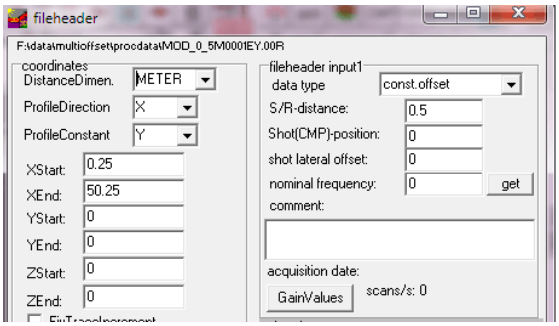
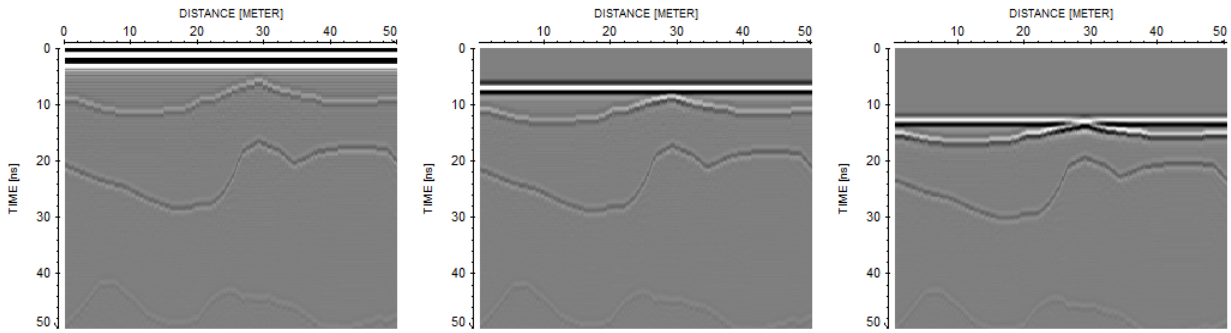
multioffset data - 2D-Velocity determination and stacking

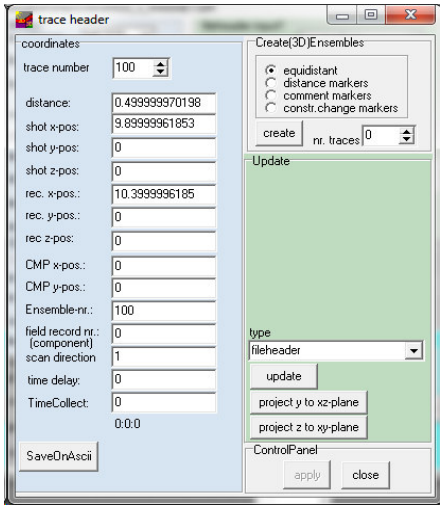
Multi-offset measurements, carried out as different simultaneous or single Constant Offset profiles with different source/receiver offsets, may provide additional information on the velocity distribution in the subsurface. Reflexw allows two methods for a fast determination of the 2-dimensional velocity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



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.

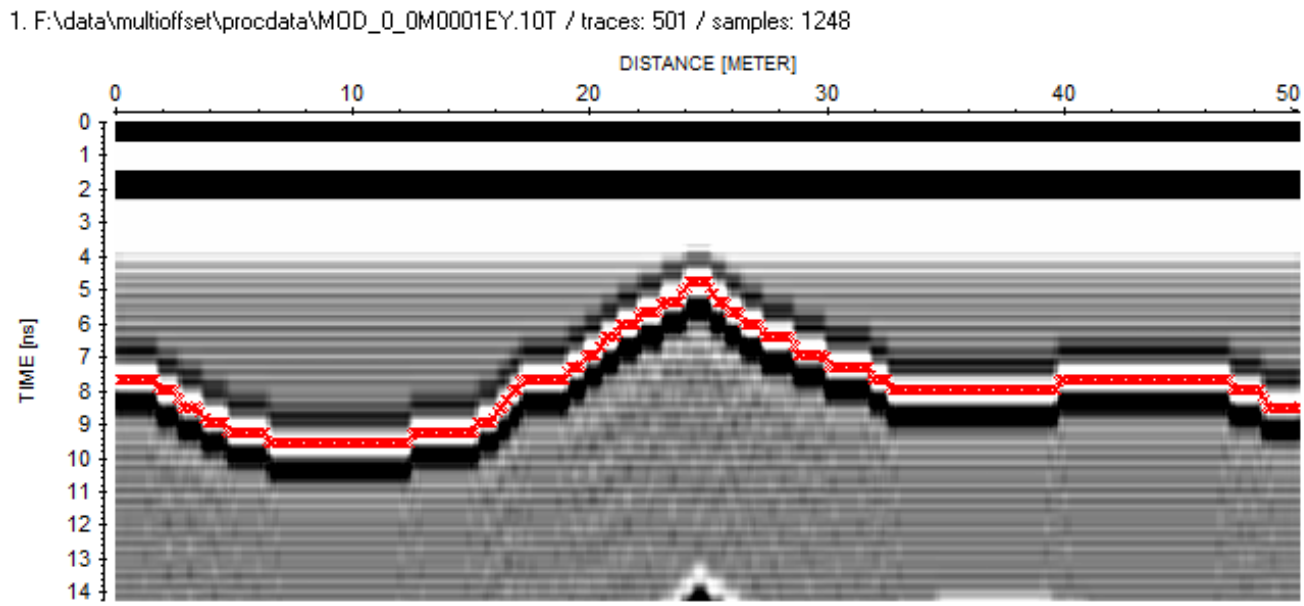


For the stacking it is necessary to update the traceheader coordinates. This may be done within the edit traceheader menu using the option update based on type fileheader. For this purpse the fileheader parameter S/R distance must have been defined correctly.
Precondition for the stacking is the same number of samples and traces for all multioffset files. If this does not hold true there exist several possibilities in order to create those datafiles, e.g. resampling, time cut for the sample number and traceincr-resampling and fix profile length for the tracenumber.

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

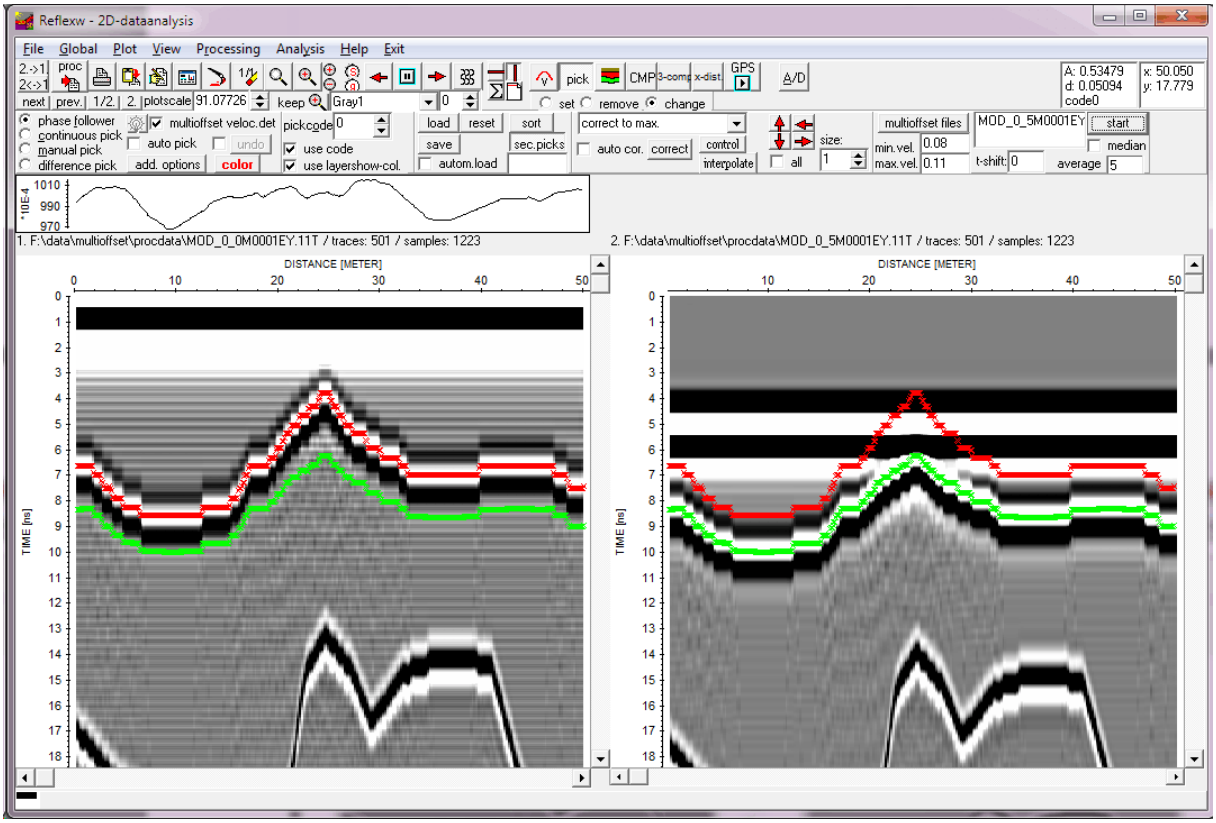
I.1 Create the velocities

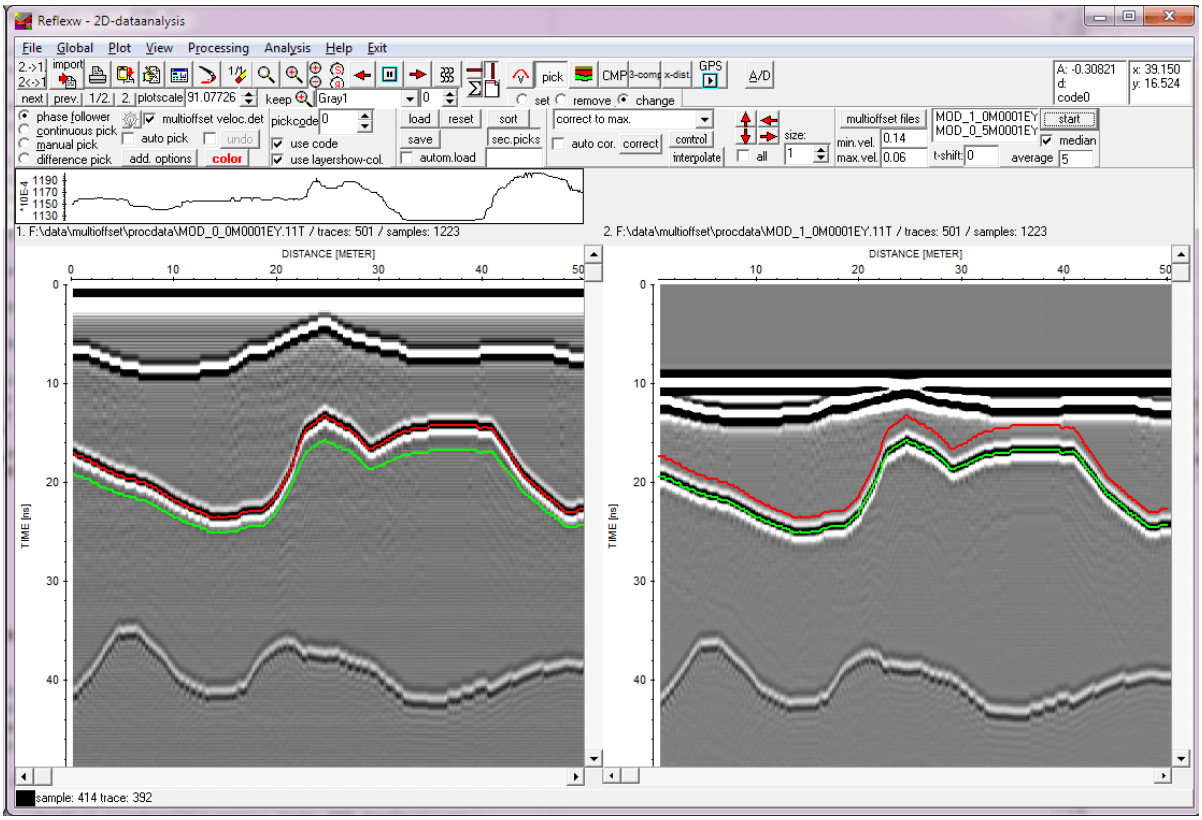
1. Load the Zero Offset line and activate the pick panel.
2. Pick the wanted reflector (not the very first arrival but the highest amplitude of one polarity).
3. Activate the option multioffset veloc.det.
4. Activate the option sec.picks and load one of the other multioffset lines (optional)
5. Enter 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.



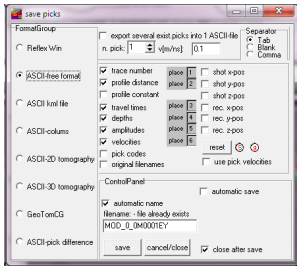


remark: for the 2. layer the black (negative) phase has been picked because of a phase shift of this reflection due to a negative velocity contrast (high to low velocities).

I.2 Use of the velocities

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

I.2.1. ASCII-output

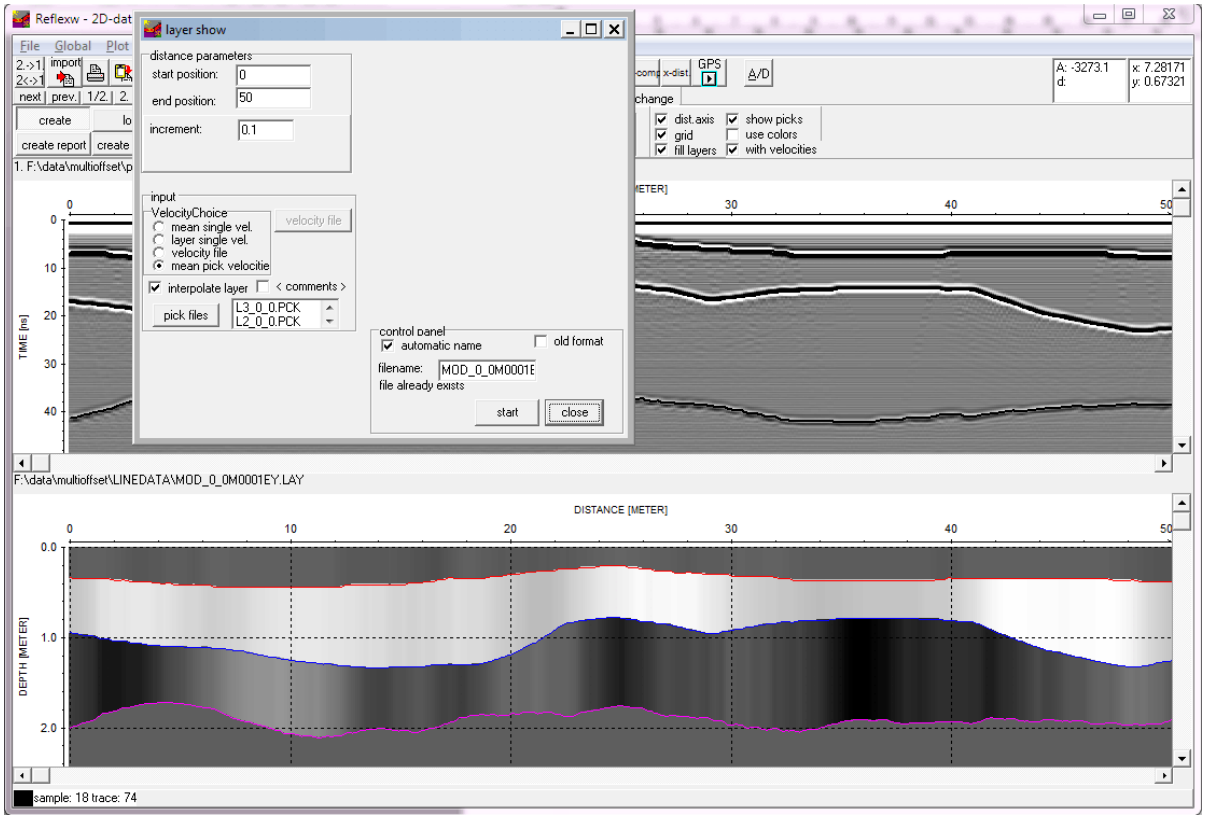


Output of the velocities when saving the picks using any ASCII-format, e.g. the ASCII free format

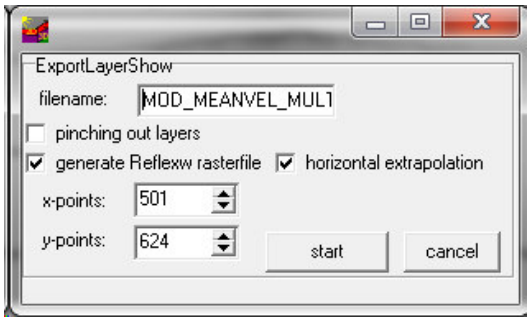
I.2.2. Layershow

create the layershow using the mean pick velocities

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

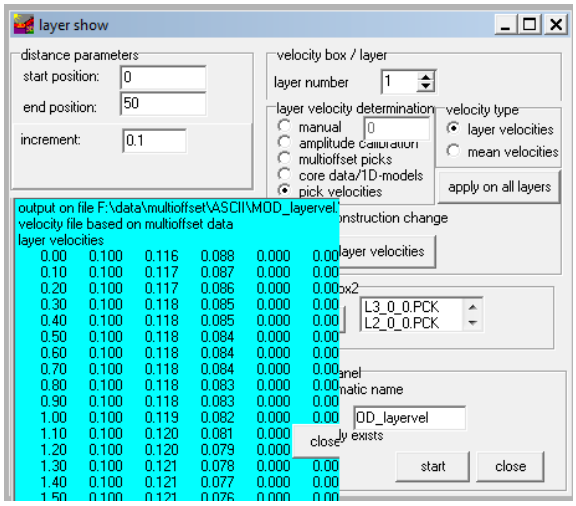


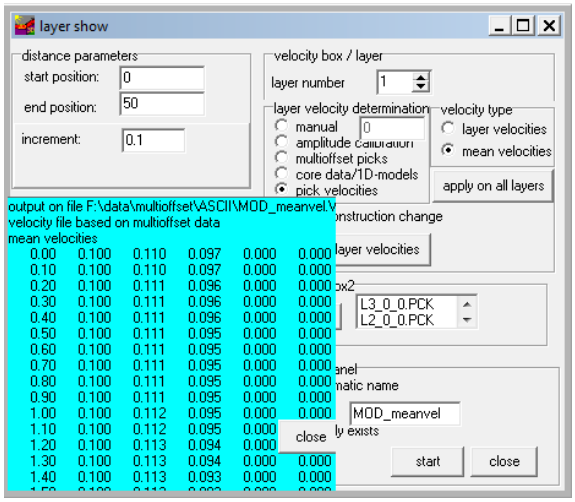
If the options “fill layers” and “with velocities” have been activated the resulting layershow will be filled using the pick mean velocities. A Reflexw rasterfile will also be generated which might be used afterwards for stacking, migration or time-depth conversion.



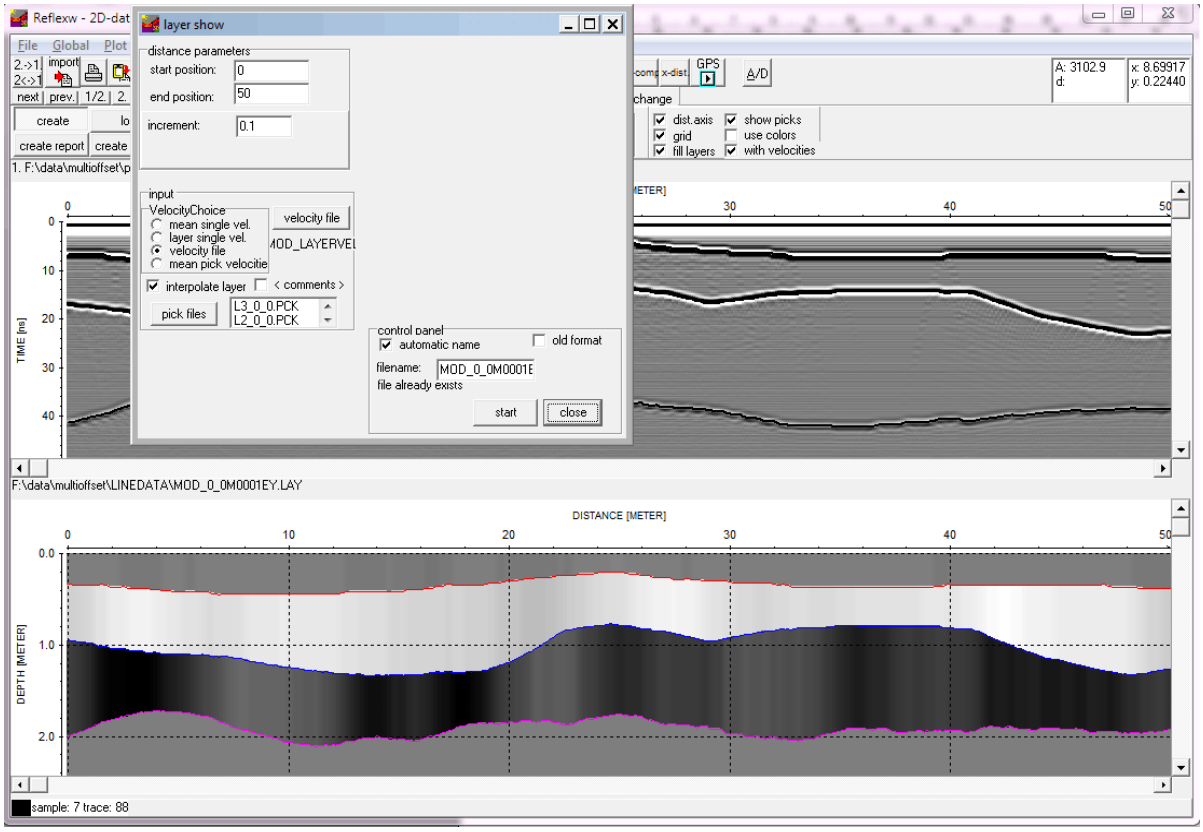
create a velocity file using the pick velocities

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.

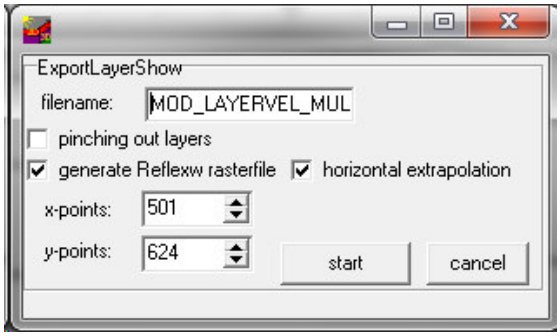


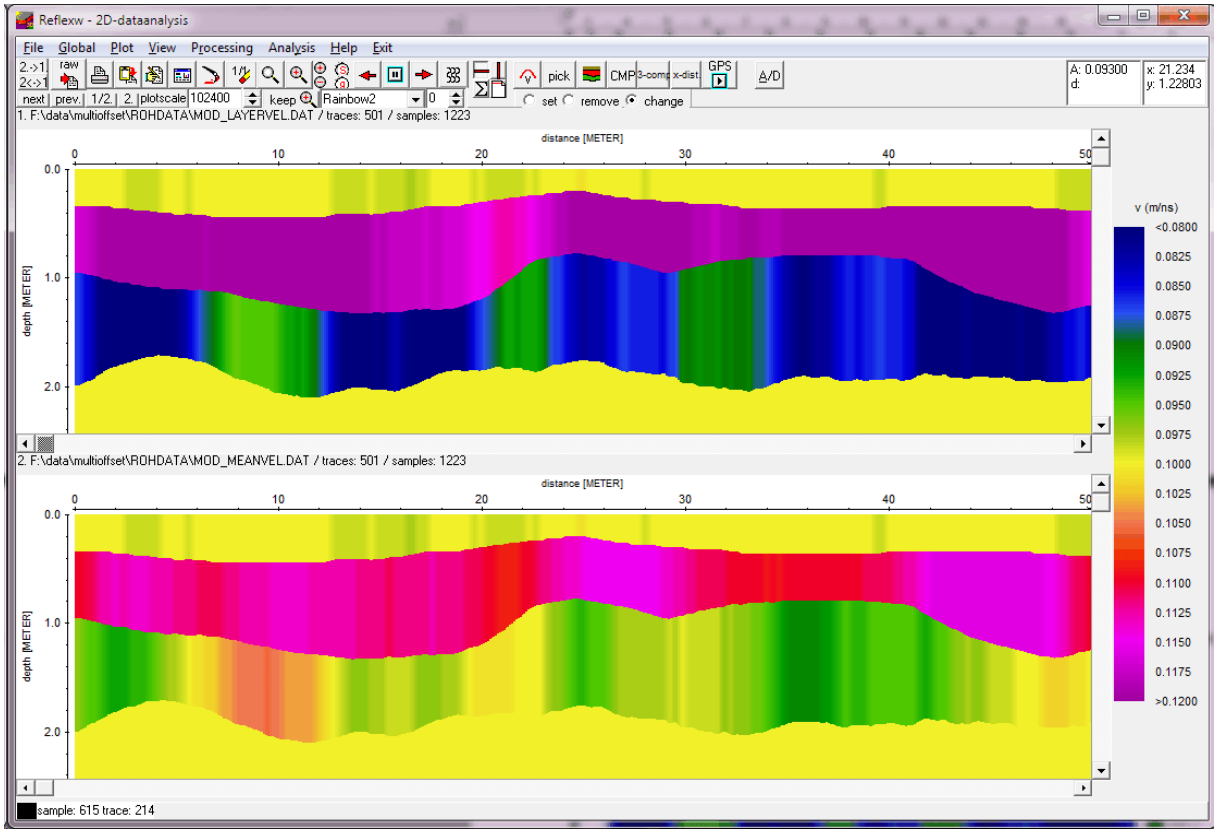


This 2D-velocity file may be used in order to create a layershow within a second step.



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. A Reflexw rasterfile will also be generated which might be used afterwards for stacking, migration or time-depth conversion. Following the velocity rasterfiles for the layer velocities (figure above) and for the mean velocities (figure below) are shown.



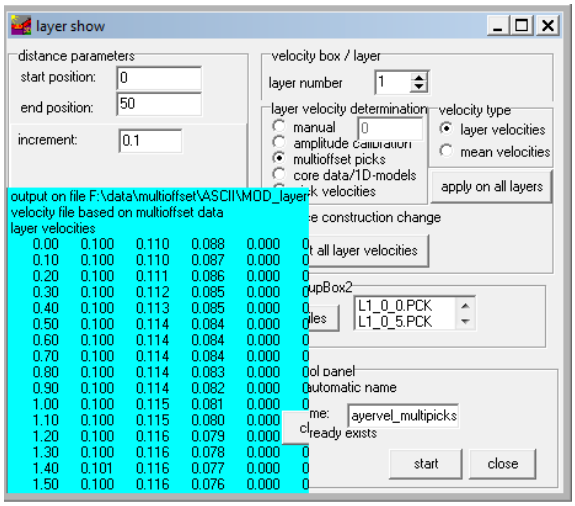


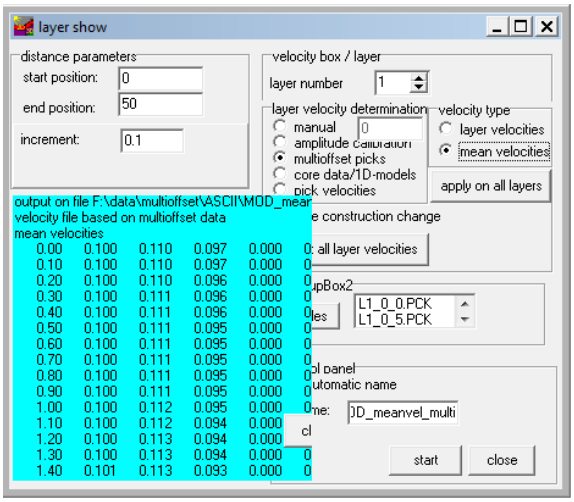
II. Velocity determination from the picked reflectors of all multioffset files

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.

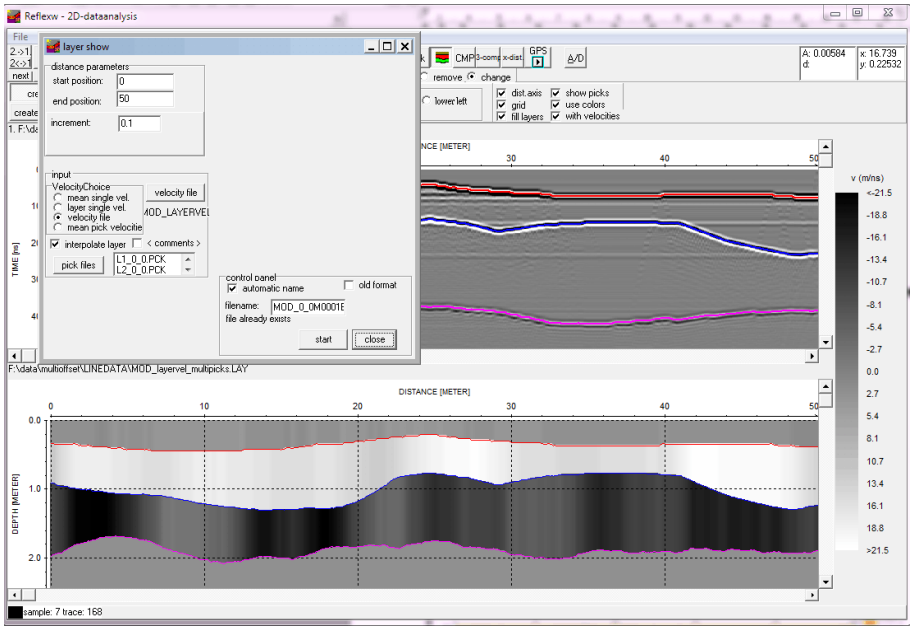
Create a velocity file using the multioffset picks

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..



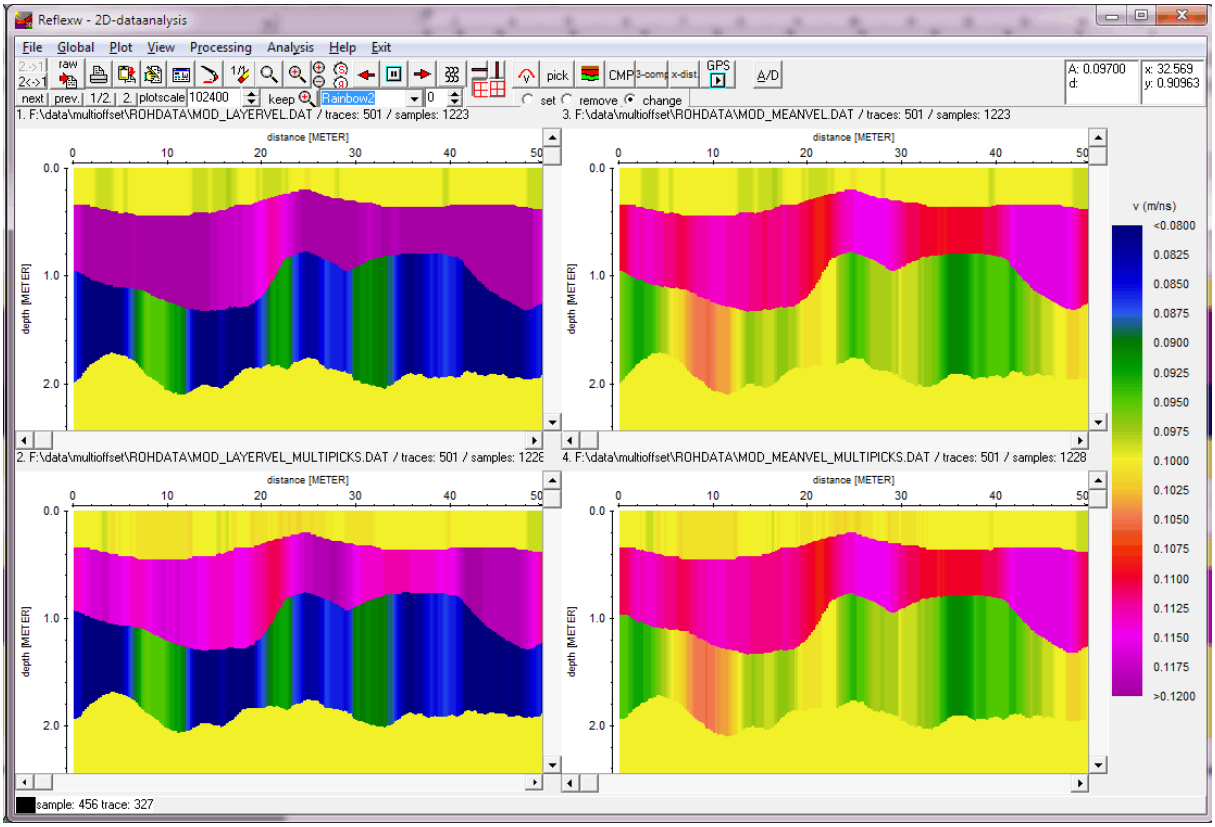


This 2D-velocity file may be used in order to create a layershow within a second step. To be considered: only the pickfiles for the Zero Offset line must be used for creating the layershow.



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

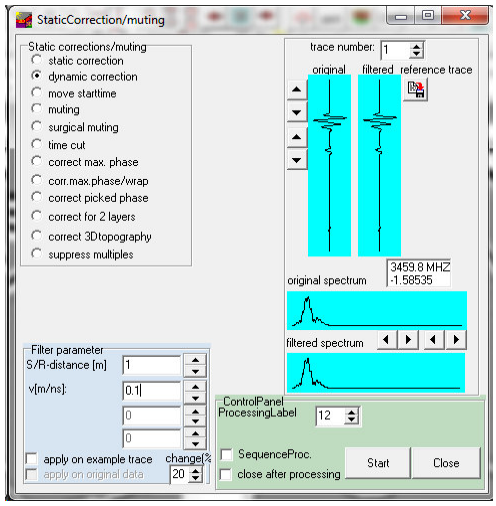
Disadvantages of method 1 (pick velocities during picking process):
- automatic detection of the reflectors within the multioffset lines which may cause problems for bad data

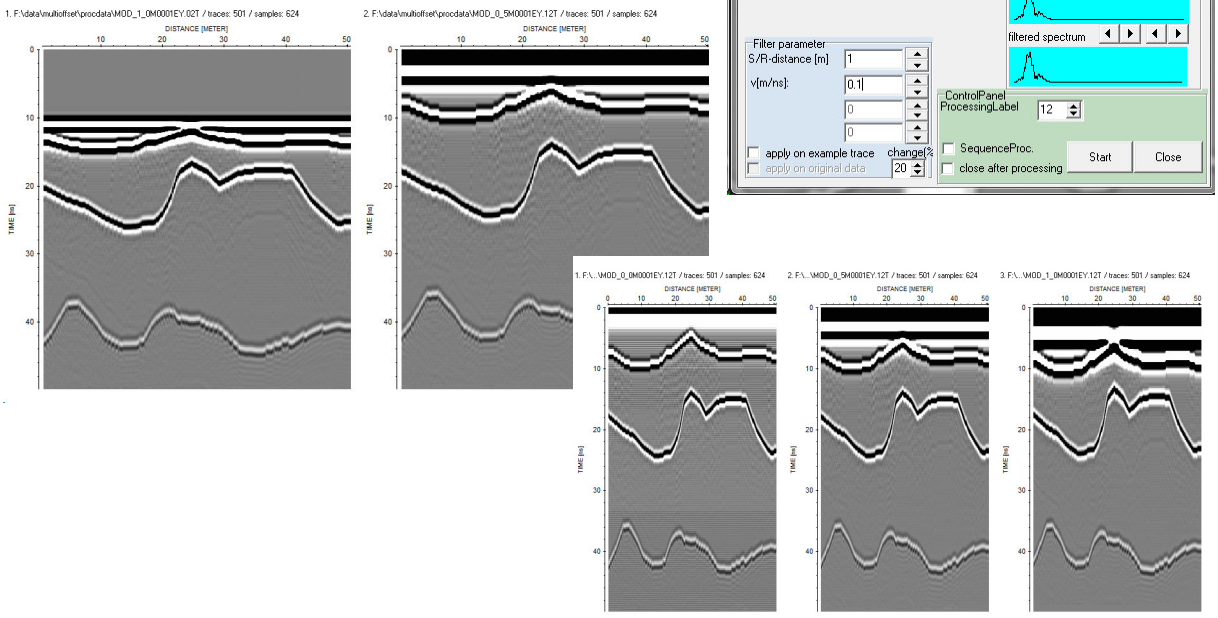
Disadvantages of method 2 (multioffset picks):
- much mor time consuming because the reflectors mus be picked within each zero and multi offset file
- a layershow must be generated in order to get the velocities

IV. Stacking the differenct Constant Offset profiles

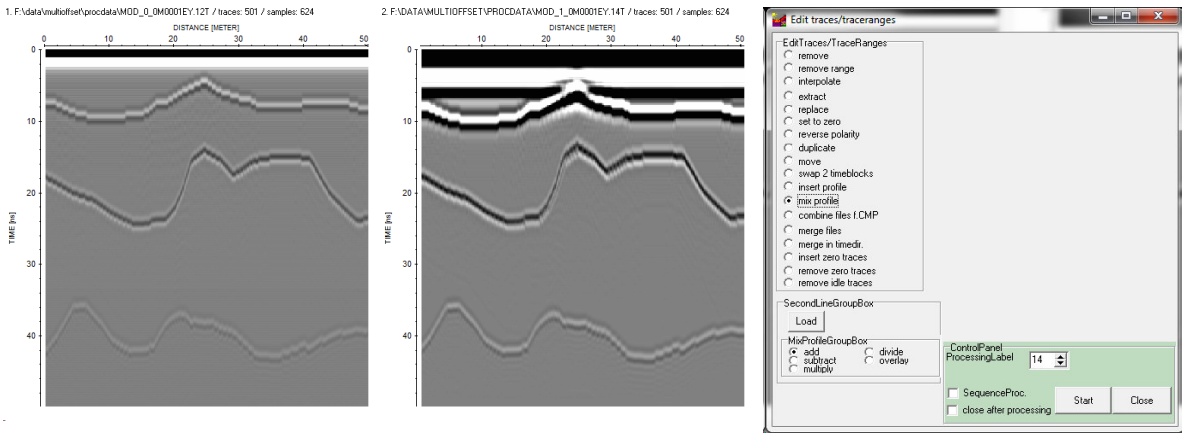
IV.1 Stacking based on constant velocity

The easiest way is the use of the dynamic correction option within the 2D-dataanalysis and after the correction you may stack the files using the option mix profiles/add for a stacking.
The dynamic correction must be applied on all files and the source/receiver distance as well as the velocity must be entered.





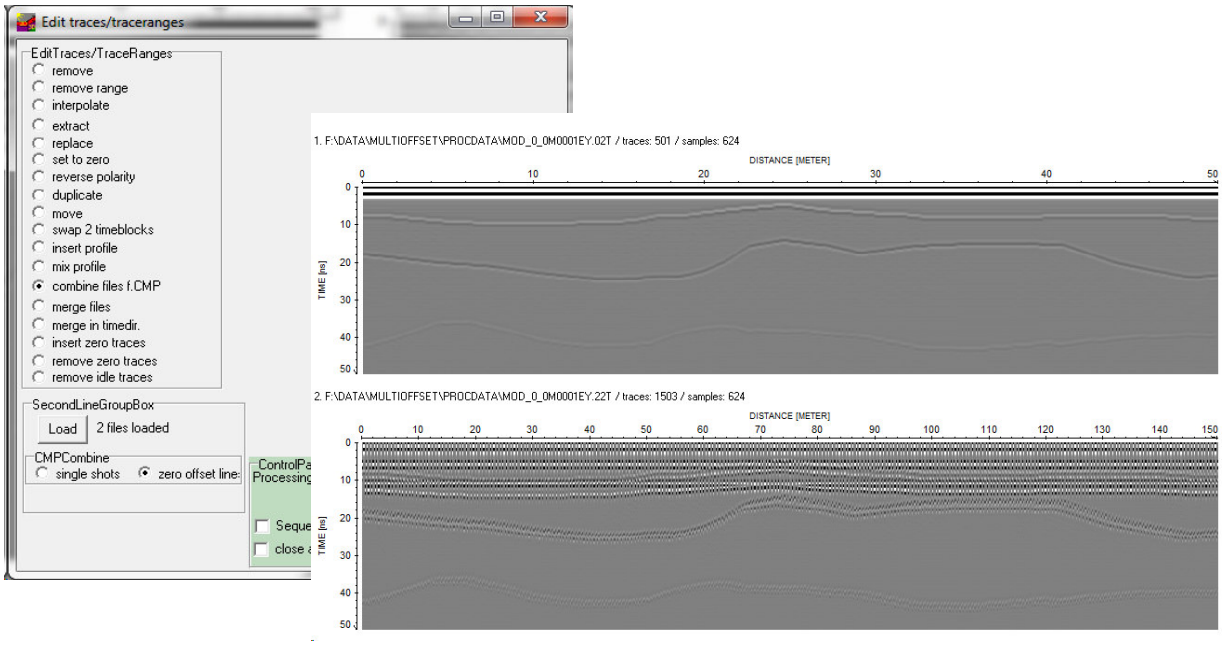
After having done the dynamic correction the corrected 2D-lines may be stacked using the option mix profile/add under processing/edit traces. As this option only allows to load one secondary file the option must be applied twice. The Figure below shows the 0-offset data (left) and the stacked section (right).



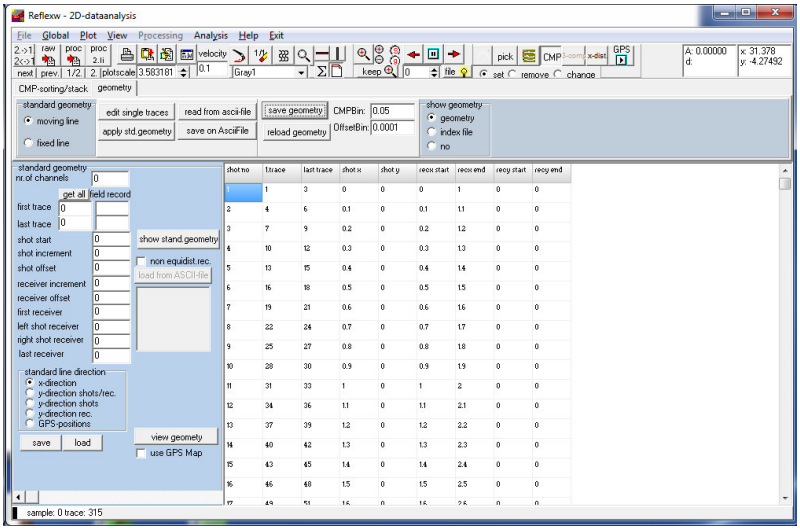
IV.2 Stacking using the CMP-processing tool

A more flexible way is given using the CMP-processing tools. For this purpose the traceheader coordinates must be updated using the update option fileheader wihtin the edit traceheader menu.

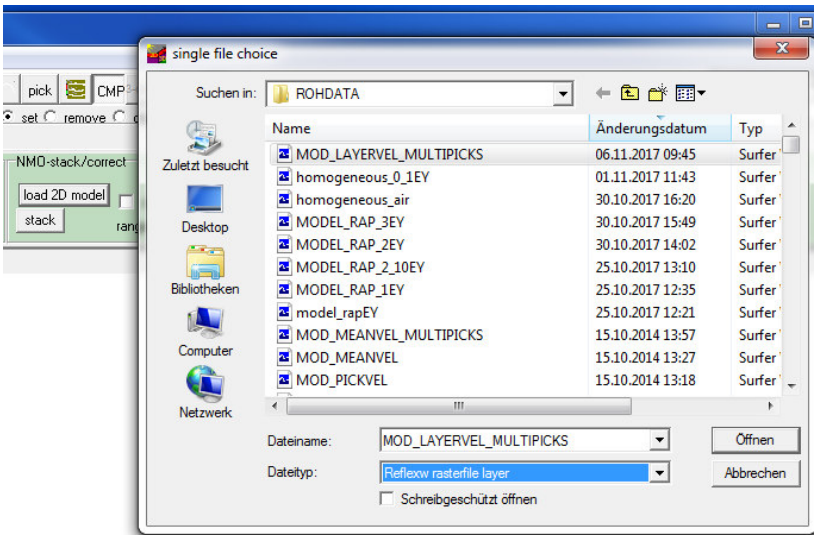
Then the different Constant Offset files may be combined using the option combine files f.CMP with suboption zero offset line.



The combined file must be set as primary profile and enter the CMP-processing and afterwards geometry. The geometry should be correct. In some cases it might be useful to increase the CMPBin if the stacking shall be done based on CMP's. After having changed the CMPBin the geometry must be saved.
Now the stacking may be done based on a constant velocity or on a 2D-velocity distribution which may be created by the standard velocity analysis (see guide for seismic reflection data).



Alternatively a Reflexw rasterfile (mean or layer velocities) which has been created using one of the options shown in chapter I.2.2 may also be used for the stacking.



The following picture shows the comparison of the stacking using the option described within chap. IV.1 (panel left) and using the layer velocity distribution (panel right).