

## RAYFRACT Tutorial specific to Val de Travers (Swiss Jura near Neuchatel) seismic survey 1990, line 2 :

### Creating a new Rayfract profile, importing the Bison 9000 Series trace files :

This tutorial describes how to import and process Bison-2 9000 Series formatted shot files TRAV0201, TRAV0203, TRAV0205, TRAV0207, TRAV0214, TRAV0215, TRAV0222, TRAV0228, TRAV0229, TRAV0236, TRAV0242, TRAV0243, TRAV0244, TRAV0247, TRAV0248, TRAV0254, TRAV0260, TRAV0261, TRAV0262, TRAV0266, TRAV0270, TRAV0274, TRAV0275, TRAV0278, TRAV0280, TRAV0283, TRAV0284, TRAV0285, TRAV0286, receiver coordinates file TRA9002.COR and first breaks file TRA9002.LST.

The shorthand notation File|New Profile means : select item „New Profile“ in menu „File“.

Start up Rayfract and select File|New Profile. Be sure that the current directory as displayed above the directory selection box is your \RAY32 root level directory. Now enter „TRA9002“ or similar in the top left text field labeled „File name“. Then hit RETURN.

Now select Header|Profile. Enter text strings „Val de Travers“, „Line 2“ and „Bison-2 9000 Series“ into the three top left edit fields labeled „Line ID“, „Job ID“ and „Instrument“. Then enter the profile spacing of 5 (distance between adjacent receiver stations, in metres) into the text field labeled „Receiver spacing“. Now hit RETURN. Confirm the prompt as now displayed with RETURN.

Now create a subdirectory named „INPUT“ or similar, in directory \RAY32\TRA9002. Do this from within your Windows Explorer or in a DOS box. To start up Windows Explorer, select item „Windows Explorer“ in menu „Programs“ as displayed when clicking on the Windows 98 „Start“ button. To open a DOS box, select item „MS-DOS Prompt“ in the menu displayed when clicking on the Windows 98 or Windows NT „Start“ button. Copy the input files TRAV0201 etc. as listed above into this new subdirectory.

The screenshot shows the 'Import shots' dialog box with the following settings:

- Import data type: Bison-2 9000 Series
- Input directory: D:\RAY32\tra9002\input
- Take shot record number from: DOS file name
- Overwrite existing shot data: Overwrite all (selected), Batch import (unchecked), Limit offset (unchecked)
- Maximum offset imported [station nrs.]: 1000.00
- Default shot hole depth [m]: 0.00
- Default spread type: 02: 48 channels
- Target Sample Format: 16-bit fixed point
- Turn around spread by 180 degrees during import: unchecked

Now select item „Import data...“ in menu „File“. Rayfract will display the „Import shots“ dialog as imaged at left. Be sure to adjust the edit fields as displayed :

Specify the correct Rayfract input directory by clicking on button „Select“ of the „Import shots“. Then navigate to your \RAY32\TRA9002\INPUT directory, select one binary trace data file e.g. TRAV0201 and hit RETURN. Be sure that the list box displayed to the right of label „Take shot record number from“ is set to entry „DOS file name“. This should happen automatically once you select Import data type Bison-2 9000 Series.

Now click on the list box below label „Default spread type“, and select the entry „02: 48 channels“. This spread type defines an equidistant receiver spread type (all receivers are separated from each other by the same receiver spacing distance interval). If you need to define your own spread type, please refer to the online help.

Now start the import of the Bison-2 9000 Series trace files by clicking on button „Import shots“ or hitting RETURN. In the following, the „Import shot“ dialog will be displayed as imaged below, once for each shot record to be imported. Please specify values for fields labeled „Layout Start“ and „Shot pos.“ as listed in the table included below, to the left of the dialog.

Shot Nr.	Layout Start	Shot Position
201	1	0.5
203	1	8.5
205	13	12.5
207	1	16.5
214	1	24.5
215	25	24.5
222	7	30.5
228	13	36.5
229	1	36.5
236	19	42.5
242	25	48.5
243	1	48.5
244	1	60.5
247	49	36.5
248	49	48.5
254	31	54.5
260	37	60.5
261	49	60.5
262	25	60.5
266	41	64.5
270	45	68.5
274	49	72.5
275	25	72.5
278	49	78.5
280	49	82.5
283	49	87.5
285	49	96.0
286	25	96.0

Import shot(s) from D:\RAY32\TRA9002\INPUT\TRAV0201...

Shot Number: 201 [Read]

Layout start [station nr.]: 1 [Skip]

Shot pos. [station nr.]: 0.00 [End]

Shot lateral offset [m]: 0.00

Shot inline offset [m]: 0.00

Shot depth [m]: 0.00

Shot delay time [msec]: 0.00

Sample interval [msec]: 1.0000

Sample count: 500

Spread type: 02: 48 channels

Active traces [from start]: 48

### Importing the recording geometry and pre-picked first breaks

Now select File|Update Station Coordinates... . Then specify the .COR receiver coordinates file TRA9002.COR (located in directory \RAY32\TRA9002\INPUT as generated above) by clicking on the „Select“ button and then selecting TRA9002.COR. Then click on button „Import file“ to import the coordinates with the default tolerance for validation of coordinates against the profile receiver spacing (as specified in Header|Profile).

Now import the pre-picked first breaks (e.g. with a reflection seismics package such as SPW or ProMax etc.) in file TRA9002.LST by selecting File|Update First Breaks and then selecting TRA9002.LST as located in directory \RAY32\TRA9002\INPUT . To check the first breaks and resulting shot sorted traveltimes curves, select Refractor|Shot breaks. Then press ALT-P and specify values 0, 100 and 130 in edit fields labeled „Minimum station number“, „Maximum station number“ and „Maximum time“. Hit return to confirm the changed display parameters.

### Delta-t-V inversion of the first breaks

First make sure that Depth|Output Horizontal Offset of CMP pos. in meters is checked. If not so, select that menu item to check it. Now make sure that Depth|Output Measured CMP Velocity is unchecked. Then select Depth|CMP Velocity vs. Depth (Delta-t-V). When the „Parameters for Delta-t-V method“ dialog is displayed, just hit RETURN once to accept the default parameter values.

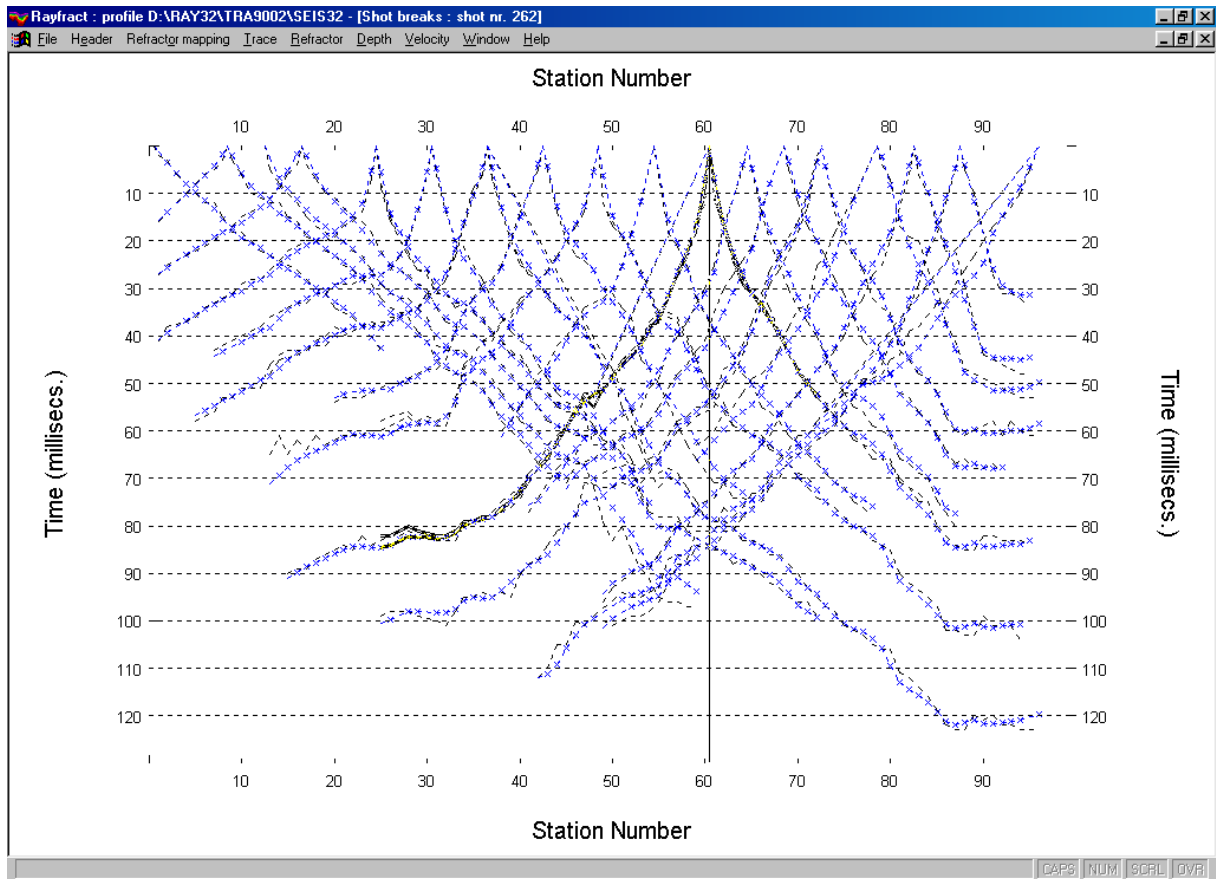
Once the inversion has been carried out, Rayfract will store the results into a comma-separated value file named DELTATV.CSV into directory \RAY32\TRA9002. Please grid the horizontal inline station offset-depth-velocity triples contained in this file with Surfer. See chapter „Delta-t-V Inversion“ of your Rayfract online help (rightmost Rayfract menu „Help“, item „Contents“) for details, or follow these instructions (assuming that you use Surfer version 7) :

Start up Surfer and select Grid|Data. Then select file \RAY32\TRA9002\DELTATV.CSV. Change values for the two edit fields in column „# of Lines“ for rows „X Direction“ and „Y Direction“ to 600 (grid columns) and 151 (grid rows), respectively. This will ensure that grid cells are small and about quadratic, a prerequisite for raytracing and tomography processing. Adjust Y Dir. # of Lines until the Y Dir. size of the cell (row spacing, as indicated in the previous column) optimally matches the X Dir. size of the cell i.e. column spacing. Now click on the OK button, of the „Scattered Data Interpolation“ dialog. In the following, Surfer will generate a disk file named DELTATV.GRD. You may want to contour and view the resulting Delta-t-V velocity model as described in other tutorials e.g. line14.pdf.

### Refining Delta-t-V velocity model with Wavepath Eikonal Traveltime tomography inversion

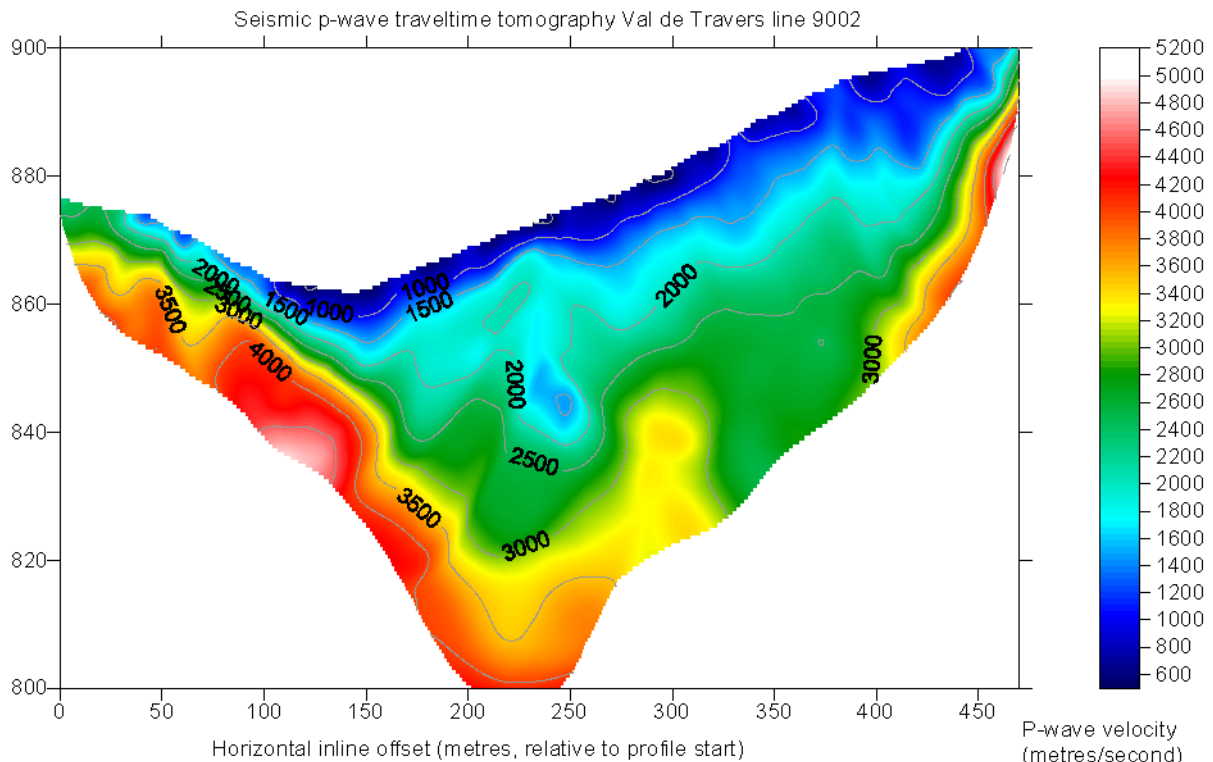
Now select Depth|Tomography processing of traveltimes ... . Then click on button „Select“ and specify the DELTATV.GRD file as generated above. Leave all other processing parameters at their default values. To generate subsurface coverage maps showing the number of ray paths going through each 2D section pixel, click on button „Edit grid file generation“ and enable option „Write section coverage grids after each iteration“. Now click on button „Start tomography processing“.

The tomography processing will terminate after 10 iterations and about ten minutes of processing time (on Pentium III processor at 500 MHz). You may want to refine the output obtained from this first run. To do so, reselect Depth|Tomography processing of traveltimes ... . Now specify the VELOIT10.GRD as obtained from the previous tomography run. Click on button „Edit velocity smoothing“ and activate option „Minimal smoothing after each tomography iteration“. Click on „Accept parameters“. Then start the second tomography processing run by clicking on button „Start tomography processing“. Once the processing terminates, select Refractors|Shot breaks to display picked and synthesized traveltimes together as shown below :

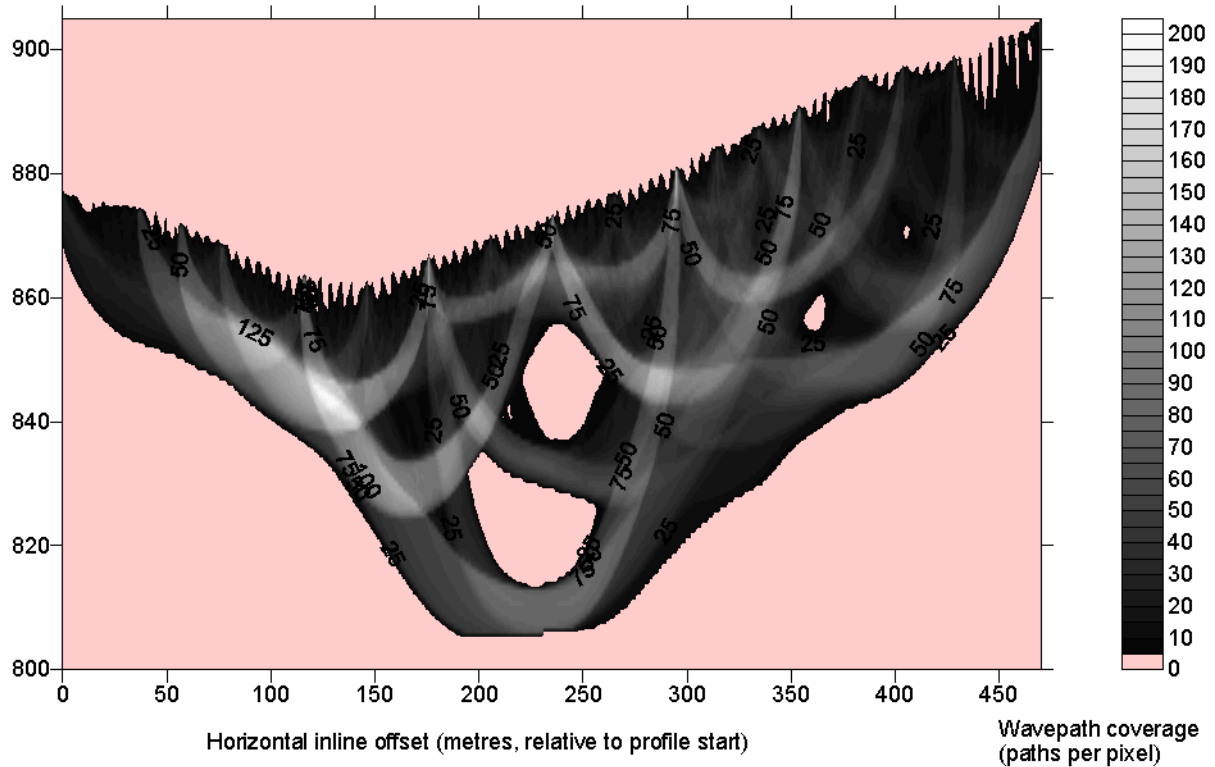


Now select Map|Contour and then file VELOIT10.GRD. Click on check boxes „Fill Contours“, „Smooth Contours“ and „Color Scale“, in the „Contour Map Properties“ dialog. Then click on OK.

Once the contour smoothing has finished and the resulting contour map is displayed, select it with the left mouse key. Now select Map|Limits and enter values 0/470 and 800/905. Confirm with OK. Now select Map|Scale and deselect the bottom left check box „Proportional XY Scaling“. Then enter a values of 6.0 in column „Length“ of the upper row „X Scale“ and a value of 4.0 in column „Length“ for the lower row „Y Scale“. Confirm with OK. Double click on the plot and click on tab „Levels“ of the „Contour Map Properties“ dialog. Click on column header „Lines“ and select color „80% Black“. Confirm all dialogs with OK to obtain a plot as shown below :



To obtain a 2D vertical subsurface section showing the coverage of each 2D pixel with ray paths, just contour the file COVERG10.GRD. In the Surfer 7 Contour Map Properties dialog, click on tab „Levels“ and then on column header „Level“. Now set parameter „Minimum“ to 0 and „Interval“ to 5. Then click on „OK“. Now double click on the topmost row of column „Fill“ (for level 0) and specify e.g. pink as foreground and background color. Click on column header „Line“ and select Style „Invisible“. Then accept all edited dialogs with „OK“. Limit the data range displayed and scale the plot as described above, to obtain a composite image of all wave paths as shown below (brighter color means higher coverage with first break energy) :



The Bison-2 9000 Series formatted shot sorted binary trace data files, the coordinate file TRA9002.COR and first breaks file TRA9002.LST as referred to above are available on the web, archive file <http://rayfract.com/tutorials/TRA9002.ZIP>

For theoretical background of our new tomography algorithm, see [Wavepath eikonal travelttime inversion: Theory](#) (Gerard T. Schuster and Aksel Quintus-Bosz 1993, GEOPHYSICS VOL. 58 NO. 9 September 1993, P. 1314 – 1323).

For more information on our Rayfract™ software, please follow the links on our web site <http://rayfract.com>.