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User's Manual for

R1D84

Interactive Modeling of One-Dimensional Velocity-Depth Functions

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11 February 1988

OPEN-FILE REPORT 88-247

Menlo Park, California
1988

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INTRODUCTION

R1D84 performs travel time modeling for one-dimensional velocity-depth models. Once a velocity-depth model is specified, several functional quantities may be readily calculated and plotted (T vs X, P vs t, P vs X, τ vs P, etc.) In addition, for the case of T vs X, record section format, you may plot arrival time picks or synthetic seismograms created by internal WKBJ (Chapman, 1978) or disc-ray theory (Wiggins, 1976) routines.

The program is highly interactive, providing graphical output of all model variables and containing an internal editor for manipulation of the velocity-depth function. All display variables may be set by simple text commands from the keyboard. For operation of the program in a Batch mode or pseudo-batch mode (where you may use the same sequence of commands repeatedly), command macro files may be used.

All derivative variables (P, T, V, τ, etc.) are calculated from the one-dimensional velocity-depth model. The model consists of up to 50 tabulated depths and corresponding velocities in order of increasing depth. Low-velocity zones and negative velocity gradients are permitted. Travel times and moveouts are calculated using standard analytic forms for transmitted ray paths only. Post-critical reflections from first-order velocity discontinuities are approximated by refracted raypaths through steep gradients. Pre-critical reflection times may be calculated for reflections from any defined depth point in the model. The source point may be placed at any defined depth of the velocity-depth function.

The initial velocity-depth function is specified by an ASCII model file or by the default model. The velocity-depth function may be modified using the internal editor. Intermediate trial models determined in the modeling process may be saved in model files.

Upon initiation, the program will clear the screen and prompt the user for a control file and an output file. If you are just starting to use the program and want to avoid the hassle of getting all the formats right in your control file, you may choose to start with the default model supplied by the program. You may tailor the model to your

own purposes using the built-in editor, and dump a properly formatted file when you EXIT. If you opt for a default model, the program will first look for a file named DEFDAT.R1D in your current directory. If none exists, it will use the version of DEFDAT.R1D in PUB1:[REFRACT.LUETGERT.R1D83].

Following initiation, the program will give you a R1D84> prompt and you may proceed to 1) interactively modify display variables, 2) edit the velocity-depth function, or 3) display model parameters in several formats. R1D84 responds to interactive text commands from the terminal or from command macro files. Commands consist of one or two command words followed by optional variables. A command line with * in the first column is considered a comment line and is disregarded. This is useful in command files for legibility. If a comment is needed within a command line, an ! may be placed in the command line after all valid command text and followed by comments. A command line with @ in the first column is considered to be a command file actuator. The file whose name follows the @ is opened and commands are read from it. Command files have a default suffix .JMP . Commands eliciting a prompt and response are directed to the terminal. When the last command has been read from the command file, control is returned to the terminal or to the next higher command file level. Six levels of command file are allowed.

After a work session, leave the program by giving the command EXIT. You will be given the option of saving a current version of your control file. When you want to make a hard copy of your graphical output to a BATCH.PLT file for plot to the Versatec, set flag 10 in the second active line of your control file to 2 or 3 and rerun the program.

CONTROL FILE

Variables controlling the appearance and operation of R1D84 are set in one of three ways; 1) via a formatted control file read by the program upon initiation, 2) via interactive text commands typed at the terminal, or 3) via a script file containing interactive text commands. The control file, described below, contains all the information needed to initialize R1D84. The first active line of the control file may be preceded by any number of comment lines which contain * in the first column.

Line 1 - The first record is an 80 character title (PLOTID) to be plotted with each plot. Although the characters on this line may be either upper or lower case, they will be plotted as upper case.

Line 2 - Integer flags which control the program. (10I1)

(1) = 0 No list output.
= 1 List input data only.
= 2 List input and output data.

(2) = 0 Flat earth.
= 1 Spherical earth.

(4) = 0 Summary file Format 1.
= 1 Summary file Format 2.

(5) = 0 Lengths given in inches.
= 1 Lengths given in centimeters.

(10) = 0 Plot to VT100 only with auto-scaling to fill the screen. The axis scaling factors read in lines 3-7 will be ignored and the axes for each plot will be independently scaled to fit an 8"x10" plot.
= 1 Plot to VT100 only with auto-scaling to fit the screen.
= 2 Go through normal plotting prompts. Scale to fit the VT100 screen.
= 3 Go through normal plotting prompts. Scale to fill the VT100 screen. The axis scaling factors read in lines 3-7 will be ignored and the axes for each plot will be independently scaled to fit an 8"x10" plot.

Line 3 - Range axis parameters - RMIN, RMAX, RSF, DR, NSR, RBIAS read under format (4F10.0, I5, F10.0)

RMIN - Minimum range for range axis in km.
RMAX - Maximum range for range axis in km.
RSF - Range scale factor in inches/km.
DR - Distance between labeled tics on range axis (km).
NSR - Number of intervals between labeled tics.
RBIAS - Additive constant applied to range axis labelling.

Line 4 - Time axis parameters - TMIN, TMAX, TSF, DT, NST read under format (4F10.0, I5)

TMIN - Minimum time for time axis in sec.
TMAX - Maximum time for time axis in sec.
TSF - Time scale factor in inches/sec.
DT - Distance between labeled tics on time axis (sec).
NST - Number of intervals between labeled tics.

Line 5 - Depth axis parameters - ZMIN, ZMAX, ZSF, DZ, NSZ, ZBIAS read under format (4F10.0, I5, F10.0)

ZMIN - Minimum depth for depth axis in km.
ZMAX - Maximum depth for depth axis in km.
ZSF - Depth scale factor in inches/km.
DZ - Distance between labeled tics on depth axis (km).
NSZ - Number of intervals between labeled tics.
ZBIAS - Additive constant applied to depth axis labelling.

Line 6 - Velocity axis parameters - VMIN, VMAX, VSF, DV, NSV read under format (4F10.0, I5)

VMIN - Minimum velocity for velocity axis in km/sec.
VMAX - Maximum velocity for velocity axis in km/sec.
VSF - Velocity scale factor in inches/(km/sec).
DV - Distance between labeled tics on velocity axis (km/sec).
NSV - Number of intervals between labeled tics.

Line 7 - Reducing velocity, tic heights, and character heights - VR, HNR, HBS, HOBS, HSYM read under format (5F10.0)

VR - Reducing velocity for travel-time plot in km/sec.
HNR - Height of labeled tics in inches (or cm.).
HBS - Height of characters for labels in inches (or cm.).
HOBS - Height of symbols for observed picks in inches (or cm.).
HSYM - Height of symbol for source in V-D plot in inches (or cm.).

Line 8 - Velocity rosette parameters - ROSER, ROSET, ROSES read under format (3F10.0)

ROSER - Range of center of velocity rosette in km.
ROSET - Time of center of velocity rosette in sec.
ROSES - Size of arms of velocity rosette in inches (or cm.).

Line 9+m Velocity-depth function parameters - Z, V, CODE read one entry per line under format (2F10.0, A3) . The velocity-depth function must be entered in increasing order of depth. The last entry in the velocity-depth function must be (0.0,0.0).

Z - Depth in km.
V - Velocity in km/sec.
CODE - Either SRC, RFL, or blank. SRC indicates the source is to be located at this depth. RFL indicates pre-critical reflections from this depth are to be calculated.

Line 10 - IB, IA read under format (2I5)

IB - Number of points to calculate for each arrival branch.
IA - First branch to calculate.

Line 11 - Name of an observed travel time data file. (or blank). Format (40A1)

Sample Control File:

The following control file is a sample of a working control file for R1D84. The entries on each line are separated by commas to terminate each format field rather than adhering strictly to the format specifications. This is a fairly safe way of avoiding the tedium of entering a strictly formatted data file. If you save the control file before exiting R1D84, it will be written in the proper format.

```
*
* Sample control file for R1D84
*
TEST DATA FOR R1D84
1000000000
0.0,    100.0, 0.1, 10.0,  1, 0.0,  RMIN,RMAX,RSF,DR,NSR,RBIAS
0.0,     10.0, 1.0,  1.0, 10,       TMIN,TMAX,TSF,DT,NST
0.0,     50.0, 0.1, 10.0,  1, 0.0,  ZMIN,ZMAX,ZSF,DZ,NSZ,ZBIAS
0.0,     10.0, 1.0,  1.0, 10,       VMIN,VMAX,VSF,DV,NSV
6.0,      0.1, 0.1,                 VR,HNR,HBS
50.,      5.0, 1.0,  1.0,           ROSER,ROSET,ROSES,ROSIGN
0.0,      3.5,SRC                   VELOCITY-DEPTH FUNCTION
1.5,      3.5,
1.5,      5.5,
5.0,      5.6,
5.0,      6.2,
12.,      6.3,
12.,      6.9,
30.,      7.1,
30.,      8.0,
50.,      8.1,
0.0,      0.0,
30,       1,                        IA,IB
```

DATA DISPLAYS

The following data display formats are available.

A) Velocity vs Depth.
B) Mean Overburden Velocity vs Depth.
C) Tau-P .
D) P vs X.
E) Minimum apparent velocity vs Distance.
F) Time vs Distance.

The Time-Distance format may be overlaid with,
i) Travel times calculated from the model
ii) Arrival time picks
iii) WKBJ synthetic seismograms
iv) Disc Ray Theory synthetic seismograms

A) Velocity vs Depth

The velocity-depth function may be displayed by issuing the command V-D. Axes will be plotted with velocity on the X-axis and depth on the Y-axis. The model velocity function will be plotted with an asterisk with size HSYM at the source depth. If you have not specified axis display variables, default values will be used such that the entire defined model is displayed.

The velocity axis is defined by the variables VMIN, VMAX, VSF, DV, NSV, where (VMIN,VMAX) are the minimum and maximum axis values; VSF is the scaling factor in units/(km/sec); DV is the interval in km/sec between labeled tics; and NSV is the number of intervals between labeled tics. These may be set by individual commands of the form, VMIN = 3.0. If you don't enter a new value, VMIN = , the program will tell you the current value and prompt for a new value, *i.e.*,

VMIN: 2.5 Enter new VMIN

If you do not enter a new value at this point, the current value is retained.

The depth axis is similarly defined by the variables ZMIN, ZMAX, ZSF, DZ, NSZ, ZBIAS, where (ZMIN,ZMAX) are the minimum and maximum axis values; ZSF is the scaling factor in units/km; DZ is the interval in km between labeled tics; NSZ is the number of intervals between labeled tics; and ZBIAS is an additive shift in km for labeling the axis.

The variables for gridding the display space are,

VMINL, VMAXL, DVLINE and
ZMINL, ZMAXL, DZLINE

The line type for plotting the velocity-depth function is specified by ISLINE.

B) Mean Overburden Velocity vs Depth

As an aid in determining appropriate normal moveout velocities for time-distance plots, the mean overburden velocity may be plotted as a function of depth by issuing the command VBAR. The axes and associated variables are the same as for the velocity-depth function plot.

C) Tau-P

The Tau-P function, intercept time versus ray parameter, may be plotted by the command TAUP.

The X-axis variables are,

TMIN, TMAX, TSF, DT, NST

The Y-axis variables are,

PMIN, PMAX, PSF, DP, NSP

These may be set individually or with commands having the form,

SET TIME 0.0, 6.0, 1.0, 1.0, 10

If you do not set the P-variables, default values will be chosen which encompass all ray parameters in your model.

Gridding variables are,

TMINL, TMAXL, DTLINE and
PMINL, PMAXL, DPLINE

D) Ray Parameter vs Distance

The ray parameter, P, may be plotted as a function of distance by giving the command PVSX. The X-axis variables are

DMIN, DMAX, DSF, DD, NSD

The Y-axis variables are

PMIN, PMAX, PSF, DP, NSP

If you do not set the P-variables, default values will be chosen which encompass all ray parameters in your model.

The gridding variables are

DMINL, DMAXL, DDLINE and
PMINL, PMAXL, DPLINE

E) Minimum Apparent Velocity vs Distance

For a given one-dimensional velocity-depth function, there is a minimum first-arrival apparent velocity observed at each range. Matumoto *et al.* (1977) have shown that, for a suite of local earthquakes poorly located in depth, apparent velocity observations at an array of stations can be used to provide constraints on the velocity-depth function. To plot the minimum apparent velocity vs distance, enter the command MAV.

The X-axis variables are

RMIN, RMAX, RSF, DR, NSR, RBIAS

The Y-axis variables are

VMIN, VMAX, VSF, DV, NSV

These may be set individually or with commands having the form,

SET DISTANCE 0.0, 60.0, .25, 10.0, 10

The gridding variables are

RMINL, RMAXL, DRLINE and
VMINL, VMAXL DVLINE

F) Time vs Distance

Time vs distance plots are plotted with distance, between RMIN and RMAX, on the X-axis and time, between TMIN and TMAX, on the Y-axis.

The X-axis variables are,

RMIN, RMAX, RSF, DR, NSR, RBIAS

The Y-axis variables are,

TMIN, TMAX, TSF, DT, NST

These may be set individually or with commands having the form,

SET DISTANCE 0.0, 60.0, 0.25, 10.0, 10, 0.0

SET TIME 0.0, 6.0, 1.0, 1.0, 10

Gridding variables are,

RMINL, RMAXL, DRLINE and

TMINL, TMAXL, DTLINE

Several formats are available for plotting time. Unreduced time may be plotted by setting RV = 0.0. Reduced time may be plotted by setting RV to the reducing velocity. A constant velocity normal moveout correction may be applied by setting VNMO to the NMO velocity and giving the command,

ENABLE NMO

A linear gradient normal moveout correction may be applied by setting V0 and V1, velocities at the top and bottom of the model, or V0 and VGRAD, the velocity at the top of the model and the gradient, and giving the command,

ENABLE NMOG

DISABLEing NMO or NMOG will return to normal reduced time plotting.

Several features may be plotted in time-distance format. The primary plot is travel time calculated from the velocity model. To get this plot, give the command T-T. Forward and reverse travel time branches will be plotted. If you have requested pre-critical reflection times, they will also be plotted. If you have specified travel-time pick files to be plotted, the picks will be overlaid on the plot.

Synthetic time series data may be internally calculated by using WKBJ (Chapman, 1978) or Disc-Ray synthetic (Wiggins, 1976) techniques. You may set two groups of variables specifying the appearance of the synthetics. Their locations are specified by SMIN, SMAX, and NTR. The traces will be calculated and plotted with SPS samples per second. The source wavelet is specified by the variables FREQ, GAMMA, SZERO, and PSI.

By default, traces are individually normalized and plotted with maximum amplitude of WIDTH in units of km. Traces are clipped at an amplitude of CLIP km. Traces may be shaded by setting SHADE to a value between -1.0 and +1.0.

A band-pass filter may be applied to the data by setting FLO and FHI and giving the command,

ENABLE FILTER

DATA DISPLAYS - General Considerations

Data plots consist of labeled X and Y axes with optional gridding of the display area; the data; the PLOTID; and the date/time of the plot. A considerable amount of control over the appearance of the plots is available through the use of interactive commands. The date/time may be turned on and off with the commands,

ENABLE DATE and DISABLE DATE

The PLOTID may be changed by the command,

PLOTID =

The size of the PLOTID is set by the variable HBS.

The size of tics and labeling on the axes is set by the variable HNR.

The optional gridding of the display area is controlled by variables of the form XMINL, XMAXL, DXLINE where X is replaced by the particular data variable being plotted. XMINL and XMAXL are the starting and ending values in data units for grid lines; DXLINE is the distance in data units between grid lines. No grid lines are plotted if DXLINE = 0.0. The form of the grid lines is controlled by the variable ISLINE.

ISLINE	Grid Line
0	Solid
1	50 dots/inch
2	25 dots/inch
3	10 dots/inch
4	5 dots/inch
5	1/16" dash
6	1/8" dash
7	1/4" dash
8	1/2" dash
9	1" dash

For plots output to the Versatec, the line width of various plot attributes may be controlled by the variable NEWPEN. By default, pen width = 1. To reset the pen width, use the command NEWPEN = to select a pen width between 1 and 6.

Plotting units may be either inches [default] or centimeters. Plot units apply to symbol sizes, scaling factors, axis lengths and trace heights. Plot units are specified by Flag(5) in the second active line of the control file or they may be selected by the commands,

SET INCHES and SET CM

There are two forms of plot scaling for the terminal screen, FILLing and FITing. These are selected by the commands,

ENABLE FILL
DISABLE FILL
ENABLE FIT
DISABLE FIT

If you have selected FIT, the plot is constructed using the values of XSF and YSF you have provided and uniformly shrunk or expanded to optimally fit within the terminal screen. If you are creating a BATCH.PLT file for later plotting to Versatec, that plot will have the actual dimensions specified.

If you have selected FILL, the values of XSF and YSF you have provided will be ignored and a plot with overall dimensions of 10X8 inches will be constructed. The image going to the BATCH.PLT file will also have overall dimensions of 10X8 inches.

Whether or not a BATCH.PLT file is created is controlled by Flag 10 in the second active line of the control file. Set it to 2 or 3 to go through the normal plotting prompts which allow you to specify a BATCH.PLT file. From within the program Flag 10 may be set with the command MODE = .

COMMAND SUMMARY

The interactive commands accepted by R1D84 are summarized in the following section. For this purpose, they are categorized as,

A) Display commands.
B) Flags.
C) General.
D) Set.
E) Save.
F) Edit commands.
G) Observed data commands.
H) Variable changing commands.

Display Commands:

The following list of commands may be used to initiate the various displays,

V-D	Display the velocity-depth function.
VBAR	Display the mean overburden velocity.
T-T	Display the travel time.
PVSX	Display ray parameter, P, versus distance.
MAV	Display minimum apparent velocity versus distance.
TAUP	Display tau versus P.
WKBJ	Calculate and plot WKBJ synthetic seismograms.
SYN	Calculate and plot disc ray synthetic seismograms.

Flags:

Numerous flags are used to control the operation of the program. These may be turned on and off with the commands ENABLE and DISABLE.

Date	When DATE is enabled [default] the current date and time appears on each plot.
NMO	Enable NMO to transform time by a constant velocity normal moveout.
NMOG	Enable NMOG to transform time by a linear gradient normal moveout.
Rose	When ROSE is enabled [default] a velocity rosette is plotted on travel time plots.
Debug	Enable DEBUG for printing of debug code.
Filter	Enable filter to filter time series data and synthetics.
Fill	Enable FILL to rescale plots to optimally fill the terminal screen.
Fit	Enable FIT to rescale plots to retain the specified scaling factors but fit within the terminal screen.
Flat	When FLAT is enabled, an earth-flattening approximation is applied to the model before calculation.

General:

Several general commands.

EXIT	Terminate the program with prompt to save the current control file.
QUIT, STOP	Terminate the program.
Pause	Pause until a [RETURN] is received from the terminal.
Erase	Erase the graphics screen.
Clear	Clear the text screen.
Type	Print the remainder of the line to the terminal.
Size	Report the size needed for plots to the Versatec.

Set:

Groups of variables may be set with the command SET.

Set Range - RMIN, RMAX, RSF, DR, NSR, RBIAS (4F10.0, I10, F10.0)
Set Distance - RMIN, RMAX, RSF, DR, NSR, RBIAS (4F10.0, I10, F10.0)
Set Time - TMIN, TMAX, TSF, DT, NST
Set Trace - WIDTH, CLIP SHADE
Set Plotid
Set Rosette - ROSES, ROSER, ROSET
Set Filter - FLO, FHI
Set Symbol - HNR, HBS, HOBS, HSYM,
Set Inches
Set Cm

Save:

Information from the program may be saved in external files.

Save Calculated	Save the calculated arrival times.
Save Model	Save the current model.
Save Control	Save the current control file.

Edit:

Commands are available for interactive editing of the velocity depth function.

LIST - Display the velocity-depth function for editing. For each entry, an entry number, the depth, the velocity, and an optional code will be displayed. This command may be abbreviated L.

CLEAR - Clear the screen of text. Makes it easier to see the plot.

CHANGE - Change a single entry in the velocity-depth function. The program will request an entry number. When you respond, the depth and velocity for that entry will be listed. Type in new values. A (CR) is interpreted as no change. This command may be abbreviated C.

INSERT - Insert a boundary in the velocity-depth function (2 entries). The program will request a depth for the new boundary. This command may be abbreviated I.

INTERPOLATE - Interpolate an entry into the velocity-depth function (1 entry). The program will request a depth for the new entry. This is most useful when you need to bury a source within a layer which has a velocity gradient.

DELETE - Delete one or more entries. The program will request entry number(s). Valid responses are of the form;

2,5,8 or 3-5,9 or 7

This command may be abbreviated D.

CODE - Alter the code associated with an entry in the velocity-depth function. The program will first request an entry number, then a new code. Valid codes are SRC, identifying the depth of the source; RFL, requesting pre-critical reflections from this depth; or blank, specifying no special action.

SRC - Move the source to a new depth. The program will request a new entry number.

RFL - Request pre-critical reflections from a given depth. The program will request an entry number. To remove a RFL code, use the CODE command and enter a blank.

SVEL - All velocities in the model will be divided by 1.732 to produce an equivalent S-velocity model.

PVEL - Convert an S-velocity model to P-velocities by multiplying by 1.732.

Observed:

Observed travel time data may be plotted as individual pick symbols overlaid on the time-distance plots. Travel-time data is read from files and placed in an internal display buffer. An observed travel time data file may be specified in the control file used to initiate the program or data files may be read under interactive control from the terminal. The following interactive commands may be used to manipulate travel time data files.

ACQUIRE - Acquire the data from an observed travel time data file for display. The program requests the name of the file. The current contents of the observed data buffer are over-written.

ADD - Same as above, but the new data are appended to the end of the observed data buffer.

DISPLAY - The contents of the observed data buffer are displayed if the current plot is in time-distance form.

REVERSE - The ranges of all entries in the observed data buffer are negated.

BIAS - The program solicits a time bias to add to all entries in the observed data buffer prior to display.

Observed travel time data are found in ASCII files (pick files) under the following format. A line with * in the first column is considered to be a comment line and is ignored.

The first line is a global parameter line, FORMAT (4F10.0), containing RNG, VR, TADD, and FUDGE. RNG is ignored by this program. VR is the reducing velocity which has been applied to the subsequent tabulated pick times. TADD is ignored. FUDGE is a multiplicative constant applied to all values of DELT.

Travel time data lines, FORMAT (A4,2F10.0), contain ID, DELT, and TIME.

ID is a four character identification, usually the location number. It is ignored by this program. DELT is the distance from the shot to the receiver. TIME is the travel time reduced by VR.

Variable Changing Commands:

Variables within the program may be changed by giving a command containing the variable name and '='. If a valid value for the variable follows the '=' sign, the variable will be reset to that value, otherwise you will be prompted for a new value. Following the prompt, if you enter a carriage return, the variable will be unchanged. The following list of changeable variables is grouped by function and default values are given.

Distance axis variables: The distance axis is used in all time-distance plots.

Range = 0.0, 60.0	Specify the minimum and maximum range for the distance axis.
Rmin = 0.0	Specify the minimum range for the distance axis.
Rmax = 60.0	Specify the maximum range for the distance axis.
Rsf = 0.25	Specify the range scale factor in plot units/km.
Dr = 5.0	Specify the distance between labeled tics on the distance axis in km.
Nsr = 5	Specify the number of intervals between labeled tics on the distance axis.
Rbias = 0.0	Specify the distance axis labeling offset in km. The minimum distance on the axis will be RMIN + RBIAS.

Time axis variables: The time axis is used for time-distance and tau-p plots.

Time = -2.0, 8.0	Specify the minimum and maximum time for the time axis.
Tmin = -2.0	Specify the minimum time for the time axis.
Tmax = 8.0	Specify the maximum time for the time axis.
Tsf = 1.0	Specify the time scale factor in plot units/sec.
Dt = 1.0	Specify the distance between labeled tics on the time axis in sec.
Nst = 10	Specify the number of intervals between labeled tics on the time axis.

Depth axis variables: The depth axis is used for velocity-depth and mean overburden velocity-depth plots.

Zmin = -2.0	Specify the minimum depth for the depth axis.
Zmax = 8.0	Specify the maximum depth for the depth axis.
Zsf = 1.0	Specify the depth scale factor in plot units/km.
Dz = 1.0	Specify the distance between labeled tics on the depth axis in sec.
Nsz = 10	Specify the number of intervals between labeled tics on the depth axis.
Zbias = 0.0	Specify the depth axis labeling offset in km. The minimum depth on the axis will be ZMIN + ZBIAS.

Velocity axis variables: The velocity axis is used for velocity-depth and mean overburden velocity-depth plots.

Vmin = 0.0	Specify the minimum velocity for the velocity axis.
Vmax = 8.0	Specify the maximum velocity for the velocity axis.
Vsf = 1.0	Specify the velocity scale factor in plot units/(km/s).
Dv = 1.0	Specify the distance between labeled tics on the velocity axis in km/sec.
Nsv = 10	Specify the number of intervals between labeled tics on the velocity axis.

Ray Parameter axis variables: The ray parameter axis is used for P-X and Tau-P plots.

Pmin = 0.0	Specify the minimum P for the P axis.
Pmax = 8.0	Specify the maximum P for the P axis.
Psf = 1.0	Specify the P scale factor in plot units/(s/km).
Dp = 1.0	Specify the distance between labeled tics on the P axis in sec/km.
Nsp = 10	Specify the number of intervals between labeled tics on the P axis.

Delta axis variables: The delta axis is used for P vs X plots. These values will be set by the program the first time a model is run.

Dmin = 0.0	Specify the minimum distance for the delta axis.
Dmax = 0.0	Specify the maximum distance for the delta axis.
Dsf = 1.0	Specify the distance scale factor in plot units/km.
Dd = 1.0	Specify the distance between labeled tics on the delta axis in km.
Nsd = 10	Specify the number of intervals between labeled tics on the delta axis.

Velocity transformation variables: These variables govern time transforms used in time-distance plots.

RV = 6.0	Reducing velocity for reduced time plots.
VNMO = 6.4	NMO velocity for constant velocity NMO plots.
V0 = 6.0	Velocity at top of section for gradient velocity NMO plots.
V1 =	Velocity at bottom of section for gradient velocity NMO plots.
VGRAD = 0.03	Velocity gradient for gradient velocity NMO plots.

Symbols for axes:

Hnr = 0.15	Size of tics and labels on the axes.
Hbs = 0.15	Size of plot ID and axis labels. To eliminate axis labels, set HBS to a small positive number (0.00001).
Hsym = 0.15	Size of the symbol used to indicate the source in the velocity-depth function plot.

Trace variables: These variables are used when plotting time series data from external files or internally calculates synthetic seismograms.

Width = 0.4 — Specify the maximum width of the trace.

Clip = 0.4 — Specify the clipping width of the trace.

Shade = 0.0 — A number between 0.0 and 1.0 indicating the fraction of the trace to shade. Make SHADE negative to shade the opposite side of the trace.

Tshift = 0.0 — Time shift in seconds to be applied to all the traces.

Filter:

Flo = 1.0 — Lower frequency bound for the filter in Hz.

Fhi = 20.0 — Upper frequency bound for the filter in Hz.

Observed data display:

Hobs = 0.1 — Observed data symbol height.

Plotid = -none- — Plot ID to be plotted with the record section.

Mode = 0 — Plotting mode.

- 0 - Plot to VT100 only; scale to fill the screen.
- 1 - Plot to VT100 only; scale to fit the screen.
- 2 - Use normal plot prompts; scale to fill the screen.
- 3 - Use normal plot prompts; scale to fit the screen.

Newpen = 1 — Sets pen width (1-6) for all lines in plot.

Velocity rosette variables:

Roser = 0.0	Distance for center of velocity rosette in km.
Roset = 7.0	Time for center of velocity rosette in sec.
Roses = 1.0	Size of arms of velocity rosette. Set ROSES to 0.0 or DISABLE ROSETTE for no rosette.

Synthetic variables:

These variables specify the placement and source function used for synthetics.

Smin = 5.0	Minimum distance at which to construct a synthetic trace.
Smax =	Maximum distance at which to construct a synthetic trace.
Ntr = 5	Number of synthetic traces to plot.
Sps = 50	Samples per second for synthetic traces.
Freq = 10.0	Dominant frequency of source.
Gamma = 3.0	Number of cycles in source pulse.
Szero = 0.0	Number of zero points preceding source.
Psi = 0.0	Phase offset in degrees of source.

Travel time calculation variables:

IA = 1	First branch to calculate.
IB = 30	Number of points per branch to calculate.

Grid line variables:

Tminl =	Minimum time for timing lines.
Tmaxl =	Maximum time for timing lines.
Dtline = 0.0	Time between timing lines. Set to 0.0 for no timing lines.
Rminl =	Minimum distance for range lines.
Rmaxl =	Maximum distance for range lines.
Drline = 0.0	Distance between range lines. Set to 0.0 for no range lines.
Zminl =	Minimum depth for depth lines.
Zmaxl =	Maximum depth for depth lines.
Dzline = 0.0	Distance between depth lines. Set to 0.0 for no depth lines.
Vminl =	Minimum velocity for velocity lines.
Vmaxl =	Maximum velocity for velocity lines.
Dvline = 0.0	Distance between velocity lines. Set to 0.0 for no velocity lines.

Isline = 2 Line type for grid lines.

0 - Solid.	5 - 1/16" dash.
1 - 50 dots/inch.	6 - 1/8" dash.
2 - 25 dots/inch.	7 - 1/4" dash.
3 - 10 dots/inch.	8 - 1/2" dash.
4 - 5 dots/inch.	9 - 1" dash.

Auxiliary Programs:

Two auxiliary programs are available for the conversion of control files to and from formats suitable for other programs.

BUB2R1D - This routine reads the input file for the reflectivity synthetic seismogram program BUBA and writes a control file suitable for R1D84.

R1DCON - This routine reads R1D84 control files and writes input files for BUBA or for RAY84, the two-dimensional ray trace routine.

References:

Chapman, C.H., 1978. A new method for computing synthetic seismograms, *Geophys. J. R. astr. Soc.*, **54**, 481-518

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Wiggins, R.A., 1976. Body Wave Amplitude Calculations - II, *Geophys. J. R. astr. Soc.*, **46**, 1-10.