,M).NE.2) GO TO 1043                                   90000
      EDIF=SLOPE*(XINTG(K,I)-PRSH)                                      90100
      KCALL=K                                                           90200
      JCALL=J                                                           90300
      MCALL=M                                                           90400
      CALL HTIME(KCALL,JCALL,MCALL,PRSH,0.,XINTG(K,I),EDIF,HV,TH)       90500
      PG2(K,M,I)=XG(K,M)                                                90600
      EG2(K,M,I)=EG(K,M)                                                90700
      Z=(TA(K,JJ,M)-TS-TH)*VOCOSG                                       90800
      ZTAN=Z*TANSG                                                      90900
      RAY=SQRT(Z**2+ZTAN**2)                                            91000
      B=SLOPE                                                           91100
      IF(I.EQ.2) B=-B                                                   91200
      XTRU=RAY*(VV-B*RAD)/DENEX                                         91300
      ZTRU=RAY*(RAD+VV*B)/DENEX                                         91400
      IF(I.EQ.1) XTRU=-XTRU                                             91500
      ERG(K,JJ,M)=EINTG(K,I)-ZTRU                                       91600
      IF (EG(K,M).GT.ERG(K,JJ,M)) GO TO 1042                            91700
      Z=0.                                                              91800
      ERG(K,JJ,M)=EG(K,M)                                               91900
      PRG(K,JJ,M)=XG(K,M)                                               92000
      TRG(K,JJ,M)=0.00001                                               92100
      GO TO 11043                                                       92200
 1042 TRG(K,JJ,M)=Z/VVCOSG                                              92300
      PRG(K,JJ,M)=XINTG(K,I)+XTRU                                       92400
11043 ZRG(K,JJ)=Z                                                       92500
 1043 CONTINUE                                                          92600
C                                                                       92700
C TEST FOR DOING OUTLYING SPS LEFT OF SPREAD, RIGHT-GOING RAYS          92800
C                                                                       92900
      IF (I.EQ.2) GO TO 1047                                            93000
      IF (JJOFF.NE.0.OR.JJ.GT.J1) GO TO 1046                            93100
 1044 JJ=JJ-1                                                           93200
      IF (JJ.GT.0) GO TO 1045                                           93300
      SUM1=0.                                                           93400
      SUM2=0.                                                           93500
      SUM3=0.                                                           93600
      PTS1=0.                                                           93700
      JJJ=0                                                             93800
      DO 2045 JJ=1,J1                                                   93900
      IF(ERS2(JJ,M,L1,1).EQ.0.) GO TO 2045                              94000
      SUM1=SUM1+TRS2(JJ,M,1)                                            94100
      SUM2=SUM2+PRS2(JJ,M,L1,1)                                         94200
      SUM3=SUM3+ERS2(JJ,M,L1,1)                                         94300
      PTS1=PTS1+1.                                                      94400
      IF(JJJ.EQ.0) JJJ=JJ                                               94500
 2045 CONTINUE                                                          94600
      IF(PTS1.EQ.0.) GO TO 1046                                         94700
      TBAR=SUM1/PTS1                                                    94800
      PBAR=SUM2/PTS1                                                    94900
      EBAR=SUM3/PTS1                                                    95000
      DO 3045 JJ=JJJ,J1                                                 95100
      TRS2(JJ,M,1)=TBAR                                                 95200
      PRS2(JJ,M,L1,1)=PBAR                                              95300
      ERS2(JJ,M,L1,1)=EBAR                                              95400
      IF(JJ.LT.J1) KRS2(JJ,M,L1,1)=IAST                                 95500
 3045 CONTINUE                                                          95600
      GO TO 1046                                                        95700
 1045 MCALL=M                                                           95800
      CALL KENDS(2,MCALL,JJ,KR(JJ,M),KN,K11,K22)                        95900
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      IF (K11.EQ.0) GO TO 1044                                          96000
      GO TO 1037                                                        96100
C                                                                       96200
C INITIALIZE FOR LEFT-GOING RAYS                                        96300
C                                                                       96400
 1046 I=2                                                               96500
      II=1                                                              96600
      K1=1                                                              96700
      K2=KL(J,M)                                                        96800
      IF (K2.NE.0) GO TO 1036                                           96900
C                                                                       97000
C TEST FOR DOING OUTLYING SPS RIGHT OF SPREAD, LEFT-GOING RAYS          97100
C                                                                       97200
 1047 IF (JJOFF.NE.0.OR.JJ.LT.J2) GO TO 1049                            97300
 1048 JJ=JJ+1                                                           97400
      IF (JJ.LE.JN) GO TO 4048                                          97500
      SUM1=0.                                                           97600
      SUM2=0.                                                           97700
      SUM3=0.                                                           97800
      PTS1=0.                                                           97900
      DO 2048 JJ=J2,JN                                                  98000
      IF(ERS2(JJ,M,L1,2).EQ.0.) GO TO 2048                              98100
      SUM1=SUM1+TRS2(JJ,M,2)                                            98200
      SUM2=SUM2+PRS2(JJ,M,L1,2)                                         98300
      SUM3=SUM3+ERS2(JJ,M,L1,2)                                         98400
      PTS1=PTS1+1.                                                      98500
      JJJ=JJ                                                            98600
 2048 CONTINUE                                                          98700
      IF(PTS1.EQ.0.) GO TO 1049                                         98800
      TBAR=SUM1/PTS1                                                    98900
      PBAR=SUM2/PTS1                                                    99000
      EBAR=SUM3/PTS1                                                    99100
      DO 3048 JJ=J2,JJJ                                                 99200
      TRS2(JJ,M,2)=TBAR                                                 99300
      PRS2(JJ,M,L1,2)=PBAR                                              99400
      ERS2(JJ,M,L1,2)=EBAR                                              99500
      IF(JJ.GT.J2) KRS2(JJ,M,L1,2)=IAST                                 99600
 3048 CONTINUE                                                          99700
      GO TO 1049                                                        99800
 4048 MCALL=M                                                           99900
      CALL KENDS(2,MCALL,JJ,1,KL(JJ,M),K11,K22)                        100000
      IF (K11.EQ.0) GO TO 1048                                         100100
      GO TO 1037                                                       100200
 1049 CONTINUE                                                         100300
 1060 CONTINUE                                                         100400
C                                                                      100500
C COMPUTE AVG ELEV OF BASE OF LAYER 1 BENEATH EACH GEO                 100600
C                                                                      100700
C--------------------------------ENTER AFTER RETURNING FROM PART 3      100800
C                                                                      100900
 1200 DO 1400 M=1,NM                                                   101000
      VV=VVA(M,1)                                                      101100
      TANSG=VV/SQRT(VHA(M,2)**2-VV**2)                                 101200
      MCALL=M                                                          101300
      IF (IFLAG.EQ.0) CALL ADMIG(L1,MCALL,DL(M))                       101400
      JN=NJ(M)                                                         101500
      KN=NK(M)                                                         101600
      DG2=(XG(KN,M)-XG(1,M))/FLOAT(KN+KN-2)                            101700
      DO 1255 K=1,KN                                                   101800
      ERX(K)=0.                                                        101900
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      ERP(K,M,1)=0.                                                    102000
      TRP(K,M,1)=0.                                                    102100
      PRP(K)=0.                                                        102200
      ERX(K)=0.                                                        102300
      IF (K.EQ.1) GO TO 1235                                           102400
      X1=(XG(K,M)+XG(K-1,M))/2.                                        102500
      GO TO 1240                                                       102600
 1235 X1=XG(1,M)-DG2                                                   102700
 1240 IF (K.EQ.KN) GO TO 1245                                          102800
      X2=(XG(K+1,M)+XG(K,M))/2.                                        102900
      GO TO 1250                                                       103000
 1245 X2=XG(KN,M)+DG2                                                  103100
 1250 CALL AVG(X1,X2,2,PRP(K),ERX(K))                                  103200
 1255 CONTINUE                                                         103300
      DO 1285 K=1,KN                                                   103400
      IF(ERX(K).EQ.0.) GO TO 1285                                      103500
      KK=K                                                             103600
      IF (PRP(K).GT.XG(K,M)) GO TO 1270                                103700
 1260 KK=KK+1                                                          103800
      IF (KK.GT.KN) GO TO 1278                                         103900
      IF(ERX(K).EQ.0.) GO TO 1260                                      104000
      GO TO 1275                                                       104100
 1270 KK=KK-1                                                          104200
      IF (KK.LT.1) GO TO 1278                                          104300
      IF(ERX(K).EQ.0.) GO TO 1270                                      104400
 1275 ERP(K,M,1)=TERP(PRP(K),ERX(K),PRP(KK),ERX(KK),XG(K,M))           104500
      GO TO 1285                                                       104600
 1278 ERP(K,M,1)=ERX(K)-(PRP(K)-XG(K,M))*SLOPE                         104700
 1285 CONTINUE                                                         104800
      DO 1290 K=1,KN                                                   104900
      IF(ERX(K).EQ.0.) GO TO 1290                                      105000
      PRP(K)=XG(K,M)                                                   105100
      TRP(K,M,1)=(EG(K,M)-ERP(K,M,1))/VV                               105200
      DEPTH=EG(K,M)-ERP(K,M,1)                                         105300
 1290 CONTINUE                                                         105400
      DO 1325 J=1,JN                                                   105500
      TRS(J,M,1)=0.                                                    105600
      ERS(J,M,1)=0.                                                    105700
 1325 CONTINUE                                                         105800
 1400 CONTINUE                                                         105900
C                                                                      106000
C FILL IN MISSING POINTS                                               106100
C                                                                      106200
      CALL FILLIN(L1)                                                  106300
C L1 SET TO 0 IN FILLIN IF NO PTS ARE DEFINED FOR LAYER L1             106400
      IF(L1.EQ.0) GO TO 1                                              106500
      IF (IFLAG.EQ.2.OR.IXIT.LE.3.OR.(IFLAG.EQ.1.AND.IXIT.EQ.4))       106600
     1 GO TO 1061                                                      106700
      IFLAG=IFLAG+1                                                    106800
      L1=1                                                             106900
      L2=2                                                             107000
      IREP=IFLAG+1                                                     107100
      GO TO 2002                                                       107200
C                                                                      107300
C-----------------------------------------------------GO TO PART 3     107400
C                                                                      107500
 1061 IF (NIXIT.EQ.1) GO TO 1070                                       107600
C                                                                      107700
C PRINT HEADING FOR RESULTS                                            107800
C                                                                      107900
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      IF(JPRT.EQ.IBL) GO TO 1070                                        108000
      PRINT 57, IDENT                                                   108100
      PRINT 1068                                                        108200
 1068 FORMAT (1HO,48HARRIVAL TIMES CORRECTED TO BASE OF LAYER 1, AND ,  108300
     1 23HELEV OF BASE OF LAYER 1)                                      108400
C                                                                       108500
C COMPUTE CORRECTED TA FOR T-D PLOT                                     108600
C                                                                       108700
 1070 DO 1092 M=1,NM                                                    108800
      JN=NJ(M)                                                          108900
      KN=NK(M)                                                          109000
      DO 1082 J=1,JN                                                    109100
      IF (J.GE.JA(M).OR.JJOFF.NE.0) GO TO 1075                          109200
      JJ=JA(1)                                                          109300
      GO TO 1076                                                        109400
 1075 IF (J.LE.JB(M).OR.JJOFF.NE.0) GO TO 1077                          109500
      JJ=JB(NM)                                                         109600
 1076 TRS(J,M,1)=TRS(JJ,M,1)                                            109700
 1077 DO 1080 K=1,KN                                                    109800
      IF (LG(K,J,M).EQ.1.OR.TR(K,J,M).EQ.0.0) GO TO 1078                109900
      TA(K,J,M)=TR(K,J,M)-TRP(K,M,1)-TRS(J,M,1)                         110000
      GO TO 1080                                                        110100
 1078 TA(K,J,M)=0.0                                                     110200
 1080 CONTINUE                                                          110300
 1082 CONTINUE                                                          110400
C                                                                       110500
C PRINT RESULTS                                                         110600
C                                                                       110700
      IF (NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 1092                         110800
      PRINT 383, IDSPR(M),(IDSP(J,M),J=1,JN)                            110900
      PRINT 384, (ERS(J,M,1),J=1,JN)                                    111000
      PRINT 385, (TRS(J,M,1),J=1,JN)                                    111100
      PRINT 387, (IBL,J=1,JN)                                           111200
      DO 1090 K=1,KN                                                    111300
      PRINT 389, K,ERP(K,M,1),TRP(K,M,1),(TA(K,J,M),P(K,J,M),J=1,JN)    111400
 1090 CONTINUE                                                          111500
 1092 CONTINUE                                                          111600
C                                                                       111700
C PLOT T-D GRAPH (LAYER 1 REMOVED)                                      111800
C                                                                       111900
 1110 IF(IPLOT.EQ.4) CALL PLOT(1)                                       112000
      IF (IXIT.EQ.2) GO TO 1                                            112100
C                                                                       112200
C*************************************************************************112300
C PART 3                                                                112400
C*************************************************************************112500
C                                                                       112600
C COMPUTE DEPTH POINTS AT BASE OF LAYER L, L.GT.2                       112700
C                                                                       112800
C LAYER LOOP -- REFR HORIZ IS BETWEEN L1 AND L2 -- LOOP ENDS AT 2190    112900
C                                                                       113000
 2000 IF (NL.LE.2) GO TO 2200                                           113100
      L2=3                                                              113200
 2001 L1=L2-1                                                           113300
      IF (ITRACE.NE.0.AND.JPRT.NE.IBL) PRINT 1027, L2                   113400
      LL=L1-1                                                           113500
      IFLAG=0                                                           113600
      IF (IREP.EQ.4) GO TO 2002                                         113700
      IREP=1                                                            113800
C                                                                       113900
```

```
C SPREAD LOOP STARTS HERE---------------------- LOOP ENDS AT 2090 + 3     114000
C                                                                        114100
C-----ENTRY POINT FROM PART 2  (FOR IREP.GE.2, IFLAG.NE.0, L1=1,L2=2)    114200
C                                                                        114300
 2002 M=1                                                                114400
      IXREP=IXIT-IREP                                                    114500
C                                                                        114600
 2003 JN=NJ(M)                                                           114700
      KN=NK(M)                                                           114800
      HV=VHA(M,L2)                                                       114900
      HV2=HV**2                                                          115000
      VV=VVA(M,L1)                                                       115100
      IF (HV.LE.VV) GO TO 9992                                           115200
      TANSG=VV/SQRT(HV2-VV**2)                                           115300
      VOCOSG=TANSG*HV                                                    115400
      IF(IREP.NE.2) BL(M)=0.                                             115500
      IF (JJOFF.EQ.0) GO TO 2004                                         115600
      J1=1                                                               115700
      J2=JN                                                              115800
      GO TO 2007                                                         115900
 2004 J1=JA(M)                                                           116000
      J2=JB(M)                                                           116100
C                                                                        116200
C PRECOMPUTE TIME AND MIGR CORR FOR ALL GEOS, SPREAD M                   116300
C ALSO CLEAR WORKING STORAGE                                             116400
C                                                                        116500
 2007 DO 2011 K=1,KN                                                     116600
      DO 2008 LR=1,2                                                     116700
      PRG2(K,LR)=0.0                                                     116800
      ERG2(K,LR)=0.0                                                     116900
      TRG2(K,LR)=0.0                                                     117000
 2008 CONTINUE                                                           117100
      IF (IREP.GT.1) GO TO 2011                                          117200
      DO 2009 LR=1,2                                                     117300
      PG2(K,M,LR)=0.0                                                    117400
      EG2(K,M,LR)=0.0                                                    117500
      TG2(K,M,LR)=0.0                                                    117600
 2009 CONTINUE                                                           117700
      RAD=SQRT(HV2-VVA(M,1)**2)                                          117800
      TVG(K)=TRP(K,M,1)*HV/RAD                                           117900
      XVG(K)=(EG(K,M)-ERP(K,M,1))*VVA(M,1)/RAD                           118000
      IF (LL.LE.1) GO TO 2011                                            118100
      DO 2010 L=2,LL                                                     118200
      RAD=SQRT(HV2-VVA(M,L)**2)                                          118300
      TVG(K)=TVG(K)+TRP(K,M,L)*HV/RAD                                    118400
      XVG(K)=XVG(K)+(ERP(K,M,L-1)-ERP(K,M,L))*VVA(M,L)/RAD               118500
 2010 CONTINUE                                                           118600
 2011 CONTINUE                                                           118700
C                                                                        118800
C SHOT POINT LOOP STARTS HERE------------------------ LOOP ENDS AT 2090   118900
C                                                                        119000
      J=J1                                                               119100
 2012 JJ=J                                                               119200
C                                                                        119300
C COMPUTE TIME AND MIGR CORR AT SP J                                     119400
C                                                                        119500
      ISPLT=0                                                            119600
      IF (IFLAG.NE.0) GO TO 12018                                        119700
      IF (ES(J,M).LE.ERS(J,M,LL)) GO TO 2016                             119800
      TC=0.0                                                             119900
```

```
      XC=0.0                                                            120000
      NONE=0                                                            120100
      DO 2015 L=1,LL                                                    120200
      IF (ES(J,M).LT.ERS(J,M,L)) GO TO 2015                             120300
      IF (IREP.EQ.1) GO TO 2013                                         120400
      LS(J,M)=L                                                         120500
      GO TO 2018                                                        120600
 2013 V1=VVA(M,L)                                                       120700
      RAD=SQRT (HV2-V1**2)                                              120800
      IF (NONE.EQ.0) GO TO 2014                                         120900
      XC=XC+(ERS(J,M,L-1)-ERS(J,M,L))*V1/RAD                            121000
      TC=TC+TRS(J,M,L)*HV/RAD                                           121100
      GO TO 2015                                                        121200
 2014 XC=(ES(J,M)-ERS(J,M,L))*V1/RAD                                    121300
      TC=((ES(J,M)-ERS(J,M,L))*HV)/(V1*RAD)                             121400
      LS(J,M)=L                                                         121500
      NONE=1                                                            121600
 2015 CONTINUE                                                          121700
      GO TO 2017                                                        121800
 2016 LS(J,M)=L1                                                        121900
      IF(IREP.EQ.1) GO TO 12017                                         122000
      IF(ES(J,M).GE.ERS(J,M,L1)) GO TO 2018                             122100
      LS(J,M)=L2                                                        122200
      ISPLT=2                                                           122300
      GO TO 2018                                                        122400
12017 DZ=ERS(J,M,LL)-ES(J,M)                                            122500
      ISPLT=1                                                           122600
 2017 IF (ISPLT.EQ.0) GO TO 2018                                        122700
      TC=-DZ*VOCOSG/VV**2                                               122800
      ELLS=ERS(J,M,LL)                                                  122900
      DS=-DZ*TANSG                                                      123000
      XC=DS                                                             123100
      GO TO 2018                                                        123200
C                                                                       123300
C INITIALIZE FOR RIGHT-GOING RAYS                                       123400
C                                                                       123500
12018 IF(LS(J,M).EQ.2) ISPLT=1                                          123600
 2018 I=1                                                               123700
      II=2                                                              123800
      SGN=1.0                                                           123900
      IF(KR(J,M).EQ.0) GO TO 2040                                       124000
      CALL KENDS(L2,M,J,KR(J,M),KN,K11,K22)                             124100
C                                                                       124200
C ENTRY POINT AFTER INITIALIZATION FOR RIGHT- OR LEFT-GOING RAYS        124300
C                                                                       124400
C--------------------TRACE SHOTPOINT RAYS, IREP=1-----                  124500
C                                                                       124600
 2019 IF (IREP.GT.1) GO TO 2021                                         124700
      XLLS=XSP(J,M)+XC*SGN                                              124800
      TLLS=TC                                                           124900
      IF(ISPLT.NE.0) GO TO 2023                                         125000
      IF(ITRACE.NE.0.AND.JPRT.NE.IBL)PRINT 2020,IREP,IDSPR(M),IDSP(J,M) 125100
     1,IZ,II,L2,L1,LS(J,M),XSP(J,M),ES(J,M),XLLS,ELLS,TLLS,DMY1,DMY2    125200
     2,DMY3,BL(M)                                                       125300
 2020 FORMAT(1H0,35HIREP SPR SP  G  I  L LL LO   XO/XL1,7X,2HEO,6X,3HXLL 125400
     1,6X,3HELL,6X,3HTLL,7X,2HXL,7X,2HEL,7X,2HTL,3X,17HBLL/BL   EPS    N 125500
     2/1X,I3,2(3X,A1),5I3,8F9.1,F9.4)                                   125600
      CALL RAYUP(L2,L1,LS(J,M),J,M,II,XSP(J,M),ES(J,M),XLLS,            125700
     1 ELLS,TLLS,DMY1,DMY2,DMY3,BL(M))                                  125800
      DS=(XLLS-XSP(J,M))*SGN                                            125900
```

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      GO TO 2023                                                        126000
C                                                                       126100
C--------------------TRACE SHOTPOINT RAYS, IREP.GT.1-----               126200
C                                                                       126300
 2021 IF((JJOFF.EQ.0.AND.J.EQ.J1.AND.I.EQ.1).OR.(JJOFF.EQ.0.AND.J.EQ.J2. 126400
     1AND.I.EQ.2)) GO TO 12021                                          126500
      IF(K11.EQ.0) GO TO 2031                                           126600
12021 IF (ISPLT.EQ.2) GO TO 2022                                        126700
      IF(ITRACE.NE.0.AND.JPRT.NE.IBL)PRINT 2020,IREP,IDSPR(M),IDSP(J,M) 126800
     1,IZ,II,L2,L2,LS(J,M),XSP(J,M),ES(J,M),PS2(J,M,I),ES2(J,M,I),DMY0  126900
     2,PRS2(J,M,L1,I),ERS2(J,M,L1,I),TRS2(J,M,I),BL(M)                  127000
      CALL RAYUP(L2,L2,LS(J,M),J,M,II,XSP(J,M),ES(J,M),                 127100
     1 PS2(J,M,I),ES2(J,M,I),DMY0,PRS2(J,M,L1,I),ERS2(J,M,L1,I),        127200
     2 TRS2(J,M,I),BL(M))                                               127300
      GO TO 2023                                                        127400
 2022 PRS2(J,M,L1,I)=XSP(J,M)                                           127500
      ERS2(J,M,L1,I)=ERS(J,M,L1)                                        127600
C                                                                       127700
C RE-ENTRY PT FOR OUTLYING SHOTPOINTS                                   127800
C                                                                       127900
 2023 IF(K11.EQ.0) GO TO 2031                                           128000
      IF(KRS2(JJ,M,L1,I).EQ.IBEE) KRS2(JJ,M,L1,I)=IBL                   128100
      DO 2030 K=K11,K22                                                 128200
      IF (LG(K,JJ,M).NE.L2) GO TO 2030                                  128300
C                                                                       128400
C--------------------TRACE GEOPHONE RAYS, IREP=1-----                  128500
C                                                                       128600
      IF (IREP.GT.1) GO TO 2026                                         128700
      IF (TG2(K,M,I).NE.0.0) GO TO 2025                                 128800
      PG2(K,M,I)=XG(K,M)-XVG(K)*SGN                                     128900
      TG2(K,M,I)=TVG(K)                                                 129000
      IF(ITRACE.NE.0.AND.JPRT.NE.IBL)PRINT 2020,IREP,IDSPR(M),IDSP(JJ,M) 129100
     1,K,I,L2,L1,I1,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),TG2(K,M,I)    129200
     2,DMY1,DMY2,DMY3,BL(M)                                             129300
      CALL RAYUP(L2,L1,1,J,M,I,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),   129400
     1 TG2(K,M,I),DMY1,DMY2,DMY3,BL(M))                                 129500
 2025 DG=(XG(K,M)-PG2(K,M,I))*SGN                                       129600
      TA(K,JJ,M)=TR(K,JJ,M)-TLLS-TG2(K,M,I)                             129700
      DSG(K)=ABS(D(K,J,M))-DS-DG                                        129800
      GO TO 2030                                                        129900
C                                                                       130000
C--------------------TRACE GEOPHONE RAYS, IREP.GT.1-----               130100
C                                                                       130200
 2026 IF (TRG2(K,I).NE.0.0) GO TO 2028                                  130300
      PRG2(K,I)=PRG(K,JJ,M)                                             130400
      ERG2(K,I)=ERG(K,JJ,M)                                             130500
      TRG2(K,I)=TRG(K,JJ,M)                                             130600
      IF(ITRACE.NE.0.AND.JPRT.NE.IBL)PRINT 2020,IREP,IDSPR(M),IDSP(JJ,M) 130700
     1,K,I,L2,L2,I1,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),DMY0,PRG2(K,I) 130800
     2,ERG2(K,I),TRG2(K,I),BL(M)                                        130900
      CALL RAYUP(L2,L2,1,J,M,I,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),   131000
     1 DMY0,PRG2(K,I),ERG2(K,I),TRG2(K,I),BL(M))                        131100
      IF(ISPLT.NE.2) GO TO 2028                                         131200
      IF(ABS((PRG2(K,I)-XSP(J,M))/(ERG2(K,I)-ES(J,M))).GT.100.)         131300
     1 GO TO 2028                                                       131400
      DMY0=BIG                                                          131500
      PRG2(K,I)=(XSP(J,M)+2.*PRG2(K,I))/3.                              131600
      IF(ITRACE.NE.0.AND.JPRT.NE.IBL) PRINT 2020,IREP,IDSPR(M),         131700
     1IDSP(JJ,M),K,I,L2,L2,I1,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),    131800
     2DMY0,PRG2(K,I),ERG2(K,I),TRG2(K,I),BL(M)                          131900
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      CALL RAYUP(L2,L2,1,J,M,I,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I)      132000
     1,DMY0,PRG2(K,I),ERG2(K,I),TRG2(K,I),BL(M))                         132100
 2028 PRG(K,JJ,M)=PRG2(K,I)                                              132200
      ERG(K,JJ,M)=ERG2(K,I)                                              132300
      TRG(K,JJ,M)=TRG2(K,I)                                              132400
 2030 CONTINUE                                                           132500
C                                                                        132600
C--------------------IREP=1  OR  IREP.GT.1----------                      132700
C                                                                        132800
 2031 IF(IREP.GT.1) GO TO 2035                                           132900
C                                                                        133000
C--------------------IREP=1----------                                    133100
C                                                                        133200
C REGRESSION OF END AND OUTLYING SP TIMES TO GET INTERCEPT T WHEN        133300
C IREP=1.  IF JJOFF=0 OUTLYING SP TIMES ARE TIED TO END SP TIMES.        133400
C                                                                        133500
      KT1=K11                                                            133600
      KT2=K22                                                            133700
      JT=JJ                                                              133800
      S1=0.                                                              133900
      S2=0.                                                              134000
      PT=0.                                                              134100
      T=0.                                                               134200
12033 IF(KT1.EQ.0) GO TO 12037                                           134300
      DO 12036 K=KT1,KT2                                                 134400
      IF(LG(K,JT,M).NE.L2) GO TO 12036                                   134500
      IF(JT.EQ.JJ) GO TO 12035                                           134600
      IF(TG2(K,M,I).NE.0.) GO TO 12034                                   134700
      PG2(K,M,I)=XG(K,M)-XVG(K)*SGN                                      134800
      TG2(K,M,I)=TVG(K)                                                  134900
      IF(ITRACE.NE.0.AND.JPRT.NE.IBL)PRINT 2020,IREP,IDSPR(M),IDSP(JT,M) 135000
     1,K,I,L2,L1,I1,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),TG2(K,M,I)     135100
     2,DMY1,DMY2,DMY3,BL(M)                                              135200
      CALL RAYUP(L2,L1,1,JT,M,I,XG(K,M),EG(K,M),PG2(K,M,I),EG2(K,M,I),   135300
     1 TG2(K,M,I),DMY1,DMY2,DMY3,BL(M))                                  135400
12034 DG=(XG(K,M)-PG2(K,M,I))*SGN                                        135500
      DSG(K)=ABS(D(K,J,M))-DS-DG                                         135600
      TA(K,JT,M)=TR(K,JT,M)-TLLS-TG2(K,M,I)                              135700
12035 S1=S1+DSG(K)                                                       135800
      S2=S2+TA(K,JT,M)                                                   135900
      PT=PT+1.                                                           136000
12036 CONTINUE                                                           136100
12037 IF(JJOFF.NE.0) GO TO 2032                                          136200
      IF(I.EQ.2) GO TO 12040                                             136300
      IF(JJ.NE.J1) GO TO 2032                                            136400
      JT=JT-1                                                            136500
      IF(JT.LT.1) GO TO 12042                                            136600
      KRS2(JT,M,L1,1)=IAST                                               136700
      CALL KENDS(L2,M,JT,KR(JT,M),KN,KT1,KT2)                            136800
      GO TO 12033                                                        136900
12040 IF(JJ.NE.J2) GO TO 2032                                            137000
      JT=JT+1                                                            137100
      IF(JT.GT.JN) GO TO 12042                                           137200
      KRS2(JT,M,L1,2)=IAST                                               137300
      CALL KENDS(L2,M,JT,1,KL(JT,M),KT1,KT2)                             137400
      GO TO 12033                                                        137500
C                                                                        137600
12042 IF(PT.EQ.0.) GO TO 2040                                            137700
      IF(PT.EQ.1.) GO TO 12055                                           137800
      XBAR=S1/PT                                                         137900
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      TBAR=S2/PT                                                        138000
      S1=0.                                                             138100
      S2=0.                                                             138200
      KT1=K11                                                           138300
      KT2=K22                                                           138400
      JT=JJ                                                             138500
12043 IF(KT1.EQ.0) GO TO 12046                                          138600
      DO 12045 K=KT1,KT2                                                138700
      IF(LG(K,JT,M).NE.L2) GO TO 12045                                  138800
      XD=DSG(K)-XBAR                                                    138900
      S1=S1+XD*TA(K,JT,M)                                               139000
      S2=S2+XD**2                                                       139100
12045 CONTINUE                                                          139200
12046 IF(I.EQ.2) GO TO 12050                                            139300
      JT=JT-1                                                           139400
      IF(JT.LT.1) GO TO 12052                                           139500
      CALL KENDS(L2,M,JT,KR(JT,M),KN,KT1,KT2)                           139600
      GO TO 12043                                                       139700
12050 JT=JT+1                                                           139800
      IF(JT.GT.JN) GO TO 12052                                          139900
      CALL KENDS(L2,M,JT,1,KL(JT,M),KT1,KT2)                            140000
      GO TO 12043                                                       140100
C                                                                       140200
12052 T=(TBAR-XBAR*S1/S2)/2.                                            140300
      GO TO 12060                                                       140400
C                                                                       140500
12055 T=(S2-S1/VHA(M,L2))/2.                                            140600
      GO TO 12060                                                       140700
C                                                                       140800
C--------------------IREP=1----------                                  140900
C                                                                       141000
C COMPUTE HORIZ TIME AND FIRST APPROX DEPTHS                            141100
C                                                                       141200
 2032 IF(K11.EQ.0) GO TO 2040                                           141300
      CALL REGRES(K11,K22,JJ,M,L2,V,T,PT,0)                             141400
      IF(PT.EQ.0.) GO TO 2040                                           141500
12060 Z=T*VOCOSG                                                        141600
      TS=Z*VOCOSG/VV**2                                                 141700
      TRS2(JJ,M,I)=TLLS+TS                                              141800
      ERS2(JJ,M,L1,I)=ELLS-Z                                            141900
      PRS2(JJ,M,L1,I)=XLLS+Z*TANSG*SGN                                  142000
 2033 ZRSP(JJ)=Z                                                        142100
      DO 2034 K=K11,K22                                                 142200
      IF (LG(K,JJ,M).NE.L2) GO TO 2034                                  142300
      EDIF=SLOPE*(PG2(K,M,I)-PRS2(JJ,M,L1,I))                           142400
      KCALL=K                                                           142500
      CALL HTIME(KCALL,J,M,PRS2(JJ,M,L1,I),0.,PG2(K,M,I),EDIF,HV,TH)    142600
      Z=(TA(K,JJ,M)-TS-TH)*VOCOSG                                       142700
      IF (Z.LT.0.0) Z=0.0                                               142800
      ZRG(K,JJ)=Z                                                       142900
      TG=Z*VOCOSG/VV**2                                                 143000
      TRG(K,JJ,M)=TG2(K,M,I)+TG                                         143100
      ERG(K,JJ,M)=EG2(K,M,I)-Z                                          143200
      PRG(K,JJ,M)=PG2(K,M,I)-Z*TANSG*SGN                                143300
 2034 CONTINUE                                                          143400
      GO TO 2040                                                        143500
C                                                                       143600
C--------------------IREP.GT.1----------                               143700
C                                                                       143800
C COMPUTE HORIZ TIME, COMPUTE TOTAL RAY TIME, AND ADJUST DEPTHS         143900
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C TO MAKE COMPUTED TIME AGREE WITH MEASURED TIME                    144000
C                                                                  144100
 2035 IF(K11.EQ.0) GO TO 2040                                      144200
      SUM1=0.                                                      144300
      PTS1=0.                                                      144400
      IF(ISPLT.EQ.2) GO TO 3035                                    144500
      P1=PRS2(J,M,L1,I)                                            144600
      E1=ERS2(J,M,L1,I)                                            144700
      GO TO 3135                                                   144800
 3035 P1=XSP(J,M)                                                  144900
      E1=ES(J,M)                                                   145000
      KRS2(JJ,M,L1,I)=IBEE                                         145100
 3135 DO 2037 K=K11,K22                                            145200
      IF (LG(K,JJ,M).NE.L2) GO TO 2037                             145300
      KRG(K,JJ,M)=IBL                                              145400
      P2=PRG2(K,I)                                                 145500
      E2=ERG2(K,I)                                                 145600
 3036 KCALL=K                                                      145700
      CALL HTIME(KCALL,J,M,P1,E1,P2,E2,HV,TH)                      145800
      TCOR=TR(K,JJ,M)-TRS2(JJ,M,I)-TH-TRG2(K,I)                    145900
      IF(ISPLT.EQ.0) TCOR=TCOR/2.                                  146000
      TCALL=TCOR                                                   146100
      IF(ABS(TCOR).LE.TLIM) GO TO 2036                             146200
      TCALL=SIGN(TLIM,TCOR)                                        146300
      KRG(K,JJ,M)=IQUES                                            146400
 2036 CALL RAYCOR(PG2(K,M,I),P2,EG2(K,M,I),E2,VV,HV,TCALL)         146500
      PRG(K,JJ,M)=P2                                               146600
      ERG(K,JJ,M)=E2                                               146700
      TRG(K,JJ,M)=TRG2(K,I)+TCALL                                  146800
      PTS1=PTS1+1.0                                                146900
      SUM1=SUM1+TCOR                                               147000
      IF (IXREP.GT.2.OR.L2.EQ.2) GO TO 2037                        147100
      GTC(K,M)=GTC(K,M)+TCOR                                       147200
      GPT(K,M)=GPT(K,M)+1.0                                        147300
 2037 CONTINUE                                                     147400
      IF (PTS1.EQ.0..OR.ISPLT.EQ.2) GO TO 2040                     147500
      IF (IXREP.GT.2.OR.L2.EQ.2) GO TO 2038                        147600
      SPTC(JJ,M)=SPTC(JJ,M)+SUM1                                   147700
      SPPT(JJ,M)=SPPT(JJ,M)+PTS1                                   147800
 2038 TCOR=SUM1/PTS1                                               147900
      IF(KRS2(JJ,M,L1,I).EQ.IQUES) KRS2(JJ,M,L1,I)=IBL             148000
      IF(ABS(TCOR).LE.TLIM) GO TO 2039                             148100
      IF(KRS2(JJ,M,L1,I).EQ.IBL) KRS2(JJ,M,L1,I)=IQUES             148200
      TCOR=SIGN(TLIM,TCOR)                                         148300
 2039 CALL RAYCOR(PS2(J,M,I),P1,ES2(J,M,I),E1,VV,HV,TCOR)          148400
      TRS2(JJ,M,I)=TRS2(JJ,M,I)+TCOR                               148500
      PRS2(JJ,M,L1,I)=P1                                           148600
      ERS2(JJ,M,L1,I)=E1                                           148700
C                                                                  148800
C TEST FOR DOING OUTLYING SPS LEFT OF SPREADS, RIGHT-GOING RAYS    148900
C                                                                  149000
 2040 IF (I.NE.1) GO TO 2070                                       149100
      IF (JJOFF.NE.0.OR.JJ.GT.J1) GO TO 2046                       149200
 2041 JJ=JJ-1                                                      149300
      IF (JJ.GT.0) GO TO 2042                                      149400
      IF(IREP.EQ.1.OR.J1.EQ.1) GO TO 2046                          149500
      SUM1=0.                                                      149600
      SUM2=0.                                                      149700
      SUM3=0.                                                      149800
      PTS1=0.                                                      149900
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      JJJ=0                                                              150000
      DO 3041 JJ=1,J1                                                    150100
      IF(ERS2(JJ,M,L1,I).EQ.0..OR.KRS2(JJ,M,L1,I).EQ.IQUES) GO TO 3041   150200
      SUM1=SUM1+TRS2(JJ,M,I)                                             150300
      SUM2=SUM2+PRS2(JJ,M,L1,I)                                          150400
      SUM3=SUM3+ERS2(JJ,M,L1,I)                                          150500
      PTS1=PTS1+1.                                                       150600
      IF(JJJ.EQ.0) JJJ=JJ                                                150700
 3041 CONTINUE                                                           150800
      IF(PTS1.EQ.0.) GO TO 2046                                          150900
      TBAR=SUM1/PTS1                                                     151000
      PBAR=SUM2/PTS1                                                     151100
      EBAR=SUM3/PTS1                                                     151200
      DO 4041 JJ=JJJ,J1                                                  151300
      TRS2(JJ,M,I)=TBAR                                                  151400
      PRS2(JJ,M,L1,I)=PBAR                                               151500
      ERS2(JJ,M,L1,I)=EBAR                                               151600
 4041 CONTINUE                                                           151700
      GO TO 2046                                                         151800
 2042 CALL KENDS(L2,M,JJ,KR(JJ,M),KN,K11,K22)                           151900
      IF (K11.EQ.0) GO TO 2041                                           152000
 2043 TRS2(JJ,M,I)=TRS2(J,M,I)                                           152100
      PRS2(JJ,M,L1,I)=PRS2(J,M,L1,I)                                     152200
      ERS2(JJ,M,L1,I)=ERS2(J,M,L1,I)                                     152300
      GO TO 2023                                                         152400
C                                                                        152500
C INITIALIZE FOR LEFT-GOING RAYS                                         152600
C                                                                        152700
 2046 I=2                                                                152800
      II=1                                                               152900
      SGN=-1.0                                                           153000
      IF(KL(J,M).EQ.0) GO TO 2090                                        153100
      CALL KENDS(L2,M,J,1,KL(J,M),K11,K22)                               153200
      GO TO 2019                                                         153300
C                                                                        153400
C TEST FOR DOING OUTLYING SPS RIGHT OF SPREADS, LEFT-GOING RAYS          153500
C                                                                        153600
 2070 IF (JJOFF.NE.0.OR.JJ.LT.J2) GO TO 2090                             153700
 2072 JJ=JJ+1                                                            153800
      IF (JJ.LE.JN) GO TO 2074                                           153900
      IF(IREP.EQ.1.OR.J2.EQ.JN) GO TO 2090                               154000
      SUM1=0.                                                            154100
      SUM2=0.                                                            154200
      SUM3=0.                                                            154300
      PTS1=0.                                                            154400
      DO 2073 JJ=J2,JN                                                   154500
      IF(ERS2(JJ,M,L1,I).EQ.0..OR.KRS2(JJ,M,L1,I).EQ.IQUES) GO TO 2073   154600
      SUM1=SUM1+TRS2(JJ,M,I)                                             154700
      SUM2=SUM2+PRS2(JJ,M,L1,I)                                          154800
      SUM3=SUM3+ERS2(JJ,M,L1,I)                                          154900
      PTS1=PTS1+1.                                                       155000
      JJJ=JJ                                                             155100
 2073 CONTINUE                                                           155200
      IF(PTS1.EQ.0.) GO TO 2090                                          155300
      TBAR=SUM1/PTS1                                                     155400
      PBAR=SUM2/PTS1                                                     155500
      EBAR=SUM3/PTS1                                                     155600
      DO 3073 JJ=J2,JJJ                                                  155700
      TRS2(JJ,M,I)=TBAR                                                  155800
      PRS2(JJ,M,L1,I)=PBAR                                               155900
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      ERS2(JJ,M,L1,I)=EBAR                                              156000
 3073 CONTINUE                                                          156100
      GO TO 2090                                                        156200
 2074 CALL KENDS(L2,M,JJ,1,KL(JJ,M),K11,K22)                           156300
      IF (K11.EQ.0) GO TO 2072                                          156400
      GO TO 2043                                                        156500
C                                                                       156600
 2090 J=J+1                                                             156700
      IF (J.LE.J2) GO TO 2012                                           156800
      IF (IREP.EQ.1)CALL ADMIG(L1,M,BL(M))                              156900
      M=M+1                                                             157000
      IF (M.LE.NM) GO TO 2003                                           157100
      IF (IFLAG.NE.0) GO TO 1200                                        157200
C                                                                       157300
C-------------------------------------FOR FLAG.NE.0  RETURN TO PART 2   157400
C                                                                       157500
C END OF SP LOOP AT 2090, END OF SPREAD LOOP AT 2090 + 3.               157600
C                                                                       157700
C COMPUTE AVG COORDS(P1,E1),(P2,E2) IN ADJACENT INTERVALS BETWEEN GEOS,  157800
C  AND THEN INTERPOLATE TO FIND SMOOTHED ELEV PTS (ERP) AT GEO POS (XG)  157900
C  BETWEEN THE TWO INTERVALS.  THEN COMPUTE LAYER VERT TRAVEL TIME (TRP) 158000
C                                                                       158100
      DO 2096 M=1,NM                                                    158200
      JN=NJ(M)                                                          158300
      KN=NK(M)                                                          158400
      DO 2094 J=1,JN                                                    158500
      TRS(J,M,L1)=0.0                                                   158600
      ERS(J,M,L1)=0.0                                                   158700
 2094 CONTINUE                                                          158800
      DO 2095 K=1,KN                                                    158900
      TRP(K,M,L1)=0.0                                                   159000
      ERP(K,M,L1)=0.0                                                   159100
 2095 CONTINUE                                                          159200
 2096 CONTINUE                                                          159300
C                                                                       159400
      M=0                                                               159500
      X1=2.*XG(1,1)-XG(2,1)                                             159600
 2100 M=M+1                                                             159700
      IF (M.GT.NM) GO TO 2114                                           159800
      M1=M                                                              159900
      KN=NK(M)                                                          160000
      K=1                                                               160100
 2102 KK=K                                                              160200
      X2=XG(K,M)                                                        160300
      IF (X2.LE.X1) GO TO 2104                                          160400
      CALL AVG(X1,X2,L2,P1,E1)                                          160500
      IF (E1.NE.0.0) GO TO 2105                                         160600
C                                                                       160700
C CONDITION IN WHICH (P1,E1) IS NOT YET DEFINED                         160800
C                                                                       160900
      X1=X2                                                             161000
 2104 K=K+1                                                             161100
      IF (K.GT.KN) GO TO 2100                                           161200
      GO TO 2102                                                        161300
C                                                                       161400
C CONDITION IN WHICH (P1,E1) IS DEFINED AND (P2,E2) IS SOUGHT           161500
C                                                                       161600
 2105 ERP(KK,M1,L1)=E1                                                  161700
      TRP(KK,M1,L1)=(ERP(KK,M1,LL)-ERP(KK,M1,L1))/VVA(M1,L1)            161800
 2106 X1=X2                                                             161900
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 2108 K=K+1                                                              162000
      IF (K.LE.KN) GO TO 2109                                            162100
      M=M+1                                                              162200
      IF (M.GT.NM) GO TO 2113                                            162300
      KN=NK(M)                                                           162400
      K=1                                                                162500
 2109 X2=XG(K,M)                                                         162600
      IF (X2.LE.X1) GO TO 2108                                           162700
      CALL AVG(X1,X2,L2,P2,E2)                                           162800
      IF (E2.EQ.0.0) GO TO 2106                                          162900
 2110 ERP(KK,M1,L1)=TERP(P1,E1,P2,E2,XG(KK,M1))                          163000
      TRP(KK,M1,L1)=(ERP(KK,M1,LL)-ERP(KK,M1,L1))/VVA(M1,L1)             163100
      KK=KK+1                                                            163200
      IF (M.NE.M1) GO TO 2111                                            163300
      IF (KK.EQ.K) GO TO 2112                                            163400
      GO TO 2110                                                         163500
 2111 IF (KK.LE.NK(M1)) GO TO 2110                                       163600
      M1=M                                                               163700
      KK=K                                                               163800
      ERP(KK,M1,L1)=TERP(P1,E1,P2,E2,XG(KK,M1))                          163900
      TRP(KK,M1,L1)=(ERP(KK,M1,LL)-ERP(KK,M1,L1))/VVA(M1,L1)             164000
 2112 P1=P2                                                              164100
      E1=E2                                                              164200
      GO TO 2106                                                         164300
 2113 X2=2.*XG(KN,NM)-XG(KN-1,NM)                                        164400
      CALL AVG(X1,X2,L2,P2,E2)                                           164500
      IF (E2.EQ.0.0) GO TO 2114                                          164600
      ERP(KN,NM,L1)=TERP(P1,E1,P2,E2,XG(KN,NM))                          164700
      TRP(KN,NM,L1)=(ERP(KN,M1,LL)-ERP(KN,M1,L1))/VVA(M1,L1)             164800
 2114 CALL FILLIN(L1)                                                    164900
C L1 SET TO 0 IN FILLIN IF NO PTS ARE DEFINED FOR LAYER L1               165000
      IF(L1.EQ.0) GO TO 1                                                165100
C                                                                        165200
C REPEAT IF IREP=1 OR IREP=2                                             165300
C                                                                        165400
      IF (IXREP.LE.3) GO TO 2190                                         165500
      IREP=IREP+1                                                        165600
      GO TO 2002                                                         165700
C                                                                        165800
 2190 L2=L2+1                                                            165900
      IF (L2.LE.NL) GO TO 2001                                           166000
C                                                                        166100
C END OF LAYER LOOP AT 2190                                              166200
C                                                                        166300
C FINAL FILTER -- TRIM-UP TIME ADJUST AT BASE OF LAYER 1                 166400
C                                                                        166500
      IF (IREP.EQ.4.OR.IXIT.LE.3) GO TO 2200                             166600
      IREP=4                                                             166700
C                                                                        166800
      DO 2196 M=1,NM                                                     166900
      JN=NJ(M)                                                           167000
      KN=NK(M)                                                           167100
      DO 2192 J=1,JN                                                     167200
      IF (SPPT(J,M).EQ.0.0) GO TO 2192                                   167300
      TCOR=SPTC(J,M)/SPPT(J,M)                                           167400
      ERS(J,M,1)=ERS(J,M,1)-TCOR*VVA(M,1)                                167500
      IF (ERS(J,M,1).GT.ESP(J,M)) ERS(J,M,1)=ESP(J,M)                    167600
 2192 CONTINUE                                                           167700
      DO 2194 K=1,KN                                                     167800
      IF (GPT(K,M).EQ.0.0) GO TO 2194                                    167900
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      TCOR=GTC(K,M)/GPT(K,M)                                            168000
      ERP(K,M,1)=ERP(K,M,1)-TCOR*VVA(M,1)                               168100
      IF (ERP(K,M,1).GT.EG(K,M)) ERP(K,M,1)=EG(K,M)                     168200
 2194 CONTINUE                                                          168300
 2196 CONTINUE                                                          168400
      GO TO 2000                                                        168500
C                                                                       168600
C PRINT RESULTS -- DEPTHS COMPUTED FROM REFRACTION ARRIVALS             168700
C                                                                       168800
 2200 IF(JPRT.EQ.IBL) GO TO 12200                                       168900
      DO 2222 M=1,NM                                                    169000
      PRINT 57, IDENT                                                   169100
      JN=NJ(M)                                                          169200
      PRINT 2201, IDSPR(M),(IDSP(J,M),J=1,JN)                           169300
 2201 FORMAT (1HO,8H SPREAD ,A1,3X,32HRAY END POINTS BENEATH GEOPHONES/ 169400
     1 '  GEO',14X,7(8X,'SP ',A1))                                      169500
      PRINT 2202, (IBL,J=1,JN)                                          169600
 2202 FORMAT('  ---',17X,7(A2,'--------L-'))                            169700
C                                                                       169800
      KN=NK(M)                                                          169900
C                                                                       170000
      DO 2210 K=1,KN                                                    170100
      PRINT 2203, K, (PRG(K,J,M),LG(K,J,M),J=1,JN)                      170200
 2203 FORMAT (1H ,I3,15X,3HPOS,7(F9.1,I2,1X))                           170300
      PRINT 2205, (ERG(K,J,M),KRG(K,J,M),J=1,JN)                        170400
 2205 FORMAT (1H ,17X,4HELEV,7(F9.1,1X,A1,1X))                          170500
      PRINT 2207                                                        170600
 2207 FORMAT (1X)                                                       170700
 2210 CONTINUE                                                          170800
C                                                                       170900
      PRINT 2211                                                        171000
 2211 FORMAT (' RAY END POINTS BENEATH SHOTPOINTS')                     171100
C                                                                       171200
      DO 2220 L2=2,NL                                                   171300
      L=L2-1                                                            171400
      PRINT 2213, L2,(PRS2(J,M,L,1),J=1,JN)                             171500
 2213 FORMAT (1HO,2HL=,I1,4X,5HRIGHT,6X,3HPOS,F9.1,6F12.1)              171600
      PRINT 2205, (ERS2(J,M,L,1),KRS2(J,M,L,1),J=1,JN)                  171700
      PRINT 2217, L2,(PRS2(J,M,L,2),J=1,JN)                             171800
 2217 FORMAT (1HO,2HL=,I1,4X,4HLEFT,7X,3HPOS,F9.1,6F12.1)               171900
      PRINT 2205, (ERS2(J,M,L,2),KRS2(J,M,L,2),J=1,JN)                  172000
 2220 CONTINUE                                                          172100
 2222 CONTINUE                                                          172200
C                                                                       172300
C PRINT RESULTS -- INTERP-EXTRAP PTS AT SPS AND GEOS                    172400
C                                                                       172500
      DO 2260 M=1,NM                                                    172600
      IF (JJOFF.EQ.0) GO TO 2225                                        172700
      J1=1                                                              172800
      GO TO 2226                                                        172900
 2225 J1=JA(M)                                                          173000
 2226 IF (JJOFF.EQ.0) GO TO 2227                                        173100
      J2=NJ(M)                                                          173200
      GO TO 2228                                                        173300
 2227 J2=JB(M)                                                          173400
 2228 PRINT 57, IDENT                                                   173500
      PRINT 2231, IDSPR(N),(L,L=2,NL)                                   173600
 2231 FORMAT (1HO,8H SPREAD ,A1,3X,28HSMOOTHED POSITION OF LAYERS ,     173700
     1 32HBENEATH SHOTPOINTS AND GEOPHONES/1HO,24X,4(11X,'LAYER',I2))   173800
C                                                                       173900
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      PRINT 2233, (IBL,L=2,NL)                                          174000
 2233 FORMAT('0 SP   POSITION  SURF ELEV ',4(A1,5X,'DEPTH  ELEV '))     174100
      PRINT 2234, (IBL,L=2,NL)                                          174200
 2234 FORMAT('  ---  --------  ---------',4(A4,'--------------'))       174300
C                                                                       174400
      DO 2246 J=J1,J2                                                   174500
      DO 2240 L=1,LN                                                    174600
      ZSG(L)=0.0                                                        174700
      IF (ERS(J,M,L).NE.0.0) ZSG(L)=ESP(J,M)-ERS(J,M,L)                 174800
 2240 CONTINUE                                                          174900
      PRINT 2243, IDSP(J,M),XSP(J,M),ESP(J,M),(ZSG(L),ERS(J,M,L),L=1,LN) 175000
 2243 FORMAT(3X,A1,2F11.1,4(2X,2F8.1))                                  175100
 2246 CONTINUE                                                          175200
C                                                                       175300
      PRINT 2249                                                        175400
 2249 FORMAT('0 GEO'/'  ---')                                           175500
      KN=NK(M)                                                          175600
      DO 2256 K=1,KN                                                    175700
      DO 2252 L=1,LN                                                    175800
      IF (ERP(K,M,L).NE.0.0) ZSG(L)=EG(K,M)-ERP(K,M,L)                  175900
 2252 CONTINUE                                                          176000
      PRINT 2255, K,XG(K,M),EG(K,M),(ZSG(L),ERP(K,M,L),L=1,LN)          176100
 2255 FORMAT (1X,I3,2F11.1,4(2X,2F8.1))                                 176200
 2256 CONTINUE                                                          176300
      PRINT 2257,(L,L=1,NL)                                             176400
 2257 FORMAT(/' VELOCITIES USED:'/7X,5(11X,'LAYER',I2))                 176500
      PRINT 2258,(VVA(M,L),L=1,LN)                                      176600
      PRINT 2259,(VHA(M,L),L=2,NL)                                      176700
 2258 FORMAT(/8X,'VERTICAL',3PF9.0,4F18.0)                              176800
 2259 FORMAT(6X,'HORIZONTAL',9X,3P4F18.0)                               176900
 2260 CONTINUE                                                          177000
12200 ITY=IBL                                                           177100
      IF(JTRL.EQ.IBL) GO TO 3010                                        177200
      TYPE 12201                                                        177300
12201 FORMAT(/' TABLE OF RAY END PTS?   T TO TYPE, <CR> TO SUPPRESS: '  177400
     1,$)                                                               177500
      ACCEPT 10006,ITY                                                  177600
      IF(ITY.EQ.IBL) GO TO 12223                                        177700
      DO 12222 M=1,NM                                                   177800
      JN=NJ(M)                                                          177900
      TYPE 12202, IDSPR(M),(IDSP(J,M),J=1,JN)                           178000
12202 FORMAT(/' SPREAD ',A1,3X,'RAY END PTS BENEATH GEOPHONES'//2X,'G'  178100
     1,5X,7(5X,'SP ',A1))                                               178200
      TYPE 12203, (IBL,J=1,JN)                                          178300
12203 FORMAT('  -'5X,7(A2,'------L'))                                   178400
      KN=NK(M)                                                          178500
      DO 12210 K=1,KN                                                   178600
      TYPE 12204,K,(PRG(K,J,M),LG(K,J,M),J=1,JN)                        178700
12204 FORMAT(/1X,I2,4X,'X',7(F7.0,I2))                                  178800
      TYPE 12205,(ERG(K,J,M),KRG(K,J,M),J=1,JN)                         178900
12205 FORMAT(6X,'EL',1X,7(F7.1,1X,A1))                                  179000
12210 CONTINUE                                                          179100
      TYPE 2207                                                         179200
      TYPE 2211                                                         179300
      DO 12220 L2=2,NL                                                  179400
      L=L2-1                                                            179500
      TYPE 12213,L2,(PRS2(J,M,L,1),J=1,JN)                              179600
12213 FORMAT(/' L',I1,' RT X',7(F7.0,2X))                               179700
      TYPE 12205,(ERS2(J,M,L,1),KRS2(J,M,L,1),J=1,JN)                   179800
      TYPE 12217,L2,(PRS2(J,M,L,2),J=1,JN)                              179900
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12217 FORMAT(/' L',I1,' LF X',7(F7.0,2X))                                  180000
      TYPE 12205,(ERS2(J,M,L,2),KRS2(J,M,L,2),J=1,JN)                      180100
12220 CONTINUE                                                             180200
12222 CONTINUE                                                             180300
C                                                                          180400
12223 TYPE 12224                                                           180500
12224 FORMAT(/' DEPTH BENEATH SPS-GEOS? T TO TYPE, <CR> TO SUPPRESS: '     180600
     1,$)                                                                  180700
      ITY=IBL                                                              180800
      ACCEPT 10006,ITY                                                     180900
      IF(ITY.EQ.IBL) GO TO 3000                                            181000
C                                                                          181100
      DO 12260 M=1,NM                                                      181200
      IF(JJOFF.EQ.0) GO TO 12225                                           181300
      J1=1                                                                 181400
      GO TO 12226                                                          181500
12225 J1=JA(M)                                                             181600
12226 IF(JJOFF.EQ.0) GO TO 12227                                           181700
      J2=NJ(M)                                                             181800
      GO TO 12228                                                          181900
12227 J2=JB(M)                                                             182000
12228 TYPE 12231,IDSPR(M),(L,L=2,NL)                                       182100
12231 FORMAT(/' SPREAD ',A1,3X,'DEPTHS BENEATH SPS & GEOS'//16X            182200
     1,4(7X,'LAYER',I2))                                                   182300
      TYPE 12233, (IBL,L=2,NL)                                             182400
12233 FORMAT(/1X,'SP',4X,'X',6X,'EL',4(A3,'DEPTH  ELEV'))                  182500
      TYPE 12234, (IBL,L=2,NL)                                             182600
12234 FORMAT(' --   ---   ----',4(A2,'------------'))                      182700
      DO 12246 J=J1,J2                                                     182800
      DO 12240 L=1,LN                                                      182900
      IF(ERS(J,M,L).NE.0.)ZSG(L)=ESP(J,M)-ERS(J,M,L)                       183000
12240 CONTINUE                                                             183100
      TYPE 12243,IDSP(J,M),XSP(J,M),ESP(J,M),(ZSG(L),ERS(J,M,L),L=1,LN)    183200
12243 FORMAT(2X,A1,F6.0,9F7.1)                                             183300
12246 CONTINUE                                                             183400
      TYPE 12249                                                           183500
12249 FORMAT(/1X,'GEO'/1X,'---')                                           183600
      KN=NK(M)                                                             183700
      DO 12256 K=1,KN                                                      183800
      DO 12252 L=1,LN                                                      183900
      IF(ERP(K,M,L).NE.0.)ZSG(L)=EG(K,M)-ERP(K,M,L)                        184000
12252 CONTINUE                                                             184100
      TYPE 12255,K,XG(K,M),EG(K,M),(ZSG(L),ERP(K,M,L),L=1,LN)              184200
12255 FORMAT(1X,I2,F6.0,9F7.1)                                             184300
12256 CONTINUE                                                             184400
      TYPE 12257,(L,L=1,NL)                                                184500
12257 FORMAT(/' VELOCITIES USED'/2X,5(7X,'LAYER',I2))                      184600
      TYPE 12258,(VVA(M,L),L=1,LN)                                         184700
      TYPE 12259,(VHA(M,L),L=2,NL)                                         184800
12258 FORMAT(1X,'VERTICAL',3PF7.0,4F14.0)                                  184900
12259 FORMAT(1X,'HORIZONTAL',5X,3P4F14.0)                                  185000
12260 CONTINUE                                                             185100
C                                                                          185200
C PLOT DEPTH GRAPH                                                         185300
C                                                                          185400
C                                                                          185500
 3000 ITY=IBL                                                              185600
      TYPE 2207                                                            185700
      TYPE 3001                                                            185800
 3001 FORMAT(' DEPTH PLOT?       ENTER T TO TYPE, <CR> TO SUPPRESS: ',$)   185900
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      ACCEPT 10006, ITY                                                 186000
 3010 IF(JPRT.NE.IBL.OR.ITY.NE.IBL) CALL PLOT(2)                        186100
      GO TO 1                                                           186200
C                                                                       186300
 9990 IF(JPRT.NE.IBL)PRINT 9991                                         186400
 9991 FORMAT (/1X,41H ERROR ON INPUT CARDS, COMPUTATION HALTED)         186500
      IF(JTRL.NE.IBL)TYPE 9991                                          186600
      GO TO 1                                                           186700
C                                                                       186800
 9992 IF(JPRT.NE.IBL)PRINT 9993, L1,L2                                  186900
      IF(JTRL.NE.IBL)TYPE 9993, L1,L2                                   187000
 9993 FORMAT (/1X,25HVELOCITY INVERSION, LAYER,I2,10H AND LAYER,I2,     187100
     1 19H COMPUTATION HALTED)                                          187200
      GO TO 1                                                           187300
      END                                                               187400
C                                                                       187500
C-----------------------------------------------------------------------187600
C                                                                       187700
      SUBROUTINE RAYUP(L,LL,LO,J,M,I,XO,EO,XLL,ELL,TLL,XL,EL,TL,BLL)    187800
      COMMON IBL                                                        187900
      COMMON/BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                               188000
     2       /BLK2/XG,ERP,SLOPE,IDIP                                    188100
     4       /BLK4/VVA,VHA                                              188200
     6       /BLK6/TRP,JJOFF                                            188300
     7       /BLK7/JA,JB,TRS,ERS,XSP,ESP,LS                             188400
     9       /BLK9/EG,ES                                                188500
     9       /BLK10/BLIM,ITRACE,TANSG                                   188600
C  IN PROGRAM SIPT                                                      188700
C TRACES RAY FROM STARTING POINT ON TOP OF LAYER L OR LL TO ENDING POINT 188800
C (XO,EO) WITHIN OR ON THE UPPER BOUNDARY OF LAYER LO.  REFRACTING HORIZ 188900
C IS THE TOP OF LAYER L.  COMPUTES AND RETURNS CORRECTED COORD OF START  189000
C POINT AND TOTAL TRAVEL TIME. FOR IREP=1, LL=L-1, AND RAY START POINT   189100
C IS TAKEN AS (XLL,ELL) ON TOP OF LAYER LL,  FOR IREP=2 OR 3, LL=L, AND  189200
C START POINT IS TAKEN AS (XL,EL) ON TOP OF LAYER L. ALSO FOR IREP=2 OR  189300
C 3, RAY INTERSECTION WITH TOP OF LAYER L-1 IS OUTPUTTED AS (XLL,ELL)    189400
C AND TIME FROM THIS POINT AS TLL. INPUT PARAMETER BLL IS PRECOMPUTED    189500
C AS AVG DIP OF REFRACTOR OVER ENTIRE SPREAD. IF BLL IS NONZERO ON INPUT 189600
C IT IS USED IN PLACE OF INTERVAL DIP BETWEEN  GEO PAIRS WHICH IS        189700
C OTHERWISE COMPUTED INTERNALLY. INPUT PARAMETER I IS PRESET TO 1 FOR    189800
C RAYS GOING UP AND RIGHT, 2 FOR RAYS GOING UP AND LEFT.                 189900
C                                                                       190000
C FOR THE CASE WHERE SHOT IS BELOW REFRACTOR (ES(J,M).LT.ERS(J,M,L1)),  190100
C TLL=BIG ON INPUT AND RAY IS TRACED FROM SHOT TO GEO.                  190200
C                                                                       190300
      DIMENSION NK(5),XG(25,5),ERP(25,5,4),VVA(5,5),VHA(5,5),NJ(5),JA(5) 190400
     1,JB(5),TRS(7,5,4),ERS(7,5,4),XSP(7,5),ESP(7,5),LS(7,5),ES(7,5)    190500
     2,EG(25,5),TRP(25,5,4)                                             190600
C                                                                       190700
      DATA BIG,SMALL/999999.,0.000001/                                  190800
C                                                                       190900
C INITIALIZE                                                            191000
C                                                                       191100
      NONE=0                                                            191200
      XLLS=XLL                                                          191300
      TLLS=TLL                                                          191400
      XLS=XL                                                            191500
      TLS=TL                                                            191600
      IF (L.EQ.LL) XLL=XL                                               191700
    2 IBLSW=0                                                           191800
    3 XREFL=XLL                                                         191900
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      XREFLL=XLL                                                        192000
      TLL=0.0                                                           192100
      TL=0.0                                                            192200
      M1=M                                                              192300
      L2=LL                                                             192400
      L1=L2-1                                                           192500
C COMPUTE SLOPE OF RAY FROM STARTING POINT                              192600
      INVAL=0                                                           192700
      MFLAG=0                                                           192800
      IF(BLL.NE.0.) BL=BLL                                              192900
C FIRST FIND K OF GEOS BOUNDING XLL                                     193000
    4 KN=NK(M1)                                                         193100
      K3=KN-1                                                           193200
      K1=1                                                              193300
      K2=2                                                              193400
      IF (XLL.LT.XG(1,M1)) GO TO 8                                      193500
      K1=KN-1                                                           193600
      K2=KN                                                             193700
      IF (XLL.GT.XG(KN,M1)) GO TO 11                                    193800
      DO 6 K1=1,K3                                                      193900
      K2=K1+1                                                           194000
      IF (XLL.LE.XG(K2,M1)) GO TO 15                                    194100
    6 CONTINUE                                                          194200
      GO TO 14                                                          194300
C CASE OF XLL LEFT OF SPREAD M1                                         194400
    8 IF (M1.EQ.1) GO TO 9                                              194500
      IF (INVAL.GT.0) GO TO 15                                          194600
      INVAL=-1                                                          194700
      M1=M1-1                                                           194800
      GO TO 4                                                           194900
C CASE OF XLL LEFT OF SPREAD 1                                          195000
    9 IF(BLL.NE.0..OR.IDIP.NE.0) GO TO 10                               195100
      KMID=KN/2                                                         195200
      K1=1                                                              195300
      K2=2                                                              195400
      IF(KMID-K1.LT.5) KMID=K1+5                                        195500
      IF(KMID.GT.KN) KMID=KN                                            195600
      CALL DIP(L1,M1,K1,KMID,K1,A,BL)                                   195700
   10 IF(JJOFF.EQ.0) GO TO 310                                          195800
      J2=JA(1)                                                          195900
      IF(XLL.GE.XSP(J2,1).OR.J2.LE.1) GO TO 310                         196000
  110 J1=J2-1                                                           196100
      IF(XLL.GE.XSP(J1,1).OR.J1.EQ.1) GO TO 210                         196200
      J2=J2-1                                                           196300
      GO TO 110                                                         196400
  210 ELL=TERP(XSP(J1,1),ERS(J1,1,L1),XSP(J2,1),ERS(J2,1,L1),XLL)       196500
      GO TO 419                                                         196600
  310 IF(IDIP.NE.0.AND.BLL.EQ.0.) BL=SLOPE                              196700
      IF(BL.GT.BLIM) BL=BLIM                                            196800
      IF(BL.LT.-BLIM) BL=-BLIM                                          196900
      ELL=TERP(X1,M1,L1)+BL*(XLL-XG(K1,M1))                             197000
  410 MFLAG=1                                                           197100
      GO TO 15                                                          197200
C CASE OF XLL RIGHT OF SPREAD M1                                        197300
   11 IF (M1.EQ.NM) GO TO 12                                            197400
      IF (INVAL.LT.0) GO TO 15                                          197500
      INVAL=1                                                           197600
      M1=M1+1                                                           197700
      GO TO 4                                                           197800
C CASE OF XLL RIGHT OF SPREAD NM                                        197900
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   12 IF(BLL.NE.0..OR.IDIP.NE.0) GO TO 13                                198000
      KMID=KN/2+1                                                        198100
      K1=KN-1                                                            198200
      K2=KN                                                              198300
      IF(K2-KMID.LT.5) KMID=K2-5                                         198400
      IF(KMID.LT.1) KMID=1                                               198500
      CALL DIP(L1,M1,KMID,K2,K2,A,BL)                                    198600
   13 IF(JJOFF.EQ.0) GO TO 313                                           198700
      JN=NJ(NM)                                                          198800
      J1=JB(NM)                                                          198900
      IF(XLL.LE.XSP(J1,NM).OR.J1.GE.JN) GO TO 313                        199000
  113 J2=J1+1                                                            199100
      IF(XLL.LE.XSP(J2,NM).OR.J2.EQ.JN) GO TO 213                        199200
      J1=J1+1                                                            199300
      GO TO 113                                                          199400
  213 ELL=TERP(XSP(J1,NM),ERS(J1,NM,L1),XSP(J2,NM),ERS(J2,NM,L1),XLL)    199500
      GO TO 413                                                          199600
  313 IF(IDIP.NE.0.AND.BLL.EQ.0.) BL=SLOPE                               199700
      IF(BL.GT.BLIM) BL=BLIM                                             199800
      IF(BL.LT.-BLIM) BL=-BLIM                                           199900
      ELL=ERP(K2,M1,L1)+BL*(XLL-XG(K2,M1))                               200000
  413 MFLAG=2                                                            200100
      GO TO 16                                                           200200
   14 K1=KN-1                                                            200300
      K2=KN                                                              200400
C K1, K2, AND M1 NOW KNOWN. COMPUTE ELL AND BL FOR LAYER L1 AT XLL.      200500
   15 ELL=TERP(XG(K1,M1),ERP(K1,M1,L1),XG(K2,M1),ERP(K2,M1,L1),XLL)       200600
   16 EL=ELL                                                             200700
      EREFL=ELL                                                          200800
      EREFLL=ELL                                                         200900
      IF (NONE.NE.0) GO TO 17                                            201000
      ELLS=ELL                                                           201100
      ELS=ELL                                                            201200
   17 IF (BLL.EQ.0.0) GO TO 18                                           201300
      BL=BLL                                                             201400
      GO TO 19                                                           201500
   18 IF (IBLSW.NE.0) GO TO 19                                           201600
      DENOM=XG(K2,M1)-XG(K1,M1)                                          201700
      IF (DENOM.GT.0.1) GO TO 118                                        201800
      BL=SLOPE                                                           201900
      GO TO 19                                                           202000
  118 IF(MFLAG.NE.0) GO TO 119                                           202100
      BL=(ERP(K2,M1,L1)-ERP(K1,M1,L1))/DENOM                             202200
  119 IF (BL.GT.BLIM) BL=BLIM                                            202300
      IF (BL.LT.-BLIM) BL=-BLIM                                          202400
   19 BLREF=BL                                                           202500
      IF(TLLS.LT.BIG) GO TO 219                                          202600
C                                                                        202700
C RAY TRACED FROM ES WHEN ES IS BELOW REFRACTOR.                         202800
C                                                                        202900
      DENOM=SQRT(((XLL-XSP(J,M))**2+(ELL-ES(J,M))**2)*(1.+BL**2))        203000
      IF(DENOM.LT.0.001) GO TO 219                                       203100
      SINR=(ELL-ES(J,M)-BL*(XLL-XSP(J,M)))/DENOM                         203200
      IF(ABS(SINR).GT.0.999) GO TO 219                                   203300
      SINI=SINR*VVA(M1,L1)/VHA(M1,L)                                     203400
      TANI=SINI/SQRT(1.-SINI**2)                                         203500
      GO TO 120                                                          203600
  219 TANI=VVA(M1,L1)/SQRT(VHA(M1,L)**2-VVA(M1,L1)**2)                   203700
C COMPUTE SLOPE OF RAY EMERGING FROM L2                                  203800
  120 IF (I.EQ.2) TANI=-TANI                                             203900
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C ENTRY PT FOR RAYS AFTER 1ST ONE                                       204000
   20 DENOM=TANI-BL                                                     204100
C DECREMENT L1 IN PREPARATION FOR FINDING INTERSECTION W/ HORIZON ABOVE 204200
      L1=L1-1                                                           204300
      L2=L2-1                                                           204400
C VERTICAL RAY TEST                                                     204500
      IF (ABS(DENOM).LT.SMALL) GO TO 39                                 204600
C NONVERTICAL RAY                                                       204700
      BRAY=(TANI*BL+1.0)/DENOM                                          204800
      ARAY=ELL-BRAY*XLL                                                 204900
C TEST FOR UPPERMOST RAY -- IF SO COMPUTE XL1, TLL, TL, AND THEN EXIT   205000
      IF (L2.GT.L0) GO TO 23                                            205100
      XL1=(E0-ARAY)/BRAY                                                205200
      T=SQRT ((XL1-XLL)**2+(E0-ELL)**2)/VVA(M1,L2)                      205300
      IF (E0.GT.ELL) GO TO 22                                           205400
  121 T=0.00001                                                         205500
   21 L3=L2+1                                                           205600
      T=T*VVA(M1,L2)/VVA(M1,L3)                                         205700
   22 TLL=TLL+T                                                         205800
      TL=TL+T                                                           205900
      GO TO 46                                                          206000
C NOT UPPERMOST RAY -- COMPUTE TENTATIVE INTERSECTION W/ HORIZON ABOVE  206100
   23 INVAL=0                                                           206200
   24 IF(BLL.NE.0.) GO TO 25                                            206300
      DENOM=XG(K2,M1)-XG(K1,M1)                                         206400
      IF(DENOM.GT.0.1) GO TO 124                                        206500
      BL=SLOPE                                                          206600
      GO TO 25                                                          206700
  124 IF(MFLAG.EQ.0) GO TO 125                                          206800
      IF(IDIP.EQ.0) GO TO 224                                           206900
      BL=SLOPE                                                          207000
      GO TO 25                                                          207100
  224 IF(MFLAG.EQ.2) GO TO 225                                          207200
C MFLAG=1 (XLL OR XL1 LEFT OF SPREAD M1)                                207300
  324 KMID=KN/2                                                         207400
      K1=1                                                              207500
      K2=1                                                              207600
      IF(KMID-K1.LT.5) KMID=K1+5                                        207700
      IF(KMID.GT.KN) KMID=KN                                            207800
      CALL DIP(L1,M1,K1,KMID,K1,A,BL)                                   207900
      IF(JJOFF.EQ.0.OR.INVAL.EQ.0) GO TO 25                             208000
      J2=JA(1)                                                          208100
      IF(XL1.GE.XSP(J2,1).OR.J2.LE.1) GO TO 25                          208200
  424 J1=J2-1                                                           208300
      IF(XL1.GE.XSP(J1,1).OR.J1.EQ.1) GO TO 524                         208400
      J2=J1                                                             208500
      GO TO 424                                                         208600
  524 BL=(ERS(J2,M1,L1)-ERS(J1,M1,L1))/(XSP(J2,M1)-XSP(J1,M1))          208700
      GO TO 25                                                          208800
C MFLAG=2 (XLL OR XL1 RIGHT OF SPREAD M1)                               208900
  225 KMID=KN/2+1                                                       209000
      K1=KN                                                             209100
      K2=KN                                                             209200
      IF(K2-KMID.LT.5) KMID=K2-5                                        209300
      IF(KMID.LT.1) KMID=1                                              209400
      CALL DIP(L1,M1,KMID,K2,K2,A,BL)                                   209500
      IF(JJOFF.EQ.0.OR.INVAL.EQ.0) GO TO 25                             209600
      JN=NJ(NM)                                                         209700
      J1=JB(NM)                                                         209800
      IF(XL1.LE.XSP(J1,NM).OR.J1.GE.JN) GO TO 25                        209900
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  625 J2=J1+1                                                          210000
      IF(XL1.LE.XSP(J2,NM).OR.J2.EQ.JN) GO TO 524                      210100
      J1=J2                                                            210200
      GO TO 625                                                        210300
  125 BL=(ERP(K2,M1,L1)-ERP(K1,M1,L1))/DENOM                           210400
   25 IF(BL.GT.BLIM) BL=BLIM                                           210500
      IF(BL.LT.-BLIM) BL=-BLIM                                         210600
      AL=ERP(K1,M1,L1)-BL*XG(K1,M1)                                    210700
C TEST FOR RAY PARALLEL WITH HORIZON ABOVE                             210800
      DENOM=BRAY-BL                                                    210900
      IF (ABS (DENOM).GE.SMALL) GO TO 28                               211000
      IF (BRAY) 32,26,36                                               211100
   26 GO TO (36,32), I                                                 211200
C TEST FOR VALID INTERSECTION                                          211300
   28 XL1=(AL-ARAY)/DENOM                                              211400
      IF(K1.EQ.K2) GO TO 30                                            211500
      IF (XL1.LT.XG(K1,M1)) GO TO 32                                   211600
      IF (XL1.GT.XG(K2,M1)) GO TO 36                                   211700
C VALID INTERSECTION FOUND                                             211800
   30 EL1=AL+BL*XL1                                                    211900
      IF (ABS (BRAY).LT.SMALL) BRAY=SIGN(SMALL,BRAY)                   212000
      IF (BL.GT.BLIM) BL=BLIM                                          212100
      IF (BL.LT.-BLIM) BL=-BLIM                                        212200
      DENOM=1.-BL/BRAY                                                 212300
      IF(ABS(DENOM).LT.SMALL) GO TO 52                                 212400
      TANR=(BL+1.0/BRAY)/DENOM                                         212500
      T=SQRT ((XL1-XLL)**2+(EL1-ELL)**2)/VVA(M1,L2)                    212600
   31 TL=TL+T                                                          212700
C TEST FOR CASE WHERE TLL STARTS ACCUMULATING AT L-1, NOT L            212800
      IF (LL.EQ.L.AND.L2.EQ.(L-1)) GO TO 43                            212900
      TLL=TLL+T                                                        213000
      GO TO 44                                                         213100
C INTERSECTION NOT VALID -- SEARCH TO LEFT                             213200
   32 IF (INVAL.GT.0) GO TO 30                                         213300
      IF (K1.EQ.1) GO TO 34                                            213400
      K2=K1                                                            213500
      K1=K2-1                                                          213600
   33 INVAL=-1                                                         213700
      GO TO 24                                                         213800
   34 IF (M1.EQ.1) GO TO 35                                            213900
      M1=M1-1                                                          214000
      KN=NK(M1)                                                        214100
      K2=KN                                                            214200
      K1=K2-1                                                          214300
      INVAL=-1                                                         214400
      GO TO 24                                                         214500
C CASE OF XL1 LEFT OF SPREAD 1                                         214600
   35 INVAL=1                                                          214700
      MFLAG=1                                                          214800
      GO TO 324                                                        214900
C INTERSECTION NOT VALID -- SEARCH TO RIGHT                            215000
   36 IF (INVAL.LT.0) GO TO 30                                         215100
      IF (K2.EQ.KN) GO TO 38                                           215200
      K1=K2                                                            215300
      K2=K1+1                                                          215400
   37 INVAL=1                                                          215500
      GO TO 24                                                         215600
   38 IF (M1.EQ.NM) GO TO 138                                          215700
      M1=M1+1                                                          215800
      KN=NK(M1)                                                        215900
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      K1=1                                                                  216000
      K2=2                                                                  216100
      INVAL=1                                                               216200
      GO TO 24                                                              216300
C CASE OF XL1 RIGHT OF SPREAD NM                                            216400
  138 INVAL=-1                                                              216500
      MFLAG=2                                                               216600
      GO TO 225                                                             216700
C VERTICAL RAY -- TEST IF UPPERMOST -- IF SO COMPJTE TL, TLL AND EXIT.      216800
   39 XL1=XLL                                                               216900
      IF (L2.GT.LO) GO TO 40                                                217000
      T=(EO-ELL)/VVA(M1,L2)                                                 217100
      IF(T.LE.0.) GO TO 121                                                 217200
      GO TO 22                                                              217300
C VERTICAL RAY -- NOT UPPERMOST ONE                                         217400
   40 IF(BLL.NE.0.) GO TO 141                                               217500
      DENOM=XG(K2,M1)-XG(K1,M1)                                             217600
      IF(DENOM.GT.0.1) GO TO 41                                             217700
      BL=SLOPE                                                              217800
      GO TO 141                                                             217900
   41 BL=(ERP(K2,M1,L1)-ERP(K1,M1,L1))/DENOM                                218000
      IF (BL.GT.BLIM) BL=BLIM                                               218100
      IF (BL.LT.-BLIM) BL=-BLIM                                             218200
  141 AL=ERP(K1,M1,L1)-BL*XG(K1,M1)                                         218300
   42 EL1=AL+BL*XL1                                                         218400
      TANR=BL                                                               218500
      T=(EL1-ELL)/VVA(M1,L2)                                                218600
      GO TO 31                                                              218700
C                                                                           218800
   43 XREFLL=XL1                                                            218900
      EREFLL=EL1                                                            219000
      ELLS=EL1                                                              219100
C PREPARE TO CONTINUE TRACING RAY UPWARD                                    219200
   44 XLL=XL1                                                               219300
      ELL=EL1                                                               219400
      SINI=VVA(M1,L1)*TANR/(SQRT(1.0+TANR**2)*VVA(M1,L2))                   219500
      TANI=SINI/SQRT (1.0-SINI**2)                                          219600
      GO TO 20                                                              219700
C EXIT FROM RAY-TRACE ROUTINE -- PREPARE TO TRACE MORE RAYS IF NECESSARY    219800
   46 IF (NONE.GT.0) GO TO 50                                               219900
C FIRST RAY TRACED -- STORE RESULTS                                         220000
      NONE=NONE+1                                                           220100
      XS1=XO-XL1                                                            220200
      XRLL1=XREFLL                                                          220300
      XRL1=XREFL                                                            220400
      ERL1=EREFL                                                            220500
      ERLL1=EREFLL                                                          220600
      TL1=TL                                                                220700
      TLL1=TLL                                                              220800
      BLREF1=BLREF                                                          220900
      EPSS=ABS(XS1)                                                         221000
      IF (ITRACE.NE.0.AND.JPRT.NE.IBL) PRINT 47, XL1,XREFLL,EREFLL,TLL      221100
     1,XREFL,EREFL,TL,XS1,NONE                                              221200
   47 FORMAT (1H ,25X,F10.1,9X,6F9.1,F15.1,I5)                              221300
      IF (ABS (XS1).LT.0.5) GO TO 67                                        221400
   49 XLL=XREFL+XS1                                                         221500
      GO TO 2                                                               221600
C SECOND RAY TRACED -- STORE RESULTS                                        221700
   50 NONE=NONE+1                                                           221800
      XS2=XO-XL1                                                            221900
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      XRL2=XREFL                                                        222000
      XRLL2=XREFLL                                                      222100
      ERL2=EREFL                                                        222200
      ERLL2=EREFLL                                                      222300
      TL2=TL                                                            222400
      TLL2=TLL                                                          222500
      BLREF2=BLREF                                                      222600
      IF (ABS(XS2).GE.EPSS) GO TO 51                                    222700
      EPSS=ABS(XS2)                                                     222800
      XLLS=XREFLL                                                       222900
      ELLS=EREFLL                                                       223000
      TLLS=TLL                                                          223100
      XLS=XREFL                                                         223200
      ELS=EREFL                                                         223300
      TLS=TL                                                            223400
   51 IF (ITRACE.NE.0.AND.JPRT.NE.IBL) PRINT 47, XL1,XREFLL,EREFLL,TLL  223500
     1,XREFL,EREFL,TL,XS2,NONE                                          223600
C MAKE TESTS FOR ACCEPTING FIRST TWO RAYS TRACED                        223700
      IF (XS1*XS2.LT.0.0) GO TO 53                                      223800
C THE TWO RAYS ARE ON SAME SIDE OF SP OR GEO                            223900
      IF (ABS (XS2).LT.ABS (XS1)) GO TO 54                              224000
C THE 2ND RAY IS NOT CLOSER TO SP OR GEO THAN 1ST RAY                   224100
      IF (NONE.GT.4) GO TO 52                                           224200
      XLL=XREFL+XS1                                                     224300
      GO TO 56                                                          224400
C GIVE UP AND RESORT TO USING SAVED INPUT VALUES, THEN RETURN           224500
   52 XLL=XLLS                                                          224600
      ELL=ELLS                                                          224700
      TLL=TLLS                                                          224800
      XL=XLS                                                            224900
      EL=ELS                                                            225000
      TL=TLS                                                            225100
      GO TO 63                                                          225200
C TEST IF 2ND RAY COMES WITHIN 10 FT OF OBJECTIVE                       225300
   53 IF (ABS(XS2).LE.10.0) GO TO 58                                    225400
C NOT WITHIN 10 FT. IF 4 OR LESS RAYS TRACED TRY ONCE MORE AFTER        225500
C INTERPOLATING BL. IF MORE THAN 4 RAYS TRACED, ACCEPT LAST PAIR.       225600
      IF (NONE.GT.4) GO TO 58                                           225700
      IBLSW=1                                                           225800
      XLL=(XRL1*XS2-XRL2*XS1)/(XS2-XS1)                                 225900
      BL=TERP(XRL1,BLREF1,XRL2,BLREF2,XLL)                              226000
      XRL1=XRL2                                                         226100
      XRLL1=XRLL2                                                       226200
      ERL1=ERL2                                                         226300
      ERLL1=ERLL2                                                       226400
      TL1=TL2                                                           226500
      TLL1=TLL2                                                         226600
      XS1=XS2                                                           226700
      GO TO 3                                                           226800
C TEST IF EXTRAPOLATION IS PERMISSIBLE                                  226900
   54 IF (ABS (XS2).LE.ABS (XS1-XS2)) GO TO 57                          227000
      IF (NONE.GT.4) GO TO 52                                           227100
C READJUST STARTING POINT AND THEN RETRACE 2ND RAY                      227200
   55 XLL=TERP(XS1,XRL1,XS2,XRL2,0.0)                                   227300
   56 XRL1=XRL2                                                         227400
      XRLL1=XRLL2                                                       227500
      ERL1=ERL2                                                         227600
      ERLL1=ERLL2                                                       227700
      TL1=TL2                                                           227800
      TLL1=TLL2                                                         227900
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      XS1=XS2                                                          228000
      BLREF1=BLREF2                                                    228100
      GO TO 2                                                          228200
C TEST IF 2ND RAY WITHIN 10 FT OF OBJECTIVE                            228300
   57 IF (ABS(XS2).LE.10.0) GO TO 58                                   228400
C NOT WITHIN 10 FT. IF 4 OR LESS RAYS TRACED TRY ONCE MORE, OTHERWISE  228500
C ACCEPT THE LAST PAIR TRACED.                                         228600
      IF (NONE.GT.4) GO TO 58                                          228700
      GO TO 55                                                         228800
C INTERPOLATE OR EXTRAPOLATE TO OBTAIN XLL,ELL,TLL,XL,EL,TL, THEN RETURN 228900
   58 XL=TERP(XS1,XRL1,XS2,XRL2,0.0)                                   229000
      XLL=TERP(XS1,XRLL1,XS2,XRLL2,0.0)                                229100
      ELL=TERP(XRLL1,ERLL1,XRLL2,ERLL2,XLL)                            229200
      EL=TERP(XRL1,ERL1,XRL2,ERL2,XL)                                  229300
      TLL=TERP(XRLL1,TLL1,XRLL2,TLL2,XLL)                              229400
      TL=TERP(XRL1,TL1,XRL2,TL2,XL)                                    229500
      IF (TL.LT.TLL) GO TO 52                                          229600
   63 IF (ITRACE.NE.0.AND.JPRT.NE.IBL) PRINT 65, XLL,ELL,TLL,XL,EL,TL,BL 229700
   65 FORMAT (45X,6F9.1,F9.4)                                          229800
      IF(TLLS.GE.BIG) TLL=0.                                           229900
      RETURN                                                           230000
C VERY CLOSE APPROXIMATION (.LT.0.5 FT). NO FURTHER RAY TRACING NEEDED 230100
   67 XLL=XREFLL                                                       230200
      XL=XREFL                                                         230300
      ELL=EREFLL                                                       230400
      EL=EREFL                                                         230500
      GO TO 63                                                         230600
      END                                                              230700
C                                                                      230800
C---------------------------------------------------------------------- 230900
C                                                                      231000
      FUNCTION TERP(X1,Y1,X2,Y2,X)                                     231100
C  IN PROGRAM SIPT                                                     231200
C COMPUTES INTERPOLATED VALUE OF Y CORRESPONDING TO X, GIVEN THE 2 PTS 231300
C (X1,Y1) AND (X2,Y2)                                                  231400
C                                                                      231500
      IF (ABS (X2-X1).LT.0.1) GO TO 2                                  231600
      TERP=((X-X1)*(Y2-Y1))/(X2-X1)+Y1                                 231700
    1 RETURN                                                           231800
    2 TERP=(Y1+Y2)/2.0                                                 231900
      GO TO 1                                                          232000
      END                                                              232100
C                                                                      232200
C---------------------------------------------------------------------- 232300
C                                                                      232400
      SUBROUTINE KENDS(L,M,J,K1,K2,K11,K22)                            232500
      COMMON/BLKO/LG                                                   232600
C  IN PROGRAM SIPT                                                     232700
C FINDS INDEX OF LEFTMOST (K11) AND RIGHTMOST (K22) SEO REPRESENTING   232800
C LAYER L FOR SP J, SPREAD M. K1 AND K2 ARE END PTS OF RANGE TO BE     232900
C TESTED, AND ARE INPUT VALUES.K11 AND K22 ARE END PTS FOUND (OUTPUT). 233000
C BOTH K11 AND K22 SET TO ZERO IF NO PTS FOUND                         233100
C                                                                      233200
      DIMENSION LG(25,7,5)                                             233300
      K11=0                                                            233400
      K22=0                                                            233500
      IF (K1.EQ.0.OR.K2.EQ.0) GO TO 12                                 233600
      DO 1 K=K1,K2                                                     233700
      IF (LG(K,J,M).NE.L) GO TO 1                                      233800
      K11=K                                                            233900
```

```
      GO TO 3                                                          234000
    1 CONTINUE                                                         234100
      GO TO 12                                                         234200
    3 DO 5 K=K11,K2                                                    234300
      IF(LG(K,J,M).EQ.L) K22=K                                         234400
    5 CONTINUE                                                         234500
   12 RETURN                                                           234600
      END                                                              234700
C                                                                      234800
C---------------------------------------------------------------------- 234900
C                                                                      235000
      SUBROUTINE REGRES(K1,K2,J,M,L,V,T,PT,IT)                         235100
      COMMON/BLK0/LG                                                   235200
     3       /BLK3/TA,TR,D                                             235300
     4       /BLK4/VVA,VHA                                             235400
C  IN PROGRAM SIPT                                                     235500
C COMPUTES VELOCITY V BY REGRESSION OF TIME PTS (TA) AT DISTANCES D FROM 235600
C SP J TO GEOS BETWEEN INDICES K1 AND K2 FOR LAYER L, SPREAD M.        235700
C ONLY NONZERO TA FOR WHICH LG=L ARE USED IN REGRESSION.               235800
C HALF INTERCEPT TIME AT SP J IS GIVEN BY T, NUM OF REGRESSED PTS IS PT. 235900
C                                                                      236000
      DIMENSION D(25),TA(25,7,5),TR(25,7,5),LG(25,7,5),VHA(5,5),VVA(5,5) 236100
     1,TAR(25)                                                         236200
C                                                                      236300
      IF(IT.EQ.1) GO TO 2                                              236400
      DO 1 K=K1,K2                                                     236500
    1 TAR(K)=TA(K,J,M)                                                 236600
      GO TO 4                                                          236700
    2 DO 3 K=K1,K2                                                     236800
    3 TAR(K)=TR(K,J,M)                                                 236900
    4 S1=0.0                                                           237000
      S2=0.0                                                           237100
      PT=0.0                                                           237200
      T=0.0                                                            237300
      V=0.0                                                            237400
      DO 5 K=K1,K2                                                     237500
      IF (LG(K,J,M).NE.L) GO TO 5                                      237600
      S1=S1+D(K)                                                       237700
      S2=S2+TAR(K)                                                     237800
      PT=PT+1.0                                                        237900
    5 CONTINUE                                                         238000
C                                                                      238100
      IF (PT.LE.1.0) GO TO 15                                          238200
      XBAR=S1/PT                                                       238300
      TBAR=S2/PT                                                       238400
      S1=0.0                                                           238500
      S2=0.0                                                           238600
      DO 10 K=K1,K2                                                    238700
      IF (LG(K,J,M).NE.L) GO TO 10                                     238800
      XD=D(K)-XBAR                                                     238900
      S1=S1+XD*TAR(K)                                                  239000
      S2=S2+XD**2                                                      239100
   10 CONTINUE                                                         239200
      V=ABS (S2/S1)                                                    239300
      T=(TBAR-XBAR*S1/S2)/2.0                                          239400
   12 RETURN                                                           239500
C                                                                      239600
   15 IF (PT.EQ.0.0) GO TO 12                                          239700
      V=VHA(M,L)                                                       239800
      IF (V.LE.0.0) GO TO 12                                           239900
```

```
      T=(S2-S1/V)/2.0                                                    240000
      GO TO 12                                                           240100
      END                                                                240200
C                                                                        240300
C-----------------------------------------------------------------------240400
C                                                                        240500
      SUBROUTINE REGV(L,NIXIT)                                           240600
      COMMON IBL                                                         240700
      COMMON/BLK0/LG                                                     240800
     1       /BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                               240900
     3       /BLK3/TA,TR,DSG                                             241000
     5       /BLK5/IDSPR,IDSP,KL,KR,D                                    241100
     9       /BLK11/VREG,PREG                                            241200
C  IN PROGRAM SIPT                                                       241300
C COMPUTES AND PRINTS REGRESSION VELOCITIES AND INTERCEPT T FOR LAYER L   241400
C                                                                        241500
      DIMENSION NJ(5),NK( 5),KL(7,5),KR(7,5),D(25,7,5),IDSPR(5),         241600
     1IDSP(7,5),VREG(5),PREG(5),LG(25,7,5),TA(25,7,5),TR(25,7,5),DSG(25) 241700
C                                                                        241800
      IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 1, L                         241900
    1 FORMAT (' LAYER',I2,' VELOCITY AND TIME INTERCEPTS COMPUTED BY',    242000
     1' REGRESSION')                                                     242100
      SUM1=0.0                                                           242200
      PTS1=0.0                                                           242300
      DO 50 M=1,NM                                                       242400
      MCALL=M                                                            242500
      NONE=0                                                             242600
      JN=NJ(M)                                                           242700
      KN=NK(M)                                                           242800
      SUM2=0.0                                                           242900
      PTS2=0.0                                                           243000
      DO 40 J=1,JN                                                       243100
      JCALL=J                                                            243200
      CALL KENDS(L,MCALL,JCALL,1,KL(J,M),KL1,KL2)                        243300
      IF (KL1.EQ.0) GO TO 10                                             243400
      DO 5 K=KL1,KL2                                                     243500
      DSG(K)=D(K,J,M)                                                    243600
    5 CONTINUE                                                           243700
      CALL REGRES(KL1,KL2,JCALL,MCALL,L,VL,TLF,PT,0)                     243800
      IF (PT.LE.1.0) GO TO 10                                            243900
      TLF=TLF+TLF                                                        244000
      SUM3=PT/VL                                                         244100
      PTS3=PT                                                            244200
      GO TO 15                                                           244300
   10 VL=0.0                                                             244400
      TLF=0.0                                                            244500
      SUM3=0.0                                                           244600
      PTS3=0.0                                                           244700
C                                                                        244800
   15 CALL KENDS(L,MCALL,JCALL,KR(J,M),KN,KR1,KR2)                       244900
      IF (KR1.EQ.0) GO TO 23                                             245000
      DO 20 K=KR1,KR2                                                    245100
      DSG(K)=D(K,J,M)                                                    245200
   20 CONTINUE                                                           245300
      CALL REGRES(KR1,KR2,JCALL,MCALL,L,VR,TRT,PT,0)                     245400
      IF (PT.LE.1.0) GO TO 23                                            245500
      TRT=TRT+TRT                                                        245600
      PTS3=PTS3+PT                                                       245700
      SUM3=SUM3+PT/VR                                                    245800
      GO TO 24                                                           245900
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   23 VR=0.0                                                              246000
      TRT=0.0                                                             246100
      AVGT=TLF                                                            246200
   24 SUM2=SUM2+SUM3                                                      246300
      PTS2=PTS2+PTS3                                                      246400
      SUM1=SUM1+SUM3                                                      246500
      PTS1=PTS1+PTS3                                                      246600
      IF (PTS3.EQ.0.0) GO TO 40                                           246700
      IF (TLF.EQ.0.0) AVGT=TRT                                            246800
      IF (TLF.NE.0.0.AND.TRT.NE.0.0) AVGT=(TLF+TRT)/2.0                   246900
      IF (NONE.NE.0) GO TO 27                                             247000
      NONE=1                                                              247100
      IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 25, IDSPR(M)                  247200
   25 FORMAT (1HO,8H SPREAD ,A1,3X,22HVEL    TIME    GEOS    SP,5X,      247300
     1 17HGEOS   TIME    VEL,8X,19HAVG V   AVG T   PTS/1H ,10X,6H------,  247400
     2 2X,4H----,2X,5H-----,3X,3H---,3X,5H-----,2X,4H----,2X,6H------,    247500
     3 6X,6H------,3X,5H-----,3X,3H---)                                   247600
   27 SUM3=PTS3/SUM3                                                      247700
      IF (NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 40                             247800
      PRINT 31, VL,TLF,KL1,KL2,IDSP(J,M),KR1,KR2,TRT,VR,SUM3,AVGT,PTS3    247900
   31 FORMAT (1H ,3PF16.0,0PF6.1,1X,2I3,4X,A1,3X,2I3,F6.1,3PF8.0,F12.0,   248000
     1 0PF8.1,F6.0)                                                       248100
   40 CONTINUE                                                            248200
C                                                                         248300
      IF (NONE.EQ.0) GO TO 50                                             248400
      SUM2=PTS2/SUM2                                                      248500
      IF (NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 50                             248600
      PRINT 41, SUM2,PTS2                                                 248700
   41 FORMAT (1HO,59X,3HAVG,3PF7.0,0PF14.0)                               248800
   42 FORMAT (1HO,52X,10HAVG OF ALL,3PF7.0,0PF14.0)                       248900
C                                                                         249000
   50 CONTINUE                                                            249100
C                                                                         249200
      IF (PTS1.EQ.0.0) GO TO 56                                           249300
      VREG(L)=PTS1/SUM1                                                   249400
      PREG(L)=PTS1                                                        249500
      IF (NM.EQ.1.OR.NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 60                  249600
      PRINT 55                                                            249700
   55 FORMAT (1HO,63X,7H-------,10X,3H---)                                249800
      PRINT 42, VREG(L),PTS1                                              249900
      GO TO 60                                                            250000
   56 VREG(L)=0.0                                                         250100
      PREG(L)=0.0                                                         250200
C                                                                         250300
      IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 57                            250400
   57 FORMAT(/////1HO,8H--NONE--)                                         250500
C                                                                         250600
   60 RETURN                                                              250700
      END                                                                 250800
C                                                                         250900
C-------------------------------------------------------------------------251000
C                                                                         251100
      SUBROUTINE HOBV(L,NIXIT)                                            251200
      COMMON IBL                                                          251300
      COMMON/BLK0/LG                                                      251400
     1      /BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                                 251500
     3      /BLK3/TA,TR,DSG                                               251600
     5      /BLK5/IDSPR,IDSP,KL,KR,D                                      251700
     9      /BLK12/VHOB,PHOB                                              251800
C  IN PROGRAM SIPT                                                        251900
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C COMPUTES HORIZ VEL OF LAYER L BY HOBSON-OVERTON METHOD                  252000
C                                                                        252100
      DIMENSION EP(25),DX(25),DT(25),NJ(5),NK(5),IDSPR(5),LG(25,7,5),    252200
     1 TA(25,7,5),KR(7,5),KL(7,5),IDSP(7,5),VHOB(5),PHOB(5),D(25,7,5) ,  252300
     2 DSG(25),KI(5),PE(5),TR(25,7,5)                                    252400
C                                                                        252500
      IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 2, L                         252600
    2 FORMAT (1HO,'LAYER',I2,' VELOCITY COMPUTED BY HOBSON-OVERTON ',    252700
     1'METHOD')                                                          252800
      SUM2=0.0                                                           252900
      PTS2=0.0                                                           253000
C                                                                        253100
      DO 22 M=1,NM                                                       253200
      MCALL=M                                                            253300
      NONE=0                                                             253400
      JN=NJ(M)                                                           253500
      KN=NK(M)                                                           253600
      SUM3=0.0                                                           253700
      PTS3=0.0                                                           253800
      J2=JN-1                                                            253900
C                                                                        254000
      DO 18 J=1,J2                                                       254100
      JCALL=J                                                            254200
      CALL KENDS(L,MCALL,JCALL,KR(J,M),KN,KR1,KR2)                       254300
      IF (KR1.EQ.0) GO TO 18                                             254400
      J1=J+1                                                             254500
C                                                                        254600
      DO 16 JJ=J1,JN                                                     254700
      JJCALL=JJ                                                          254800
      CALL KENDS(L,MCALL,JJCALL,1,KL(JJ,M),KL1,KL2)                      254900
      K1=MAXO(KR1,KL1)                                                   255000
      K2=MINO(KR2,KL2)                                                   255100
      IF (KL1.EQ.0.OR.(K2-K1).LE.0) GO TO 16                             255200
C                                                                        255300
C BEGIN HOBSON-OVERTON ROUTINE                                           255400
C                                                                        255500
      SDX=0.0                                                            255600
      SDX2=0.0                                                           255700
      SDT=0.0                                                            255800
      SDTDX=0.0                                                          255900
      SEEP=0.0                                                           256000
      PT=0.0                                                             256100
      DO 3 K=1,12                                                        256200
      EP(K)=0.0                                                          256300
    3 CONTINUE                                                           256400
      DO 4 K=K1,K2                                                       256500
      IF (LG(K,J,M).NE.L.OR.LG(K,JJ,M).NE.L) GO TO 4                     256600
      DX(K)=ABS(D(K,J,M))-ABS(D(K,JJ,M))                                 256700
      SDX=SDX+DX(K)                                                      256800
      SDX2=SDX2+DX(K)**2                                                 256900
      DT(K)=TA(K,J,M)-TA(K,JJ,M)                                         257000
      SDT=SDT+DT(K)                                                      257100
      SDTDX=SDTDX+DX(K)*DT(K)                                            257200
      PT=PT+1.0                                                          257300
    4 CONTINUE                                                           257400
      IF (PT.LE.1.0) GO TO 9                                             257500
      V=(SDX2-SDX**2/PT)/(SDTDX-(SDX*SDT)/PT)                            257600
      TDSP=(SDT-SDX/V)/PT                                                257700
      DO 6 K=K1,K2                                                       257800
      IF (LG(K,J,M).NE.L.OR.LG(K,JJ,M).NE.L) GO TO 6                     257900
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      EP(K)=DT(K)-DX(K)/V-TDSP                                          258000
      SEEP=SEEP+EP(K)**2                                                258100
    6 CONTINUE                                                          258200
      SEEP=SQRT (SEEP/PT)                                               258300
      DO 8 IK=1,5                                                       258400
      KI(IK)=0                                                          258500
      PE(IK)=0.                                                         258600
      DO 7 K=K1,K2                                                      258700
      IF(ABS(EP(K)).LE.ABS(PE(IK))) GO TO 7                             258800
      PE(IK)=EP(K)                                                      258900
      KI(IK)=K                                                          259000
    7 CONTINUE                                                          259100
      IF(KI(IK).EQ.0) GO TO 8                                           259200
      K=KI(IK)                                                          259300
      EP(K)=0.                                                          259400
    8 CONTINUE                                                          259500
      GO TO 10                                                          259600
    9 V=0.0                                                             259700
      PT=0.0                                                            259800
C                                                                       259900
C END HOBSON-OVERTON ROUTINE                                            260000
C                                                                       260100
   10 IF (PT.EQ.0.0) GO TO 16                                           260200
      SUM3=SUM3+V*PT                                                    260300
      PTS3=PTS3+PT                                                      260400
      IF (NIXIT.EQ.1) GO TO 16                                          260500
      IF (NONE.NE.0) GO TO 12                                           260600
      NONE=1                                                            260700
      IF(JPRT.EQ.IBL) GO TO 16                                          260800
      PRINT 11, IDSPR(M)                                                260900
   11 FORMAT('0 SPREAD ',A1,40X,'5 HIGHEST EPS'/7X,'VEL    SPS    GEOS',  261000
     1'   TDSP   SE EP',5(4X,'EP    GEO')/5X,'------',2X,'---  -----  ----'  261100
     2,2X,'-----',5(3X,'---------'))                                    261200
   12 IF(JPRT.NE.IBL) PRINT 13, V,IDSP(J,M),IDSP(JJ,M),K1,K2,TDSP,SEEP,  261300
     1(PE(K),KI(K),K=1,5)                                               261400
   13 FORMAT (1H ,3PF10.0,2X,A1,1X,A1,1X,213,0PF6.1,F7.3,5(F8.3,I4))    261500
   16 CONTINUE                                                          261600
   18 CONTINUE                                                          261700
C                                                                       261800
      SUM2=SUM2+SUM3                                                    261900
      PTS2=PTS2+PTS3                                                    262000
      IF (PTS3.EQ.0.0) GO TO 22                                         262100
      SUM3=SUM3/PTS3                                                    262200
      IF (NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 20, SUM3,PTS3               262300
   20 FORMAT (1HO,5X,4HAVG=,3PF7.0,4H FOR,0PF5.0,7H POINTS)             262400
   22 CONTINUE                                                          262500
C                                                                       262600
      IF (PTS2.EQ.0.0) GO TO 26                                         262700
      SUM2=SUM2/PTS2                                                    262800
      IF (NM.EQ.1.OR.NIXIT.EQ.1.OR.JPRT.EQ.IBL) GO TO 28                262900
      PRINT 25, SUM2,PTS2                                               263000
   25 FORMAT('0  AVG OF ALL=',3PF7.0,4H FOR,0PF5.0,7H POINTS)           263100
      GO TO 28                                                          263200
   26 IF(NIXIT.EQ.0.AND.JPRT.NE.IBL) PRINT 27                           263300
   27 FORMAT(1HO,2X,17HNOT ENOUGH POINTS)                               263400
C                                                                       263500
   28 VHOB(L)=SUM2                                                      263600
      PHOB(L)=PTS2                                                      263700
C                                                                       263800
      RETURN                                                            263900
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      END                                                                   264000
C                                                                           264100
C-----------------------------------------------------------------------    264200
C                                                                           264300
      SUBROUTINE EXTRP(L,M,K1,K2,A,B,VV)                                    264400
      COMMON/BLK2/XG,ERP,SLOPE,IDIP                                         264500
     6       /BLK6/TRP,JJOFF                                                264600
     9       /BLK9/EG,ES                                                    264700
C  IN PROGRAM SIPT                                                          264800
C COMPUTES ERP AND TRP BETWEEN GEOS K1 AND K2 USING EQUATION CONSTS A,B     264900
C                                                                           265000
      DIMENSION XG(25,5),ERP(25,5,4),TRP(25,5,4),EG(25,5),ES(7,5)           265100
C                                                                           265200
      DO 2 K=K1,K2                                                          265300
      ERP(K,M,L)=A+B*XG(K,M)                                                265400
      IF (L.EQ.1) GO TO 1                                                   265500
      TRP(K,M,L)=(ERP(K,M,L-1)-ERP(K,M,L))/VV                               265600
      GO TO 2                                                               265700
    1 TRP(K,M,L)=(EG(K,M)-ERP(K,M,L))/VV                                    265800
    2 CONTINUE                                                              265900
      RETURN                                                                266000
      END                                                                   266100
C                                                                           266200
C-----------------------------------------------------------------------    266300
C                                                                           266400
      SUBROUTINE ELCOR(TANI,VV,HV,XSG,ESG,AD,BD,I,TC,XC,XINT,EINT)          266500
      COMMON/BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                                   266600
C  IN PROGRAM SIPT                                                          266700
C COMPUTES TIME CORR (TC) AND X CORR (XC) FOR SURF-TO-DATUM SLANT RAYS      266800
C FOR LAYER 1, GIVEN X POS OF SHOT OR GEO (XSG), ELEV OF SHOT OR GEO        266900
C (ESG), INTCPT AND SLOPE OF DATUM (AD AND BD), AND SIGN OF BOA=COT I       267000
C (I=1 FOR PLUS, 2 FOR MINUS). XINT,EINT IS COORD OF INTERSECTION OF        267100
C RAY AND DATUM.                                                            267200
C                                                                           267300
      DIMENSION NJ(5),NK(5)                                                 267400
      BI=TANI                                                               267500
      IF(I.EQ.2) BI=-BI                                                     267600
      BOA=(1.-BI*BD)/(BI-BD)                                                267700
      AOA=ESG-BOA*XSG                                                       267800
      XINT=(AD-AOA)/(BOA-BD)                                                267900
      EINT=AD+BD*XINT                                                       268000
      OA=SQRT ((XSG-XINT)**2+(ESG-EINT)**2)                                 268100
      TC=OA/VV                                                              268200
      XC=OA*VV/HV                                                           268300
      IF (ESG.LE.EINT) GO TO 4                                              268400
    3 TC=-TC                                                                268500
      XC=-XC                                                                268600
    4 RETURN                                                                268700
      END                                                                   268800
C                                                                           268900
C-----------------------------------------------------------------------    269000
C                                                                           269100
      SUBROUTINE DIP(L,M,K1,K2,KK,A,B)                                      269200
      COMMON/BLK2/XG,ERP,SLOPE,IDIP                                         269300
C  IN PROGRAM SIPT                                                          269400
C COMPUTES EQUATION CONSTANTS A AND B (Y=A+BX) FOR REGRESSION LINE          269500
C FITTED TO ERP OVER GEOS K1 TO K2 WITH LINE PASSING THROUGH POINT          269600
C XG(KK,M),ERP(KK,M,L)                                                      269700
C                                                                           269800
      DIMENSION XG(25,5),ERP(25,5,4)                                        269900
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1-80-1

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C                                                                       270000
      IF (IDIP.EQ.0.AND.XG(K1,M).LT.XG(K2,M)) GO TO 1                   270100
      A=ERP(KK,M,L)                                                     270200
      B=SLOPE                                                           270300
      GO TO 4                                                           270400
    1 SUM1=0.0                                                          270500
      SUM2=0.0                                                          270600
      DO 2 K=K1,K2                                                      270700
      SUM1=SUM1+XG(K,M)                                                 270800
      SUM2=SUM2+1.0                                                     270900
    2 CONTINUE                                                          271000
      XBAR=SUM1/SUM2                                                    271100
      SUM1=0.0                                                          271200
      SUM2=0.0                                                          271300
      DO 3 K=K1,K2                                                      271400
      XD=XG(K,M)-XBAR                                                   271500
      SUM1=SUM1+XD*ERP(K,M,L)                                           271600
      SUM2=SUM2+XD**2                                                   271700
    3 CONTINUE                                                          271800
      B=SUM1/SUM2                                                       271900
      A=ERP(KK,M,L)-B*XG(KK,M)                                          272000
    4 RETURN                                                            272100
      END                                                               272200
C                                                                       272300
C-----------------------------------------------------------------------272400
C                                                                       272500
      SUBROUTINE AVG(X1,X2,L2,PA,EA)                                    272600
      COMMON IBL                                                        272700
      COMMON/BLK0/LG                                                    272800
     1    /BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                                272900
     8    /BLK8/PRG,ERG,KRG,PRS2,ERS2,KRS2,ZRSP,ZRG                     273000
C  IN PROGRAM SIPT                                                      273100
C COMPUTES AVG COORD (PA,EA) OF ALL PTS IN ARRAYS (PRG,ERG) AND         273200
C (PRS2,ERS2) WHOSE X POSITION IS GE X1 .AND. LT X2. AND WHOSE REFRACTOR 273300
C IS LAYER L2. IF PTS.LE.2.AND.L2.GT.2 INTERVAL IS EXPANDED BY          273400
C DX=X2-X1 ON EACH SIDE.                                                273500
C                                                                       273600
      DIMENSION LG(25,7,5),NJ(5),NK(5),PRG(25,7,5),ERG(25,7,5),         273700
     1 KRG(25,7,5),PRS2(7,5,4,2),ERS2(7,5,4,2),KRS2(7,5,4,2),ZRSP(7),   273800
     2 ZRG(25,7)                                                        273900
C                                                                       274000
      SUM1=0.0                                                          274100
      SUM2=0.0                                                          274200
      PTS=0.0                                                           274300
      L1=L2-1                                                           274400
      X11=X1                                                            274500
      X22=X2                                                            274600
      DX=0.0                                                            274700
C                                                                       274800
    1 DO 14 M=1,NM                                                      274900
      JN=NJ(M)                                                          275000
      KN=NK(M)                                                          275100
      DO 12 J=1,JN                                                      275200
      I=1                                                               275300
    2 IF (ERS2(J,M,L1,I).EQ.0..OR.KRS2(J,M,L1,I).NE.IBL) GO TO 3        275400
      E1=ERS2(J,M,L1,I)                                                 275500
      P1=PRS2(J,M,L1,I)                                                 275600
      GO TO 10                                                          275700
    3 IF (I.EQ.2) GO TO 5                                               275800
    4 I=2                                                               275900
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      GO TO 2                                                          276000
    5 K=1                                                              276100
    6 IF (LG(K,J,M).NE.L2.OR.ERG(K,J,M).EQ.0.0.OR.KRG(K,J,M).NE.IBL) GO 276200
     1 TO 8                                                            276300
      E1=ERG(K,J,M)                                                    276400
      P1=PRG(K,J,M)                                                    276500
      I=3                                                              276600
      GO TO 10                                                         276700
    8 K=K+1                                                            276800
      IF (K.GT.KN) GO TO 12                                            276900
      GO TO 6                                                          277000
   10 IF (P1.LT.X11.OR.P1.GE.X22) GO TO 11                             277100
      SUM1=SUM1+P1                                                     277200
      SUM2=SUM2+E1                                                     277300
      PTS=PTS+1.0                                                      277400
   11 GO TO (4,5,8),I                                                  277500
   12 CONTINUE                                                         277600
   14 CONTINUE                                                         277700
      IF (PTS.EQ.0.0) GO TO 18                                         277800
      IF (PTS.LE.2..AND.L2.GT.2) GO TO 19                              277900
      PA=SUM1/PTS                                                      278000
      EA=SUM2/PTS                                                      278100
   16 RETURN                                                           278200
   18 PA=0.0                                                           278300
      EA=0.0                                                           278400
      GO TO 16                                                         278500
   19 DX=X22-X11                                                       278600
      X11=X11-DX                                                       278700
      X22=X22+DX                                                       278800
      GO TO 1                                                          278900
      END                                                              279000
C                                                                      279100
C---------------------------------------------------------------------- 279200
C                                                                      279300
      SUBROUTINE ADMIG(L1,M,B)                                         279400
      COMMON IBL                                                       279500
      COMMON/BLK0/LG                                                   279600
     1       /BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                             279700
     2       /BLK2/XG,ERP,SLOPE,IDIP                                   279800
     5       /BLK5/IDSPR,IDSP,KL,KR,D                                  279900
     6       /BLK6/TRP,JJOFF                                           280000
     7       /BLK7/JA,JB,TRS,ERS,XSP,ESP,LS                            280100
     8       /BLK8/PRG,ERG,KRG,PRS2,ERS2,KRS2,ZRSP,ZRG                 280200
     9       /BLK9/EG,ES                                               280300
     9       /BLK10/BLIM,ITRACE,TANSG                                  280400
C IN PROGRAM SIPT                                                      280500
C COMPUTES TAN OF AVG ANGLE OF DIP (B) OF BOTTOM OF L1 FOR SPREAD M    280600
C BY REGRESSION OF POINTS (PRS2,ERS2) AND (PRG,ERG).                   280700
C                                                                      280800
      DIMENSION NJ(5),NK(5),KL(7,5),KR(7,5),LG(25,7,5),LS(7,5),        280900
     1 PRS2(7,5,4,2),ERS2(7,5,4,2),KRS2(7,5,4,2),PRG(25,7,5),          281000
     2 ERG(25,7,5),IDSPR(5),IDSP(7,5),ERS(7,5,4),XSP(7,5),ESP(7,5),    281100
     3 D(25,7,5),KRG(25,7,5),TRP(25,5,4),JA(5),JB(5),TRS(7,5,4),XG(25,5) 281200
     4,EG(25,5),ES(7,5),ERP(25,5,4),ZRSP(7),ZRG(25,7)                  281300
C                                                                      281400
      B=0.                                                             281500
      JN=NJ(M)                                                         281600
      KN=NK(M)                                                         281700
      L0=L1-1                                                          281800
      L2=L1+1                                                          281900
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C                                                                       282000
C  COMPUTE AVERAGE PRG AND PRS2 (XBAR)                                  282100
C                                                                       282200
      S1=0.                                                             282300
      S2=0.                                                             282400
      P1=0.                                                             282500
      P2=0.                                                             282600
C                                                                       282700
      DO 22 J=1,JN                                                      282800
      JCALL=J                                                           282900
C                                                                       283000
C  UP-RIGHT AND DOWN-LEFT RAYS                                          283100
C                                                                       283200
      IF(KR(J,M).EQ.0) GO TO 18                                         283300
      CALL KENDS(L2,M,JCALL,KR(J,M),KN,K11,K22)                         283400
      IF(K11.EQ.0) GO TO 18                                             283500
      DO 17 K=K11,K22                                                   283600
      IF(LG(K,J,M).NE.L2) GO TO 17                                      283700
      S1=S1+PRG(K,J,M)                                                  283800
      P1=P1+1.                                                          283900
   17 CONTINUE                                                          284000
      IF((JJOFF.EQ.0.AND.J.LT.JA(M)).OR.KRS2(J,M,L1,1).NE.IBL) GO TO 18 284100
      S2=S2+PRS2(J,M,L1,1)                                              284200
      P2=P2+1.                                                          284300
C                                                                       284400
C  UP-LEFT AND DOWN-RIGHT RAYS                                          284500
C                                                                       284600
   18 IF(KL(J,M).EQ.0) GO TO 22                                         284700
      CALL KENDS(L2,M,JCALL,1,KL(J,M),K11,K22)                          284800
      IF(K11.EQ.0) GO TO 22                                             284900
      DO 20 K=K11,K22                                                   285000
      IF(LG(K,J,M).NE.L2) GO TO 20                                      285100
      S2=S2+PRG(K,J,M)                                                  285200
      P2=P2+1.                                                          285300
   20 CONTINUE                                                          285400
      IF((JJOFF.EQ.0.AND.J.GT.JB(M)).OR.KRS2(J,M,L1,2).NE.IBL) GO TO 22 285500
      S1=S1+PRS2(J,M,L1,2)                                              285600
      P1=P1+1.                                                          285700
   22 CONTINUE                                                          285800
C                                                                       285900
      IF((P1+P2).LT.2.) GO TO 99                                        286000
      XBAR1=0.                                                          286100
      XBAR2=0.                                                          286200
      IF(P1.NE.0.) XBAR1=S1/P1                                          286300
      IF(P2.NE.0.) XBAR2=S2/P2                                          286400
C                                                                       286500
C  COMPUTE AVERAGE DIP (B)                                              286600
C                                                                       286700
      S1=0.                                                             286800
      S2=0.                                                             286900
      SS1=0.                                                            287000
      SS2=0.                                                            287100
      P1=0.                                                             287200
      P2=0.                                                             287300
      DO 52 J=1,JN                                                      287400
      JCALL=J                                                           287500
C                                                                       287600
C  UP-RIGHT AND DOWN-LEFT RAYS                                          287700
C                                                                       287800
      IF (KR(J,M).EQ.0) GO TO 48                                        287900
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      CALL KENDS(L2,M,JCALL,KR(J,M),KN,K11,K22)                          288000
      IF (K11.EQ.0) GO TO 48                                             288100
      DO 47 K=K11,K22                                                    288200
      IF(LG(K,J,M).NE.L2.OR.XBAR1.EQ.0.) GO TO 47                        288300
      X=PRG(K,J,M)-XBAR1                                                 288400
      S1=S1+X*ERG(K,J,M)                                                 288500
      SS1=SS1+X**2                                                       288600
      P1=P1+1.                                                           288700
   47 CONTINUE                                                           288800
      IF((JJOFF.EQ.0.AND.J.LT.JA(M)).OR.KRS2(J,M,L1,1).NE.IBL.OR.        288900
     1 XBAR2.EQ.0.) GO TO 48                                             289000
      X=PRS2(J,M,L1,1)-XBAR2                                             289100
      S2=S2+X*ERS2(J,M,L1,1)                                             289200
      SS2=SS2+X**2                                                       289300
      P2=P2+1.                                                           289400
C                                                                        289500
C UP-LEFT AND DOWN-RIGHT RAYS                                            289600
C                                                                        289700
   48 IF(KL(J,M).EQ.0) GO TO 52                                          289800
      CALL KENDS(L2,M,JCALL,1,KL(J,M),K11,K22)                           289900
      IF(K11.EQ.0) GO TO 52                                              290000
      DO 50 K=K11,K22                                                    290100
      IF(LG(K,J,M).NE.L2.OR.XBAR2.EQ.0.) GO TO 50                        290200
      X=PRG(K,J,M)-XBAR2                                                 290300
      S2=S2+X*ERG(K,J,M)                                                 290400
      SS2=SS2+X**2                                                       290500
      P2=P2+1.                                                           290600
   50 CONTINUE                                                           290700
      IF((JJOFF.EQ.0.AND.J.GT.JB(M)).OR.KRS2(J,M,L1,2).NE.IBL.OR.        290800
     1 XBAR1.EQ.0.) GO TO 52                                             290900
      X=PRS2(J,M,L1,2)-XBAR1                                             291000
      S1=S1+X*ERS2(J,M,L1,2)                                             291100
      SS1=SS1+X**2                                                       291200
      P1=P1+1.                                                           291300
   52 CONTINUE                                                           291400
C                                                                        291500
      R1=0.                                                              291600
      R2=0.                                                              291700
      IF(SS1.NE.0.) R1=S1/SS1                                            291800
      IF(SS2.NE.0.) R2=S2/SS2                                            291900
      B=(P1*R1+P2*R2)/(P1+P2)                                            292000
      IF(IDIP.NE.0) B=SLOPE                                              292100
      IF(B.GT.BLIM) B=BLIM                                               292200
      IF(B.LT.-BLIM) B=-BLIM                                             292300
C                                                                        292400
C MIGRATE RAY END POINTS                                                 292500
C                                                                        292600
      B1=B                                                               292700
      IF(L1.EQ.1) B1=(B-SLOPE)/(1.+B*SLOPE)                              292800
      COSA=1./SQRT(1.+B1**2)                                             292900
      ZRK=(1.+B1*TANSG)*COSA-1.                                          293000
      XRK=TANSG-COSA*(TANSG-B1)                                          293100
      ZLK=(1.-B1*TANSG)*COSA-1.                                          293200
      XLK=TANSG-COSA*(TANSG+B1)                                          293300
C                                                                        293400
      DO 72 J=1,JN                                                       293500
C                                                                        293600
C UP-RIGHT AND DOWN-LEFT RAYS                                            293700
C                                                                        293800
      JCALL=J                                                            293900
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      IF(KR(J,M).EQ.0) GO TO 68                                          294000
      CALL KENDS(L2,M,JCALL,KR(J,M),KN,K11,K22)                          294100
      IF(K11.EQ.0) GO TO 68                                              294200
      DO 67 K=K11,K22                                                    294300
      IF(LG(K,J,M).NE.L2.OR.XBAR1.EQ.0.) GO TO 67                        294400
      ERG(K,J,M)=ERG(K,J,M)-ZRG(K,J)*ZRK                                 294500
      PRG(K,J,M)=PRG(K,J,M)+ZRG(K,J)*XRK                                 294600
   67 CONTINUE                                                           294700
      IF(XBAR2.EQ.0..OR.KRS2(J,M,L1,1).NE.IBL) GO TO 68                  294800
      ERS2(J,M,L1,1)=ERS2(J,M,L1,1)-ZRSP(J)*ZLK                          294900
      PRS2(J,M,L1,1)=PRS2(J,M,L1,1)-ZRSP(J)*XLK                          295000
C                                                                        295100
C UP-LEFT AND DOWN-RIGHT RAYS                                            295200
C                                                                        295300
   68 IF(KL(J,M).EQ.0) GO TO 72                                          295400
      CALL KENDS(L2,M,JCALL,1,KL(J,M),K11,K22)                           295500
      IF(K11.EQ.0) GO TO 72                                              295600
      DO 70 K=K11,K22                                                    295700
      IF(LG(K,J,M).NE.L2.OR.XBAR2.EQ.0) GO TO 70                         295800
      ERG(K,J,M)=ERG(K,J,M)-ZRG(K,J)*ZLK                                 295900
      PRG(K,J,M)=PRG(K,J,M)-ZRG(K,J)*XLK                                 296000
   70 CONTINUE                                                           296100
      IF(XBAR1.EQ.0..OR.KRS2(J,M,L1,2).NE.IBL) GO TO 72                  296200
      ERS2(J,M,L1,2)=ERS2(J,M,L1,2)-ZRSP(J)*ZRK                          296300
      PRS2(J,M,L1,2)=PRS2(J,M,L1,2)+ZRSP(J)*XRK                          296400
   72 CONTINUE                                                           296500
C                                                                        296600
   99 RETURN                                                             296700
      END                                                                296800
C                                                                        296900
C------------------------------------------------------------------------297000
C                                                                        297100
      SUBROUTINE RAYCOR(X1,X2,E1,E2,VV,HV,TCOR)                          297200
C  IN PROGRAM  SIPT                                                      297300
C ADJUSTS COORDINATES OF BOTTOM END POINT OF RAY ENTERING OR LEAVING THE 297400
C REFRACTING HORIZON SO THAT TOTAL TIME OF COMPUTER-TRACED RAY AGREES    297500
C WITH TOTAL OBSERVED TIME.                                              297600
C                                                                        297700
      DX=X1-X2                                                           297800
      DE=E1-E2                                                           297900
      DENOM=SQRT (DX**2+DE**2)/VV-ABS (DX)/HV                            298000
      IF (DENOM.LT.0.1) DENOM=0.1                                        298100
      FCTR=TCOR/DENOM                                                    298200
      X2=X2-DX*FCTR                                                      298300
      E2=E2-DE*FCTR                                                      298400
    5 RETURN                                                             298500
      END                                                                298600
C                                                                        298700
C------------------------------------------------------------------------298800
C                                                                        298900
      SUBROUTINE FILLIN(L)                                               299000
      COMMON IBL                                                         299100
      COMMON/BLK1/NM,NJ,NK,JTRL,JPRT,IDUM                                299200
     2       /BLK2/XG,ERP,SLOPE,IDIP                                     299300
     4       /BLK4/VVA,VHA                                               299400
     5       /BLK5/IDSPR,IDSP,KL,KR,D                                    299500
     6       /BLK6/TRP,JJOFF                                             299600
     7       /BLK7/JA,JB,TRS,ERS,XSP,ESP,LS                              299700
     8       /BLK8/PRG,ERG,KRG,PRS2,ERS2,KRS2,ZRSP,ZRG                   299800
     9       /BLK9/EG,ES                                                 299900
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     9      /BLK10/BLIM,ITRACE,TANSG                                          300000
C  IN PROGRAM SIPT                                                           300100
C COMPUTES MISSING (ZERO) ELEV AND TIMES AT GEOS (ERP AND TRP) AND AT        300200
C SPS (ERS AND TRS) BY INTERP OR EXTRAP OF NONZERO VALUES OF ERP AND TRP     300300
C                                                                            300400
      DIMENSION KA(5),KB(5),NJ(5),NK(5),XG(25,5),EG(25,5),TRP(25,5,4),       300500
     1 ERP(25,5,4),TRS(7,5,4),ERS(7,5,4),XSP(7,5),ESP(7,5),JA(5),JB(5),      300600
     2 ES(7,5),VVA(5,5),VHA(5,5),LS(7,5),PRG(25,7,5),ERG(25,7,5),            300700
     3 KRG(25,7,5),PRS2(7,5,4,2),ERS2(7,5,4,2),KRS2(7,5,4,2),IDSPR(5),       300800
     4 IDSP(7,5),KL(7,5),KR(7,5),D(25,7,5),ZRSP(7),ZRG(25,7)                 300900
C                                                                            301000
C                                                                            301100
C FIRST INTERP TO FILL IN GAPS WITHIN EACH SPREAD                            301200
C                                                                            301300
      DO 20 M=1,NM                                                           301400
      KN=NK(M)                                                               301500
C SEARCH FOR 1ST NONZERO VALUE                                               301600
      DO 4 K=1,KN                                                            301700
      IF (TRP(K,M,L).NE.0.0) GO TO 6                                         301800
    4 CONTINUE                                                               301900
      KA(M)=0                                                                302000
      KB(M)=0                                                                302100
      GO TO 20                                                               302200
C NONZERO VALUE FOUND -- SEARCH FOR ZERO VALUE                               302300
    6 KA(M)=K                                                                302400
      KB(M)=K                                                                302500
      K1=K+1                                                                 302600
    8 IF (K1.GT.KN) GO TO 20                                                 302700
      DO 10 K=K1,KN                                                          302800
      IF (TRP(K,M,L).EQ.0.0) GO TO 12                                        302900
      KB(M)=K                                                                303000
   10 CONTINUE                                                               303100
      GO TO 20                                                               303200
C ZERO VALUE FOUND -- STORE INDEX OF PRECEDING NONZERO VALUE AND SEARCH      303300
C FOR NEXT NONZERO VALUE                                                     303400
   12 K11=K-1                                                                303500
      K1=K+1                                                                 303600
      IF (K1.GT.KN) GO TO 20                                                 303700
      DO 14 K=K1,KN                                                          303800
      IF (TRP(K,M,L).NE.0.0) GO TO 16                                        303900
   14 CONTINUE                                                               304000
      GO TO 20                                                               304100
   16 K22=K                                                                  304200
      KB(M)=K                                                                304300
      K1=K11+1                                                               304400
      K2=K22-1                                                               304500
      DO 18 K=K1,K2                                                          304600
      ERP(K,M,L)=TERP(XG(K11,M),ERP(K11,M,L),XG(K22,M),ERP(K22,M,L),         304700
     1 XG(K,M))                                                              304800
      TRP(K,M,L)=TERP(XG(K11,M),TRP(K11,M,L),XG(K22,M),TRP(K22,M,L),         304900
     1 XG(K,M))                                                              305000
   18 CONTINUE                                                               305100
      K1=K22+1                                                               305200
      GO TO 8                                                                305300
   20 CONTINUE                                                               305400
C                                                                            305500
C CONNECT PTS BETWEEN SPREADS                                                305600
C                                                                            305700
      IF (NM.NE.1) GO TO 21                                                  305800
      M111=1                                                                 305900
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      M222=1                                                                    306000
      GO TO 100                                                                 306100
   21 M=NM-1                                                                    306200
      DO 52 M1=1,M                                                              306300
      KN1=NK(M1)                                                                306400
      M2=M1+1                                                                   306500
      KN2=NK(M2)                                                                306600
      K1=KB(M1)                                                                 306700
      K2=KA(M2)                                                                 306800
      IF (K1.EQ.0.OR.K2.EQ.0) GO TO 52                                          306900
      IF (XG(1,M2).GE.XG(KN1,M1)) GO TO 44                                      307000
C END GEOS OF THE TWO SPREADS OVERLAP                                           307100
      IF (XG(K2,M2).LT.XG(K1,M1)) GO TO 30                                      307200
C END PTS WHERE ERP IS DEFINED DONT OVERLAP -- INTERPOLATE IN THIS INTVL        307300
      K11=K1+1                                                                  307400
      KK1=K1                                                                    307500
      IF (K11.GT.KN1) GO TO 24                                                  307600
      DO 22 K=K11,KN1                                                           307700
      IF (XG(K,M1).GT.XG(K2,M2)) GO TO 24                                       307800
      ERP(K,M1,L)=TERP(XG(K1,M1),ERP(K1,M1,L),XG(K2,M2),ERP(K2,M2,L),           307900
     1 XG(K,M1))                                                                308000
      TRP(K,M1,L)=TERP(XG(K1,M1),TRP(K1,M1,L),XG(K2,M2),TRP(K2,M2,L),           308100
     1 XG(K,M1))                                                                308200
      KK1=K                                                                     308300
   22 CONTINUE                                                                  308400
   24 K22=K2-1                                                                  308500
      KK2=K2                                                                    308600
      IF (K22.LT.1) GO TO 28                                                    308700
      NONE=0                                                                    308800
      DO 26 K=1,K22                                                             308900
      IF (XG(K,M2).LT.XG(K1,M1)) GO TO 26                                       309000
      ERP(K,M2,L)=TERP(XG(K1,M1),ERP(K1,M1,L),XG(K2,M2),ERP(K2,M2,L),           309100
     1 XG(K,M2))                                                                309200
      TRP(K,M2,L)=TERP(XG(K1,M1),TRP(K1,M1,L),XG(K2,M2),TRP(K2,M2,L),           309300
     1 XG(K,M2))                                                                309400
      IF (NONE.EQ.1) GO TO 26                                                   309500
      NONE=1                                                                    309600
      KK2=K                                                                     309700
   26 CONTINUE                                                                  309800
   28 K1=KK1                                                                    309900
      KB(M1)=K1                                                                 310000
      K2=KK2                                                                    310100
      KA(M2)=K2                                                                 310200
C NOW THE END PTS DO OVERLAP                                                    310300
C FIRST FILL IN SPREAD M1 GOING TO THE RIGHT                                    310400
      K22=KB(M2)-1                                                              310500
   30 K11=K1+1                                                                  310600
      IF (K11.GT.KN1.OR.K22.LT.1) GO TO 37                                      310700
      DO 36 K=K11,KN1                                                           310800
      DO 32 KK=K2,K22                                                           310900
      IF (XG(K,M1).GE.XG(KK,M2).AND.XG(K,M1).LE.XG(KK+1,M2)) GO TO 34           311000
   32 CONTINUE                                                                  311100
      GO TO 36                                                                  311200
   34 IF (TRP(KK,M2,L).EQ.0.0.OR.TRP(KK+1,M2,L).EQ.0.0) GO TO 36                311300
      ERP(K,M1,L)=TERP(XG(KK,M2),ERP(KK,M2,L),XG(KK+1,M2),ERP(KK+1,M2,L)        311400
     1,XG(K,M1))                                                                311500
      TRP(K,M1,L)=TERP(XG(KK,M2),TRP(KK,M2,L),XG(KK+1,M2),TRP(KK+1,M2,L)        311600
     1,XG(K,M1))                                                                311700
      KB(M1)=K                                                                  311800
   36 CONTINUE                                                                  311900
```

```
C THEN FILL IN SPREAD M2 GOING TO THE LEFT                                312000
   37 K11=KA(M1)+1                                                        312100
      K22=K2-1                                                            312200
      IF (K11.GT.KN1) GO TO 52                                            312300
      IF (K22.LT.1) GO TO 52                                              312400
      NONE=0                                                              312500
      DO 42 K=1,K22                                                       312600
      DO 38 KK=K11,K1                                                     312700
      IF (XG(K,M2).GE.XG(KK-1,M1).AND.XG(K,M2).LE.XG(KK,M1)) GO TO 40     312800
   38 CONTINUE                                                            312900
      GO TO 42                                                            313000
   40 IF (TRP(KK-1,M1,L).EQ.0.0.OR.TRP(KK,M1,L).EQ.0.0) GO TO 42          313100
      ERP(K,M2,L)=TERP(XG(KK-1,M1),ERP(KK-1,M1,L),XG(KK,M1),ERP(KK,M1,L)  313200
     1,XG(K,M2))                                                          313300
      TRP(K,M2,L)=TERP(XG(KK-1,M1),TRP(KK-1,M1,L),XG(KK,M1),TRP(KK,M1,L)  313400
     1,XG(K,M2))                                                          313500
      IF (NONE.NE.0) GO TO 42                                             313600
      NONE=1                                                              313700
      KA(M2)=K                                                            313800
   42 CONTINUE                                                            313900
      GO TO 52                                                            314000
C                                                                         314100
C END GEOS DONT OVERLAP -- INTERPOLATE BETWEEN NONZERO END PTS            314200
C FIRST GO RIGHT ON SPREAD M1                                             314300
   44 K11=K1+1                                                            314400
      IF (K11.GT.KN1) GO TO 48                                            314500
      DO 46 K=K11,KN1                                                     314600
      ERP(K,M1,L)=TERP(XG(K1,M1),ERP(K1,M1,L),XG(K2,M2),ERP(K2,M2,L),     314700
     1 XG(K,M1))                                                          314800
      TRP(K,M1,L)=TERP(XG(K1,M1),TRP(K1,M1,L),XG(K2,M2),TRP(K2,M2,L),     314900
     1 XG(K,M1))                                                          315000
   46 CONTINUE                                                            315100
      KB(M1)=KN1                                                          315200
C THEN GO LEFT ON SPREAD M2                                               315300
   48 K22=K2-1                                                            315400
      IF (K22.LT.1) GO TO 52                                              315500
      DO 50 K=1,K22                                                       315600
      ERP(K,M2,L)=TERP(XG(K1,M1),ERP(K1,M1,L),XG(K2,M2),ERP(K2,M2,L),     315700
     1 XG(K,M2))                                                          315800
      TRP(K,M2,L)=TERP(XG(K1,M1),TRP(K1,M1,L),XG(K2,M2),TRP(K2,M2,L),     315900
     1 XG(K,M2))                                                          316000
   50 CONTINUE                                                            316100
      KA(M2)=1                                                            316200
   52 CONTINUE                                                            316300
C                                                                         316400
C FILL IN INTERMEDIATE SPREADS WITH NO DEPTH PTS DEFINED                  316500
C                                                                         316600
      DO 54 M1=1,NM                                                       316700
      IF (KA(M1).NE.0) GO TO 58                                           316800
   54 CONTINUE                                                            316900
      IF(JPRT.NE.IBL)PRINT 56, L                                          317000
      IF(JTRL.NE.IBL)TYPE 56,L                                            317100
   56 FORMAT (/1X,30HNO DEPTH PTS DEFINED FOR LAYER,I2,                   317200
     1 17H.  QUIT IN FILLIN)                                              317300
      L=0                                                                 317400
      GO TO 200                                                           317500
   58 M111=M1                                                             317600
   60 M11=M1+1                                                            317700
      IF (M11.GE.NM) GO TO 80                                             317800
      DO 62 MM=M11,NM                                                     317900
```

```
      IF (KA(MM).EQ.0) GO TO 64                                          318000
      M1=MM                                                              318100
   62 CONTINUE                                                           318200
C NO SUCH SPREADS OCCUR                                                  318300
      GO TO 80                                                           318400
   64 MM=MM+1                                                            318500
      DO 66 M2=MM,NM                                                     318600
      IF (KA(M2).NE.0) GO TO 68                                          318700
   66 CONTINUE                                                           318800
      GO TO 80                                                           318900
C SUCH A SPREAD DOES OCCUR                                               319000
   68 K1=KB(M1)                                                          319100
      K2=KA(M2)                                                          319200
      M11=M1+1                                                           319300
      M22=M2-1                                                           319400
      DO 72 MM=M11,M22                                                   319500
      KN=NK(MM)                                                          319600
      DO 70 K=1,KN                                                       319700
      ERP(K,MM,L)=TERP(XG(K1,M1),ERP(K1,M1,L),XG(K2,M2),ERP(K2,M2,L),    319800
     1 XG(K,MM))                                                         319900
      TRP(K,MM,L)=TERP(XG(K1,M1),TRP(K1,M1,L),XG(K2,M2),TRP(K2,M2,L),    320000
     1 XG(K,MM))                                                         320100
   70 CONTINUE                                                           320200
      KA(MM)=1                                                           320300
      KB(MM)=KN                                                          320400
   72 CONTINUE                                                           320500
      M1=M2                                                              320600
      GO TO 60                                                           320700
C                                                                        320800
C FILL IN INTERMEDIATE SPREADS WITH ONLY ONE DEPTH PT DEFINED            320900
C                                                                        321000
   80 DO 88 M=M111,NM                                                    321100
      KN=NK(M)                                                           321200
      IF (KA(M).EQ.0) GO TO 90                                           321300
      KK=KA(M)                                                           321400
      IF (KK.NE.KB(M)) GO TO 88                                          321500
      IF (M.EQ.M111) GO TO 84                                            321600
C DO TO THE LEFT OF PT                                                   321700
      M1=M-1                                                             321800
      K1=KB(M1)                                                          321900
      K2=KK-1                                                            322000
      IF (K2.LT.1) GO TO 84                                              322100
      DO 82 K=1,K2                                                       322200
      ERP(K,M,L)=TERP(XG(K1,M1),ERP(K1,M1,L),XG(KK,M),ERP(KK,M,L),       322300
     1 XG(K,M))                                                          322400
      TRP(K,M,L)=TERP(XG(K1,M1),TRP(K1,M1,L),XG(KK,M),TRP(KK,M,L),       322500
     1 XG(K,M))                                                          322600
   82 CONTINUE                                                           322700
      KA(M)=1                                                            322800
C DO TO THE RIGHT OF PT                                                  322900
   84 M2=M+1                                                             323000
      IF (M2.GT.NM) GO TO 88                                             323100
      IF (KA(M2).EQ.0) GO TO 92                                          323200
      K1=KK+1                                                            323300
      IF (K1.GT.KN) GO TO 88                                             323400
      K2=KA(M2)                                                          323500
      DO 86 K=K1,KN                                                      323600
      ERP(K,M,L)=TERP(XG(KK,M),ERP(KK,M,L),XG(K2,M2),ERP(K2,M2,L),       323700
     1 XG(K,M))                                                          323800
      TRP(K,M,L)=TERP(XG(KK,M),TRP(KK,M,L),XG(K2,M2),TRP(K2,M2,L),       323900
```

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     1 XG(K,M))                                                          324000
    86 CONTINUE                                                          324100
       KB(M)=KN                                                          324200
    88 CONTINUE                                                          324300
       M222=NM                                                           324400
       GO TO 100                                                         324500
    90 M=M-1                                                             324600
    92 M222=M                                                            324700
C                                                                        324800
C EXTRAPOLATE END GEOS AND END SPREADS                                   324900
C                                                                        325000
C  LEFT OF SPREAD                                                        325100
C                                                                        325200
   100 KMID=(KB(M111)-KA(M111))/2                                        325300
       IF(KMID-KA(M111).LT.5) KMID=KA(M111)+5                            325400
       IF(KMID.GT.KB(M111)) KMID=KB(M111)                                325500
       CALL DIP(L,M111,KA(M111),KMID,KA(M111),A1,B1)                     325600
       K1=KA(M111)-1                                                     325700
       IF (K1.LT.1) GO TO 102                                            325800
       CALL EXTRP(L,M111,1,K1,A1,B1,VVA(M111,L))                         325900
   102 IF (M111.EQ.1) GO TO 106                                          326000
       M11=M111-1                                                        326100
       DO 104 M=1,M11                                                    326200
       MCALL=M                                                           326300
       CALL EXTRP(L,MCALL,1,NK(M),A1,B1,VVA(M,L))                        326400
   104 CONTINUE                                                          326500
C                                                                        326600
C RIGHT OF SPREAD                                                        326700
C                                                                        326800
   106 KMID=(KB(M222)-KA(M222))/2+1                                      326900
       IF(KB(M222)-KMID.LT.5) KMID=KB(M222)-5                            327000
       IF(KMID.LT.KA(M222)) KMID=KA(M222)                                327100
       CALL DIP(L,M222,KMID,KB(M222),KB(M222),A2,B2)                     327200
       KN=NK(M222)                                                       327300
       K2=KB(M222)+1                                                     327400
       IF (K2.GT.KN) GO TO 108                                           327500
       CALL EXTRP(L,M222,K2,KN,A2,B2,VVA(M222,L))                        327600
   108 IF (M222.EQ.NM) GO TO 112                                         327700
       M22=M222+1                                                        327800
       DO 110 M=M22,NM                                                   327900
       MCALL=M                                                           328000
       CALL EXTRP(L,MCALL,1,NK(M),A2,B2,VVA(M,L))                        328100
   110 CONTINUE                                                          328200
C                                                                        328300
C INTERP-EXTRAP ELEV AND TIME AT SPS AND PREVENT CRISS-CROSS OF LAYERS   328400
C                                                                        328500
   112 DO 160 M=1,NM                                                     328600
       IF (JJOFF.EQ.0) GO TO 113                                         328700
       J1=1                                                              328800
       J2=NJ(M)                                                          328900
       GO TO 116                                                         329000
   113 J1=JA(M)                                                          329100
       J2=JB(M)                                                          329200
   116 KN=NK(M)                                                          329300
       DO 146 J=J1,J2                                                    329400
       MM=M                                                              329500
       KNM=NK(M)                                                         329600
       IF (TRS(J,M,L).NE.0.0) GO TO 142                                  329700
       IF (XSP(J,M).GE.XG(1,MM)) GO TO 118                               329800
   117 IF (MM.EQ.1) GO TO 136                                            329900
```

```
      MM=MM-1                                                          330000
      KNM=NK(MM)                                                       330100
      IF (XSP(J,M).LT.XG(1,MM)) GO TO 117                              330200
      GO TO 122                                                        330300
  118 IF (XSP(J,M).LE.XG(KNM,MM)) GO TO 122                            330400
  119 IF (MM.EQ.NM) GO TO 138                                          330500
      MM=MM+1                                                          330600
      KNM=NK(MM)                                                       330700
      IF (XSP(J,M).GT.XG(KNM,MM)) GO TO 119                            330800
C                                                                      330900
  122 IF (XG(2,MM).GE.XSP(J,M)) GO TO 128                              331000
      IF (XG(KNM-1,MM).LE.XSP(J,M)) GO TO 126                          331100
      DO 124 K=2,KNM                                                   331200
      IF (XG(K,MM).GE.XSP(J,M)) GO TO 134                              331300
  124 CONTINUE                                                         331400
C                                                                      331500
  126 K1=KNM-1                                                         331600
      X1=XG(K1,MM)                                                     331700
      E1=ERP(K1,MM,L)                                                  331800
      X2=XG(KNM,MM)                                                    331900
      E2=ERP(KNM,MM,L)                                                 332000
      GO TO 140                                                        332100
C                                                                      332200
  128 X1=XG(1,MM)                                                      332300
      E1=ERP(1,MM,L)                                                   332400
      X2=XG(2,MM)                                                      332500
      E2=ERP(2,MM,L)                                                   332600
      GO TO 140                                                        332700
C                                                                      332800
  134 K1=K-1                                                           332900
      X1=XG(K1,MM)                                                     333000
      E1=ERP(K1,MM,L)                                                  333100
      X2=XG(K,MM)                                                      333200
      E2=ERP(K,MM,L)                                                   333300
      GO TO 140                                                        333400
C                                                                      333500
C CASE WHERE MM=1                                                      333600
C                                                                      333700
  136 KMID=KNM/2                                                       333800
      IF(KMID.LT.6) KMID=6                                             333900
      IF(KMID.GT.KNM) KMID=KNM                                         334000
      CALL DIP(L,1,1,KMID,1,A1,B1)                                     334100
      IF(JJOFF.EQ.0.OR.J.GE.JA(1)) GO TO 7136                          334200
      E1=0.                                                            334300
      JJ2=J-1                                                          334400
      IF(JJ2.LT.1) GO TO 2136                                          334500
      DO 1136 JJ=1,JJ2                                                 334600
      JR=JJ2-JJ+1                                                      334700
      IF(ERS2(JR,1,L,1).EQ.0) GO TO 1136                               334800
      X1=PRS2(JR,1,L,1)                                                334900
      E1=ERS2(JR,1,L,1)                                                335000
      GO TO 2136                                                       335100
 1136 CONTINUE                                                         335200
 2136 JJ1=J                                                            335300
      JJ2=JA(1)-1                                                      335400
 3136 DO 4136 JJ=JJ1,JJ2                                               335500
      IF(ERS2(JJ,1,L,1).EQ.0.) GO TO 4136                              335600
      X2=PRS2(JJ,1,L,1)                                                335700
      E2=ERS2(JJ,1,L,1)                                                335800
      JLAST=JJ                                                         335900
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      GO TO 6136                                                        336000
 4136 CONTINUE                                                          336100
      IF(E1.EQ.0.) GO TO 7136                                           336200
 5136 X2=XG(1,1)                                                        336300
      E2=ERP(1,1,L)                                                     336400
      GO TO 140                                                         336500
 6136 IF(E1.NE.0) GO TO 140                                             336600
      X1=X2                                                             336700
      E1=E2                                                             336800
      JJ1=JLAST+1                                                       336900
      IF(JJ1.LE.JJ2) GO TO 3136                                         337000
      GO TO 5136                                                        337100
 7136 ERS(J,M,L)=ERP(1,MM,L)-B1*(XG(1,MM)-XSP(J,M))                     337200
      GO TO 142                                                         337300
C                                                                       337400
C CASE WHERE MM=NM                                                      337500
C                                                                       337600
  138 KMID=KNM/2+1                                                      337700
      IF(KNM-KMID.LT.5) KMID=KNM-5                                      337800
      IF(KMID.LT.1) KMID=1                                              337900
      CALL DIP(L,NM,KMID,KNM,KNM,A2,B2)                                 338000
      IF(JJOFF.EQ.0.OR.J.LE.JB(NM)) GO TO 7138                          338100
      E2=0.                                                             338200
      JN=NJ(NM)                                                         338300
      JJ1=J+1                                                           338400
      IF(JJ1.GT.JN) GO TO 2138                                          338500
      DO 1138 JJ=JJ1,JN                                                 338600
      IF(ERS2(JJ,NM,L,2).EQ.0.) GO TO 1138                              338700
      X2=PRS2(JJ,NM,L,2)                                                338800
      E2=ERS2(JJ,NM,L,2)                                                338900
      GO TO 2138                                                        339000
 1138 CONTINUE                                                          339100
 2138 JJ2=J                                                             339200
      JJ1=JB(NM)+1                                                      339300
 3138 DO 4138 JJ=JJ1,JJ2                                                339400
      JR=JJ2-JJ+JJ1                                                     339500
      IF(ERS2(JR,NM,L,2).EQ.0.) GO TO 4138                              339600
      X1=PRS2(JR,NM,L,2)                                                339700
      E1=ERS2(JR,NM,L,2)                                                339800
      JLAST=JR                                                          339900
      GO TO 6138                                                        340000
 4138 CONTINUE                                                          340100
      IF(E2.EQ.0.) GO TO 7138                                           340200
 5138 X1=XG(KNM,NM)                                                     340300
      E1=ERP(KNM,NM,L)                                                  340400
      GO TO 140                                                         340500
 6138 IF(E2.NE.0.) GO TO 140                                            340600
      X2=X1                                                             340700
      E2=E1                                                             340800
      JJ2=JLAST-1                                                       340900
      IF(JJ1.LE.JJ2) GO TO 3138                                         341000
      GO TO 5138                                                        341100
 7138 ERS(J,M,L)=ERP(KNM,MM,L)+B2*(XSP(J,M)-XG(KNM,MM))                 341200
      GO TO 142                                                         341300
C                                                                       341400
  140 ERS(J,M,L)=TERP(X1,E1,X2,E2,XSP(J,M))                             341500
C                                                                       341600
  142 IF (L.EQ.1) GO TO 144                                             341700
      IF (ERS(J,M,L).LE.ERS(J,M,L-1)) GO TO 143                         341800
      ERS(J,M,L)=ERS(J,M,L-1)-.00001                                    341900
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      TRS(J,M,L)=0.00001                                                  342000
      GO TO 146                                                           342100
  143 TRS(J,M,L)=(ERS(J,M,L-1)-ERS(J,M,L))/VVA(M,L)                       342200
      GO TO 146                                                           342300
  144 IF (ERS(J,M,L).LE.ES(J,M)) GO TO 145                                342400
      LS(J,M)=2                                                           342500
      TRS(J,M,L)=0.00001                                                  342600
      IF (ERS(J,M,L).GT.ESP(J,M)) ERS(J,M,L)=ESP(J,M)-.00001              342700
      GO TO 146                                                           342800
  145 TRS(J,M,L)=(ES(J,M)-ERS(J,M,1))/VVA(M,L)                            342900
C                                                                         343000
  146 CONTINUE                                                            343100
C                                                                         343200
      IF (L.EQ.1) GO TO 150                                               343300
      DO 148 K=1,KN                                                       343400
      IF (ERP(K,M,L-1)-ERP(K,M,L).GE.0.00001) GO TO 148                   343500
      ERP(K,M,L)=ERP(K,M,L-1)-0.00001                                     343600
      TRP(K,M,L)=0.00001                                                  343700
  148 CONTINUE                                                            343800
      GO TO 160                                                           343900
C                                                                         344000
  150 DO 152 K=1,KN                                                       344100
      IF (EG(K,M)-ERP(K,M,L).GE.0.00001) GO TO 152                        344200
      TRP(K,M,L)=0.00001                                                  344300
      ERP(K,M,L)=EG(K,M)-0.00001                                          344400
  152 CONTINUE                                                            344500
C                                                                         344600
  160 CONTINUE                                                            344700
C                                                                         344800
  200 IF(ITRACE.EQ.0.OR.JPRT.EQ.IBL) GO TO 300                            344900
      DO 260 M=1,NM                                                       345000
      KN=NK(M)                                                            345100
      L2=L+1                                                              345200
      IF(JJOFF.NE.0) GO TO 206                                            345300
      J1=JA(M)                                                            345400
      J2=JB(M)                                                            345500
      GO TO 208                                                           345600
  206 J1=1                                                                345700
      J2=NJ(M)                                                            345800
  208 PRINT 210, L2,IDSPR(M)                                              345900
  210 FORMAT(/' OUTPUT OF SUBR FILLIN FOR LAYER',I2,'  SPREAD ',A1)       346000
      DO 230 J=J1,J2                                                      346100
      PRINT 220, IDSP(J,M),XSP(J,M),ESP(J,M),ERS(J,M,L),TRS(J,M,L)        346200
  220 FORMAT('  SP=',1X,A1,'  XSP=',F8.1,'  ESP=',F8.1,'  ERS=',F12.4,    346300
     1'  TRS=',F12.4)                                                     346400
  230 CONTINUE                                                            346500
      DO 250 K=1,KN                                                       346600
      PRINT 240, K,XG(K,M),EG(K,M),ERP(K,M,L),TRP(K,M,L)                  346700
  240 FORMAT('  K=',I2,'    XG=',F8.1,'    EG=',F8.1,'  ERP=',F12.4,     346800
     1'  TRP=',F12.4)                                                     346900
  250 CONTINUE                                                            347000
  260 CONTINUE                                                            347100
  300 RETURN                                                              347200
      END                                                                 347300
C                                                                         347400
C-------------------------------------------------------------------------347500
C                                                                         347600
      SUBROUTINE PLOT(IGOTO)                                              347700
C  IN PROGRAM  SIPT                                                       347800
C PLOTS T-D GRAPH (IGOTO=1) OR DEPTH GRAPH (IGOTO=2)                      347900
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C                                                                       348000
      COMMON IBL,IQUES,IP,IT,ICOLN,IPLUS,ISQ,IDASH,IS,IAST,IDEF,IL,NL,  348100
     1LN,P,TSCALE,XSCALE,XSCO2,ESCALE,XLIM1,XLIM2,IPLOT,IDENT           348200
      COMMON/BLK0/LG                                                    348300
     1       /BLK1/NM,NJ,NK,IDUM,JPRT,JTRL                              348400
     2       /BLK2/XG,ERP,SLOPE,IDIP                                    348500
     3       /BLK3/TA,TR,DSG                                            348600
     5       /BLK5/IDSPR,IDSP,KL,KR,D                                   348700
     6       /BLK6/TRP,JJOFF                                            348800
     7       /BLK7/JA,JB,TRS,ERS,XSP,ESP,LS                             348900
     8       /BLK8/PRG,ERG,KRG,PRS2,ERS2,KRS2,ZRSP,ZRG                  349000
     9       /BLK9/EG,ES                                                349100
C                                                                       349200
C COMMON ARRAYS                                                         349300
C                                                                       349400
      DIMENSION IDENT(16),IL(5),IDSPR(5),JA(5),JB(5),NJ(5),NK(5),       349500
     1 XSP(7,5),ESP(7,5),ES(7,5),IDSP(7,5),KL(7,5),KR(7,5),IP(103),     349600
     2 IT(53),ERS(7,5,4),PRS2(7,5,4,2),ERS2(7,5,4,2),KRS2(7,5,4,2),     349700
     3 XG(25,5),EG(25,5),P(25,7,5),TA(25,7,5),LG(25,7,5), DSG(25),      349800
     4 PRG(25,7,5),ERG(25,7,5),KRG(25,7,5),ERP(25,5,4),D(25,7,5),       349900
     5 TRS(7,5,4),TRP(25,5,4),LS(7,5),TR(25,7,5),ZRSP(7),ZRG(25,7)      350000
C                                                                       350100
C INTERNAL ARRAYS                                                       350200
C                                                                       350300
      DIMENSION LB(11),PRGALL(875),ERGALL(875),ISYMBL(875),             350400
     1 PRSALL(280),ERSALL(280),JSYMBL(280) ,                            350500
     1 ENEXT(4),ELAST(4),ERITE(4),                                      350600
     2 JPTR(5),KPTR(5),                                                 350700
     4 KJPT(7,5)                                                        350800
       DATA BIG/9999999./                                               350900
C                                                                       351000
C                                                                       351100
      GO TO (500,3000),IGOTO                                            351200
C                                                                       351300
C T-D PLOT ROUTINE                                                      351400
C                                                                       351500
  500 LBINC=IFIX (10.0*TSCALE)                                          351600
C                                                                       351700
C MAIN T-D GRAPH PLOT LOOP                                              351800
C                                                                       351900
      LB(1)=0                                                           352000
      DO 510 I=2,11                                                     352100
      LB(I)=LB(I-1)+LBINC                                               352200
  510 CONTINUE                                                          352300
      IF(JPRT.NE.IBL)PRINT 57, IDENT                                    352400
   57 FORMAT (1H1,16A5)                                                 352500
      GO TO (515,520,525,530),IPLOT                                     352600
  515 IF(JPRT.NE.IBL)PRINT 516                                          352700
      IF(JTRL.NE.IBL)TYPE 518                                           352800
  518 FORMAT(/1X,'S',6X,'T-D PLOT -- RAW DATA, NO CORRECTIONS')         352900
  516 FORMAT (1HO,' S',20X,'TIME-DISTANCE PLOT  --  RAW DATA WITH NO'   353000
     1,' CORRECTIONS APPLIED')                                          353100
      GO TO 540                                                         353200
  520 IF(JPRT.NE.IBL)PRINT 521                                          353300
      IF(JTRL.NE.IBL)TYPE 10521                                         353400
10521 FORMAT(/1X,'S',6X,'T-D PLOT -- T CORRECTED TO DATUM ELEV')        353500
  521 FORMAT (1HO,' S',20X,'TIME-DISTANCE PLOT  --  TIMES CORRECTED TO' 353600
     1,' DATUM ELEVATION')                                              353700
      GO TO 540                                                         353800
  525 IF(JPRT.NE.IBL) PRINT 526                                         353900
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      IF(JTRL.NE.IBL) TYPE 527                                          354000
  526 FORMAT('0 S',20X,'TIME-DISTANCE PLOT -- PRE-DEPTH VALUES WITH'    354100
     1,' TIE CORR IF JJOFF=0')                                          354200
  527 FORMAT(/' S',6X,'T-D PLOT -- PRE-DEPTH W/ TIE CORR IF JJOFF=0')   354300
      GO TO 540                                                         354400
  530 IF(JPRT.NE.IBL)PRINT 531                                          354500
      IF(JTRL.NE.IBL)TYPE 10531                                         354600
10531 FORMAT(/1X,'S',6X,'T-D PLOT -- LAYER 1 REMOVED')                  354700
  531 FORMAT (1H0,2H S,40X,39HTIME-DISTANCE PLOT  --  LAYER 1 REMOVED)  354800
  540 IF(JPRT.NE.IBL)PRINT 541                                          354900
      IF(JTRL.NE.IBL)TYPE 10541                                         355000
10541 FORMAT(1X,'P  G',65X,'D'/1X,'R  E  S',62X,'I'/' E  O  P',62X,'S',  355100
     1/1X,'A',68X,'T'/1X,'D',13X,'T I M E    ( M I L L I S E C O N D S )  355200
     2')                                                                355300
  541 FORMAT (1H ,5H P  G,62X,50X,1HD/1H ,8H R  E  S,59X,50X,1HI/1H ,   355400
     1 8H E  O  P,59X,50X,1HS/1H ,2H A,62X,53X,1HT/1H ,2H D,40X,        355500
     238HT I M E    ( M I L L I S E C O N D S ))                        355600
      IF(JPRT.NE.IBL)PRINT 584, (LB(I),I=1,11)                          355700
      IF(JTRL.NE.IBL)TYPE 10584,(LB(I),I=1,11,2)                        355800
10584 FORMAT(1X,I9,5I10)                                                355900
  584 FORMAT (1H ,11I10)                                                356000
      IF(JPRT.NE.IBL)PRINT 585                                          356100
      IF(JTRL.NE.IBL)TYPE 10585                                         356200
10585 FORMAT(9X,'+',5('---------+'))                                    356300
  585 FORMAT (1H ,9X,1H+,10(10H---------+))                             356400
C                                                                       356500
C INITIALIZE POINTERS AND XLIM                                          356600
C   JPTR(M) FOR SP LABELS                                               356700
C   KPTR(M) FOR GEO LABELS                                              356800
C   KJPT(J,M) FOR ARRIVAL TIMES                                         356900
C                                                                       357000
      DO 595 M=1,NM                                                     357100
      KPTR(M)=1                                                         357200
      IF (M.EQ.1.OR.JJOFF.EQ.0) GO TO 586                               357300
      J=1                                                               357400
      GO TO 587                                                         357500
  586 J=JA(M)                                                           357600
  587 IF (XSP(J,M).GE.(XLIM1-XSCALE)) GO TO 588                         357700
      J=J+1                                                             357800
      IF (J.LE.NJ(M)) GO TO 587                                         357900
      J=NJ(M)                                                           358000
  588 JPTR(M)=J                                                         358100
      JN=NJ(M)                                                          358200
      DO 590 J=1,JN                                                     358300
      KJPT(J,M)=1                                                       358400
  590 CONTINUE                                                          358500
  595 CONTINUE                                                          358600
      XLIM=XLIM1                                                        358700
      XMIN=XLIM1-XSCALE                                                 358800
  627 KFLAG=0                                                           358900
      LBLJ=IBL                                                          359000
      LBLM=IBL                                                          359100
      XMID=XLIM-XSC02                                                   359200
C SET TYPE FOR PRINTING LBLM (SPREAD) AND LBLJ (SP), ALSO SET KFLAG     359300
C                                                                       359400
C     KFLAG=-1 FOR M AND J LABEL                                        359500
C     KFLAG= 0 FOR NO LABEL (BLANK)                                     359600
C     KFLAG= 1 FOR M, K AND J LABEL                                     359700
C                                                                       359800
      DO 645 M=1,NM                                                     359900
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      KN=NK(M)                                                          360000
      JN=NJ(M)                                                          360100
      IF (M.EQ.NM) JN=JB(NM)                                            360200
      KP=KPTR(M)                                                        360300
      IF (KP.GT.KN) GO TO 635                                           360400
      IF (XG(KP,M).GE.XLIM) GO TO 635                                   360500
      KFLAG=1                                                           360600
      LBLM=IDSPR(M)                                                     360700
      LK=KP                                                             360800
      DIST=XG(KP,M)                                                     360900
      KPTR(M)=KPTR(M)+1                                                 361000
  635 JP=JPTR(M)                                                        361100
      IF (JP.GT.JN) GO TO 645                                           361200
      IF (XSP(JP,M).GE.XLIM.OR.XSP(JP,M).LT.XMIN) GO TO 645             361300
      IF (KFLAG.EQ.1) GO TO 638                                         361400
      KFLAG=-1                                                          361500
  638 LBLM=IDSPR(M)                                                     361600
      LBLJ=IDSP(JP,M)                                                   361700
      DIST=XSP(JP,M)                                                    361800
      JPTR(M)=JPTR(M)+1                                                 361900
  645 CONTINUE                                                          362000
C                                                                       362100
C SET TYPE FOR BACKGROUND AND BORDER OF GRAPH                           362200
C                                                                       362300
      DO 650 I=1,103                                                    362400
      IP(I)=IBL                                                         362500
  650 CONTINUE                                                          362600
      DO 655 II=1,53                                                    362700
  655 IT(II)=IBL                                                        362800
      IF (KFLAG.EQ.0) GO TO 662                                         362900
      DO 660 I=2,102,10                                                 363000
  660 IP(I)=IPLUS                                                       363100
      DO 661 II=2,52,10                                                 363200
  661 IT(II)=IPLUS                                                      363300
      GO TO 665                                                         363400
  662 IP(2)=IDASH                                                       363500
      IP(102)=IDASH                                                     363600
      IT(2)=IDASH                                                       363700
      IT(52)=IDASH                                                      363800
C                                                                       363900
C SET TYPE FOR ARRIVAL TIMES                                            364000
C                                                                       364100
  665 DO 710 M=1,NM                                                     364200
      KN=NK(M)                                                          364300
      JN=NJ(M)                                                          364400
      DO 700 J=1,JN                                                     364500
      KK=KJPT(J,M)                                                      364600
      IF (KK.GT.KN) GO TO 668                                           364700
      IF (P(KK,J,M).GE.XLIM) GO TO 666                                  364800
      I=IFIX(TA(KK,J,M)/TSCALE + 2.5)                                   364900
      II=(I-2)/2+2                                                      365000
      GO TO 677                                                         365100
  666 IF (KK.NE.1) GO TO 669                                            365200
C                                                                       365300
C PREPARE TO INTERP BETWEEN TIME=0 AT JA(M) AND TA(1,J,M)               365400
C                                                                       365500
      IF (J.NE.JA(M)) GO TO 700                                         365600
      T2=TA(1,J,M)                                                      365700
      IF (T2.EQ.0.0) GO TO 700                                          365800
      P1=XSP(J,M)                                                       365900
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      P2=P(1,J,M)                                                       366000
      T1=0.0                                                            366100
      GO TO 674                                                         366200
C                                                                       366300
C PREPARE TO INTERP BETWEEN TIME=0 AT JB(M) AND TA(KN,J,M)              366400
C                                                                       366500
  668 IF (J.NE.JB(M)) GO TO 700                                         366600
      T1=TA(KN,J,M)                                                     366700
      IF (T1.EQ.0.0) GO TO 700                                          366800
      P1=P(KN,J,M)                                                      366900
      P2=XSP(J,M)                                                       367000
      T2=0.0                                                            367100
      GO TO 674                                                         367200
C                                                                       367300
C PREPARE TO INTERP FOR KK=K2=2 TO KN AND K1=K2-1 USING TA(K1,..TA(K2,..367400
C                                                                       367500
  669 K2=KK                                                             367600
      K1=K2-1                                                           367700
  670 T1=TA(K1,J,M)                                                     367800
      IF (T1.NE.0.0) GO TO 671                                          367900
      IF (K1.EQ.KR(J,M).OR.K1.EQ.KL(J,M)) GO TO 700                     368000
      K1=K1-1                                                           368100
      IF (K1.LT.1) GO TO 700                                            368200
      GO TO 670                                                         368300
C                                                                       368400
  671 T2=TA(K2,J,M)                                                     368500
      IF (T2.NE.0.0) GO TO 672                                          368600
      IF (K2.EQ.KR(J,M).OR.K2.EQ.KL(J,M)) GO TO 700                     368700
      K2=K2+1                                                           368800
      IF (K2.GT.KN) GO TO 700                                           368900
      GO TO 671                                                         369000
C                                                                       369100
C NONZERO PAIR OF TA FOUND -- TEST IF SP J OCCURS BETWEEN P1 AND P2     369200
C   IF SO PREPARE TO INTERP BETWEEN TIME=0 AT SP AND APPROPRIATE TA     369300
C   IF NOT PREPARE TO INTERP BETWEEN TA PAIR                            369400
  672 P1=P(K1,J,M)                                                      369500
      P2=P(K2,J,M)                                                      369600
      IF (XSP(J,M).GT.P2.OR.XSP(J,M).LT.P1) GO TO 674                   369700
      IF (XMID.LE.XSP(J,M)) GO TO 673                                   369800
      P1=XSP(J,M)                                                       369900
      T1=0.0                                                            370000
      GO TO 674                                                         370100
C                                                                       370200
  673 P2=XSP(J,M)                                                       370300
      T2=0.0                                                            370400
C                                                                       370500
C INTERPOLATE TO COMPUTE I AND THEN SET IP(I)                           370600
C                                                                       370700
  674 IF(XMID.LT.P1.OR.XMID.GT.P2) GO TO 700                            370800
      I=IFIX (TERP(P1,T1,P2,T2,XMID)/TSCALE+2.5)                        370900
      II=(I-2)/2+2                                                      371000
      IF (I.LT.2.OR.I.GT.102) GO TO 700                                 371100
      IF (IP(I).EQ.IBL.OR.IP(I).EQ.IPLUS.OR.IP(I).EQ.IDASH) IP(I)=ICOLN 371200
      IF(IT(II).EQ.IBL.OR.IT(II).EQ.IPLUS.OR.IT(II).EQ.IDASH)           371300
     1 IT(II)=ICOLN                                                     371400
      GO TO 700                                                         371500
  677 IF (I.GT.1) GO TO 678                                             371600
      I=1                                                               371700
      II=1                                                              371800
      GO TO 684                                                         371900
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  678 IF (I.LT.103) GO TO 681                                              372000
      I=103                                                                372100
      II=53                                                                372200
  684 IP(I)=ISQ                                                            372300
      IT(II)=ISQ                                                           372400
      GO TO 690                                                            372500
  681 IF(IP(I).NE.IBL.AND.IP(I).NE.IPLUS.AND.IP(I).NE.IDASH) IP(I)=ISQ     372600
      IF(IT(II).NE.IBL.AND.IT(II).NE.IPLUS.AND.IT(II).NE.IDASH)            372700
     1IT(II)=ISQ                                                           372800
  686 LGP=LG(KK,J,M)                                                       372900
      IF (LGP.EQ.0) GO TO 687                                              373000
      IF(IP(I).NE.ISQ)IP(I)=IL(LGP)                                        373100
      IF(IT(II).NE.ISQ)IT(II)=IL(LGP)                                      373200
      GO TO 690                                                            373300
  687 IF(IP(I).NE.ISQ)IP(I)=IDSP(J,M)                                      373400
      IF(IT(II).NE.ISQ)IT(II)=IDSP(J,M)                                    373500
  690 KJPT(J,M)=KJPT(J,M)+1                                                373600
  700 CONTINUE                                                             373700
  710 CONTINUE                                                             373800
C                                                                          373900
C PRINT A LINE OF GRAPH                                                    374000
C                                                                          374100
      IF (KFLAG) 725,720,730                                               374200
  720 IF(JPRT.NE.IBL)PRINT 722, (IP(I),I=1,103)                            374300
  722 FORMAT (1H ,8X,50A1,53A1)                                            374400
      IF(JTRL.NE.IBL)TYPE 723,(IT(II),II=1,53)                             374500
  723 FORMAT(8X,53A1)                                                      374600
      GO TO 745                                                            374700
  725 IF(JPRT.NE.IBL)PRINT 727, LBLM,LBLJ,(IP(I),I=1,103),DIST             374800
  727 FORMAT (1H ,1X,A1,5X,51A1,53A1,F10.0)                                374900
      IF(JTRL.NE.IBL)TYPE 728,LBLM,LBLJ,(IT(II),II=1,53),DIST              375000
  728 FORMAT(1X,A1,5X,54A1,F10.0)                                          375100
      GO TO 745                                                            375200
  730 IF(JPRT.NE.IBL)PRINT 732, LBLM,LK,LBLJ,(IP(I),I=1,103),DIST          375300
  732 FORMAT (1H ,1X,A1,I3,2X,51A1,53A1,F10.0)                             375400
      IF(JTRL.NE.IBL)TYPE 733,LBLM,LK,LBLJ,(IT(II),II=1,53),DIST           375500
  733 FORMAT(1X,A1,I3,2X,54A1,F10.0)                                       375600
C                                                                          375700
C INCREMENT XLIM FOR NEXT LINE AND LOOP BACK UNLESS GRAPH IS COMPLETE      375800
C                                                                          375900
  745 IF (XLIM.GT.XLIM2) GO TO 750                                         376000
      XLIM=XLIM+XSCALE                                                     376100
      GO TO 627                                                            376200
C                                                                          376300
C GRAPH IS COMPLETE -- PRINT BOTTOM BORDER                                 376400
C                                                                          376500
  750 IF(JPRT.EQ.IBL) GO TO 752                                            376600
      PRINT 585                                                            376700
      PRINT 584, (LB(I),I=1,11)                                            376800
  752 IF(JTRL.EQ.IBL) GO TO 800                                            376900
      TYPE 10585                                                           377000
      TYPE 10584,(LB(I),I=1,11,2)                                          377100
  800 RETURN                                                               377200
C                                                                          377300
C END OF T-D PLOT ROUTINE                                                  377400
C                                                                          377500
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC 377600
C                                                                          377700
C DEPTH PLOT ROUTINE                                                       377800
C                                                                          377900
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C FIRST FIND HIGHEST SURFACE ELEV (EMAX)                                  378000
C                                                                         378100
 3000 EMAX=-BIG                                                           378200
      DO 3014 M=1,NM                                                      378300
      KN=NK(M)                                                            378400
      IF (JJOFF.EQ.0) GO TO 3002                                          378500
      J1=1                                                                378600
      J2=NJ(M)                                                            378700
      GO TO 3008                                                          378800
 3002 J1=JA(1)                                                            378900
      J2=JB(M)                                                            379000
 3008 DO 3010 J=J1,J2                                                     379100
      IF (ESP(J,M).GT.EMAX) EMAX=ESP(J,M)                                 379200
 3010 CONTINUE                                                            379300
      DO 3012 K=1,KN                                                      379400
      IF (EG(K,M).GT.EMAX) EMAX=EG(K,M)                                   379500
 3012 CONTINUE                                                            379600
 3014 CONTINUE                                                            379700
C                                                                         379800
C COMPUTE ELEV SCALE LABELS LB(I) -- COMPUTE EMIN                         379900
C                                                                         380000
      LBINC=IFIX (10.0*ESCALE+0.5)                                        380100
      LMAX=LBINC*(IFIX (EMAX+ESCALE)/LBINC+1)                             380200
      LB(1)=LMAX-10*LBINC                                                 380300
      EMIN=FLOAT (LB(1))                                                  380400
      DO 3016 I=2,11                                                      380500
      LB(I)=LB(I-1)+LBINC                                                 380600
 3016 CONTINUE                                                            380700
C                                                                         380800
C PRINT HEADING AND LABELS                                                380900
C                                                                         381000
      IF(JPRT.EQ.IBL) GO TO 3020                                          381100
      PRINT 57, IDENT                                                     381200
      PRINT 3018                                                          381300
 3018 FORMAT (1H ,60X,58X,1HS/1H ,4X,1HD,60X,50X,4HG  P/1H ,4X,1HI,60X,   381400
     1 47X,7HS  E  R/1H ,4X,1HS,38X,32HE L E V A T I O N   ( F E E T ),   381500
     2 37X,7HP  O  E/1H ,4X,1HT,60X,53X,1HA/1H ,60X,58X,1HD)              381600
      PRINT 584, (LB(I),I=1,11)                                           381700
      PRINT 585                                                           381800
 3020 IF(JTRL.EQ.IBL) GO TO 3024                                          381900
      TYPE 3022                                                           382000
 3022 FORMAT(68X,'S'/5X,'D',59X,'G  P'/5X,'I',56X,'S  E  R'/5X,'S',13X    382100
     1,'E L E V A T I O N   ( F E E T )',11X,'P  O  E'/5X,'T',62X,'A'/     382200
     268X,'D')                                                            382300
      TYPE 10584,(LB(I),I=1,11,2)                                         382400
      TYPE 10585                                                          382500
C                                                                         382600
C SORT PRG(K,J,M),ERG(K,J,M) ARRAYS INTO PRGALL(KJM),ERGALL(KJM) COLUMNS  382700
C                                                                         382800
 3024 KJM=1                                                               382900
 3030 PMIN=BIG                                                            383000
      DO 3034 M=1,NM                                                      383100
      JN=NJ(M)                                                            383200
      KN=NK(M)                                                            383300
      DO 3033 J=1,JN                                                      383400
      DO 3032 K=1,KN                                                      383500
      IF (PRG(K,J,M).GE.PMIN.OR.ERG(K,J,M).EQ.0.0) GO TO 3032             383600
      PMIN=PRG(K,J,M)                                                     383700
      K1=K                                                                383800
      J1=J                                                                383900
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      M1=M                                                              384000
 3032 CONTINUE                                                          384100
 3033 CONTINUE                                                          384200
 3034 CONTINUE                                                          384300
C                                                                       384400
      IF (PMIN.EQ.BIG) GO TO 3040                                       384500
      PRGALL(KJM)=PMIN                                                  384600
      ERGALL(KJM)=ERG(K1,J1,M1)                                         384700
      ISYMBL(KJM)=KRG(K1,J1,M1)                                         384800
      IF (ISYMBL(KJM).EQ.IBL) ISYMBL(KJM)=IDSP(J1,M1)                   384900
      KJM=KJM+1                                                         385000
C                                                                       385100
      ERG(K1,J1,M1)=0.0                                                 385200
      GO TO 3030                                                        385300
C                                                                       385400
 3040 NKJM=KJM-1                                                        385500
C                                                                       385600
C SORT AND MERGE 4-D ARRAYS PRS2(J,M,L,I) AND ERS2(J,M,L,I) INTO COLUMN 385700
C ARRAYS PRSALL(JML) AND ERSALL(JML).                                   385800
C                                                                       385900
      JML=1                                                             386000
 3050 PMIN=BIG                                                          386100
      DO 3056 M=1,NM                                                    386200
      JN=NJ(M)                                                          386300
      DO 3055 J=1,JN                                                    386400
      DO 3054 L=1,LN                                                    386500
      DO 3052 LR=1,2                                                    386600
 3051 IF (PRS2(J,M,L,LR).GT.PMIN.OR.ERS2(J,M,L,LR).EQ.0.) GO TO 3052    386700
      PMIN=PRS2(J,M,L,LR)                                               386800
      J1=J                                                              386900
      M1=M                                                              387000
      L1=L                                                              387100
      I=LR                                                              387200
C                                                                       387300
 3052 CONTINUE                                                          387400
 3054 CONTINUE                                                          387500
 3055 CONTINUE                                                          387600
 3056 CONTINUE                                                          387700
C                                                                       387800
      IF (PMIN.EQ.BIG) GO TO 3070                                       387900
      PRSALL(JML)=PMIN                                                  388000
      ERSALL(JML)=ERS2(J1,M1,L1,I)                                      388100
      JSYMBL(JML)=KRS2(J1,M1,L1,I)                                      388200
      ERS2(J1,M1,L1,I)=0.0                                              388300
      IF (JSYMBL(JML).EQ.IBL) JSYMBL(JML)=IS                            388400
      JML=JML+1                                                         388500
      GO TO 3050                                                        388600
C                                                                       388700
 3070 NJML=JML-1                                                        388800
C                                                                       388900
C SET POINTERS TO INITIAL VALUES -- JPTR(M) FOR SP  LABELS AND PLOT PTS 389000
C                                  KPTR(M) FOR GEO LABELS AND PLOT PTS  389100
C  AND INITIALIZE XLIM             JML     FOR PRSALL(JML)              389200
C  AFTER EXTENDING XLIM1 AND XLIM2 KJM     FOR PRGALL(KJM)              389300
C  TO RANGE XSP(J1,1)-XSP(J2,NM)                                        389400
C  OR PRGALL(1)-PRGALL(NKJM), WHICHEVER IS LARGER                       389500
C                                                                       389600
      KN=NK(1)                                                          389700
      DX=XG(KN,1)-XG(1,1)                                               389800
      DX3=DX+DX+DX                                                      389900
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      J1=JA(1)                                                          390000
      J2=JB(NM)                                                         390100
      IF(JJOFF.EQ.0) GO TO 3071                                         390200
      J1=1                                                              390300
      J2=NJ(NM)                                                         390400
 3071 XLIM=XSP(J1,1)                                                    390500
      DO 13071 KJM=1,NKJM                                               390600
      IF(ISYMBL(KJM).NE.IQUES) GO TO 13072                              390700
13071 CONTINUE                                                          390800
      KJM=NKJM                                                          390900
13072 IF(PRGALL(KJM).LT.XLIM) XLIM=PRGALL(KJM)                          391000
      IF (XLIM.LT.XLIM1-DX3) XLIM=XLIM1-DX3                             391100
      IF (XLIM1.LE.XLIM) GO TO 3072                                     391200
      XLIM1=XLIM+XSCO2                                                  391300
 3072 XLIM=XSP(J2,NM)                                                   391400
      DO 3073 KJM=1,NKJM                                                391500
      KJMR=NKJM-KJM+1                                                   391600
      IF(ISYMBL(KJMR).NE.IQUES) GO TO 13073                             391700
 3073 CONTINUE                                                          391800
      KJMR=1                                                            391900
13073 IF(PRGALL(KJMR).GT.XLIM) XLIM=PRGALL(KJMR)                        392000
      IF (XLIM.GT.XLIM2+DX3) XLIM=XLIM2+DX3                             392100
      IF (XLIM2.LT.XLIM) XLIM2=XLIM                                     392200
C                                                                       392300
 3074 DO 3080 M=1,NM                                                    392400
      KPTR(M)=1                                                         392500
      IF (JJOFF.EQ.0) GO TO 3076                                        392600
      J=1                                                               392700
      GO TO 3077                                                        392800
 3076 J=JA(M)                                                           392900
 3077 IF (XSP(J,M).GE.(XLIM1-XSCALE)) GO TO 3078                        393000
      J=J+1                                                             393100
      IF (J.LE.NJ(M)) GO TO 3077                                        393200
      J=NJ(M)                                                           393300
 3078 JPTR(M)=J                                                         393400
 3080 CONTINUE                                                          393500
      JML=1                                                             393600
      KJM=1                                                             393700
      XLIM=XLIM1                                                        393800
      XMIN=XLIM1-XSCALE                                                 393900
      XMID=XLIM-XSCO2                                                   394000
      PLAST=XLIM1                                                       394100
      PLSUR=PLAST                                                       394200
      ELSUR=ESP(1,1)                                                    394300
      IF(JJOFF.NE.0) GO TO 3084                                         394400
      JLEFT=JA(1)                                                       394500
      JRITE=JB(NM)                                                      394600
      GO TO 3086                                                        394700
 3084 JLEFT=1                                                           394800
      JRITE=NJ(NM)                                                      394900
 3086 PJB=XSP(JRITE,NM)                                                 395000
      B1=SLOPE                                                          395100
      B2=SLOPE                                                          395200
      DO 3090 L=1,LN                                                    395300
      IF(IDIP.NE.0) GO TO 3088                                          395400
      KMID=NK(1)/2                                                      395500
      IF(KMID.LT.6) KMID=6                                              395600
      IF(KMID.GT.NK(1)) KMID=NK(1)                                      395700
      LCALL=L                                                           395800
      CALL DIP(LCALL,1,1,KMID,1,A,B1)                                   395900
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      KMID=NK(NM)/2+1                                                    396000
      IF(KMID.LT.7) KMID=NK(NM)-5                                        396100
      IF(KMID.LT.1) KMID=1                                               396200
      CALL DIP(LCALL,NM,KMID,NK(NM),NK(NM),A,B2)                         396300
 3088 ELAST(L)=ERS(JLEFT,1,L)-B1*(XSP(JLEFT,1)-XLIM1)                    396400
      ERITE(L)=ERS(JRITE,NM,L)+B2*(XLIM2-PJB)                            396500
 3090 CONTINUE                                                           396600
      ELSUR=ESP(JLEFT,1)-SLOPE*(XSP(JLEFT,1)-XLIM1)                      396700
C                                                                        396800
C MAIN PLOT LOOP                                                         396900
C                                                                        397000
 3100 KFLAG=0                                                            397100
      LBLJ=IBL                                                           397200
      LBLM=IBL                                                           397300
      DO 3122 I=1,103                                                    397400
 3122 IP(I)=IBL                                                          397500
      DO 3123 I=1,53                                                     397600
 3123 IT(I)=IBL                                                          397700
      IP(2)=IDASH                                                        397800
      IP(102)=IDASH                                                      397900
      IT(2)=IDASH                                                        398000
      IT(102)=IDASH                                                      398100
C                                                                        398200
C SET TYPE FOR PRINTING SPREAD AND SP LABELS, DIST, AND PLOT PTS         398300
C                                                                        398400
C SET KFLAG=-1 FOR M AND J LABELS AND DIST                               398500
C     KFLAG= 0 FOR NO LABELS                                             398600
C     KFLAG= 1 FOR M, J AND K LABELS AND DIST                            398700
C                                                                        398800
      DO 3120 M=1,NM                                                     398900
      KN=NK(M)                                                           399000
      IF (JJOFF.EQ.0) GO TO 3101                                         399100
      JN=NJ(M)                                                           399200
      GO TO 3102                                                         399300
 3101 JN=JB(M)                                                           399400
 3102 JP=JPTR(M)                                                         399500
      IF (JP.GT.JN) GO TO 3110                                           399600
      IF (XSP(JP,M).GE.XLIM) GO TO 3110                                  399700
      IF(XSP(JP,M).LT.XMIN) GO TO 3108                                   399800
      KFLAG=-1                                                           399900
      LBLM=IDSPR(M)                                                      400000
      LBLJ=IDSP(JP,M)                                                    400100
      DIST=XSP(JP,M)                                                     400200
      DO 3103 I=2,102,10                                                 400300
 3103 IP(I)=IPLUS                                                        400400
      DO 3104 I=2,52,10                                                  400500
 3104 IT(I)=IPLUS                                                        400600
      ELSUR=ESP(JP,M)                                                    400700
      PLSUR=XSP(JP,M)                                                    400800
      CALL SETIP(ES(JP,M),EMIN,ESCALE,IAST)                              400900
      DO 3105 L=1,LN                                                     401000
      CALL SETIP(ERS(JP,M,L),EMIN,ESCALE,ICOLN)                          401100
      ELAST(L)=ERS(JP,M,L)                                               401200
 3105 CONTINUE                                                           401300
      PLAST=XSP(JP,M)                                                    401400
C                                                                        401500
 3108 JPTR(M)=JPTR(M)+1                                                  401600
      GO TO 3102                                                         401700
C                                                                        401800
 3110 KP=KPTR(N)                                                         401900
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      IF (KP.GT.KN) GO TO 3120                                          402000
      IF (XG(KP,M).GE.XLIM) GO TO 3120                                  402100
      IF(XG(KP,M).LT.XMIN) GO TO 3118                                   402200
      IF (KFLAG.NE.0) GO TO 3115                                        402300
C                                                                       402400
      DIST=XG(KP,M)                                                     402500
      DO 3111 I=2,102,10                                                402600
 3111 IF(IP(I).EQ.IBL) IP(I)=IPLUS                                      402700
      DO 3112 I=2,52,10                                                 402800
 3112 IF(IT(I).EQ.IBL) IT(I)=IPLUS                                      402900
C                                                                       403000
 3115 LK=KP                                                             403100
      LBLM=IDSPR(M)                                                     403200
      KFLAG=1                                                           403300
      E=EG(KP,M)+ESCALE                                                 403400
      CALL SETIP(E,EMIN,ESCALE,IDEE)                                    403500
      ELSUR=EG(KP,M)                                                    403600
      PLSUR=XG(KP,M)                                                    403700
      DO 3117 L=1,LN                                                    403800
      CALL SETIP(ERP(KP,M,L),EMIN,ESCALE,ICOLN)                         403900
      ELAST(L)=ERP(KP,M,L)                                              404000
 3117 CONTINUE                                                          404100
      PLAST=XG(KP,M)                                                    404200
C                                                                       404300
 3118 KPTR(M)=KPTR(M)+1                                                 404400
      GO TO 3110                                                        404500
 3120 CONTINUE                                                          404600
C                                                                       404700
 3124 IF (JML.GT.NJML) GO TO 3126                                       404800
      IF (PRSALL(JML).GE.XLIM) GO TO 3126                               404900
      CALL SETIP(ERSALL(JML),EMIN,ESCALE,JSYMBL(JML))                   405000
      JML=JML+1                                                         405100
      GO TO 3124                                                        405200
C                                                                       405300
 3126 IF (KJM.GT.NKJM) GO TO 3128                                       405400
      IF (PRGALL(KJM).GE.XLIM) GO TO 3128                               405500
      CALL SETIP(ERGALL(KJM),EMIN,ESCALE,ISYMBL(KJM))                   405600
      KJM=KJM+1                                                         405700
      GO TO 3126                                                        405800
C                                                                       405900
C INTERPOLATE TO FIND LAYER BOUNDARIES BETWEEN SPS AND GEOS             406000
C                                                                       406100
 3128 IF (KFLAG.NE.0) GO TO 3171                                        406200
      IF(XLIM.LE.PJB) GO TO 13129                                       406300
      PNEXT=XLIM2                                                       406400
      DO 13128 L=1,LN                                                   406500
13128 ENEXT(L)=ERITE(L)                                                 406600
      PNSUR=XLIM2                                                       406700
      ENSUR=ESP(JRITE,NM)+SLOPE*(XLIM2-PJB)                             406800
      GO TO 3140                                                        406900
13129 PNEXT=BIG                                                         407000
      PNSUR=BIG                                                         407100
      KNM=NK(NM)                                                        407200
      DO 3138 M=1,NM                                                    407300
      JP=JPTR(M)                                                        407400
      KP=KPTR(M)                                                        407500
      IF (JJOFF.EQ.0) GO TO 3129                                        407600
      JN=NJ(M)                                                          407700
      GO TO 3130                                                        407800
 3129 JN=JB(M)                                                          407900
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 3130 KN=NK(M)                                                          408000
      IF (JP.GT.JN.OR.KP.GT.KN) GO TO 3131                              408100
      IF (XG(KP,M).LE.XSP(JP,M)) GO TO 3132                             408200
      GO TO 3134                                                        408300
 3131 IF(KP.GT.KN.AND.JP.GT.JN) GO TO 3138                              408400
      IF(KP.GT.KN) GO TO 3134                                           408500
      IF(JP.GT.JN) GO TO 3132                                           408600
      IF(XSP(JP,M).LT.XG(KP,M)) GO TO 3134                              408700
 3132 IF (XG(KP,M).GT.PNEXT) GO TO 3138                                 408800
      PNEXT=XG(KP,M)                                                    408900
      PNSUR=PNEXT                                                       409000
      ENSUR=EG(KP,M)                                                    409100
      DO 3133 L=1,LN                                                    409200
 3133 ENEXT(L)=ERP(KP,M,L)                                              409300
      GO TO 3138                                                        409400
C                                                                       409500
 3134 IF (XSP(JP,M).GT.PNEXT.AND.XSP(JP,M).LE.XG(KNM,NM)) GO TO 3138    409600
      PNEXT=XSP(JP,M)                                                   409700
      PNSUR=PNEXT                                                       409800
      ENSUR=ESP(JP,M)                                                   409900
      DO 3135 L=1,LN                                                    410000
 3135 ENEXT(L)=ERS(JP,M,L)                                              410100
 3138 CONTINUE                                                          410200
C                                                                       410300
C                                                                       410400
 3140 I1=2+IFIX ((TERP(PLSUR,ELSUR,PNSUR,ENSUR,XMID)-EMIN)/ESCALE+0.5)  410500
      I2=(I1-2)/2+2                                                     410600
      IF (I1.LE.0) I1=1                                                 410700
      IF(I2.LE.0) I2=1                                                  410800
      IF(I2.GT.53) I2=53                                                410900
      IF (I1.GT.103) I1=103                                             411000
      IF(IT(I2).EQ.IBL) IT(I2)=ICOLN                                    411100
      IF (IP(I1).EQ.IBL) IP(I1)=ICOLN                                   411200
      DO 3169 L=1,LN                                                    411300
      I1=2+IFIX ((TERP(PLAST,ELAST(L),PNEXT,ENEXT(L),XMID)-EMIN)/ESCALE 411400
     1 +0.5)                                                            411500
      I2=(I1-2)/2+2                                                     411600
      IF (I1.LE.0) I1=1                                                 411700
      IF(I2.LE.0) I2=1                                                  411800
      IF (I1.GT.103) I1=103                                             411900
      IF(I2.GT.53) I2=53                                                412000
      IF (IP(I1).EQ.IBL) IP(I1)=ICOLN                                   412100
      IF(IT(I2).EQ.IBL) IT(I2)=ICOLN                                    412200
 3169 CONTINUE                                                          412300
C                                                                       412400
C PRINT A LINE OF GRAPH                                                 412500
C                                                                       412600
 3171 IF(JPRT.EQ.IBL) GO TO 3184                                        412700
      IF (KFLAG) 3172,3176,3180                                         412800
 3172 PRINT 3174, DIST,(IP(I),I=1,103),LBLJ,LBLM                        412900
 3174 FORMAT (1H ,F8.0,50A1,53A1,1X,A1,5X,A1)                           413000
      GO TO 3184                                                        413100
 3176 PRINT 3178, (IP(I),I=1,103)                                       413200
 3178 FORMAT (1H ,8X,50A1,53A1)                                         413300
      GO TO 3184                                                        413400
 3180 PRINT 3182, DIST,(IP(I),I=1,103),LBLJ,LK,LBLM                     413500
 3182 FORMAT (1H ,F8.0,50A1,53A1,1X,A1,I3,2X,A1)                        413600
 3184 IF(JTRL.EQ.IBL) GO TO 3200                                        413700
      IF(KFLAG) 3186,3190,3194                                          413800
 3186 TYPE 3188,DIST,(IT(I),I=1,53),LBLJ,LBLM                           413900
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 3188 FORMAT(1X,F7.0,53A1,1X,A1,5X,A1)                                  414000
      GO TO 3200                                                        414100
 3190 TYPE 3192,(IT(I),I=1,53)                                          414200
 3192 FORMAT(8X,53A1)                                                   414300
      GO TO 3200                                                        414400
 3194 TYPE 3196,DIST,(IT(I),I=1,53),LBLJ,LK,LBLM                        414500
 3196 FORMAT(1X,F7.0,53A1,1X,A1,I3,2X,A1)                               414600
C                                                                       414700
C PREPARE TO LOOP BACK TO COMPUTE NEXT LINE, OR IF DONE PRINT BORDER     414800
C                                                                       414900
 3200 IF (XLIM.GT.XLIM2) GO TO 3210                                     415000
      XMIN=XLIM                                                         415100
      XLIM=XLIM+XSCALE                                                  415200
      XMID=XLIM-XSC02                                                   415300
      KN=NK(NM)                                                         415400
      JN=JB(NM)                                                         415500
      IF(JJOFF.NE.0) JN=NJ(NM)                                          415600
      GO TO 3100                                                        415700
C                                                                       415800
 3210 IF(JPRT.EQ.IBL) GO TO 3212                                        415900
      PRINT 585                                                         416000
      PRINT 584, (LB(I),I=1,11)                                         416100
      PRINT 3018                                                        416200
 3212 IF(JTRL.EQ.IBL) GO TO 3214                                        416300
      TYPE 10585                                                        416400
      TYPE 10584,(LB(I),I=1,11,2)                                       416500
 3214 RETURN                                                            416600
      END                                                               416700
C                                                                       416800
C-----------------------------------------------------------------------416900
C                                                                       417000
      SUBROUTINE SETIP(E,EMIN,ESCALE,ISYM)                              417100
C  IN PROGRAM SIPT                                                      417200
C SETS TYPE FOR LINE OF DEPTH PT GRAPH                                  417300
C                                                                       417400
      COMMON IBL,IQUES,IP,IT,ICOLN,IPLUS,ISQ,IDASH                      417500
C                                                                       417600
      DIMENSION IP(103),IT(53)                                          417700
C                                                                       417800
      I=2+IFIX ((E-EMIN)/ESCALE+0.5)                                    417900
      II=(I-2)/2+2                                                      418000
      IF (I.GT.0) GO TO 1                                               418100
      I=1                                                               418200
      II=1                                                              418300
      GO TO 2                                                           418400
C                                                                       418500
    1 IF (I.LE.103) GO TO 2                                             418600
      I=103                                                             418700
      II=53                                                             418800
C                                                                       418900
    2 IPI=IP(I)                                                         419000
      ITI=IT(II)                                                        419100
      IF(IPI.EQ.IBL.OR.IPI.EQ.ICOLN.OR.IPI.EQ.IPLUS.OR.IPI.EQ.IDASH)    419200
     1 GO TO 4                                                          419300
      IP(I)=ISQ                                                         419400
      GO TO 6                                                           419500
    4 IP(I)=ISYM                                                        419600
    6 IF(ITI.EQ.IBL.OR.ITI.EQ.ICOLN.OR.ITI.EQ.IPLUS.OR.ITI.EQ.IDASH)    419700
     1 GO TO 8                                                          419800
      IT(II)=ISQ                                                        419900
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      GO TO 10                                                          420000
    8 IT(II)=ISYM                                                       420100
   10 RETURN                                                            420200
      END                                                               420300
C                                                                       420400
C-----------------------------------------------------------------------420500
C                                                                       420600
       SUBROUTINE HTIME(K,J,M,P1,E1,P2,E2,HV,TH)                        420700
C  IN PROGRAM SIPT                                                      420800
      COMMON/BLK2/XG,ERP,SLOPE,IDIP                                     420900
     5       /BLK5/IDSPR,IDSP,KL,KR,D                                   421000
     7       /BLK7/JA,JB,TRS,ERS,XSP,ESP,LS                             421100
     9       /BLK9/EG,ES                                                421200
     9       /BLK10/BLIM,ITRACE,TANSG                                   421300
C                                                                       421400
      DIMENSION XG(25,5),ERP(25,5,4),JA(5),JB(5),TRS(7,5,4),ERS(7,5,4)  421500
     1,XSP(7,5),ESP(7,5),LS(7,5),EG(25,5),ES(7,5),IDSPR(5),IDSP(7,5)    421600
     2,KL(7,5),KR(7,5),D(25,7,5)                                        421700
C                                                                       421800
      DE=E2-E1                                                          421900
      DP=P2-P1                                                          422000
      DSX=XG(K,M)-XSP(J,M)                                              422100
      DSE=EG(K,M)-ES(J,M)                                               422200
      SH=SQRT(DSX**2+DSE**2)                                            422300
      D1=D(K,J,M)                                                       422400
      DP=SIGN(DP,DSX*DP*D1)                                             422500
      IF (DSX.EQ.0..OR.DP.EQ.0.) GO TO 10                               422600
      IF (ABS(DE/DP).GT.BLIM) DE=BLIM*DP                                422700
      TH=SIGN(D1*SQRT(DP**2+DE**2)/SH,DP)/HV                            422800
      RETURN                                                            422900
   10 DH=D1-ABS(P1-XSP(J,M))-ABS(P2-XG(K,M))                            423000
      TH=SIGN(SQRT(DH**2+DE**2),DH)/HV                                  423100
      RETURN                                                            423200
      END                                                               423300
C                                                                       423400
C-----------------------------------------------------------------------423500
C                                                                       423600
      SUBROUTINE TIE(L2,M,J,JJ,K11,K22,KT1,KT2,KN,I,JJTIE)              423700
      COMMON IBL,IQUES,IP,IT,ICOLN,IPLUS,ISQ,IDASH,IS,IAST,IDEE,IL,NL   423800
      COMMON/BLK0/LG                                                    423900
     1       /BLK3/TA,TR,DSG                                            424000
     2       /BLK4/VVA,VHA                                              424100
     3       /BLK5/IDSPR,IDSP,KL,KR,D                                   424200
C                                                                       424300
C  IN PROGRAM  SIPT                                                     424400
C MAKES TIE CORRECTION FOR OUTLYING SP JJ TO NEXT INNER SP J            424500
      DIMENSION LG(25,7,5),TA(25,7,5),DSG(25),TR(25,7,5),D(25,7,5),     424600
     1IP(103),IT(53),IL(5),IDSPR(5),IDSP(7,5),KL(7,5),KR(7,5),VVA(5,5)  424700
     2,VHA(5,5)                                                         424800
C                                                                       424900
      CALL KENDS(L2,M,J,KT1,KT2,KT11,KT22)                              425000
      IF (KT11.EQ.0) GO TO 99                                           425100
      DO 10 K=1,KN                                                      425200
   10 DSG(K)=ABS(D(K,J,M))                                              425300
      SUM1=0.                                                           425400
      PTS1=0.                                                           425500
      K1=MAXO(K11,KT11)                                                 425600
      K2=MINO(K22,KT22)                                                 425700
      IF(K2.LT.K1) GO TO 50                                             425800
C                                                                       425900
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C OVERLAP BETWEEN J AND JJ ARRIVALS                                    426000
C                                                                      426100
   20 DO 30 K=K1,K2                                                    426200
      IF (LG(K,JJ,M).NE.L2) GO TO 30                                   426300
      SUM1=SUM1+TR(K,JJ,M)-TR(K,J,M)                                   426400
      PTS1=PTS1+1.                                                     426500
   30 CONTINUE                                                         426600
      IF (PTS1.EQ.0.) GO TO 50                                         426700
      SUM1=SUM1/PTS1                                                   426800
   35 DO 40 K=K11,K22                                                  426900
      IF (LG(K,JJ,M).EQ.L2) TR(K,JJ,M)=TR(K,JJ,M)-SUM1                 427000
   40 CONTINUE                                                         427100
      IF(JJTIE.EQ.0) GO TO 60                                          427200
      IF(I.EQ.2) GO TO 44                                              427400
      KK=K22+1                                                         427500
      IF(KK.GT.KN) GO TO 99                                            427600
      DO 42 K=KK,KN                                                    427700
      IF(TR(K,JJ,M).NE.0) TR(K,JJ,M)=TR(K,JJ,M)-SUM1                   427800
   42 CONTINUE                                                         427900
      GO TO 99                                                         428000
   44 KK=K11-1                                                         428100
      IF(KK.LT.1) GO TO 99                                             428200
      DO 46 K=1,KK                                                     428300
      IF(TR(K,JJ,M).NE.0) TR(K,JJ,M)=TR(K,JJ,M)-SUM1                   428400
   46 CONTINUE                                                         428500
      GO TO 99                                                         428550
C                                                                      428600
C GAP BETWEEN J AND JJ ARRIVALS                                        428700
C                                                                      428800
   50 CALL REGRES(KT11,KT22,J,M,L2,VJ,TJ,PT,1)                         428900
      IF(PT.EQ.0.) GO TO 99                                            429000
      CALL REGRES(K11,K22,JJ,M,L2,VJJ,TJJ,PT,1)                        429100
      IF(PT.EQ.0.) GO TO 99                                            429200
      IF(I.EQ.2) GO TO 54                                              429300
      DMID=(DSG(K22)+DSG(KT11))/2                                      429400
   52 SUM1=(TJJ+TJJ+DMID/VJJ)-(TJ+TJ+DMID/VJ)                          429500
      GO TO 35                                                         429600
   54 DMID=(DSG(K11)+DSG(KT22))/2                                      429700
      GO TO 52                                                         429800
C                                                                      429900
C TIE DOWN POINTS FOR DEEPER LAYERS L2+1 THRU NL (SP JJ)               430000
C                                                                      430100
   60 LNEXT=L2+1                                                       430200
      IF(LNEXT.GT.NL) GO TO 99                                         430300
      DT1=SUM1                                                         430400
      DO 80 L=LNEXT,NL                                                 430500
      L1=L-1                                                           430600
      DT2=DT1*VHA(M,L1)/VHA(M,L)                                       430700
      DO 70 K=1,KN                                                     430800
      IF(LG(K,JJ,M).EQ.L) TR(K,JJ,M)=TR(K,JJ,M)-DT2                    430900
   70 CONTINUE                                                         431000
      DT1=DT2                                                          431100
   80 CONTINUE                                                         431200
      JJTIE=1                                                          431300
C                                                                      431400
   99 RETURN                                                           431500
      END                                                              431600
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