

Introduction to the interpretation of seismic refraction data within REFLEXW

In the following the complete interpretation of seismic refraction data is described including import of the seismic data, picking the first onsets, putting together the picked traveltimes, assigning to specific layers and doing the layer inversion.

Another possibility of interpreting seismic refraction data is the refraction tomography (see modelling/tomography guide).

I. Import the data and pick the first onsets (done within the module 2D-dataanalysis)

1. Enter the module **2D-dataanalysis**
2. Activate the option **import**
3. Choose the following options within the **import menu**:

data type: single shot

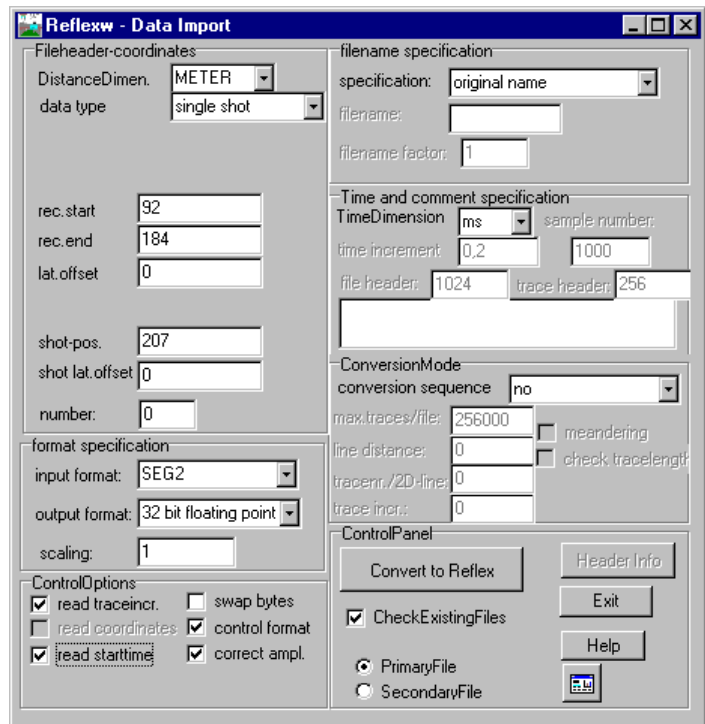
rec.start: start of the receiver line

rec.end: end of the receiver line

shot-pos.: position of the shot

outputformat: 32 bit floating point for a higher data resolution

To be considered for SEG2 or SEG2-data: the option **swap bytes** controls if the original data originate from UNIX (activate option) or DOS-machines (deactivate option). If the conversion fails try to change this parameter.

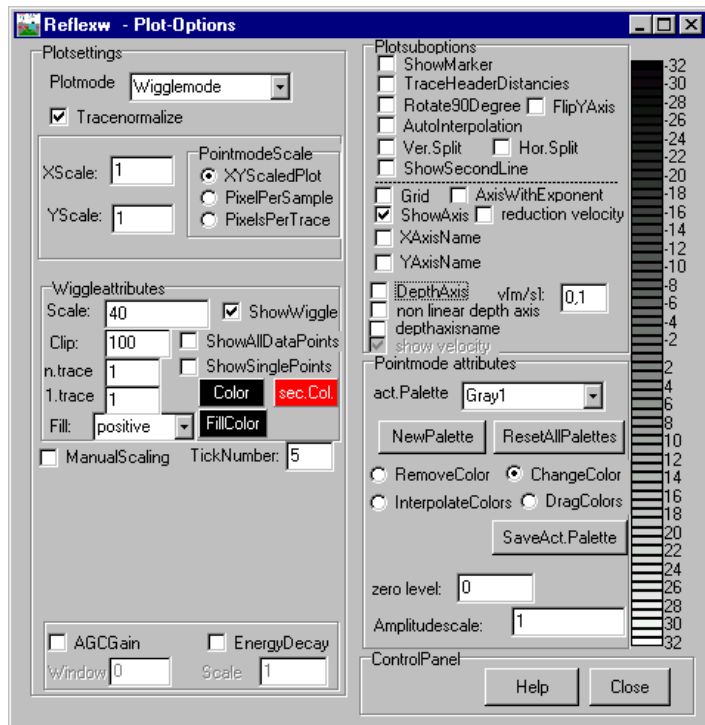


The following **plot options** should be set (the option may be activated within the import menu (the speed button below the help option):

Plotmode: Wigglemode

tracenormalize activated

XYScaledPlot activated

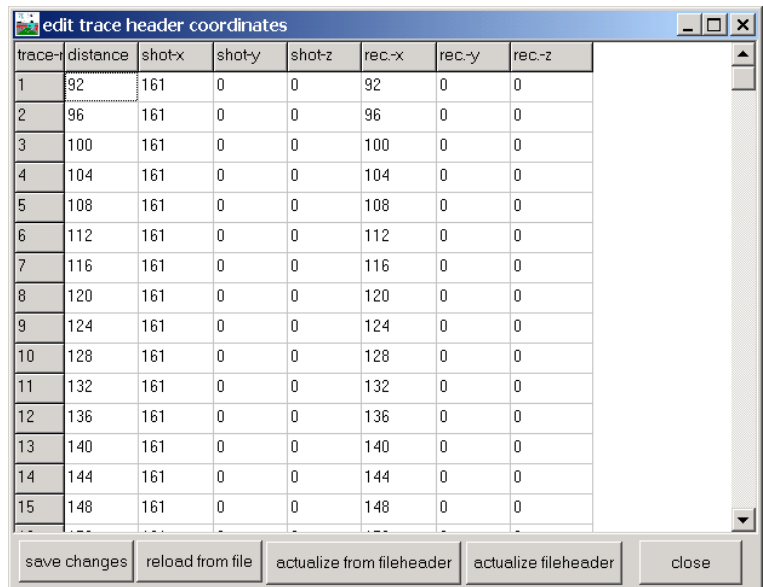


4. Activate the option **Convert to Reflex** and choose the wanted original datafile from the filelist.

REFLEXW uses the individual **traceheader coordinates** stored with each trace for the further travelttime analysis. The coordinates defined above (shot-pos. and rec.start and rec.end) only serve as so called header coordinates and may be used to actualize the traceheader coordinates (see below).

REFLEXW automatically reads in the shot and receiver positions of the individual traces if these are defined within the original files and stores them into the traceheader coordinates. After the import the traceheader coordinates are automatically shown within a tabella.

Normally the x-coordinates are used, the y- and z-coordinates are only listed for completeness.



trace	distance	shot-x	shot-y	shot-z	rec.-x	rec.-y	rec.-z
1	92	161	0	0	92	0	0
2	96	161	0	0	96	0	0
3	100	161	0	0	100	0	0
4	104	161	0	0	104	0	0
5	108	161	0	0	108	0	0
6	112	161	0	0	112	0	0
7	116	161	0	0	116	0	0
8	120	161	0	0	120	0	0
9	124	161	0	0	124	0	0
10	128	161	0	0	128	0	0
11	132	161	0	0	132	0	0
12	136	161	0	0	136	0	0
13	140	161	0	0	140	0	0
14	144	161	0	0	144	0	0
15	148	161	0	0	148	0	0

If the traceheader coordinates are not correct (e.g. because they are not stored within the original files) these coordinates must be defined separately:

a. within the tabella - enter the correct values within the tabella or use the option **actualize from fileheader** and then **save changes** in order to actualize the traceheadercoordinates based on the entered fileheader coordinates (shot position, rec. start and end, see above). To be considered for manual editing: distance value and rec.-x value should be equal for each trace.

b. within the **traceheader menu**. The traceheader menu is entered within the **fileheader menu** using the option **ShowTraceHeader**. Here different actualization options are available. You may choose either fileheader, ASCII-file or tabella and then you must press the button **actualize** to actualize the traceheader coordinates. For a further description of the individual options please refer to the online-help of the traceheader menu.

5. Do any **processing** if necessary or change the settings within the **fileheader** (option edit/fileheader), eg. the start time,

6. **Pick** the first arrivals and save them on file. It is recommended to use the automatic name for saving the picks. It is not necessary to enter the layer number and the velocity within the save picks menu. These parameters are only necessary for reflection data. The warning message may be ignored.

7. Do this procedure for all wanted shots. Then the picked traveltimes are ready for interpretation.

8. You also may perform a simple **intercepttime interpretation** within the 2D-dataanalysis module. For that purpose load the wanted shot, enter the option analyse/velocity adaptation and activate the option intercept time analysis. Now click on the data and move the cursor with clicked mouse button to the first bending point and leave the mouse button. The first point is automatically set to time zero and to the shot position. Activate again the left mouse button and move to the next bending point, and so on. The velocities derived from these settings must increase with depth. After having finished the settings the depth and velocities of the calculated 1D-model are shown in a window.

To be considered: if the geophone positions are not equidistant you must activate the plotoption traceheader distances in order to plot the traces at these positions stored within the traceheader distance positions (distance position should be equal rec.x position).

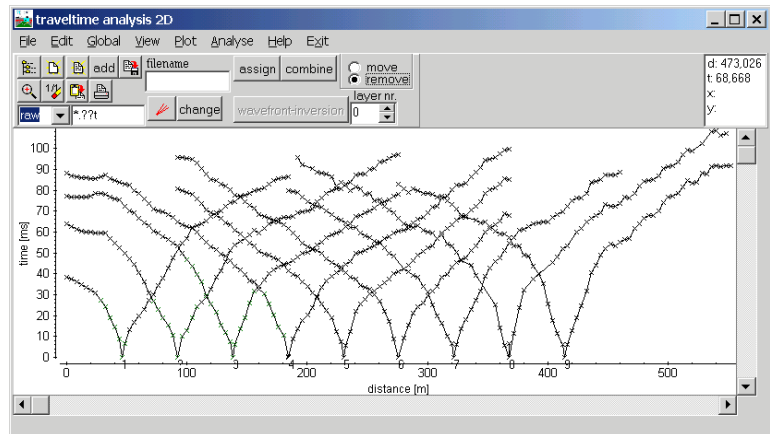
II. interpretation of the picked traveltimes (done within the module **traveltimes analysis 2D**)

1. Enter the module **traveltimes analysis 2D**

2. **Load** the wanted traveltimes which shall be interpreted together - option file/load traveltimes. Choose all wanted pickfiles which shall be interpreted together - multiple choice using the shift or str-key.

3. Use the option **edit/Insert shotZero**traveltimes in order to insert a zero traveltimes at all shot points if this zero traveltimes is not still defined. This is useful in order to better determine the velocities of the uppermost layer.

4. Enter a filename for the actually put together traveltimes and save them on disk.



5. Increase the **layer-nr** to 1

6. Activate the option **assign** in order to assign the wanted traveltimes to layer 1.

7. Assign the traveltimes to layer 1 by using the different possibilities - see also online help. The traveltimes assigned to layer 1 will be highlighted (default colour green), save the traveltimes.

8. Activate the option **combine** in order to do the inversion for the first layer (to be considered: the inversion for the first layer only consists of the determination of the velocity).

9. Activate the option **wavefront-inversion** and a new window opens (the modelling window) and a model has been automatically created consisting of one layer with the velocities taken from the linear regression analysis of the assigned traveltimes.

10. Do some changes of the model if you want (e.g. remove some unwanted velocity points) - to be considered: the option topography should be deactivated.

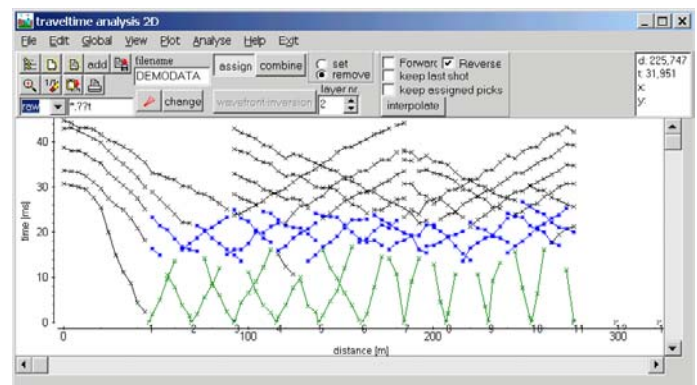
11. Enter a modelfile name and save this model on disk

12. Close the modelling window

13. Increase the **layer-nr.** to 2

14. Activate the option **assign** in order to assign the wanted traveltimes to layer 2.

15. Assign the traveltimes to layer 2 by using the different possibilities - see also online help. The traveltimes assigned to layer 2 will be highlighted (default colour blue).

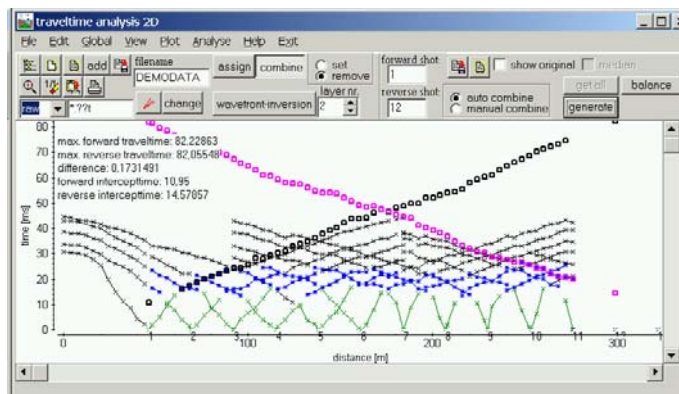


16. Activate the option **combine** in order to do the inversion for the second layer

17. Enter the **forward** and the **reverse shot numbers** - these numbers define the range for doing the inversion of the actual layer

18. Activate the option **generate** when the option autocombine is chosen - a complete combined traveltimetable (forward and reverse) is generated and the total forward and reverse traveltimes are shown.

19. If total forward and reverse traveltimes differ significantly (e.g. more than 5 ms) activate the option **balance** in order to balance the forward and reverse traveltimetable branches.



20. Activate the option **wavefront-inversion** - a file choice window opens and you must choose the modelfile containing the first layer already interpreted.

21. The chosen modelfile is shown within the modelling window- the inversion must be started manually within the **RayGroupBox** on the right hand side of the model. To be considered: The max. depth of the model must be chosen in such a way that the max. estimated depth of the layerboundary to be inverted is smaller than this max. depth value.

22. Enter the wanted increment **DeltaX** for the wavefront inversion (e.g. 0.5 m)

23. Start the wavefront-inversion using the option **start**. Note: If the inversion fails (because of not setting an appropriate max. depth values, e.g.) do not use the options start to start the inversion a second time. Please shut the modelling window and activate again the option wavefront-inversion in the module traveltimetable analysis 2D to start the inversion again (ref. to 20).

24. The new layer boundary is plotted into the model.

25. Extrapolate the inverted boundary to the model borders (option hor.extrap. or extrapolate) and do some changes of the model if you want to (see also modelling guide).

26. Save the model using the old or another filename.

27. Close the modelling menu.

28. Repeat step 13-27 for layer 3 and so on.

29. After having done the complete inversion the model should always be checked and changed if necessary using the forward raytracing included within the modelling menu. For that purpose please refer to the modelling guide, chap. III.