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**Program TracePlot, Version 2.0
Seismic trace plotting program for the Macintosh**

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ABSTRACT

Program TracePlot, Version 2.0, is a Macintosh software application to access a SEG-Y format seismic data file and display the seismic traces on the CRT screen of a Macintosh micro-computer. Both color and monochrome monitors are supported. Display modes are Wiggle-trace, Variable Area, or Wiggle plus Variable Area. Horizontal and vertical resolution is dependant upon the size of the monitor that is attached to the computer. The user controls the following parameters: 1) number of traces to be displayed on the screen at any one time, 2) the time window displayed, 3) the seismic trace in the file at which to begin plotting and trace increment to display thereafter, 4) plot direction 5) timing-line annotation increment, 6) type of gain to apply (either constant gain factor, or trace-by-trace normalization), and 7) SEG-Y header word to use for annotations at the top of the display. A pull-down menu provides interactive help during program execution. A utility program is also included which provides the function of copying a portion of a SEG-Y format data file to another file.

INTRODUCTION

Program TracePlot, Version 2.0, accesses a SEG-Y format seismic data file and displays the seismic traces on the CRT screen of a Macintosh micro-computer. The program was developed on a Macintosh IIx using the Microsoft QuickBasic, Version 1.0 compiler. This program is equivalent to the SEG-Y display program, PLOTSEGY for DOS-based computers (Zihlman, 1992a).

TracePlot is quite flexible and provides a number of options which allow the user to display the seismic traces in different ways. The parameters which the user can control are described in the section entitled "The Parameter Input Screen." During program execution, the user can get help on any of the parameters by utilizing a pull-down menu.

A utility program, called TraceCopy, Version 2.0 is also included and will copy a portion of a SEG-Y format data file to another file. A subset of the traces in the file and/or a subset of the samples in the traces can be copied. Thus, large files can be separated into smaller-size files which can more easily be transferred to floppy disk, or transmitted over a network.

This document assumes that the user is familiar with the operation of Macintosh applications, specifically keyboard entry of text in standard Macintosh requestor boxes, and the use of the mouse pointer to make selections on the screen and to access pull-down menus.

The programs are invoked by double clicking the mouse pointer on the program's Icon, or selecting the Icon with a single click and then selecting OPEN from the FILE menu.

DIFFERENCES BETWEEN VERSION 1.1 AND 2.0

Listed below are the differences between version 1.1 and version 2.0. The first difference is correction of an error in the program code. The other differences are improvements to the program.

1. Known Error: An error in the original program code for version 1.1 may cause a problem in plotting SEG-Y seismic data that have extremely low amplitudes ($\ll 1.0$). For most stacked and scaled seismic data, this error will not occur. This error is corrected in version 2.0.

2. Writing the PDF file to a write-locked device: When attempting to write the ".PDF" file, TracePlot will detect if the destination device is write-locked and will continue to operate. Version 1.1 would fail, giving a fatal error message if the destination device was write locked.

3. Addition of all 4 types of SEG-Y formats: Version 2.0 can access all four types of SEG-Y sample values: 32-bit floating point, 32-bit Integer (fixed point), 16-bit integer, and 32-bit with gain code (16-bit data, 8 bit gain).

4. Annotation: Two lines of annotation are provided at the top of the seismic display: 1) a sequential trace number and 2) the value of a user-selected trace header word.

5. Parameter Input Screen: The parameter input screen has been modified to reflect the above additions. The text requestor boxes are narrower, there are buttons to select the annotation type, and the "Accept" and "Quit" buttons have been removed from the screen.

TERMS USED

A number of terms related to the geophysical Industry and specifically seismic data processing and interpretation are used in this report and are defined below. Refer to Figure 1 for examples of some of these terms. Some definitions were taken from The Encyclopedic Dictionary of Exploration Geophysics (Sheriff, 1976), which provides a comprehensive list and definitions of geophysical terms. A complete list of header words is given in the Appendix.

Trace	A record of one seismic channel, either unprocessed or processed.
Trace-sequential	A format by which all samples of an individual trace are stored without interruption from minimum to maximum travel time, followed sequentially, by other traces (sometimes called demultiplexed format). SEG-Y format is designed to store data in trace-sequential format. The opposite of trace sequential is multiplexed format whereby all samples from the same travel time are stored without interruption from low channel to high channel.
Gather	A group of traces related by some common attribute (e.g. a shot gather is all the traces recorded from the same shot; a CDP gather is all the traces that map the same Common Depth Point, etc.).
Wiggle trace	A method of displaying a seismic trace whereby a continuous solid line is drawn connecting each sample to the next.
Variable Area	A method of displaying a seismic trace whereby only samples having positive values are drawn and the area between 0 amplitude and the positive value is filled in by a solid color.
Trace Width	The distance between the origin of one trace and the origin of the adjacent trace on a seismic display.
Reel Header	A record, or records, located at the beginning of a magnetic tape or disk file that contains information that is common to all of the rest of the records on the tape or file. For the SEG-Y format, the reel header is composed of 3200 bytes in EBCDIC format (40, 80-byte card images) that describe the data to follow, and a 400-byte binary header that contains information like number of samples/trace, sample interval, data sample type, etc.

Trace Header	A block of information at the beginning of each trace that contains information common to that particular trace, like sequential trace number in the file, original file number, processing file number, etc. For SEG-Y format, this is a fixed-length, 240-byte block of data that is immediately followed by the data samples for that trace.
Header Word	An item of information in the trace or reel header. SEG-Y Examples: For the binary reel header, header word #8 (bytes 21-22) contains the number of samples per trace. For the trace-header, header word #3 (bytes 9-12) contains the original field record number.

SOFTWARE/HARDWARE REQUIREMENTS AND AVAILABILITY

SOFTWARE/HARDWARE

TracePlot, Version 2.0 is a Macintosh application designed to display the seismic traces contained in a SEG-Y format disk file on the CRT screen of a Macintosh micro-computer. User-controlled options are available to specify display parameters like scale, gain, plotting style, timing line annotation, plot direction, etc. Color and Monochrome monitors are supported.

Input files must be in standard SEG-Y format as specified by the Society of Exploration Geophysicists (Barry, et al, 1975).

TraceCopy, Version 2.0 is designed to copy a portion of a SEG-Y format disk file to another file. A subset of the traces and/or a subset of the samples from each trace can be copied to another, smaller file which facilitates the transfer of the data using floppy disks or other media having limited storage capacity.

The programs were developed on a Macintosh IIx using the Microsoft QuickBasic, Version 1.0 compiler, binary math version, and are designed to run on any standard Macintosh computer, using operating system 6.0, or higher. It is possible that the programs will run on Macintoshes running operating systems released prior to system 6.0 but this has not been tested.

Many of the newer Macintosh computers available at the time of publication (those that have a 68030 or higher processing chip), use 32-bit addressing which will cause TracePlot and TraceCopy to fail, giving a system error #1. If such an error occurs, the programs can be successfully executed by disabling 32-bit addressing in the following manner:

1. Open the "apple" menu at the upper left of the main screen
2. Open the control-panel
3. Open the Memory icon
4. Click 32-bit addressing button to "off"
5. Restart the machine to invoke this option

After performing the above 5 steps, the programs should execute successfully.

HARDWARE-SPECIFIC VERSIONS

Two versions of TracePlot are provided. Their names and hardware requirements are as follows:

1. TracePlot-bw: This version should work on all Macintoshes including those with only monochrome screens (black and white). The background of the screen is set to white and the foreground is set to black.
2. TracePlot: This version should work on all Macintoshes that have a color monitor. The background color is set to blue and the foreground color is set to white.

EXPECTED DATA FILE FORMAT (SEG-Y)

The SEG-Y seismic data format standard was developed by the Society of Exploration Geophysicists (SEG) in 1975 and has been in common use throughout the geophysical industry since that time. A complete description of the SEG-Y format is given in Barry, et al (1975); TracePlot and TraceCopy, Versions 2.0 expect as input, a disk-image of the SEG-Y data format described therein. That document assumes 9-track, magnetic tape recording media; naturally, the inter-record and inter-block gaps described for magnetic tape media will not exist on the disk-image. Thus, the programs expect a continuous file composed of a 3200-byte EBCDIC header, a 400 byte binary header, and data traces, each composed of a 240 byte trace-header followed by a fixed number of seismic data samples.

The SEG-Y format provides for four (4) different sample types:

1. Floating point (4 bytes (32-bits) per sample),
2. Fixed point (4 bytes/sample),
3. Fixed point (2 bytes/sample), and
4. Fixed point with gain code (4 bytes/sample).

Sample type 1 is by far, the most commonly used version of SEG-Y. TracePlot, Version 2.0 is designed to display SEG-Y data samples that conform all 4 sample types. If TracePlot cannot determine the sample type from appropriate bytes of the binary header (bytes 25-26), the user will be prompted to supply the sample type.

TracePlot, Version 2.0 uses binary math (IEEE standard) to internally represent integer and floating point numbers. IEEE-format represents numbers differently from IBM-format and thus TracePlot cannot read the IBM-format numbers directly from disk. Each header value and data sample is read byte-by-byte (as characters, rather than numbers) and the integer or floating point value is reconstructed according to the IBM standard. The resulting numbers are stored in IEEE-format for internal use. Interested readers can refer to the source code (subroutines Make2Byte, Make4Byte, and ReadTrace) for the method used. Zihlman (1992a) gives a complete description of a method to convert the 32-bit IBM standard into an IEEE 32-bit floating point number for computers running the DOS operating system. TraceCopy, Version 2.0 performs a byte-by-byte copy and thus has no need to perform numeric conversions on the data samples.

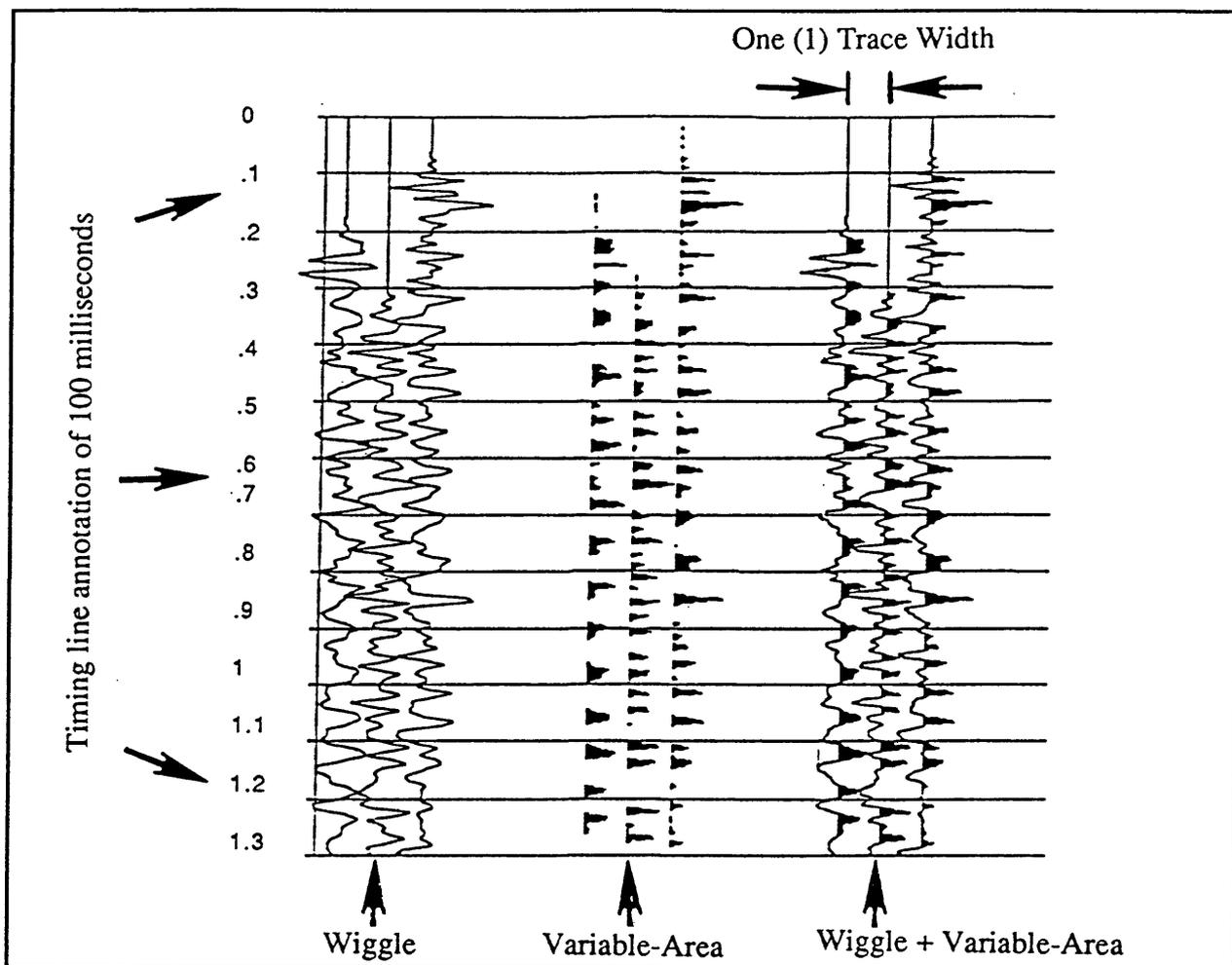


Figure 1. Seismic traces displayed using the display styles of Wiggle-trace (left), Variable-Area (center), and Variable-Area plus Wiggle-trace (right). A number of terms used in the text are illustrated by annotations on this figure.

SOURCE CODE

The source code for TracePlot and TraceCopy is provided on the diskette in files TracePlot.bas and TraceCopy.bas, respectively. These files are contained in the folder named Source-Code. Interested readers can inspect these files by importing them into most commercial word processing programs. Readers who have the QuickBasic compiler can use the compiler to access these files.

TRACEPLOT, VERSION 2.0; USER'S GUIDE AND TUTORIAL

The following sections describe the features and operation of TracePlot, Version 2.0. These descriptions are performed by means of tutorial instructions on how to plot the sample data file StackData (included on the diskette). Except for items specific to the actual plotting of the data, many of the sections contain information that is also relevant to TraceCopy, the file copy utility program (parameter input screen, start and stop Plotting (copying), etc.). Details of TraceCopy are given in the last section of this document.

INSTALLATION

TracePlot and TraceCopy can be executed directly from the diskette included with this publication. However, it is recommended that you install the programs on a hard disk. It is also recommended that you make a copy of the diskette and use that copy to continue with this installation and/or to perform the plotting of the sample SEG-Y data file. Keep the original diskette as a backup. Refer to your Macintosh User's guide for instructions on how to duplicate a 3.5 " disk.

To install the program on a hard disk, create a new folder on the hard disk. Decide which hardware-specific version of TracePlot you wish to install and copy that file to the new folder. Next, copy files TraceCopy and StackData to the folder. Installation is complete.

PLOTTING THE SAMPLE SEG-Y FORMAT DATA FILE

File **StackData** is a SEG-Y format file, and can be used to test the operation of TracePlot and TraceCopy. This file contains a number of "stacked" seismic traces which are the final product of a typical sequence of seismic data processing steps. Each trace contains 251 samples at an 8 ms sample interval. Thus the maximum time of any one trace is 2000 msec ($(251-1)*4$). The following sections of this user's guide assume that you will be plotting file **StackData**. Any other SEG-Y format data file that you might have can be plotted by substituting its name for StackData in the following instructions.

Start TracePlot by either clicking the mouse pointer twice on its Icon, or clicking once on its icon, and then selecting OPEN from the FILE menu. A welcome screen will appear; click on the button labeled "Continue" or wait a few seconds; the parameter input screen will appear and a File-Open Dialog box will appear.

THE PARAMETER INPUT SCREEN

The Parameter Input Screen (Figure 2) contains requestor boxes and "buttons" which allow the user to control various parameters for plotting. Two small windows will be displayed at the bottom of the screen. The left window contains global parameters determined from the header of the current SEG-Y data file. The right window is used to display help and error messages. The following are details of each parameter.

- 1. FILE NAME:** The file name that contains the SEG-Y data. This can be any valid Macintosh file name that actually exists. This file is selected from the File-Open dialog box which appears at the beginning of the program, or from selecting the File-Open menu (see below).
- 2. FIRST TRACE:** The SEQUENTIAL trace in the file to display at the left or right edge of the plotting screen. Example: If the file contains shot gathers composed of 96 traces each and you wish to begin plotting at the second shot gather, type 97 for this parameter.
- 3. MINIMUM TIME:** The time at the top of the display, in ms. This time must be ≥ 0 AND \leq the maximum time of a trace. The lower left message window will display the maximum trace time of the current file.
- 4. MAXIMUM TIME:** The time at the bottom of the display, in ms. This value must be $>$ minimum time. If this value is greater than the maximum trace time, then the display will be compressed in the vertical direction. The vertical exaggeration of the display can be controlled by appropriate use of this parameter, in combination with the parameters 1) minimum time, 2) maximum traces on screen, and 3) trace increment.
- 5. GAIN:** Two methods of defining the gain factor are available:

Normalization: Type NORM (or any word beginning with the letter n) to invoke this option. This option will "normalize" EACH trace before plotting using the following method: The absolute value of each sample between the minimum and maximum times specified, is calculated; the maximum of these values is set equal to the value of the Overlap parameter, described below. Thus if overlap = 1.2, the maximum amplitude of each trace will be plotted 1.2 trace-widths to the left or right of its origin (0-amplitude). This option does not preserve the relative amplitudes between traces, but is a useful option to use when displaying data that have large amplitude differences from trace to trace, like unscaled shot gathers.

Scalar Multiplier: The scalar by which to multiply all sample values of all traces, prior to plotting. This value can be any integer or floating-point number. If you type a negative value, the polarity of the traces will be reversed. This method of scaling preserves the relative amplitudes between traces. The following method is used: The first trace to be plotted (parameter FIRST TRACE, above) is analyzed. A "baseline" scale factor is calculated such that the average of the absolute value of all non-zero samples will be plotted at 1/2 of a trace width to the left or right of 0-amplitude. This baseline scale factor is then multiplied by the GAIN specified and this final GAIN factor is multiplied to all samples plotted.

6. TIMING LINES: The increment, in ms, to draw timing lines. Example: 100 means to draw timing lines at integer multiples of 100 ms (100, 200, etc.).

7. MAXIMUM TRACES ON SCREEN: The number of traces to plot on the screen. The larger that this number is, the closer together the traces will be plotted. The vertical exaggeration of the display can be controlled by appropriate use of this parameter in combination with the parameters 1) minimum time, 2) maximum time, and 3) trace increment.

8. OVERLAP: This parameter is used differently depending on the value GAIN, described above.

For GAIN = NORM: Overlap is the distance from 0 amplitude, in terms of trace widths, of the normalized, maximum amplitude of each trace. Thus, if overlap = 1.5, the maximum amplitude of each trace will be plotted 1.5 trace widths to the left or right of its 0 amplitude point.

For GAIN = any number: Overlap is the maximum excursion to the left or right of 0 amplitude for any one trace, in terms of trace widths. Thus, if this number is 1.5, then any amplitude of a trace that would be plotted greater than 1.5 trace widths away from its origin (0-amplitude) will be truncated to that distance.

9. TRACE INCREMENT: The increment at which to display traces, beginning at the 1st trace. Example: if this parameter is specified as 3 and the first trace to be displayed is 5, then traces 5, 8, 11, . . . , etc. will be displayed. The vertical exaggeration of the display can be controlled by appropriate use of this parameter in combination with the parameters 1) minimum time, 2) maximum time, and 3) maximum traces on screen.

10. PLOTTING STYLE: The style in which the traces are drawn. Figure 1 shows examples of the types of plotting styles available. Click on the left-most button, labeled WG to plot Wiggle-traces only. Click on the middle button, labeled VA, for the Variable-Area style: No negative trace samples are plotted and the area between 0 amplitude and the positive trace samples will be filled in. Click on the right-most button, labeled VA+WG to overlay a wiggle trace on top of a Variable-Area display.

11. PLOT DIRECTION: The direction of progression for plotting the traces: Click on the left-most button, labeled L-R to plot the first trace at the left edge of the screen and plot subsequent traces sequentially to the right. Click on the right-most button, labeled R-L to plot from the right edge to the left.

12. HEADER ANNOTATION: The trace header word to use for annotation at the top of the display. The SEG has pre-defined 71 header words (Barry, et al, 1975), utilizing the first 180 bytes of the 240-byte trace header. TracePlot assumes that the remaining 60 bytes will be used by 30 additional header words, each word having a length of 2 bytes. Thus, there will be 101 words in the SEG-Y trace header. Selector buttons for four commonly used header words are displayed: CDP, FFID, ESP#, and DIST (Figure 2). These are the Common-Depth-Point number, Field-File-Identification Number, Energy-Source-Point Number, and Source-Receiver Distance, respectively. If you click on any of these buttons, its header word number will appear in the requestor box located immediately below the buttons (words 6, 3, 5, and 12, respectively). You can also click inside the requestor box and type any number between 1 and 101. A complete list of header words is given in appendix.

File Stop Plotting Help

SEG Y File Name--> StackData

1 st trace--> Plot

Min. Time (ms)---> Header Words

Max. Time (ms)---> CDP

Gain--> FFID

Timing (ms)---> ESP#

Traces--> DIST

Overlap--> <--Hdr Word*
(Max = 101)

Trace Increment-->

Style--> UA WG UA+WG

Plot Direction--> LR RL

<p>Determined from Header: Sample Interval (ms): 8 Number of Samples/trace: 251 Maximum trace time (ms): 2000 Number of traces in file: 150 Format: 32-bit Floating Point</p>	<p>The increment, in ms, to draw timing lines. Example: 100 means to draw timing lines at integer multiples of 100 ms (100, 200, etc.).</p>
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Figure 2. Example of the Parameter Input Screen. Parameters displayed are default values that were determined from the header of the sample SEG-Y format data file. The lower right window displays a help message describing the timing line increment parameter.

SELECT THE SEG-Y FILE

At the beginning of the program, a standard File-Open Dialog box will appear. Files in the folder from which the program was started will be listed in the menu. This dialog box also allows access to files in different folders or on different disks. Select the file named **StackData**, then click on the Open button. If you click on Cancel before opening a file, the program will require that you either end the program, or select a file. If you have already opened a file, you can open a new file by choosing the File-Open Menu. The above described dialog box will reappear.

Once the file is opened, its header is read and the number of samples per trace, sample interval, and sample type are determined. These are listed in the box at the lower left of the screen. If any of these values are unreasonable, possibly because they were not stored properly in the header, you will be given the opportunity to either provide these parameters directly, or to select a new file. For file **StackData**, the header is valid and the values contained within it are reasonable and so the above mentioned problem will not occur.

THE PDF FILE

After the file is opened successfully, the program will attempt to open a file with the same name as the SEG-Y data file, but with an extension of ".PDF". This file is called the Parameter Definition File (referred to as the PDF-file), and contains the plotting parameters used the last time that the data file was plotted. For file **StackData**, the PDF-file will be named **StackData.PDF**; if the file was named **SEGYDATA.SGY**, the PDF-file will be named **SEGYDATA.PDF**, etc.

Of course, the first time that a data file is plotted, its corresponding PDF-file will not exist. The program will determine plotting parameters, based on the number of samples per trace and sample interval, and these parameters will be listed on the screen as initial defaults.

If the PDF-file already exists, the parameters contained within it will be read and transferred to the screen to be used as initial defaults. When plotting begins, the PDF-file will be updated with the latest plotting parameters.

The PDF-file is written to the same folder in which the TracePlot application file resides, not the folder where the SEG-Y data file resides. Thus, that folder must not be write-locked. If the folder is write-locked for any reason the program will inform you that the PDF-file cannot be written; the program will still function, but the plotting parameters will not be recovered the next time that the SEG-Y data file is plotted.

MODIFY PLOTTING PARAMETERS

The user may modify any of the plotting parameters listed on the Parameter input screen, by typing the new parameter in the appropriate requestor box or clicking on the appropriate button. For all requestors, there are two ways to tell the program to accept the value typed:

1. Press the return (Enter) key. Control will be transferred to the next requestor in the list (or the top requestor box if the current requestor is at the bottom of the list).
3. Click the mouse in another requestor: Control will be transferred to that requestor.

As mentioned above, file **StackData** contains 251 samples per trace. On most Macintosh screens, there are 400-600 pixels in the vertical direction. Such a screen has more than adequate resolution for plotting the traces from file **StackData**. However, for traces that contain more samples than there are pixels in the vertical direction, the resolution can be poor, especially if using the plot style of Variable Area+Wiggle (VA+WG). One way to increase the resolution of the display is to change the plot style to Variable Area (VA) OR to Wiggle (WG), or to reduce the gain. Another possibility is to reduce the number of samples being plotted by "windowing" the trace. For example, if plotting a trace having 1,500 samples at a 4 ms sample interval (5s total time), you could change the minimum and maximum plot times to 2000 and 3000, respectively, resulting in a time "window" that contains only 251 samples. The user must experiment with the plotting parameters for each data file in order to determine the optimum parameters for that data set.

BEGIN PLOTTING

After entering the desired plotting parameters, click the Plot button near the top of the screen. The plotting parameters will be analyzed and if they are acceptable, the screen will clear and the plotting will begin. If any errors are discovered, a message will appear in the box at the lower right of the screen and control will be transferred to the requestor that must be changed. The following will be checked before plotting:

1. Minimum plot time is ≥ 0
2. Minimum plot time is \leq Maximum time of any sample in a trace
3. Maximum plot time is $>$ Minimum plot time
4. The header-word for annotation is ≥ 1 and ≤ 101
5. The first trace to plot is ≥ 1

If any of the above are not true, then a "beep" will sound, a warning message will appear in the lower right message box, and control will be transferred to the appropriate requestor box.

AUTOMATIC STOP OF THE PLOTTING

Plotting will stop if either 1) the end of the data file is reached or 2) the screen is completely filled with traces. If the end of the file is reached, a message to that effect will appear on the bottom line of the screen; press any key to return to the parameter input screen. If the screen is completely filled with traces and there are more traces in the file left to display, a message to that effect will appear on the bottom line of the screen. Press ESC to return to the parameter input screen; press any OTHER key clear the display and continue plotting with the next available trace.

FORCE THE PLOTTING TO STOP

When plotting begins, you can temporarily stop plotting by pressing the Escape key. Plotting will stop after the current trace is displayed and a message will appear at the bottom of the screen. If you press Escape again, the parameter input screen will appear; if you press any OTHER key, plotting will resume with the next available trace. You can also choose the menu item entitled "Stop Plotting" to return to the parameter input screen immediately after the current trace is displayed. When the parameter input screen reappears, any of the parameters listed can be changed and the plot can be restarted.

DISPLAY ANNOTATION

Two lines of annotation will appear at the top of the screen. The top line will contain the values of the trace header word chosen for annotation. The lower line will be the sequential trace number in the file, which is dependant on the starting trace number and the trace increment provided by the user. The frequency of annotation at the top of the display is dependant upon the maximum number of traces displayed across the entire width of the screen (parameter 7, described above). The program attempts to annotate approximately 20 traces. Thus if 20 traces are displayed across the entire width of the screen, each trace will be annotated; if 40 traces are displayed, every 2nd trace will be annotated, etc. This scheme insures that in most cases, the numbers used for annotation will not overlap each other, unless they are very large numbers ($>9,999$).

END THE PROGRAM

Choose the Quit item under the File menu at any time.

ERRORS DURING PLOTTING

Recoverable Error: A scale-factor error can occur if you are using a Gain factor that preserves relative amplitudes between traces, and the first trace to be plotted does not have any non-zero samples in the time window specified. If this error occurs, a window will appear on the screen and you will be instructed to provide a different trace as the 1st trace to be plotted.

Unrecoverable Errors: Most unrecoverable errors are related to numeric overflows in the data samples. This can occur when the gain factor specified is too large, if the file being plotted is corrupted, or if the file is not really a SEG-Y data file. If an unrecoverable error occurs, a window will appear, informing you of the error and you will have to restart the program.

LIMITATIONS

1. Screen Savers: Many users install a screen saver program on their Macintosh system to avoid pixel burn-out of the monitor. If a screen saver program covers the screen while either TracePlot or TraceCopy is running, the screen will not be restored properly when the screen saver stops. Thus the user should disable any screen saver programs before executing TracePlot or TraceCopy for an extended period of time.

2. Initial Help Request: On some Macintoshes, if the user chooses a help item from the pull-down menu immediately after beginning the program, keyboard control of the initial requestor box may be lost. If such a situation occurs, click the mouse pointer on any other requestor, or button, and control should be returned.

3. Screen Size: The programs automatically detect the size of the screen attached to the computer and attempt to adjust the items on the parameter input screen and size of the seismic display accordingly. However, if the screen is extremely small, such as with a Macintosh Classic, the resolution of the seismic display may be too limited to be useful.

4. Invalid Input File Format: Both TracePlot and TraceCopy will open any input file selected. Checks are made to verify that the sample interval, number of samples and length of the file based on those parameters are reasonable (i.e. the file is large enough to contain at least one seismic trace), and that the data sample type (32-bit floating point, 16-bit integer, etc.) can be determined. However, it is possible that reasonable values for these parameters could exist in any file. In that case, the programs will attempt to copy or plot the data contained in the file, with unpredictable results (although usually a data overflow error will occur when plotting). Furthermore, if the programs determine that the above parameters are unreasonable, the user is given the opportunity to provide a sample interval, number of samples per trace, or data sample type directly. Once reasonable parameters are provided, the program will then plot, or copy the data. For example, it is even possible to provide the application's source code (TracePlot.bas) as input, and attempt to plot it as seismic data.

HARDCOPY

To get a hardcopy of TracePlot's seismic display, wait until the display pauses and then press Command+Shift+3 (hold down the Command key and Shift key and then press the numeral 3 key). This multi-key combination will cause the screen image to be saved in a graphics "PICT" file and will be named Picture 1, Picture 2, etc. This file can then be loaded into a graphics software package (Adobe Illustrator, Aldus Superpaint, etc.) and sent to your printer. Figure 2 was created using this technique.

TRACECOPY, VERSION 2.0; USER'S GUIDE

The operation of TraceCopy, Version 2.0, is very similar to that of TracePlot. The parameter input screen is much simpler because parameters specific to plotting are eliminated (plotting style, plot direction, timing line annotation increment, gain, overlap between adjacent traces, and header word for annotation). A parameter for the output file name is added.

The remaining plotting parameters in TracePlot are used as copying parameters in TraceCopy:

1. The sequential trace in the data file to **COPY** first
2. The **Minimum COPY** time, in milliseconds
3. The **Maximum COPY** time, in milliseconds
4. Total number of traces to **COPY**
5. The trace increment for **COPY**ing

As with TracePlot, you must first select the input file. TraceCopy does not use a PDF-file; default parameters are calculated from the number of samples/trace and sample interval stored in the file's header. As with TracePlot, if file's header contains unreasonable values, you will have the opportunity to provide these parameters directly. The parameters that you provide directly will replace the invalid parameters in the output file's header. This feature allows you to repair an invalid file header by copying all the traces from the input file.

The initial output file name will be the same as the input file name, with the words "copy of" attached to the beginning of the file (e.g. if the input file is SEGYPDATA, the output file will be COPY OF SEGYPDATA). You can provide a different output file name by choosing the Output File item of the File menu.

Note: If you provide a file name that already exists, you will be asked if you wish to replace the existing file. Answer Yes to this item, even if you wish to append traces to the end of the file. When the copy process begins, you will be able to tell the program to append traces to the end of the file (see below).

Begin the copying process by clicking on the copy button near the top of the screen. The program will check the copying parameters to make sure that the minimum and maximum times are within the actual data range and that the maximum time is \geq minimum time. Next the specified output file is checked; if a file having the same name already exists (and is not empty), you will be given the opportunity to either overwrite the file, append traces to the end of the file, or select a different file. If you decide to append traces to the end of an existing file, those traces must have the same number of samples, sample interval, and sample type as the original file. If the output file has the same name as the input file, you will be informed. No other checks are made prior to beginning the copy process.

The 3200-byte descriptive header block and the 400-byte binary header are copied. If the number of samples per trace being copied is different from that of the original file, the appropriate values in the binary header and in each trace's header are changed. Exception: if you are appending traces to an existing file, the header of the input file will not be copied.

The copying can be paused and/or stopped, and the program can be ended, in the same way that plotting is paused, stopped, and ended.

APPENDIX

The following tables are lists of the header words for the 400-byte binary header and the 240-byte trace header as defined for the SEG-Y format. The descriptive terms are taken from Zihlman (1992b). Please refer to Barry, et al (1975) or Zihlman (1992b) for a detailed description of all pre-defined header words.

Table I. The 400-byte binary header. The first 60 bytes are pre-defined and are assigned to standard parameters. The remaining 360 bytes are reserved for optional information. TracePlot uses words 6, 8, and 10 only.

Word #	Byte #'s	Descriptive Term
1	[01 - 04]	jobID
2	[05 - 08]	lineNumber
3	[09 - 12]	reelNumber
4	[13 - 14]	tracesPerRecord
5	[15 - 16]	auxTracesPerRecord
6	[17 - 18]	sampleRateReel
7	[19 - 20]	sampleRateOrig
8	[21 - 22]	samplesPerTraceReel
9	[23 - 24]	samplesPerTraceOrig
10	[25 - 26]	dataFormatCode
11	[27 - 28]	CDPfold
12	[29 - 30]	traceSortCode
13	[31 - 32]	verticalSumCode
14	[33 - 34]	sweepFreqStart
15	[35 - 36]	sweepFreqEnd
16	[37 - 38]	sweepLength
17	[39 - 40]	sweepTypeCode
18	[41 - 42]	sweepChannelTraceNumber
19	[43 - 44]	sweepTraceTaperLengthStart
20	[45 - 46]	sweepTraceTaperLengthEnd
21	[47 - 48]	taperType
22	[49 - 50]	correlatedData
23	[51 - 52]	binaryGainRecovered
24	[53 - 54]	amplitudeRecovery
25	[55 - 56]	measurementSystem
26	[57 - 58]	impulseSignalPolarity
27	[59 - 60]	vibratoryPolarityCode
	[61 - 400]	Unassigned for optional information

Table II. The 240-byte binary header. The first 180 bytes are pre-defined and are assigned to 71 standard parameters. The remaining 60 bytes are reserved for optional information. TracePlot can annotate the top of the display using any of the 101 possible header words. The Display-Label will be printed at the top left of the screen display to identify the header word being used.

Word #	Byte Numbers	Descriptive term	Display Label
1	[01 - 04]	traceSequenceNumberLine	LNSQ
2	[05 - 08]	traceSequenceNumberReel	RLSQ
3	[09 - 12]	origFieldRecordNumber	FFID
4	[13 - 16]	fieldRecordTraceNumber	FFTR
5	[17 - 20]	energySourcePt	ESP#
6	[21 - 24]	cdpNumber	CDP
7	[25 - 28]	traceCdpNumber	CDPTR
8	[29 - 30]	traceIdNumber	TRID
9	[31 - 32]	verticallySummedTraces	VSUM
10	[33 - 34]	horizontallyStackedTraces	HSUM
11	[35 - 36]	dataUse	TYPE
12	[37 - 40]	sourceToReceiver	DIST
13	[41 - 44]	receiverElevation	RELEV
14	[45 - 48]	sourceSurfaceElevation	SELEV

15	[49 - 52]	sourceDepth	SRCZ
16	[53 - 56]	receiverDatumElevation	RDATM
17	[57 - 60]	sourceDatumElevation	SDATM
18	[61 - 64]	sourceWaterDepth	SW-Z
19	[65 - 68]	groupWaterDepth	GRW-Z
20	[69 - 70]	elevationScalar	ESCAL
21	[71 - 72]	coordinateScalar	CSCAL
22	[73 - 76]	sourceXCoordinate	SRC-X
23	[77 - 80]	sourceYCoordinate	SRC-Y
24	[81 - 84]	groupXCoordinate	GRP-X
25	[85 - 88]	groupYCoordinate	GRP-Y
26	[89 - 90]	coordinateUnits	UNITS
27	[91 - 92]	weatheringVelocity	WVEL
28	[93 - 94]	subWeatheringVelocity	SWVEL
29	[95 - 96]	sourceUpholeTime	S-UH
30	[97 - 98]	groupUpholeTime	GR-UH
31	[99 - 100]	sourceStaticCorrection	SSTAT
32	[101 - 102]	groupStaticCorrection	GSTAT
33	[103 - 104]	totalStaticApplied	TSTAT
34	[105 - 106]	lagTimeA	LAG-A
35	[107 - 108]	lagTimeB	LAG-B
36	[109 - 110]	delayRecordingTime	DELAY
37	[111 - 112]	muteTimeStart	MSTRT
38	[113 - 114]	muteTimeEnd	M-END
39	[115 - 116]	numberOfSamples	NSAMP
40	[117 - 118]	sampleInterval	SINT
41	[119 - 120]	gainType	GAINT
42	[121 - 122]	gainConstant	GAINC
43	[123 - 124]	initialGain	INITG
44	[125 - 126]	correlated	CORR
45	[127 - 128]	sweepFrequencyStart	SWFRS
46	[129 - 130]	sweepFrequencyEnd	SWFRE
47	[131 - 132]	sweepLength	SWLN
48	[133 - 134]	sweepType	SWTYP
49	[135 - 136]	sweepTraceTaperStart	STAPS
50	[137 - 138]	sweepTraceTaperEnd	STAPE
51	[139 - 140]	taperType	TAPTY
52	[141 - 142]	aliasFilterFrequency	FRALS
53	[143 - 144]	aliasFilterSlope	SLALS
54	[145 - 146]	notchFilterFrequency	NOTCH
55	[147 - 148]	notchFilterSlope	NOTSL
56	[149 - 150]	lowCutFrequency	LC-FR
57	[151 - 152]	highCutFrequency	HC-FR
58	[153 - 154]	lowCutSlope	LC-SL
59	[155 - 156]	highCutSlope	HC-CT
60	[157 - 158]	yearRecorded	YEAR
61	[159 - 160]	dayOfYear	DAY
62	[161 - 162]	hourOfDay	HOUR
63	[163 - 164]	minuteOfHour	MIN
64	[165 - 166]	secondOfMinute	SEC
65	[167 - 168]	timeBasisCode	TIMBS
66	[169 - 170]	traceWeightingFactor	TRWT
67	[171 - 172]	geophoneNumberRollSwitch1	SWPOS
68	[173 - 174]	geophoneNumberTrace1	G#TR1
69	[175 - 176]	geophoneNumberLastTrace	G#LST
70	[177 - 178]	gapSize	GAPSZ
71	[179 - 180]	overTravel	OVER
72	[181 - 182]	Optional Header Word 72	H72
73	[183 - 184]	Optional Header Word 73	H73
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.	.	.	.
.	.	.	.
101	[239 - 240]	Optional Header Word 101	H101

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