

User's Manual
SeisOpt[®] Picker[™] Version 1.5



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1.0 SeisOptPicker Overview

SeisOptPicker is a first arrival, picking module that can read in raw shot gathers recorded in many different formats (for example, ABEM Terraloc, SEG-Y, SEG-2, and ES1225) and perform automatic and manual picking of first breaks. The picks and the survey geometry information can then be easily exported into files that can be used directly by SeisOpt @2D, **Optim's** refraction interpretation software. In addition, the module also allows the user to interactively input and edit survey geometry, manipulate various display options, perform basic processing like Automatic Gain Control (AGC) and filtering, display and edit trace header values, compute frequency spectra and do a linear velocity analysis. It also has a printing module that enables the user to produce report-quality output. See the 'Installation' pamphlet for details of the installation procedure. The installation directory for SeisOptPicker is **C:\Optim\Pickerv15** if installed as a stand-alone, **C:\Optim\TKv20** if part of SeisOpt ToolKit™, and **C:\Optim\Prov20** if part of SeisOpt Pro™ v2.0. A shortcut is placed in the desktop and it can also be launched from the Programs Menu which and be accessed from the Start button. Figure 1 shows this desktop icon.



Figure 1: Desktop icon of SeisOptPicker. Double-click on it to launch the first-break-picking module

2.0 The SeisOptPicker User Interface

Selecting SeisOptPicker from the desktop by clicking on its icon (Figure 1) brings up the SeisOptPicker user interface. Figure 2 shows this window, or main graphical user interface (GUI), as it appears when it first opens up. One can either select the operations to perform using the pull-down menu or click on the appropriate icon (Figure 2) arranged along the top of the GUI (Figure 3).



Figure 2: Use these icons, arranged along the top of the GUI, or use the pull-down menus

The functionality of the icons in Figure 2 is listed below, starting from left to right:

- ◆ Load a new seismic SU file
- ◆ Launch the help file (nonfunctional).
- ◆ Re-display the shot records
- ◆ Zoom: press on a corner, with the left mouse button, and release on the other corner of the area to enlarge. To un-zoom, click on the re-display full record icon (cross-shaped double arrow headed lines).
- ◆ Launch seismic data conversion module
- ◆ Print a seismic record
- ◆ Re-display the full record
- ◆ Reverse trace polarity: select this option and click on a trace
- ◆ Kill traces: select this option and click on traces to kill it
- ◆ Calculate Frequency spectrum: select one or many traces whose frequency spectra are to be calculated
- ◆ Stop kill, reverse, zoom, and frequency modules

- ◆ Enter survey geometry
- ◆ Export to SeisOpt @2D: input files used by SeisOpt @2D are automatically written
- ◆ Exit SeisOptPicker

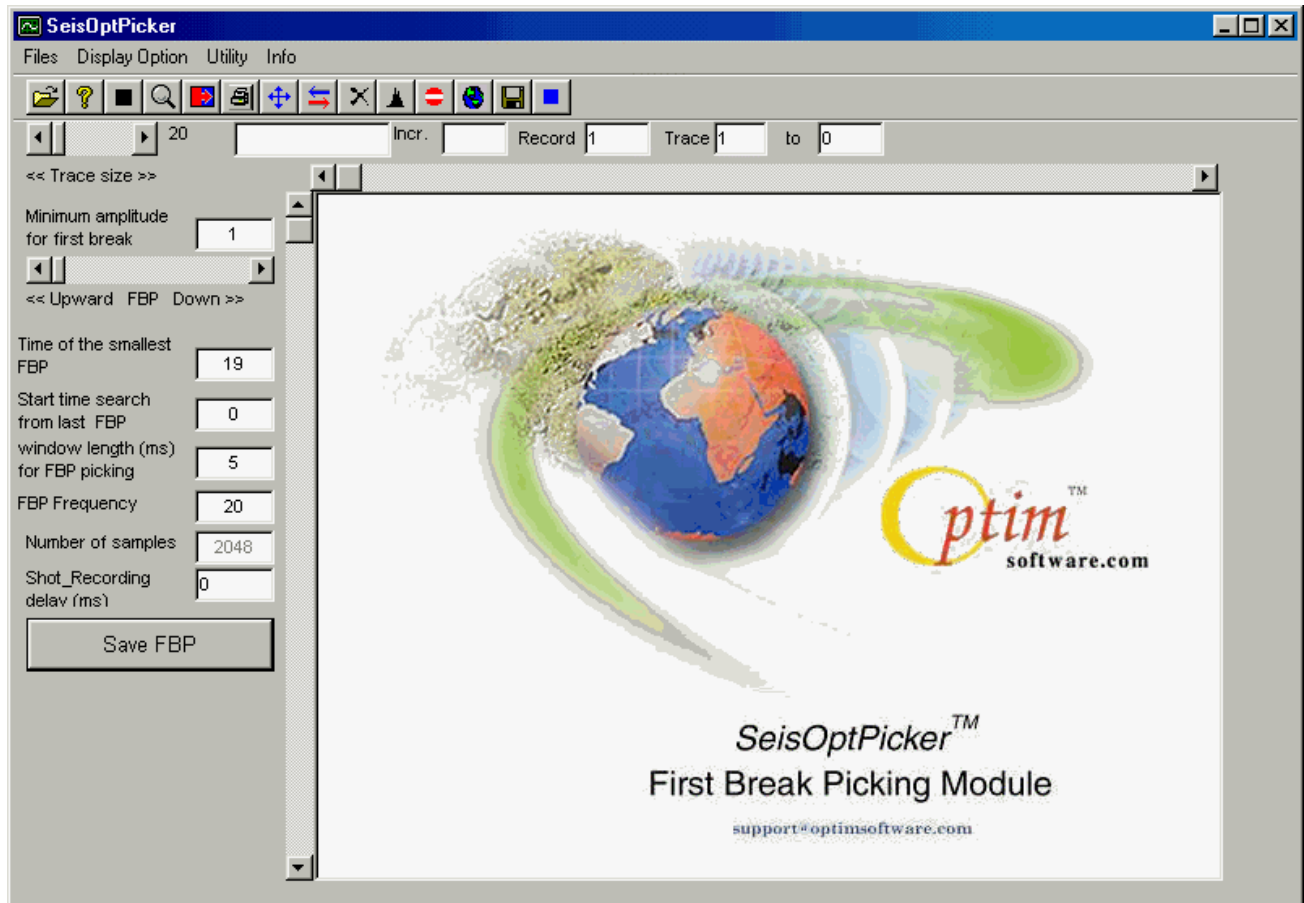


Figure 3: The main graphical user interface (GUI) of SeisOptPicker

3.0 Converting Data to SU Format

Before loading the field data, it needs to be **converted** to **Seismic Unix (SU)** format (© CWP, Colorado School of Mines). This format is very close to standard SEG-Y format, the main difference being the lack of record headers (3,600 bytes). To do this, choose the “Convert field data to SU format” option under the ‘Files’ menu or click the “arrow” icon (Figure 2) in the main GUI (Figure 3) The window shown in Figure 4 opens up.

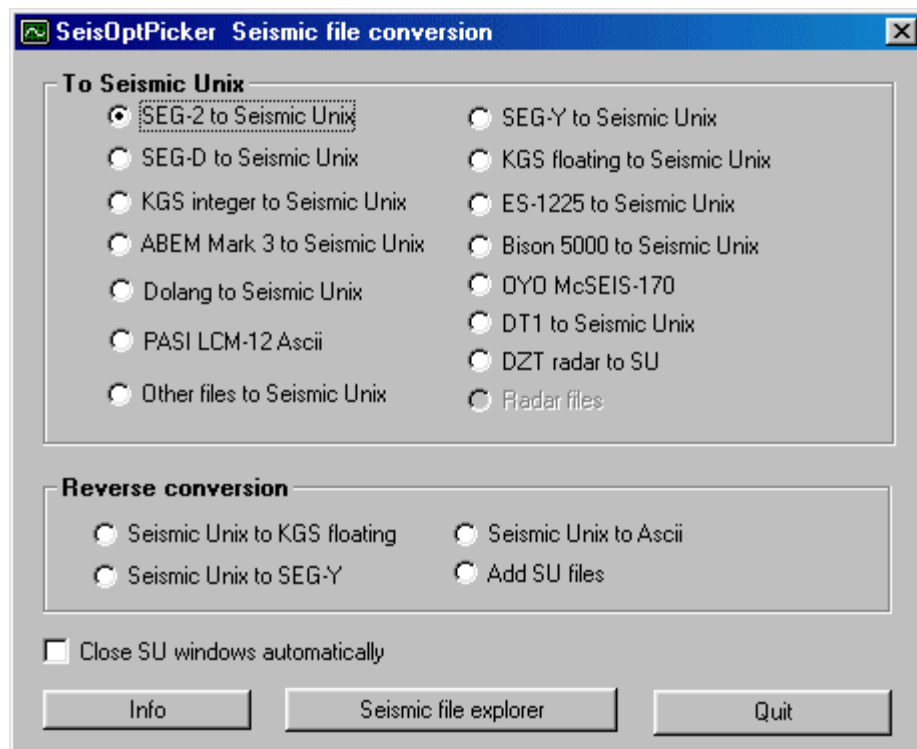


Figure 4: Seismic file conversion window. Choose the conversion type and click “Convert”

Now, depending on the format of your data, choose the conversion you want to perform and click the button “Convert”. If you are not familiar with the format of your data, please contact us at support@optimsoftware.com. On the other hand, if you do know the format and all the particulars regarding the file (like number of samples, sample rate, etc), but it does not appear on the list, choose “Other files to Seismic Unix”. In almost all the conversion modules, you will find an “Info” or “?” button which you can click to get an explanation about the parameters required to execute that particular conversion. In the following sections, we only enumerate on conversion from SEG-2 and SEG-Y formats

3.1 SEG-2 to SU conversion

In order to convert SEG-2 files to SU, choose the “SEG-2 to Seismic Unix” option in Figure 4 and press the “Convert” button. The window shown in Figure 5 will open up.

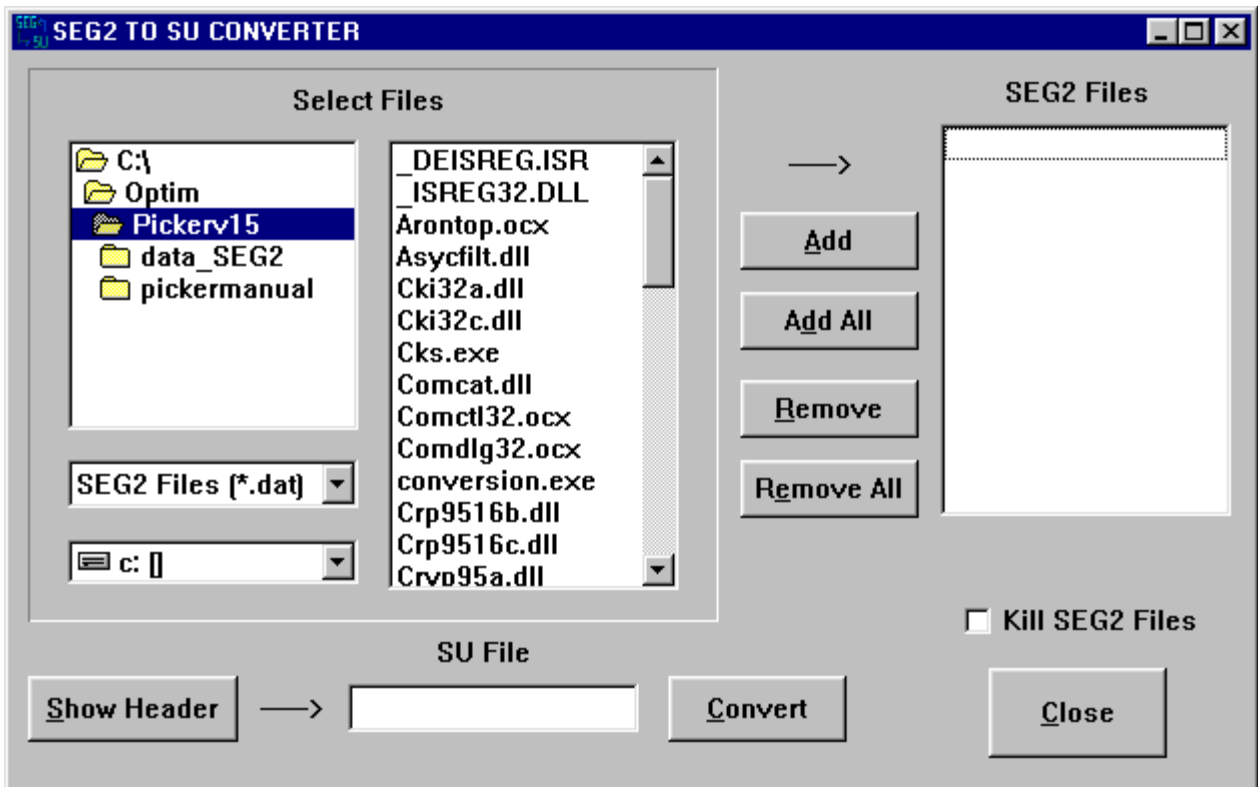


Figure 5: Window that opens up when clicking "Convert" after choosing the SEG-2 to SU conversion option

Now, choose either a single SEG-2 (*.DAT) file or multiple SEG-2 files (if more than one shot gather) and press "Add", if there are other files in the directory, or press "Add All" if these are the only files in the directory.

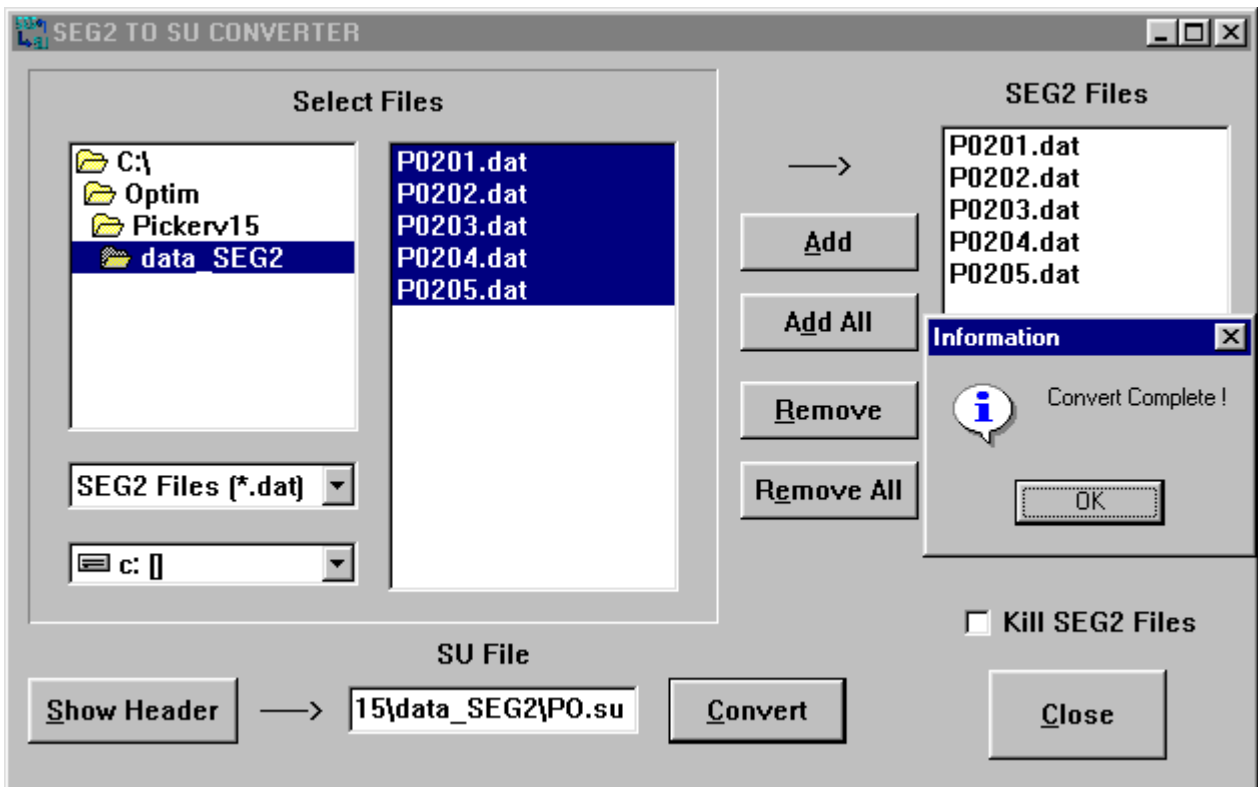


Figure 6: The five SEG-2 files are converted into a single SU file called PO.su

The default name of the SU file is default.su. To change it, double-click in the space below “SU File” and enter the desired file name. For example, we chose the files in subdirectory data_SEG2 and name the converted SU file (one file) as “PO.su”. On pressing the ‘Convert’ button, SeisOptPicker executes the conversion and the window “Convert Complete” shows up (Figure 6). Click “OK” on the convert complete window to complete the conversion. You can check the header values of the converted SU file by clicking “Show Header”.

The converted SU file is now ready to be loaded onto the main GUI (Figure 3) of SeisOptPicker.

3.1 SEG-Y to SU conversion

SEG-Y files come in different flavors, so one needs to try out various options to perform the conversion properly. First choose “SEG-Y to Seismic Unix” from the options in the conversion window (Figure 4). The window shown in Figure 7 opens up. It is always a good practice to check and see if the SEG-Y file you are about to read in has the correct file size. You can calculate the number of bytes and learn more information about the parameters listed in Figure 7 by clicking the "SEG-Y" button. A help file, shown in Figure 8, will open up.

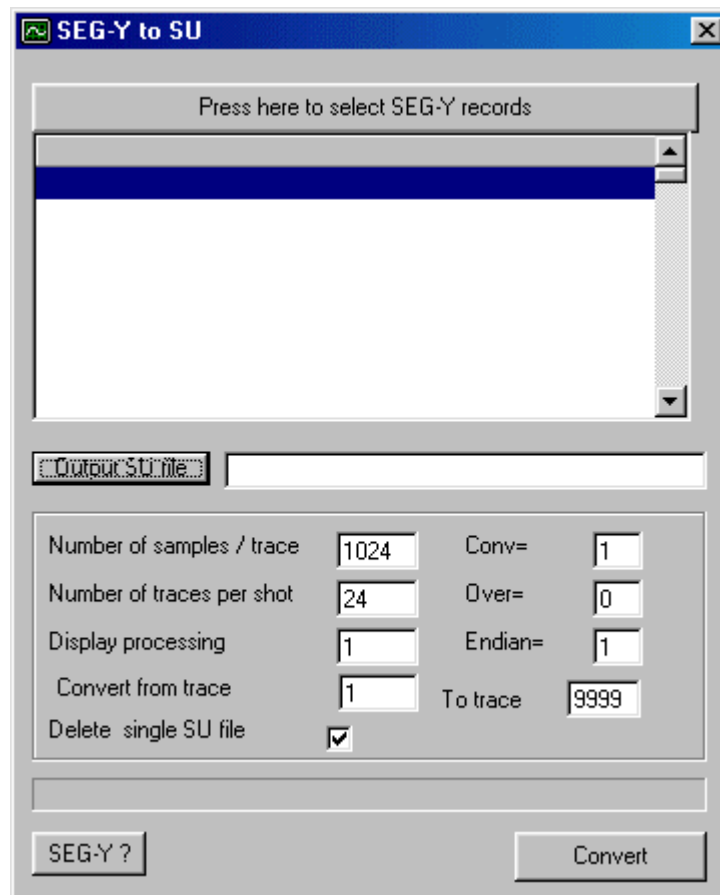


Figure 7: SEG-Y to SU initial conversion window

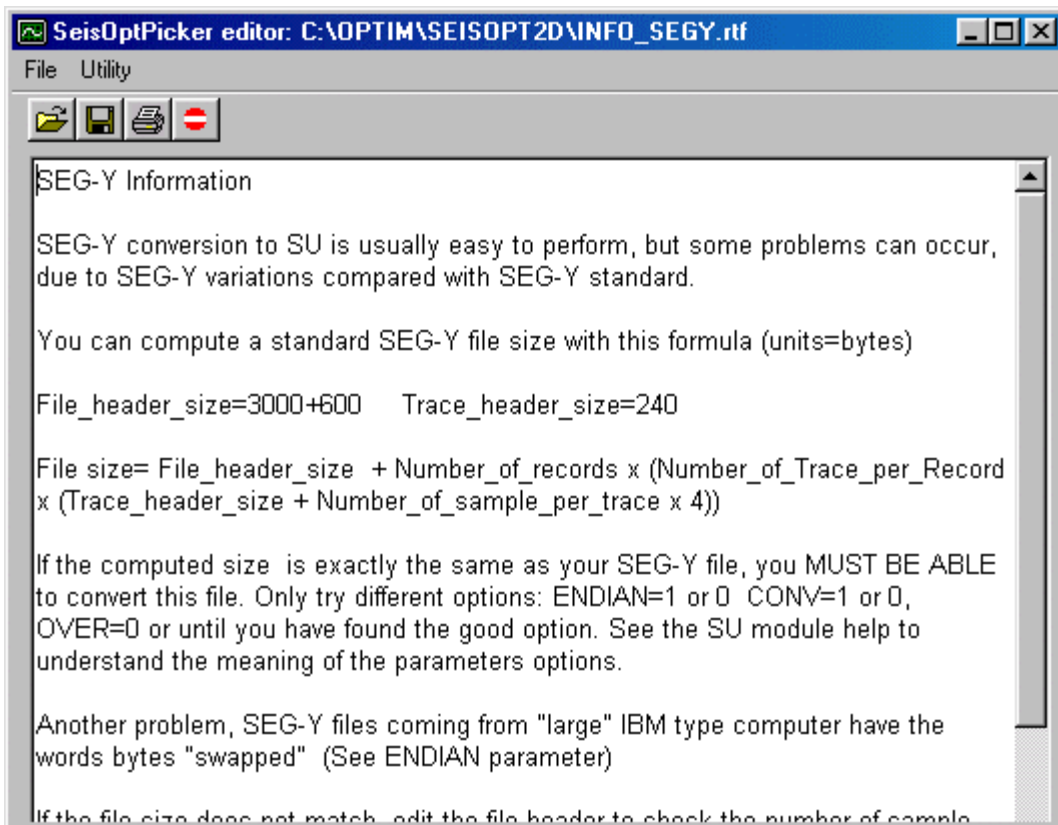


Figure 8: SEG-Y help file window

Press the button “Press here to select SEG-Y files” and choose the file to be converted as shown in Figure 9.

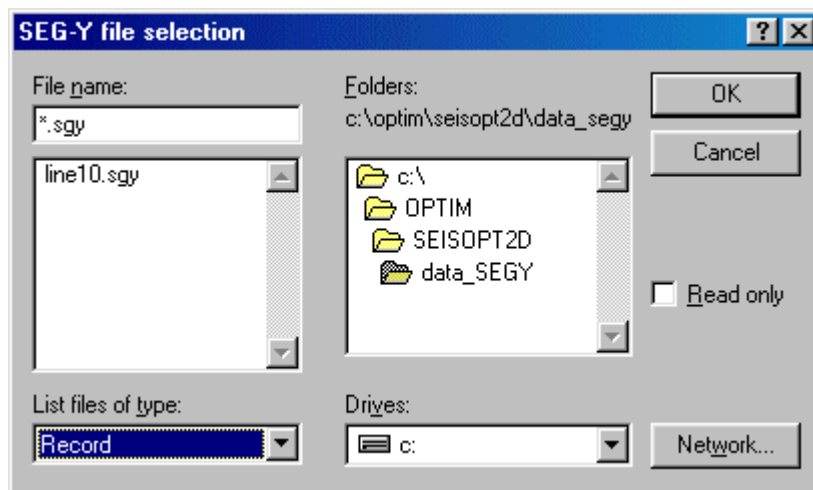


Figure 9: Choose the SEG-Y to be converted and click "OK"

The default SU format output file name created by SeisOptPicker has the extension ‘.su’ appended on to the main part of the SEG-Y filename. For example, if the input SEG-Y file name is line10.sgy the default output SU filename will be line10.su. You can change the pathname and filename by entering the desired names in the space next to “Output SU file”. After loading the SEG-Y file, you will sometimes need to set the number of samples/trace and the number of traces by entering the appropriate values. The other values that need to be set are as follows:

Conv: It can assume two values 0 or 1. If set to 1, the routine converts IBM floating point numbers into native format of the machine. If set to 0, it will assume data is in native format. In short, depending on the type of machine (that is, PC's DEC's or UNIX) the floating-point format of the traces will be different.

Over: This is a flag for whether or not to override the format of the binary SEG-Y file header. This routine supports three formats:

1. IBM floating point (2 byte)
2. IBM fixed point (4 byte)
3. IBM fixed point (2 byte)

So, if you set the value of over to 0, the SEG-Y conversion routine will quit if the binary trace header is not one of the above. If you set over to 1, the routine will override the header format and attempt conversion.

Endian: Set this equal to 0, for little-endian machines like PC's and DEC's. It is set to 1, for big-endian machines like SUN's and IBM's. For SeisOpt Picker, this is usually set to 0.

Unfortunately, given the variability of SEG-Y formats, you will have to play with different combinations of the above for the conversion to work correctly. If the conversion still fails, do the following:

Open up an MS-DOS window. Go to the directory containing your SEG-Y file and at the DOS prompt type:

```
segypread tape=[input file name] >[output file name] endian=0 conv=0  
over=1 ns=[number of samples/trace]
```

If this fails, you can go back to the main conversion window (Figure 4) and use the "Other files to Seismic Unix" option and manually enter in all the file parameters and try the conversion.

NOTE: Make sure the file names and the path names do not have any spaces in them. If they do, the conversion routine will not work.

4.0 Load and Display the Data

Once you have converted your field data to SU format, you are now ready to load and pick first arrivals. Use the "Read SU file" option under "Files" menu or click on the "open folder" icon in the main SeisOptPicker GUI (Figure 2) and choose the SU file you want to load. A "File parameters" dialog box opens up (Figure 10), in which you can set parameters like amplitude, number of traces to display, which traces to display, sample rate, and field record to display first.

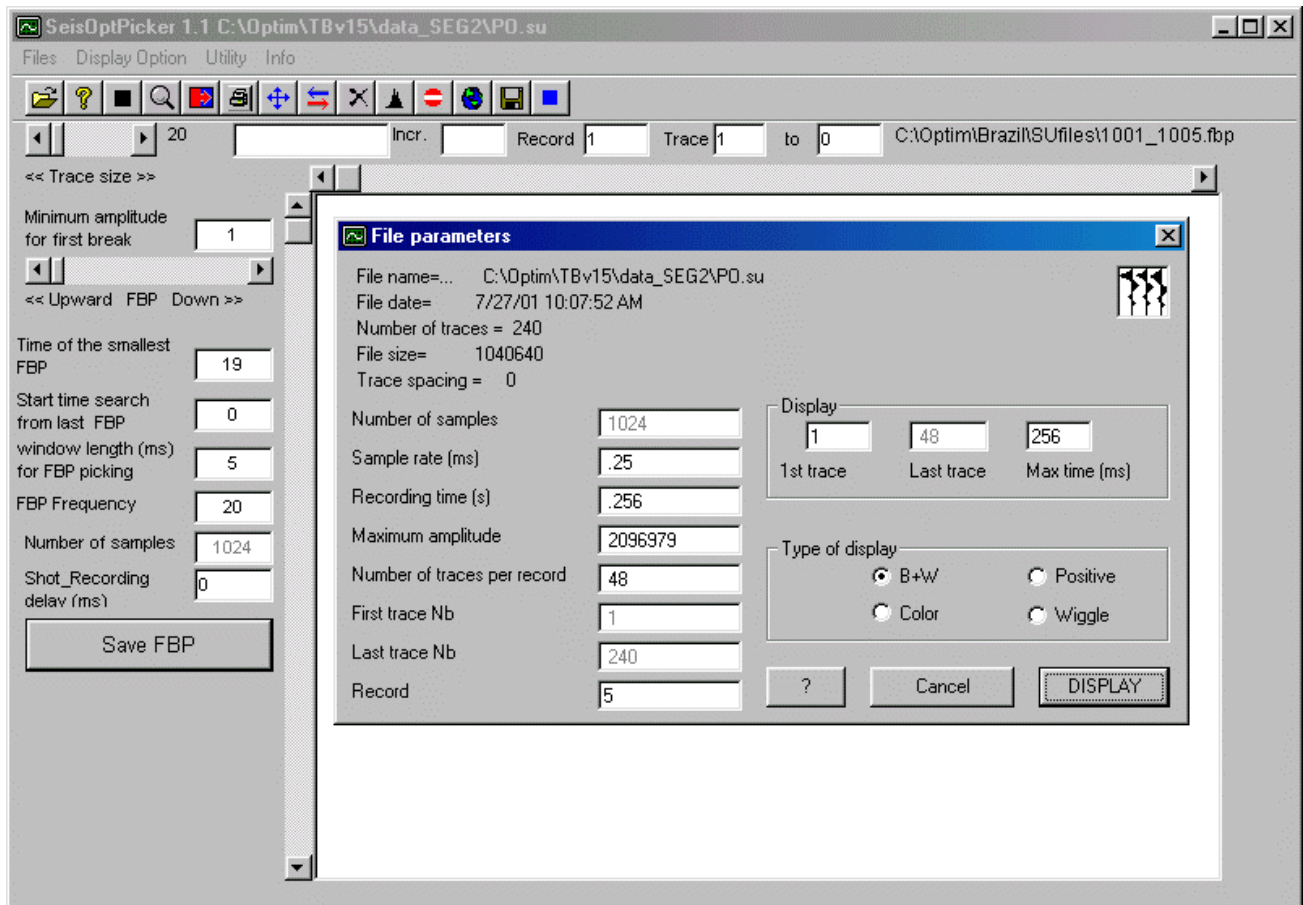


Figure 10: Loading a SU file. Adjust display parameters in the "File parameters" window, if needed

Click the "DISPLAY" button and the data will be displayed (Figure 11).

You can change the display parameter by choosing the various options under "Display Options" menu. Another parameter you may have to adjust is the "Trace Size" sliding bar, present in the upper left-hand corner of the SeisOptPicker GUI. You can increase the amplitude of the trace display by sliding the bar to the right. The other options include:

- ◆ Wiggle trace display and B&W or color display
- ◆ Polarity reversal
- ◆ Clip amplitudes to avoid overlapping
- ◆ Trace equalization or true amplitude display
- ◆ Interval of the time lines on the display can be adjusted
- ◆ Zoom in
- ◆ To see part of the recording time, press and release the mouse on the time scale

Note that depending on how many traces you specify to be displayed, one to all shot gathers will be displayed. For example, for the data set shown in Figure 11 (You can load the same data from C:\optim\Pickerv15\data_SEG2\PO.su) only a single gather is displayed. You need to use the scroll bar on the display window to scroll through the remaining shot gathers.

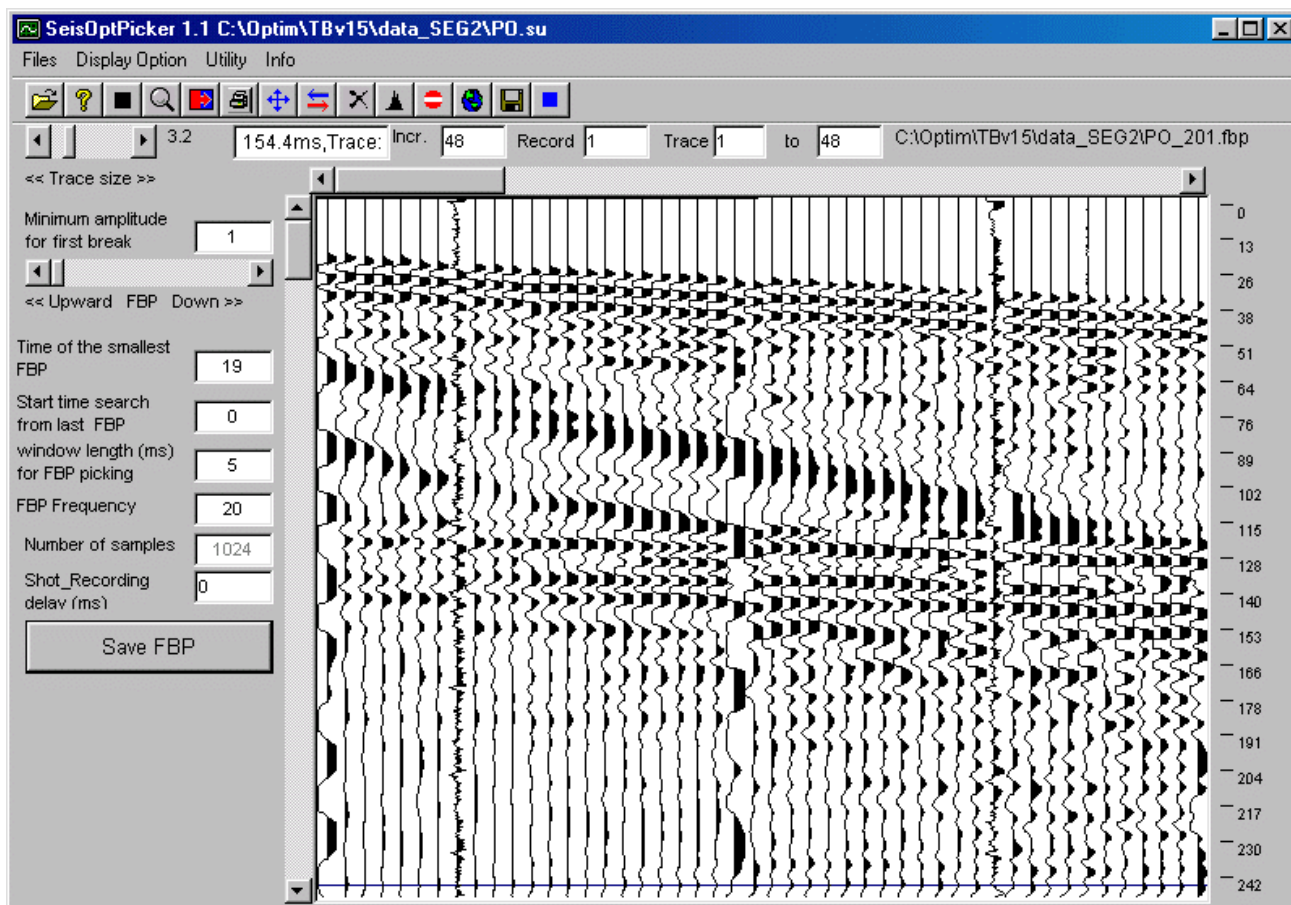


Figure 11: Display showing one shot gather. Use the options under “Display Option” menu to adjust the display parameters

5.0 Interactive Geometry Input

Before you go on to pick the data, you need to enter the survey geometry. Doing this will enable you to automatically export the files needed for SeisOpt @2D. The geometry module enables you to enter the geometry of the survey and record it in the trace headers. Note that the geometry of the data have to be entered and correct in order for the input files for SeisOpt @2D to be correct. To do this, first choose the “Enter Geometry data” option under the “Files” menu or click the “globe” icon from the main GUI (see icon in Figure 2). A dialog box opens up (Figure 12) inquiring the number of receivers in the survey. This is the number of receivers for the entire line and not just one spread. If you have more than one spread, this number should be the total number of receivers for the entire line. One thing to keep in mind is that different spreads must still have the same horizontal (x) origin coordinates.

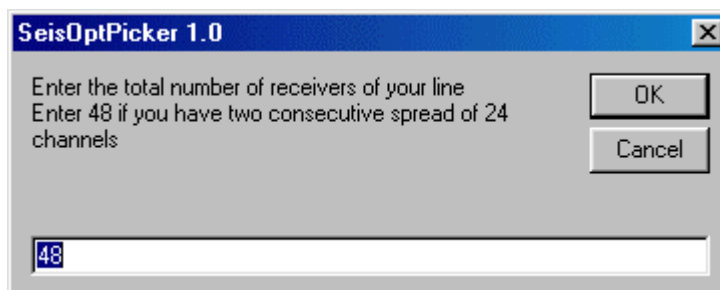


Figure 12: First step in interactive geometry input. Enter the total number of receivers in the survey

On clicking "OK", the window shown in Figure 13 opens up. Geometry is entered for a single shot gather at a time. If there are multiple spreads, the number entered next to 'First active channel' indicates the first active geophone the shot is recording into. The number of traces per record ('Trace / record') indicates the total number of channels that are active. In the schematic at the bottom of the window, the thick blue line indicates the active spread and the blue tick marks the active channels. The red-pronged 'V' represents the source. These change as the source coordinate and spread that is recording into are changed.

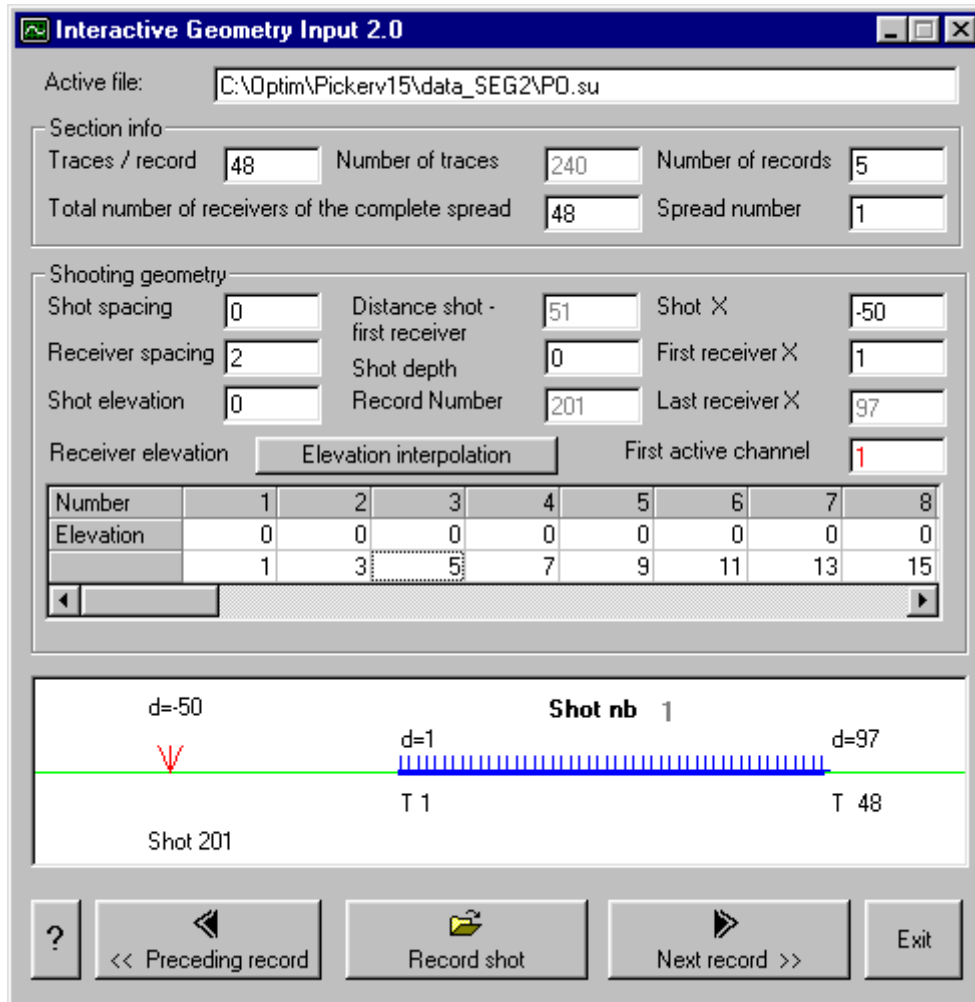


Figure 13: Interactive Geometry input window. Enter all parameters for the 1st shot and then click "Record shot" to save. Click "Next record" to proceed to next shot gather

Here are the steps to follow in order to record the geometry:

- ◆ Make sure the entries corresponding to "Number of Records", "Spread number", "Trace / Record", and "Total number of receivers..." are correct. If not, check the data set.
- ◆ Enter the 1st shot elevation.
- ◆ Enter the 1st shot horizontal ('X') distance.
- ◆ If the shot is buried, enter the shot depth.
- ◆ Enter the shot spacing. SeisOptPicker uses this value to automatically increment the subsequent shot x-coordinates. If the shots are irregularly spaced, just edit the 'Shot X' appropriately.
- ◆ Enter the receiver spacing.

- ◆ Enter the first receiver x (horizontal) location. Remember all receivers and shots in the survey must have only one origin coordinate. SeisOptPicker uses this value and the receiver spacing value to assign the horizontal coordinates to all the receivers. If the receivers are irregularly spaced, edit the appropriate receiver distance (from origin) in the row beneath the row marked 'Elevation'.
- ◆ Enter the elevation for each receiver in the row marked 'Elevation'. This needs to be done only once for all receivers. One can interpolate the elevation between the receivers by clicking on "Elevation interpolation". Note that the interpolation will work only if there is no elevation entries (should be blank) for the receivers whose elevation needs to be determined.
- ◆ Make the 'First active channel' entry. This is the first channel or geophone number of the active spread, that is, the spread that the entered source is recording into. For a single spread this will be the same for all the sources. For multiple spreads, this number has to be changed when the spread into which it is recording changes.
- ◆ Verify whether the 'Distance shot-first receiver' and 'Last receiver X' are correct.
- ◆ Verify the schematic diagram at the bottom to see if the survey diagram is correct
- ◆ Record this shot by clicking on "Record shot"
- ◆ Go to the next shot gather by clicking on "Next record"

Be sure that all the entries are correct before proceeding on to the next shot gather. Your entries will not be properly displayed when you scroll back.

6.0 Picking First Arrivals

SeisOptPicker can be used to pick first arrivals from the data, both in the manual and automatic mode. Before picking the data, make sure the delay time is correct. SeisOpt Picker automatically extracts the value of the delay time from the header and is displayed in the left hand side of the Picker window (above the 'Save FBP' button). This value is **subtracted** from the picks. Hence, if this value is negative, for example -10 , then 10 milliseconds will be added to your picks. So, if you wish 10 milliseconds to be subtracted from the picks, make sure this value is positive (that is 10 and not -10). To do this you can either change the value in this box or edit the header value *delrt*. To edit the header, go to the Utility menu and select Header edit. Scroll down the window and look for the 36th header value, *delrt*. The delay time for each trace is displayed. To change the value, double-click in each box. The color of the box changes to gray. Type the correct value. The color of the box changes to yellow. After the correct value is entered, double-click in the box once again till the color changes back to gray (Figure 13a). This has to be done for every trace for which the delay time has to be corrected. Once done, click the 'Display' button in the upper right hand corner for the changes to take effect. Now, when the SU file is re-displayed the correct delay time should appear in the

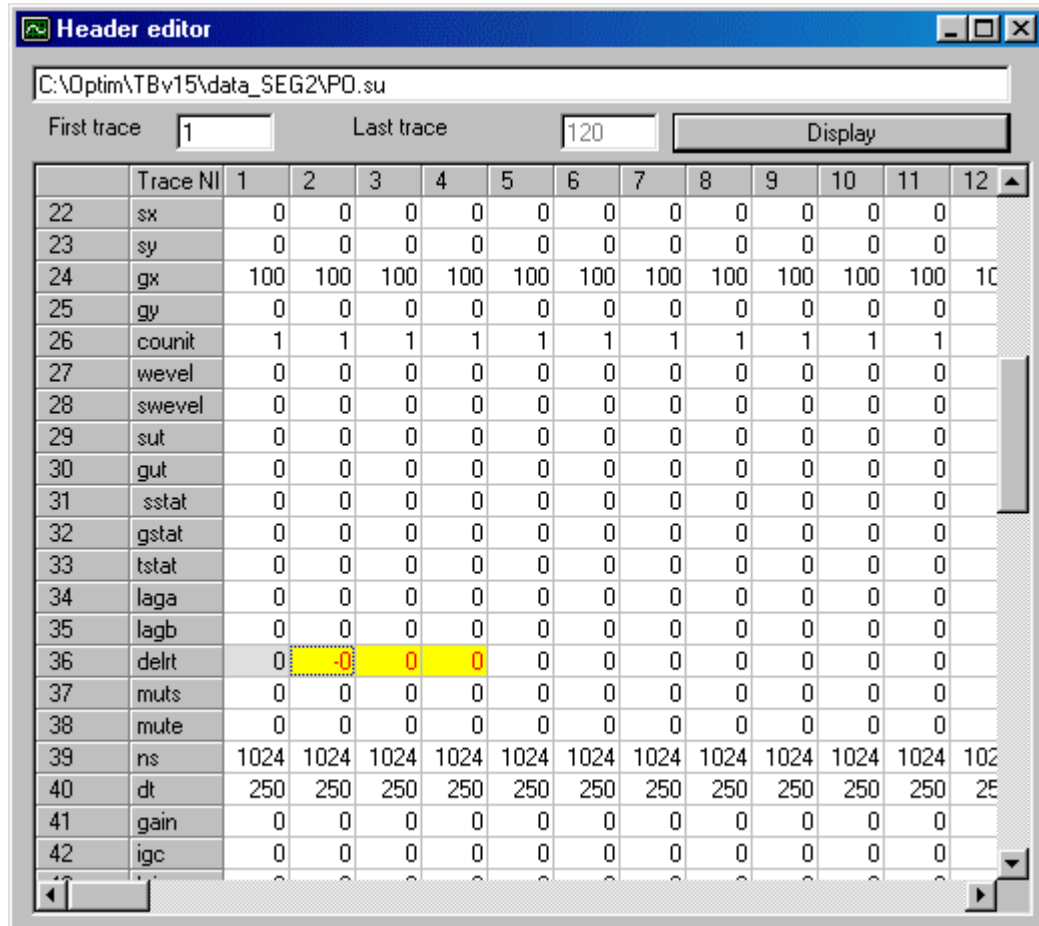


Figure 13a: Edit the header value 'delrit' if the delay time displayed is incorrect. Double-click on each box, enter the correct value and double-click once again till the box changes back to gray.

6.1 Manual Picking

To manually pick first arrivals, click the left mouse button at the first arrival time on each trace. The middle button can be used to delete bad picks. Use the "zoom" option, by clicking on the lens icon and drawing a box using the left button over the desired area, to enlarge any desired area for more accurate picking. To un-zoom, click on the cross-shaped double arrow headed icon. Click "Save FBP" button on the left-hand side of the GUI to record the picks. They will be saved to an ASCII file with the name, [shot gather].fbp, to the directory containing the data in units of milliseconds and to the header of the SU file in units of milliseconds multiplied by 10.

6.2 Automatic Picking

Click on the option "How to pick first breaks" under the "Info" menu in the main GUI to see the steps to follow in order to pick first arrivals. The information window is shown in Figure 14.

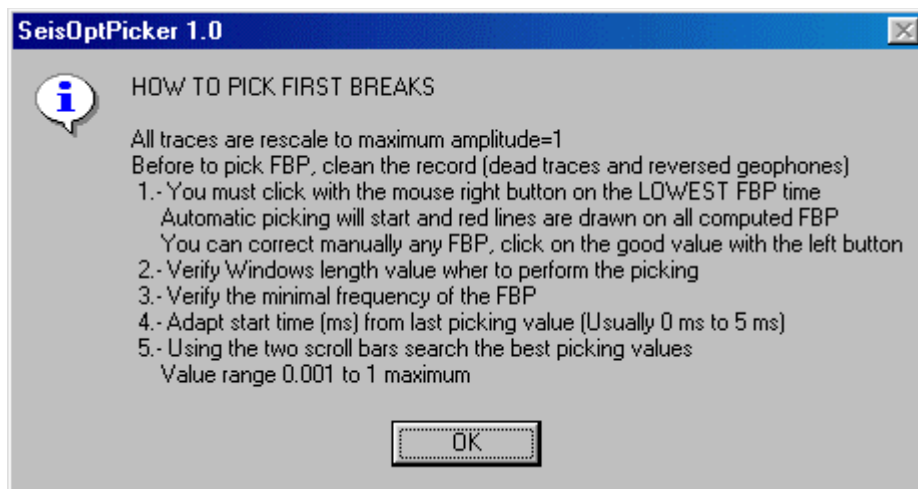


Figure 14: Online help window for automatic picking of first arrivals using SeisOptPicker

Note that for picking, SeisOptPicker re-scales the amplitude of the traces so that the maximum amplitude is 1. First, make sure only a single shot gather is displayed in the viewing area. You can use the options present on the upper part of the window, like “Incr”, “Record”, and “Trace” to adjust what you see in the window. Then, if needed, kill all bad or dead traces using the “Kill traces” option under the “Utility” menu, or using the kill icon along the top. Next, click the right mouse button on the lowest first break time. Generally, this will be on the trace closest to the source (shot). As soon as you do this, red marks will appear on all the traces corresponding to the automatic first break pick as estimated by the automatic picker. If they don't, it means the minimum amplitude of automatic first-break picker is too low. Use the "minimum amplitude" scroll bar to increase the amplitude for the automatic picker to use. Keep increasing the amplitude until a few red marks appear. The automatic picks will move up or down, as you change this "minimum amplitude" value. Stop when the picks are good. You can then adjust the following parameters on the left-hand side of the window (Figure 15) to improve the accuracy of the automatic picker:

- ◆ *Time of the smallest FBP:* This is value of the pick with the minimum time and corresponds to the first pick made during the automatic picking process.
- ◆ *Minimum amplitude for first-break:* This can either be adjusted by using the "minimum amplitude" slide bar on the upper left side of the main SeisOptPicker GUI (below “Trace Size”) or by typing in an appropriate number between 0 and 1. As described in the previous paragraph, adjust this value until the red tick marks appear on all the traces.
- ◆ *Start time search from last FBP:* This entry, in milliseconds, controls the time from which the automatic first break picker should start looking for the first-break pick on the adjacent trace. It is 0, the automatic picker will start looking for the first-break pick on the adjacent trace, at a larger source-receiver offset, starting at the same time as the current pick. This also means that it will not look for the pick at a time **earlier** than the current pick. So, for traces where the first arrival might come in earlier, the auto pick has to be manual adjusted.
- ◆ *Window length (ms):* This is the length, in milliseconds, of the time window for the automatic picker to look for the first arrival on a trace. For gathers where the first arrivals between adjacent traces are spaced far apart, that is, travel time gap between the adjacent first-break arrivals is large, this window length has to be set to a large value. Setting it too large or too small might cause the automatic picker to pick spurious arrivals.

- ◆ *FBP frequency*: This is the frequency of the first break arrivals. In noisy data, setting this frequency to the desired value will help the automatic picker to correctly pick the first arrival (see **Section 7.2**). In other cases this may not be a very useful parameter.

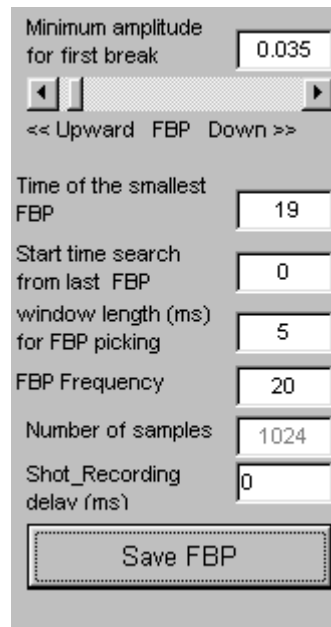


Figure 15: Parameters to adjust to get the optimize the automatic picking module

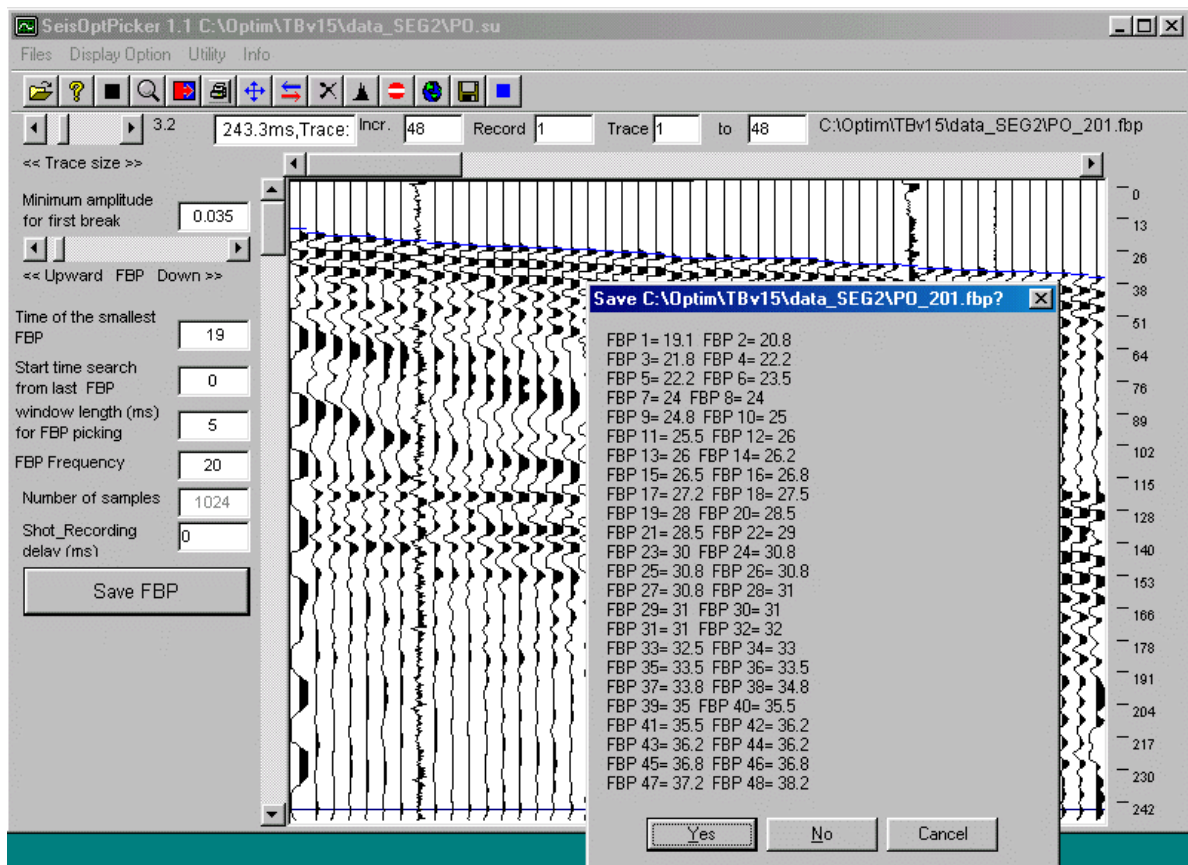


Figure 16: Automatic picking of first arrivals. Click on “Save FBP” on the GUI and “Yes” on the dialog box to save the picks to an ASCII file and to the SU file header

Once the automatic picks are made, you can adjust them manually using the mouse buttons. Use the left mouse button to move the pick and the middle button to set the pick to zero (delete the pick). When the picks are saved, the pick marks turn from red to blue. Clicking on the arrow or sliding the bar along the top of the window can display the next shot gather. Once again, begin the automatic picking by clicking the right button on the minimum first break time. Repeat the steps to fine-tune the picks. Once the picking is done, save it to an ASCII file (has .fbp extension and picks will be in units of milliseconds) by clicking on the "Save FBP" button (Figure 16). This will also store the picks in the header of the SU file in units of milliseconds and the value itself will be multiplied 10.

7.0 Other Utilities

7.1 Display/change trace amplitude values

Use the "Trace values display" option under "Utility" menu to look at the amplitude values of each trace. To change any value on the trace value display, go to the cell to modify and use the "back space" key to delete the existing value and enter the desired value. The cell will turn yellow (figure 17). To save the change, double-click on this cell. The background will turn gray and the changes are saved. This is a useful tool to modify values of bad traces.

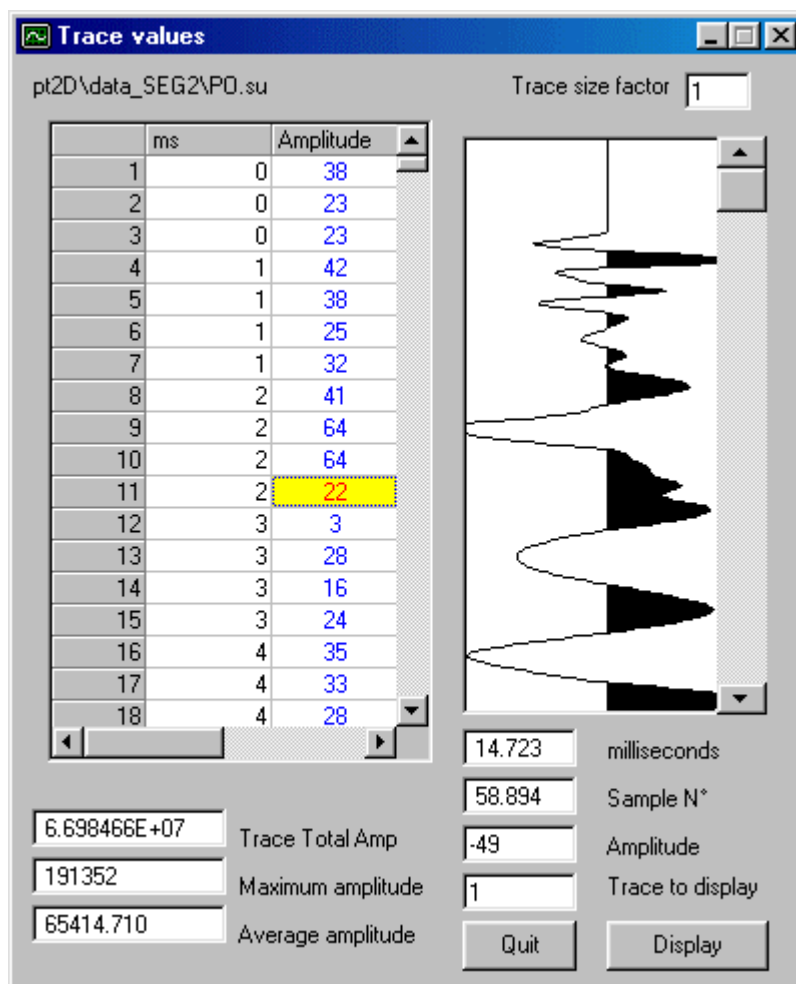


Figure 17: Adjust trace amplitudes

One can also edit the trace header and check or modify any value by choosing the “Header Edit” option under the ‘Utility’ menu.

7.2 Frequency spectra, AGC, and filtering

One can use the frequency spectrum module to determine the frequency content of the seismic data. Choose the “Frequency Spectrum” option location in the ‘Utility’ menu (or click on the spectrum icon). Now, use the press the left mouse button and draw a box (will be shaded blue) enclosing the traces whose frequency content needs to be determined. When the mouse is released, the window shown in Figure 18 opens up showing the frequency spectra. Note that only a maximum of 16 traces can be used for the frequency calculation at one time. One can toggle between one or all the traces by clicking the appropriate box in the legend. This module can also be used to determine the frequency of the first arrivals. For noisy data, this can be useful for fine-tuning the automatic picking process (see **Section 6.2**).

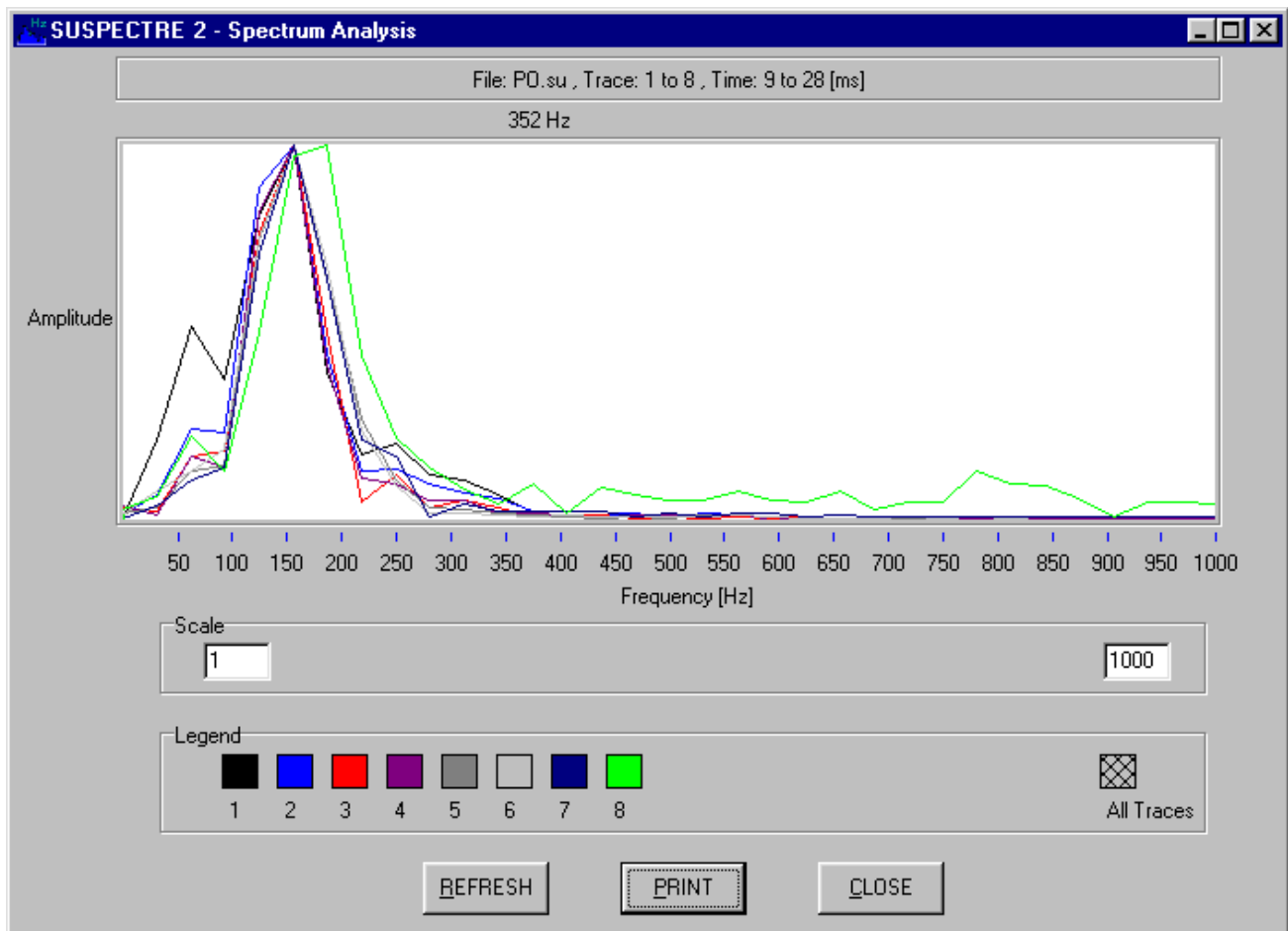


Figure 18: Frequency spectra of traces

Automatic Gain Control and filtering module (under Utility/Processing menu) can be used to enhance the first arrivals before running the automatic picker.

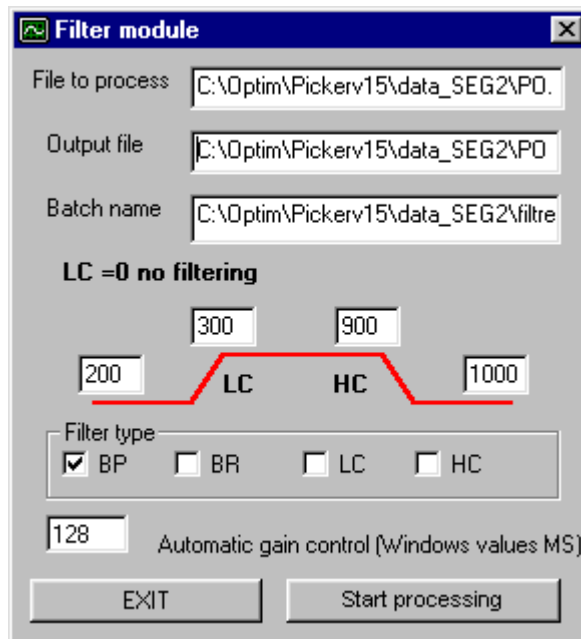


Figure 19: Perform AGC and filtering on the data

Now, perform AGC/Filter by choosing this option, present under the "Utility" menu under "Processing". The dialog box shown in Figure 19 opens up. By default, the file after AGC and/or filtering is written to the same directory as the input, SU format file and has ‘_flt’ appended to the file name. Note that the output file name is also in SU format and to see the result of the processing, this file has to be loaded (see **Section 4.0**) into SeisOptPicker GUI. Double clicking in the box next to ‘Output file’ and choosing the desired location and name can change the default output directory and filename. If one wishes to perform only filtering and not an AGC, delete the value in the ‘Automatic gain control’ box. If this value is set to 0, SeisOptPicker performs trace equalization. SeisOptPicker filtering module allows for 4 kinds of filter, namely, band pass (BP), band reject (BR), low cut (LC), and high cut (HC). The appropriate frequency values can be specified next to the appropriate boxes. To not perform any filtering, set the value of LC to 0. For AGC, it is recommended to choose a large time window (1/3 to 1/2 the total time).

After setting the desired parameters, click the ‘Start processing’ button. A dialog box opens up showing the parameters in a batch file that SeisOptPicker uses to perform the AGC/filtering operation. If filtering and AGC are being performed on the data set, the dialog box will show two operations - SUFILTER and SUGAIN, respectively. Click ‘Yes’ on the dialog box to continue the processing. An MS-DOS window opens up, showing the execution of the batch file. After the processing is done, the window closes. If on the other hand, this does not appear, or if it appears but does not close, it means the process was not properly executed. Check if the file exists and if the filename and/or the pathname have any spaces in them. AGC and filtering will not work if spaces exist. Rename the file to remove the spaces and run the process again.

NOTE: When using this module make sure the filenames and pathnames do not have any spaces in them. If they do, the AGC and filtering process will not work.

8.0 Exporting Picks for SeisOpt® @2D™

The picks and the survey geometry information can be exported to files that can be used as input files for SeisOpt @2D, the automatic velocity optimization software. To do this, choose the “Export

files SeisOpt @2D” option under “Files” or click on the “floppy” icon along the top of the GUI. The “SeisOptPicker Value Control” window shown in Figure 20 opens up.

Field record	205	205	205	205	205	205	205	205
Shot X location	150	150	150	150	150	150	150	150
Shot Y location	0	0	0	0	0	0	0	0
Shot Z location	0	0	0	0	0	0	0	0
Receiver X location	82	84	86	88	90	92	94	96
Receiver Y location	0	0	0	0	0	0	0	0
Receiver Z location	0	0	0	0	0	0	0	0
Receiver distance	80	82	84	86	88	90	92	94
First beak pick (ms)	23.5	23.2	22.2	21.5	21.5	20.5	20.2	20.5

Figure 20: Pick and geometry information to be exported to files for input into SeisOpt @2D

This lists the shot coordinates, receiver coordinates, receiver distance and first break picks. Note that the values displayed are those in the header. If the geometry has not been entered, the values will be incorrect. The scalar multiple for X and Y coordinate (of source and receivers) is listed on the top right corner. The actual value of the coordinates is obtained by dividing the displayed values by this number. This is due to the fact that the displayed header coordinate values can only be an integer. If needed, edit the values by clicking on the appropriate cell and typing in the correct value. If the values are correct, click “Save SeisOptPick files” button. Clicking the button will save three files, with the extensions _obs.txt (containing picks), _rec.txt (containing receiver coordinates, and _src.txt (source coordinates), to the directory containing the data.

50.00	0.00	48
1.00	0.00	48
47.00	0.00	48
97.00	0.00	48
150.00	0.00	48

Figure 21: View, edit, and/or print the input files to SeisOpt @2D

It uses the main name of the data file as the prefix for the filename. For example, if data filename is called PO.su the saved files will be called PO_src.txt, PO_obs.txt, and PO_rec.txt. Refer to the SeisOpt @2D manual for details on the format of the three files. After saving these files, the files can be further viewed, edited, and/or printed by first clicking on the "Show files" button. The window shown in Figure 21 opens up. Clicking on "S", "F" and "G" toggles between the source, picks, and receiver files, respectively.

9.0 Printing the Seismic Record

The SU data files displayed in SeisOptPicker can be printed using the print module. To use it, either choose the "Print SU file" under the "Files" menu or click the "printer" icon on the SeisOptPicker window. The "SuPrint" window shown in Figure 22 opens up.

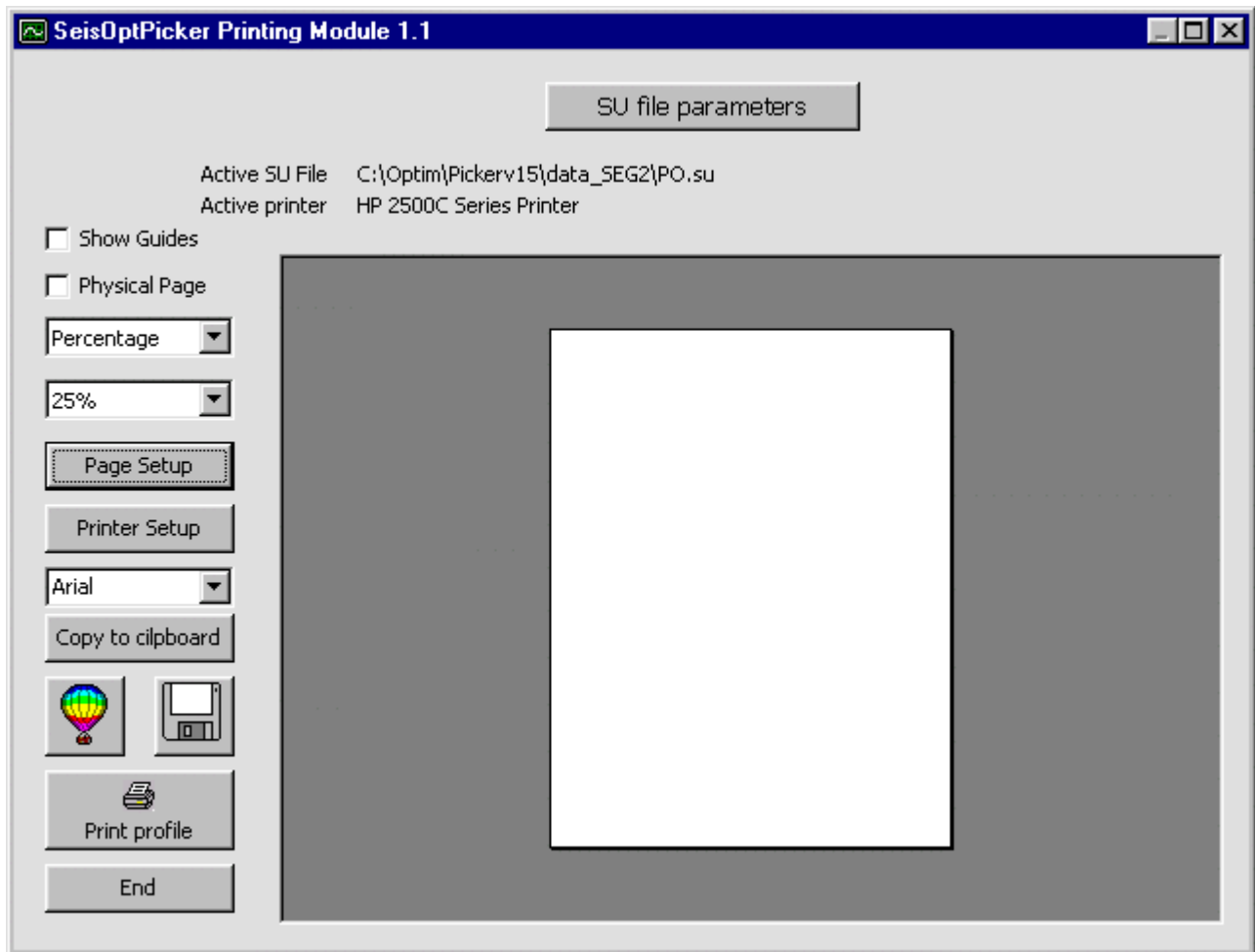


Figure 22: Set the page and printer properties. Choose the level of magnification and fonts to be used in the plot

Set the page and printer parameters in this window. Then, click on the "SU file parameters" button to bring up the "SuPrint drawing parameters" window shown in Figure 23.

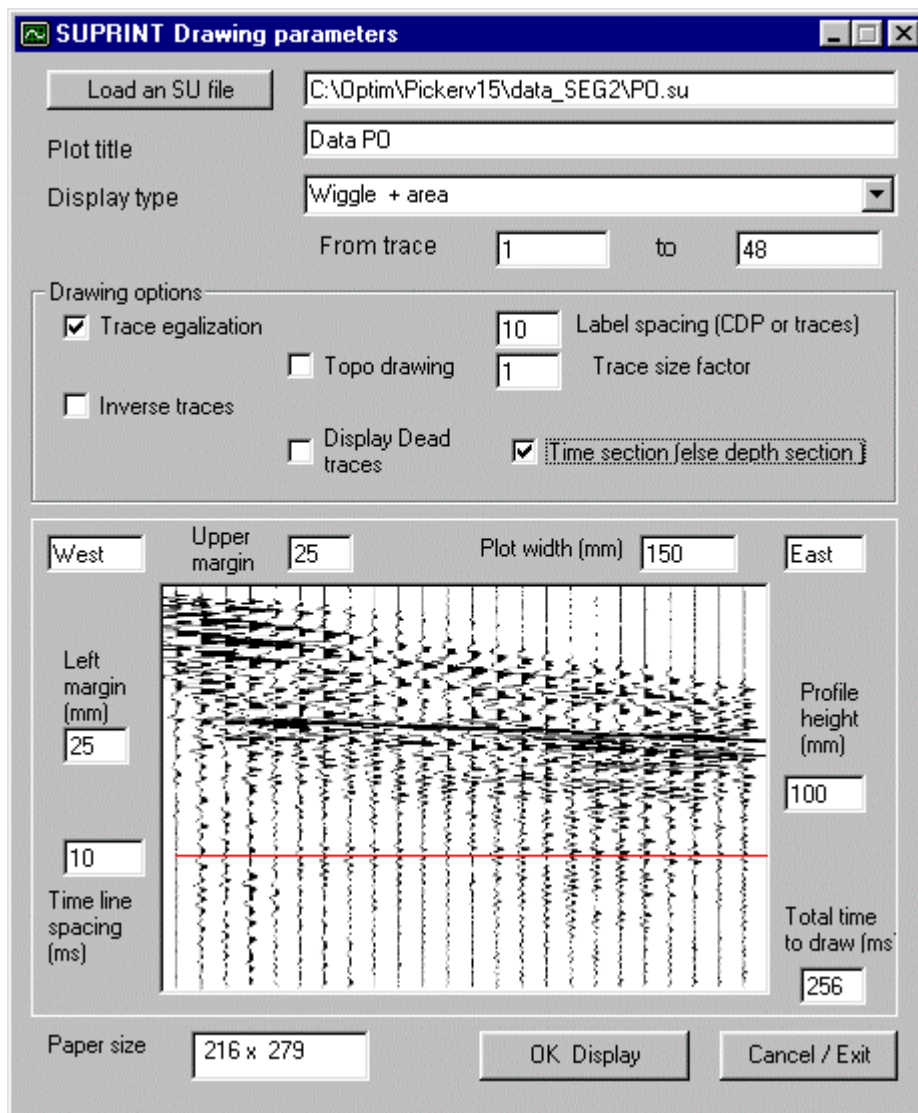


Figure 23: Set the plot parameters, including type of display, plot width and height and labels, in this window and click "OK"

In this window you can set the plot parameters, like, type display, plot size, trace size, paper size and label spacing. You can also set the plot title and labels. Note that the gather displayed on this window is **not** an image of the loaded SU file. It is just an image. On clicking "Ok Display" the window plot that will print will appear on the "SuPrint" window (Figure 24). Check to see if it is satisfactory. The plot can then be sent to a printer or saved as WMP file or stored in the clipboard, in order to paste the image in a report.

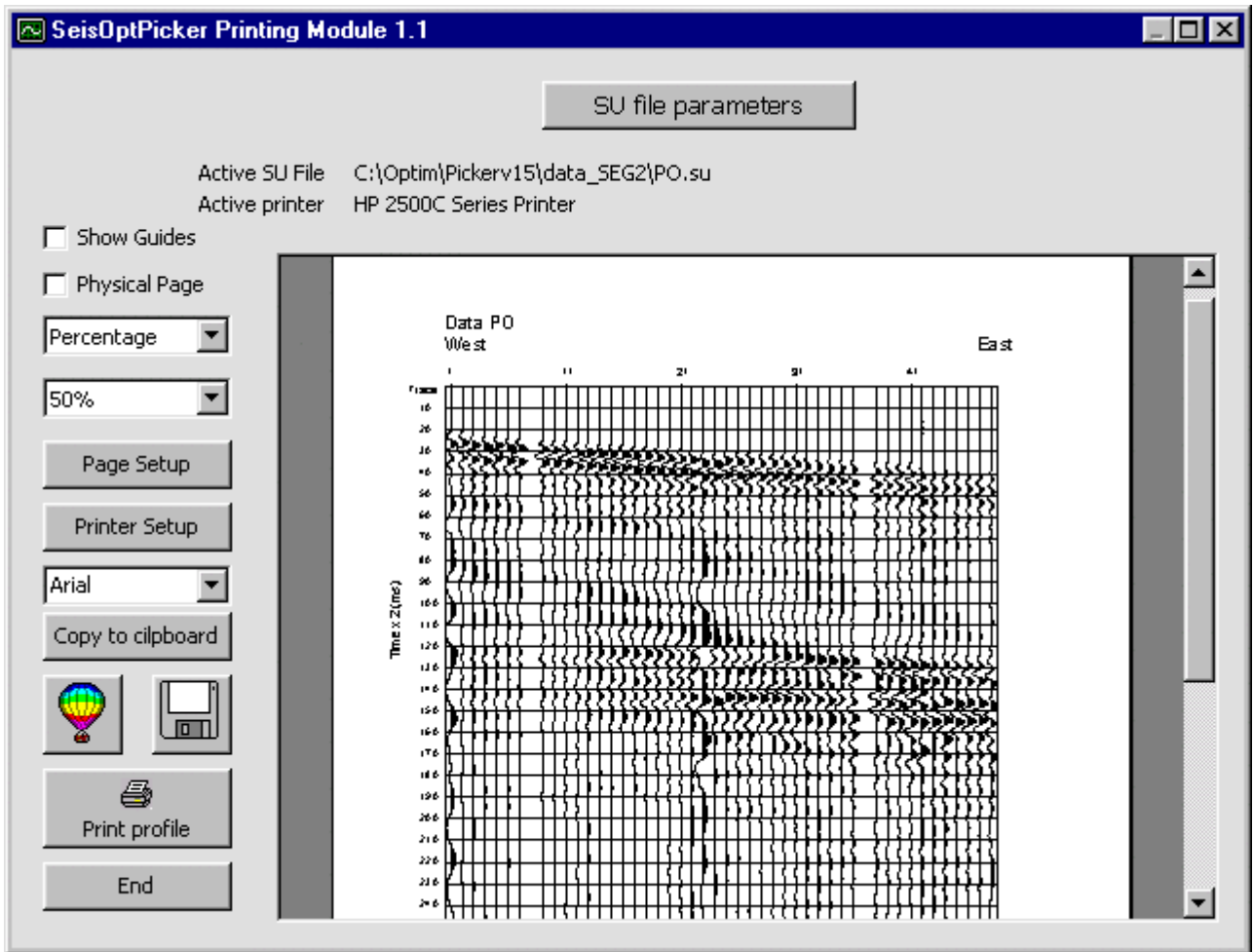


Figure 24: Preview the plot before printing. Change the level of magnification to see the plot preview properly.