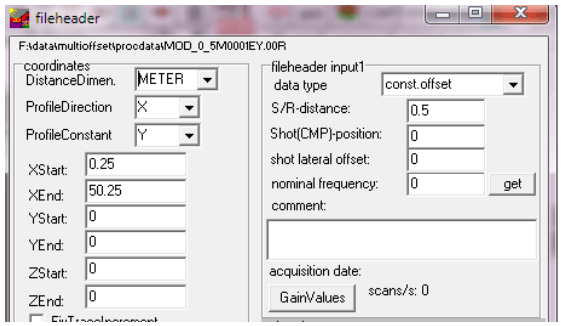
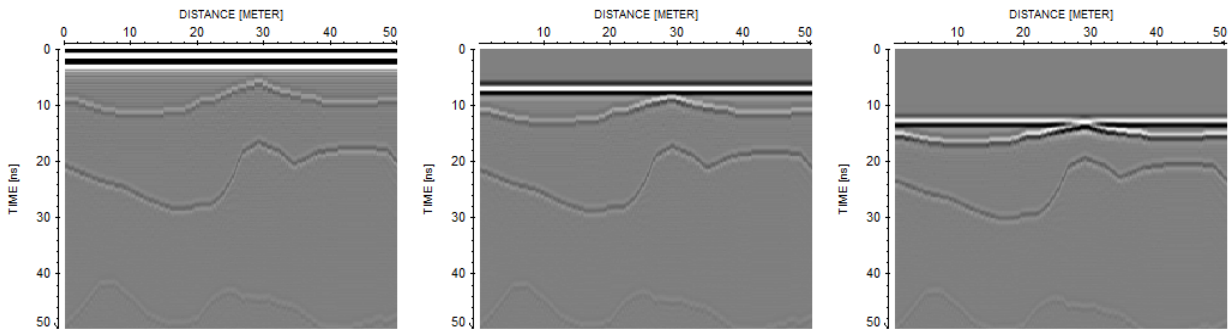
2D-Velocity determination from multioffset data

Multi-offset measurements, carried out as different simultaneous or single Constant Offset profiles with different source/receiver offsets, may provide additional information on the velocity distribution in the subsurface. Reflexw allows two methods for a fast determination of the 2-dimensional velocity distribution apart from the standard CMP processing which of course may also be used for a velocity check.



Precondition for both methods are Constant Offset lines with the source-received distance stored within the fileheader (option S/R-distance).
A Zero Offset profile must be present or it must be created from a Constant Offset line using the processing option dynamic correction.
All multioffset lines must be corrected for the start time (see figure below with 3 profiles of 0, 0.5 and 1 m shot receiver offset). This might be tricky if the start time is not known and different for the single multioffset lines. In addition you must determine where to set time zero - either to the very beginning (like in the example below) or to the extremum of the phase to be picked.

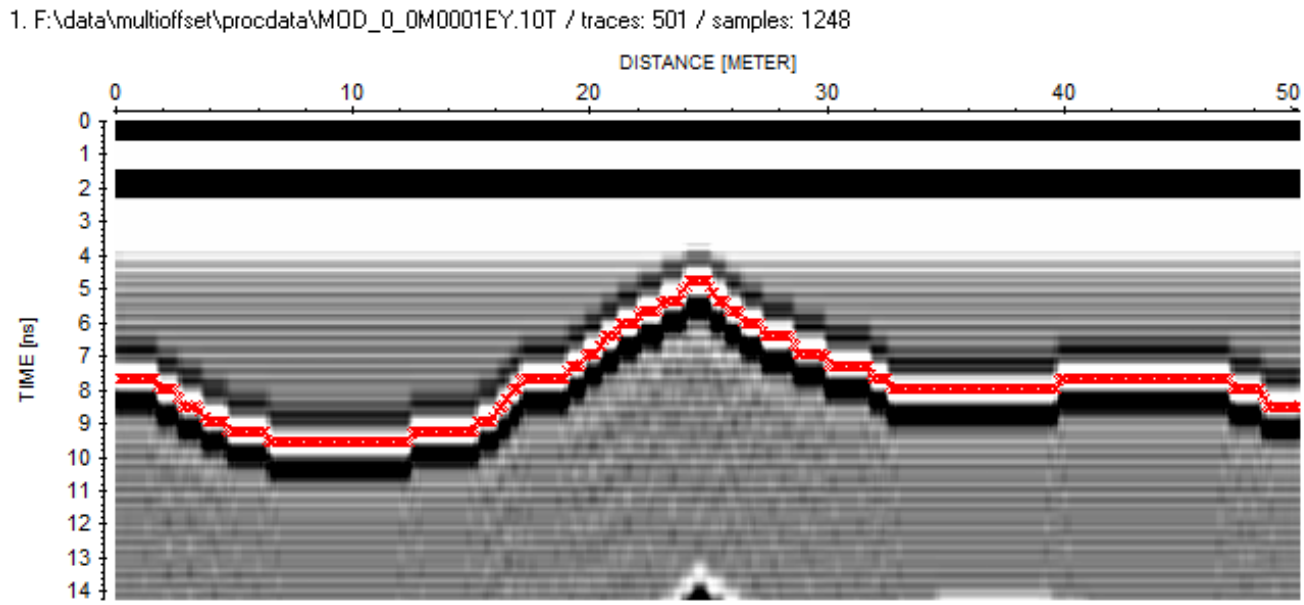


Both methods for the automatic velocity determination methods are based on picked reflectors. The first method only needs the picking of the reflectors for the Zero Offset line. The second method needs the picking of the reflectors for all multioffset lines.

I. Velocity determination during picking the reflectors within the Zero Offset line

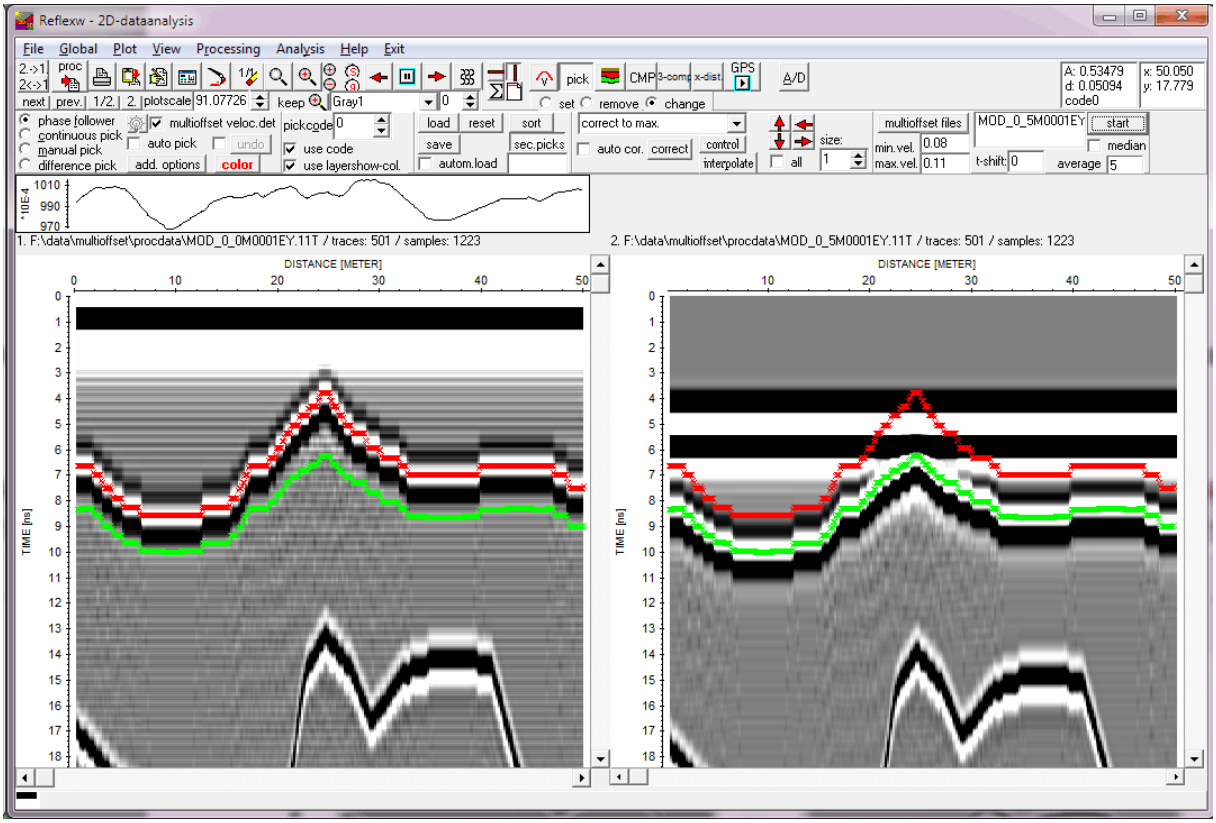
Create the velocities

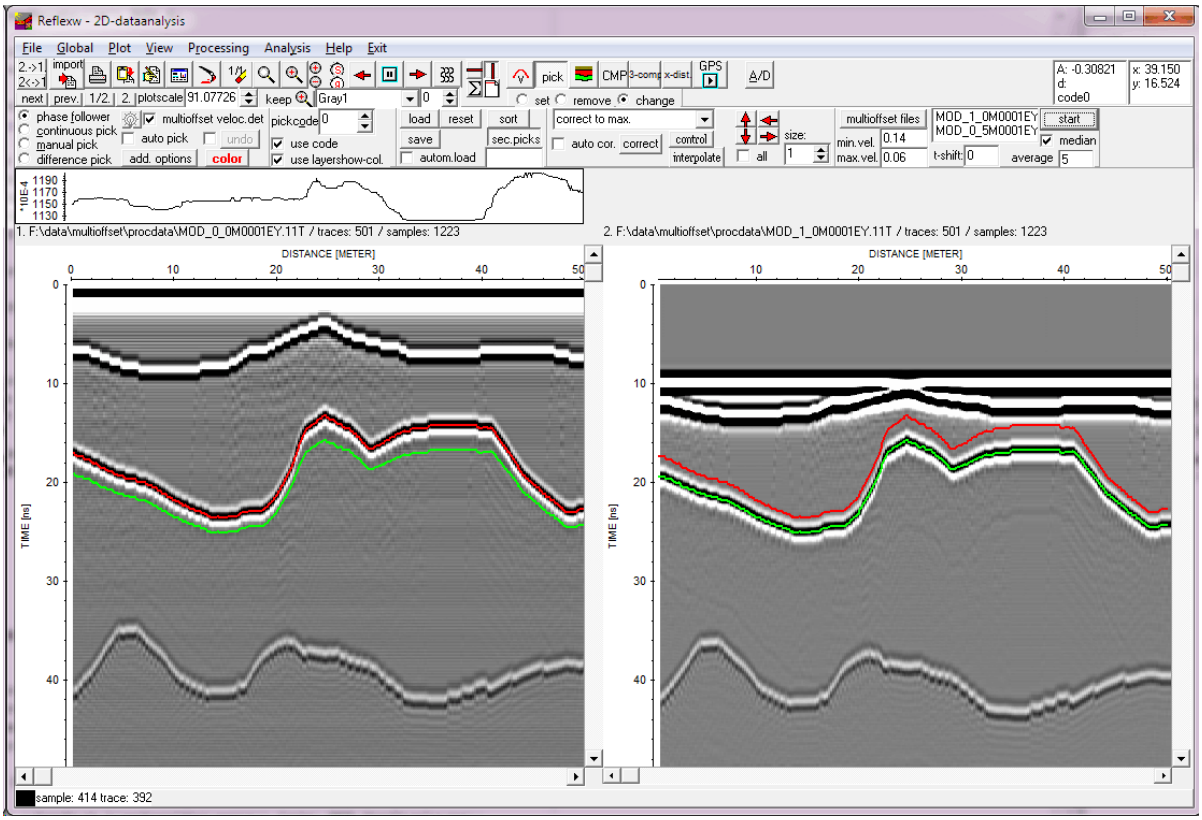
1. Load the Zero Offset line and activate the pick panel.
2. Pick the wanted reflector (not the very first arrival but the highest amplitude of one polarity).
3. Activate the option multioffset veloc.det.
4. Activate the option sec.picks and load one of the other multioffset lines (optional)
5. Enter the velocity range (options min. vel. and max. vel.)
6. Choose the multioffset files from which the velocities shall be determined
7. Enter an average value if wanted
8. Enter a time shift (option t-shift) if the data had not been corrected for the picked phase. In the following example time zero is at the very beginning of the phase but the positive (white) phase has been picked. Therefore a time shift of 1 ns should be entered in order to correct the velocity determination for this value. (To be considered: the picked interface in this example does not represent the correct depth of the reflector. For the correct depth such a time shift must also be performed.) If the data have been static corrected to the positive phase such a time shift value is not necessary (see figures on the next page).



8. Click on start

Dependent on the picked interface within the Zero Offset lines the program automatically detects the reflector within the other multioffsets lines. For this purpose each pick will be shifted based on the entered velocity range and the S/R distance and the best fit (identical polarity, highest amplitude value) gives the mean velocity for this pick. A control of the method is given if one of the multioffset files has been loaded as a secondary file and the option sec.picks has been activated. Then the found picked interface will be plotted in addition (lines in green).
The calculated mean velocities will be saved with the picks and are shown in an additional window (option view/add. 2. Colum data will be automatically acvtivated). The following pictures show the result for two reflectors.



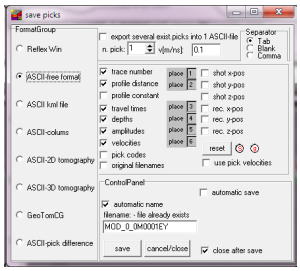


remark: for the 2. layer the black (negative) phase has been picked because of a phase shift of this reflection due to a negative velocity contrast (high to low velocities).

Use of the velocities

The velocities calculated from multioffset data from a picked interface may be used in different manners:

1. ASCII-output



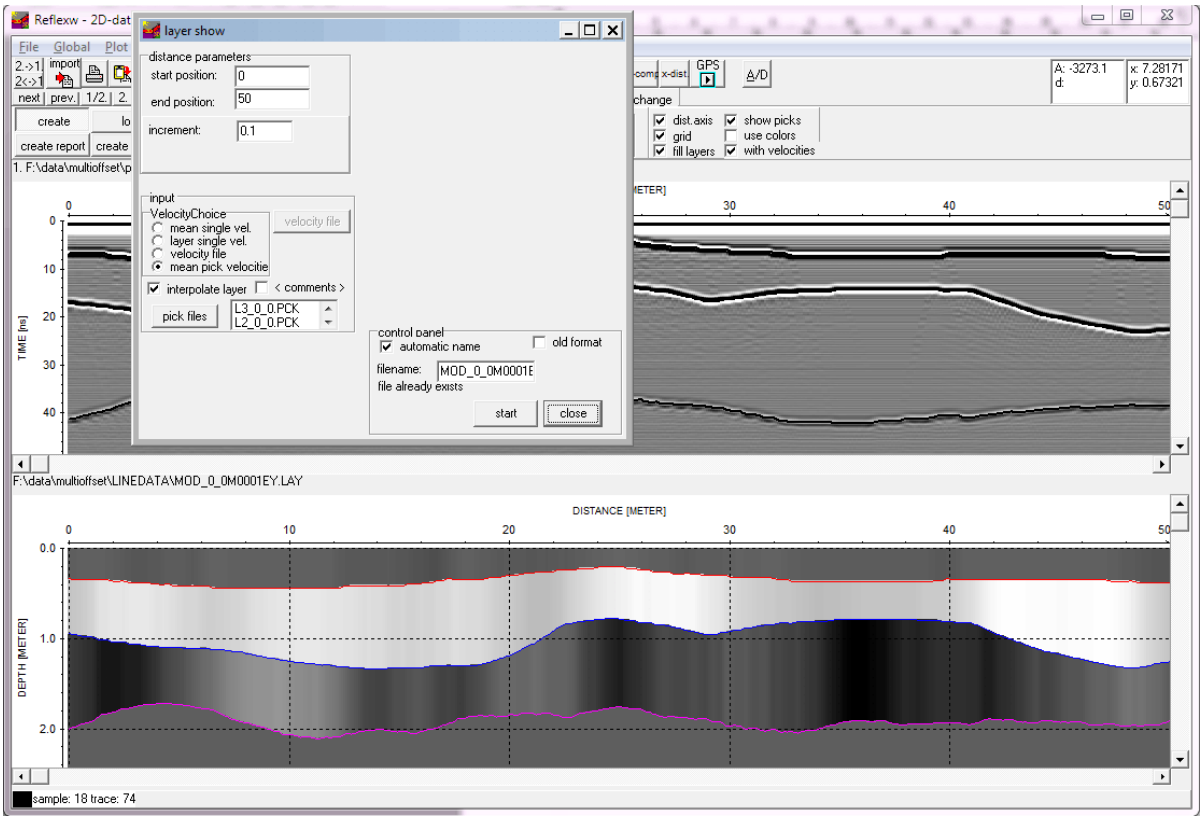
Output of the velocities when saving the picks using any ASCII-format, e.g. the ASCII free format

2. Layershow

2.1 create the layershow using the mean pick velocities

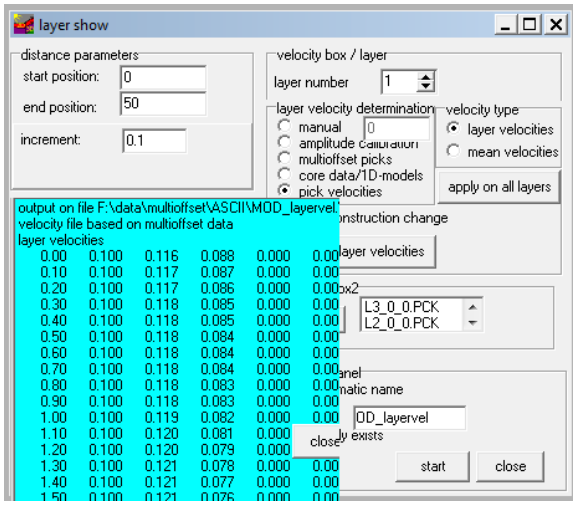
A layershow may be directly created using the mean pick velocities.

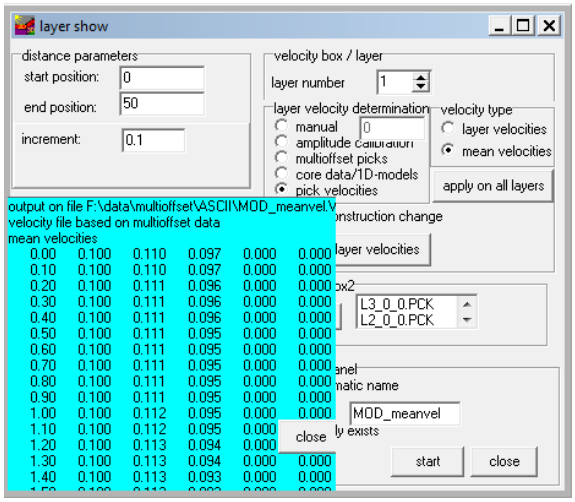
If the options “fill layers” and “with velocities” have been activated the resulting layershow will be filled using the pick mean velocities.



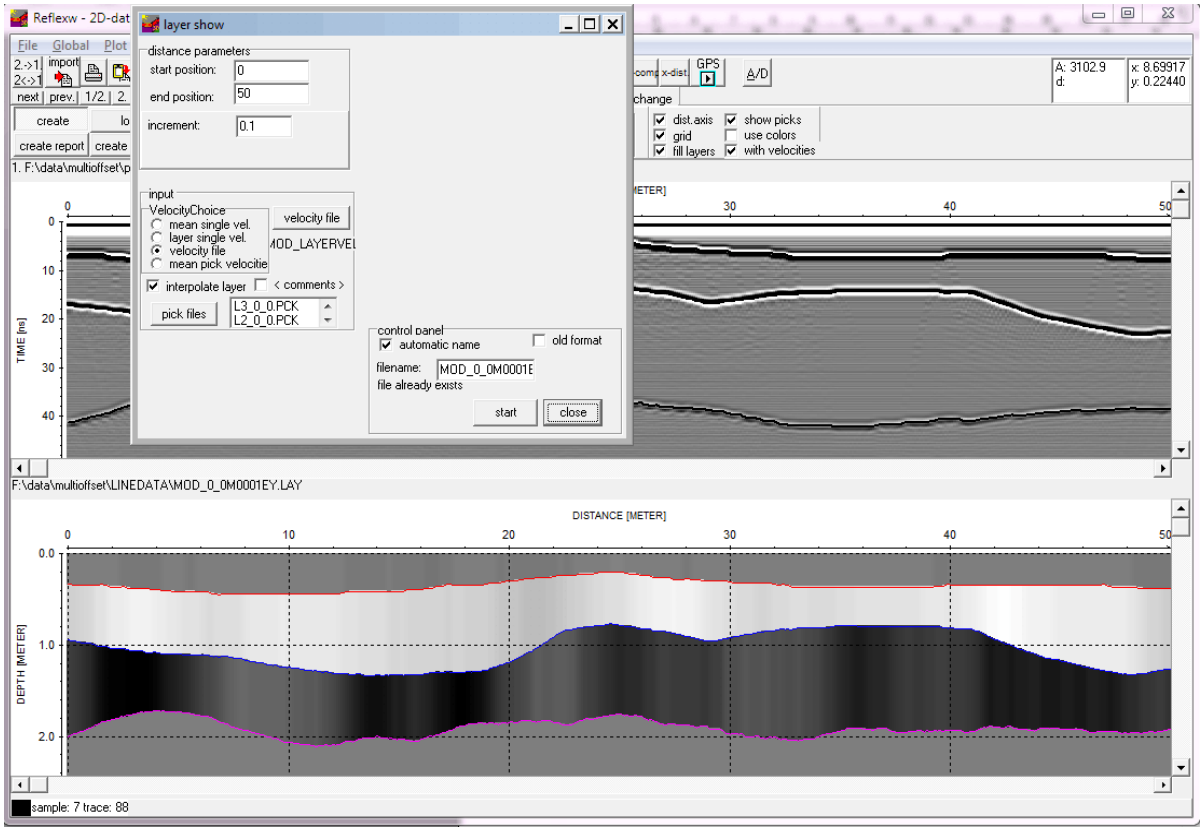
2.2 create a velocity file using the pick velocities

Using the option create velocity within the layershow the pick velocities may be used in order to create a 2D-velocity file from the different picked reflectors.
This option allows to define if layer or mean velocities shall be created. If layer velocities is activated (see figures on the left) the mean pick velocities will be automatically transformed into layer velocities. Remark: the velocities for the 1. layer are identical for layer and mean velocities.

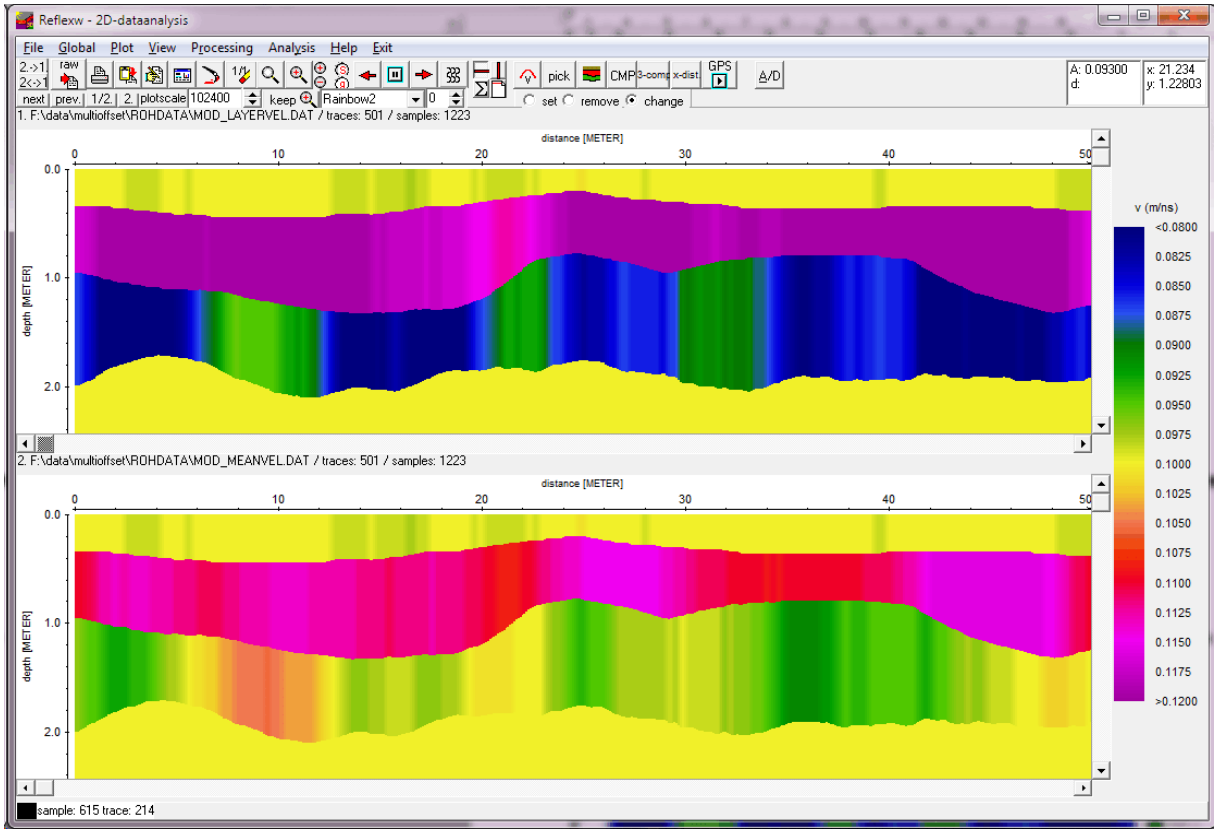




This 2D-velocity file may be used in order to create a layershow within a second step.



If the options fill layers and with velocities are active a Reflexw formatted rasterfile of the velocity distribution will be automatically generated. These rasterfiles may be loaded in just the same as “normal” Reflexw files. Following the velocity rasterfiles for the layer velocities (figure above) and for the mean velocities (figure below) are shown.

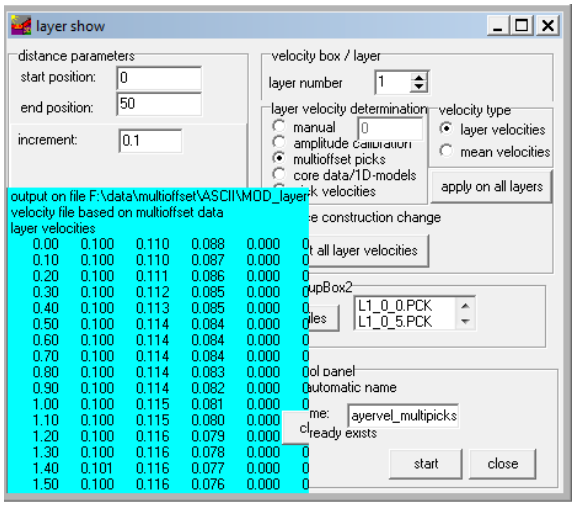


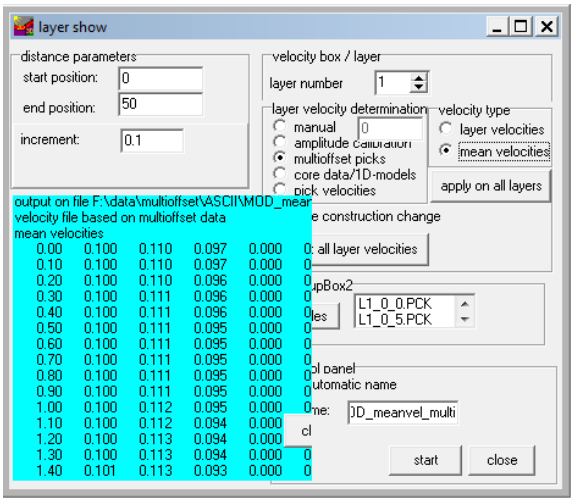
II. Velocity determination from the picked reflectors of all multioffset files

Another possibility of determing the 2D velocity distribution is given within the layershow. For this purpose the reflectors must be picked within all multioffset files. The velocities are not determined during during the picking process.
Within the layershow first a layer velocity file must be created and then based on this velocity file the layershow may be generated.

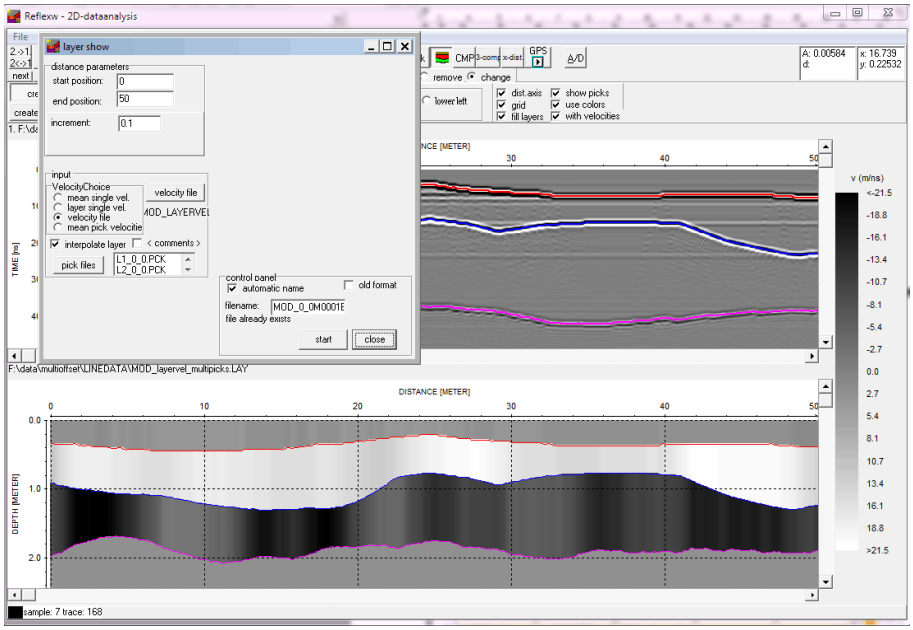
Create a velocity file using the multioffset picks

Using the option create velocity within the layershow the multi offsets picks may be used in order to create a 2D-velocity file from the different picked reflectors. It is necessary to load all pickfiles for all multioffset data (example: 3 reflectors with 3 different offsets gives 9 pick files in total).
This option allows to define if layer (see figure on the left) or mean velocities shall be created..



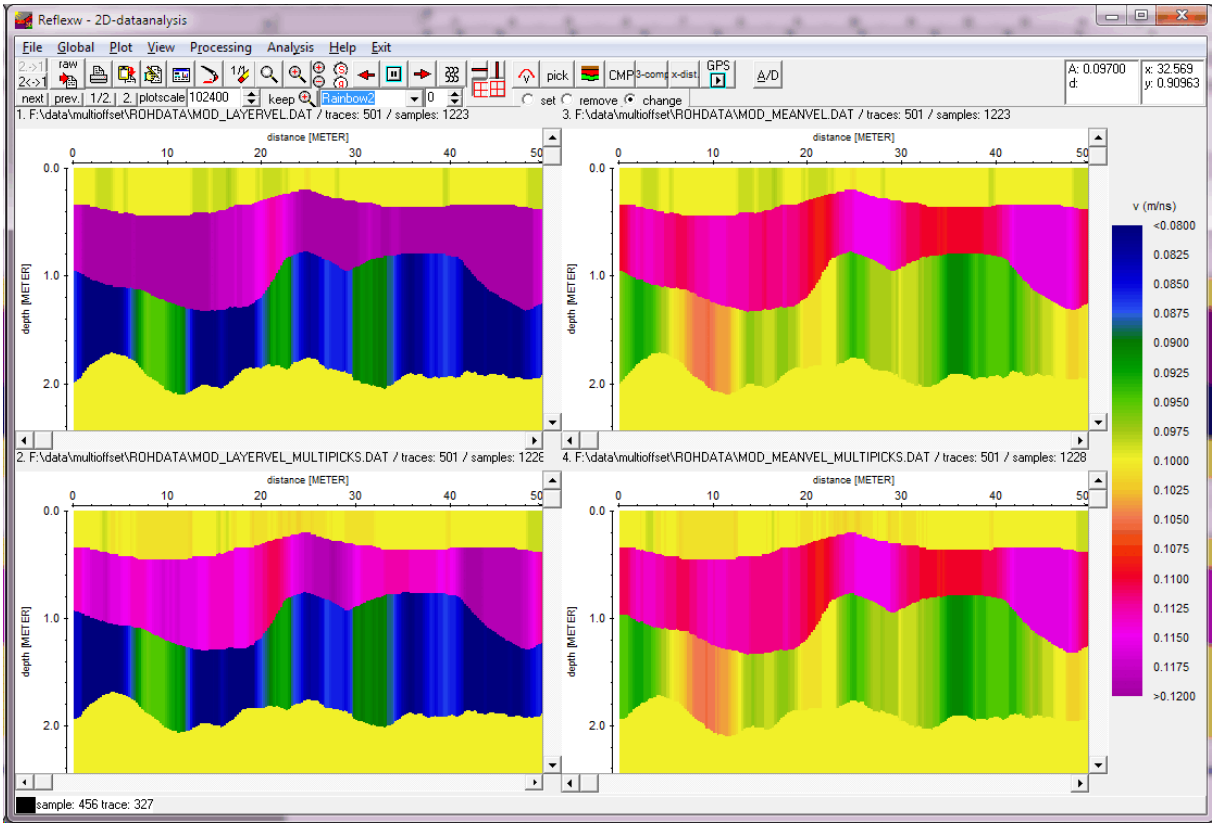


This 2D-velocity file may be used in order to create a layershow within a second step. To be considered: only the pickfiles for the Zero Offset line must be used for creating the layershow.



III. Comparison of the two method for the velocity determination from multioffset files

The following pictures shows a comparison of the 2D-velocity distribution of the two different methods both with layer (left) and mean (right) velocities. The upper figures show the result got from the pick velocities, the lower figures from the multioffset picks.



Advantages of method 1 (pick velocities during picking process):
- the reflector only needs to be picked within the Zero Offset line
- a direct access to the velocities within the picking process is given

Advantages of method 2 (multioffset picks):
- more flexible for bad data because the picking is done manually for all zero and multi offset datafiles

Disadvantages of method 1 (pick velocities during picking process):
- automatic detection of the reflectors within the multioffset lines which may cause problems for bad data

Disadvantages of method 2 (multioffset picks):
- much mor time consuming because the reflectors mus be picked within each zero and multi offset file
- a layershow must be generated in order to get the velocities