RAYFRACT Tutorial specific to IGT line 1 January 2000 :

Creating a new Rayfract profile, based on the Gremix header data exclusively :

This tutorial describes how to import and process Interpex Gremix header data as available in file LINE1.GRM. Data types available in Gremix .GRM files are : shot point position and elevation; shot hole depth; for each receiver : receiver position, receiver elevation and first break.

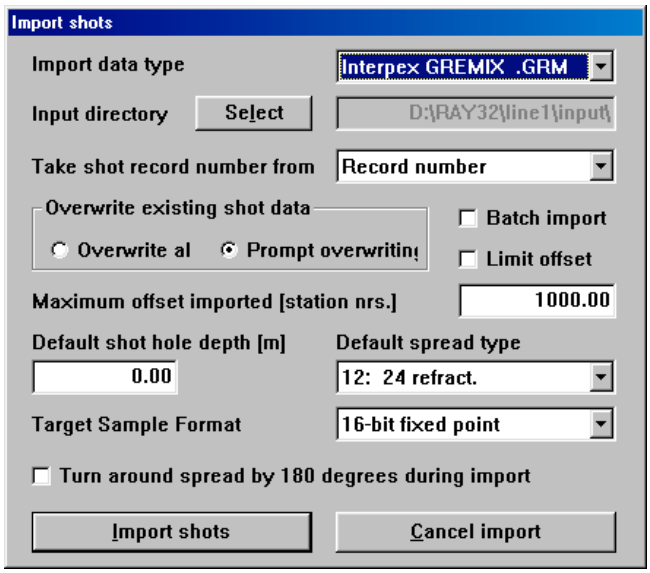
The shorthand notation File|New Profile means : select item „New Profile“ in menu „File“.

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 directory. Now enter „Line1“ or similar in the text field labeled „File name“. Then hit RETURN.

Now select Header|Profile. Enter text strings „I.G.T. line 1“, „Refraction survey“ and „GEOMETRICS“ into the three top left edit fields labeled „Line ID“, „Job ID“ and „Instrument“. Then enter the profile spacing of 2.5 metres (minimum distance between adjacent receiver stations) 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\LINE1. 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 95 „Start“ button. To open a DOS box, select item „MS-DOS Prompt“ in the menu displayed when clicking on the Windows 95 „Start“ button. Copy the Gremix file LINE1.GRM into that directory.

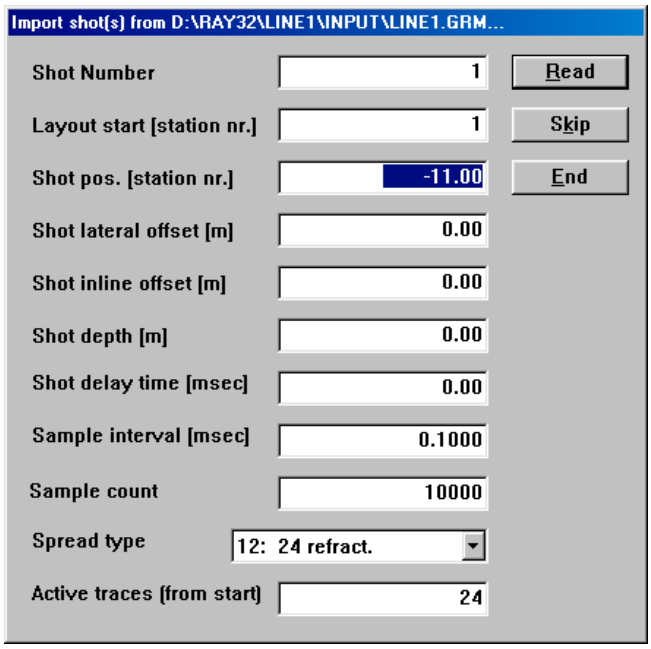
Now select item „Import data...“ in menu „File“. Rayfract will display the „Import shots“ dialog as imaged below. Be sure to adjust the edit fields as displayed.



Specify the correct Rayfract input directory by clicking on button „Select“. Then navigate to your \RAY32\LINE1\INPUT directory, select file LINE1.GRM and hit RETURN. Be sure that the list box displayed to the right of label „Take shot record number from“ is set to entry „Record number“. This should happen automatically once you select Import data type „Interpex GREMIX .GRM“.

Now click on the list box below label „Default spread type“, and select the entry „12: 24 refract.“. This spread type defines a non-equidistant receiver spread type, as customary in refraction seismic recording. If you need to define your own spread type, please refer to the online help.

Now start the import of the Interpex GREMIX .GRM trace header file 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.



The default station number value for the first receiver station as displayed in text field „Layout start“ is 1. Shot and receiver positions are specified in the LINE1.GRM file in station numbers already. So there is no need for any transformation.

Just hit RETURN or click on the „Read“ button once for every shot header displayed to import the shots.

Delta-t-V inversion of the first breaks

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.

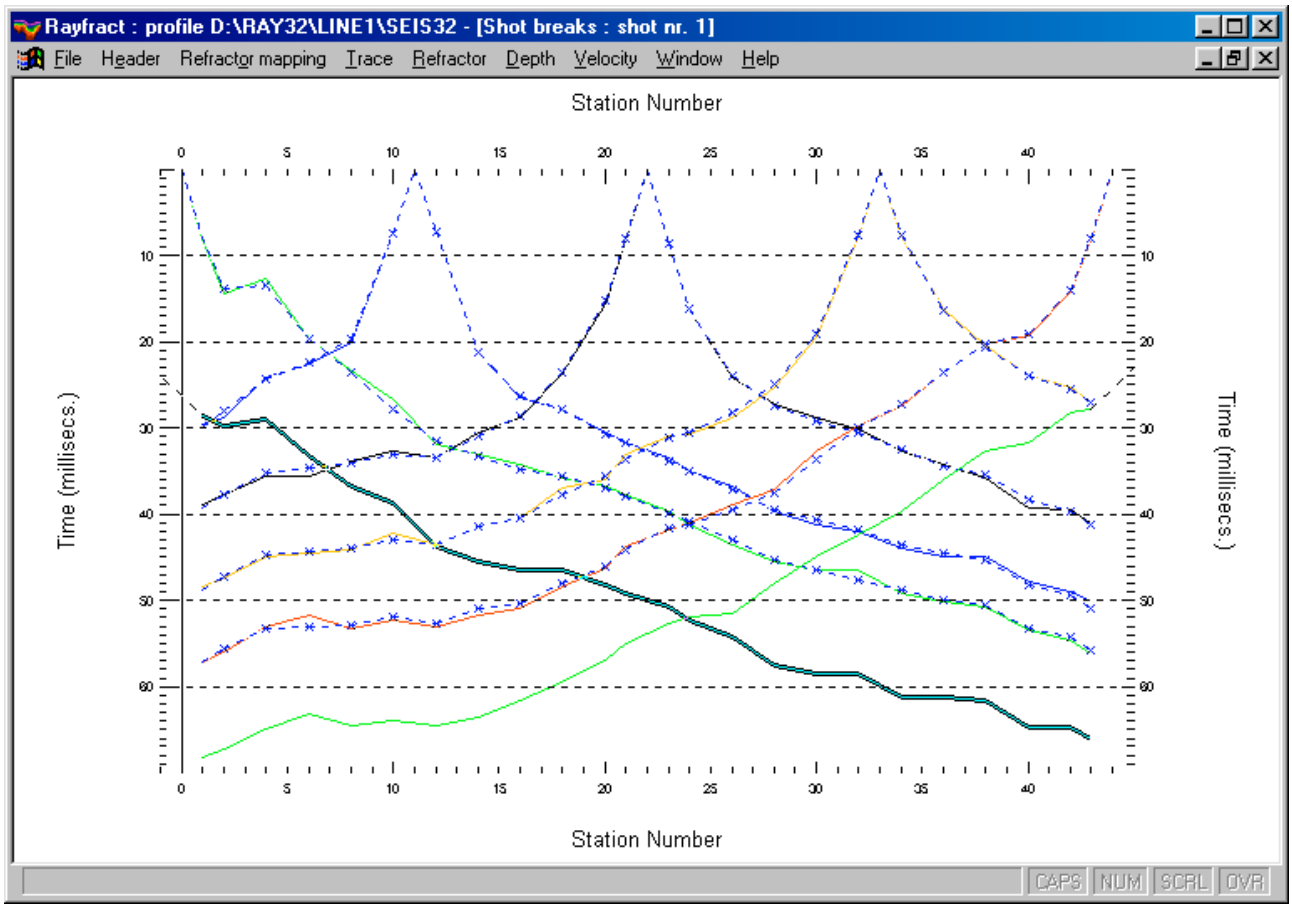
Once the inversion has been carried out, Rayfract will store the results into a comma-separated value file named DELTATV.CSV into directory \RAY32\LINE1. Grid the horizontal inline offset-depth-velocity triples contained in this file with Surfer. See chapter „Delta-t-V Inversion“ of your Rayfract online help (rightmost Rayfract menu „Help“, item „Contents“) for details, or follow these instructions :

Start up Surfer version 7 and select Grid|Data. Then select file \RAY32\LINE1\DELTATV.CSV. Change values for the two edit fields in column „# of lines“ for rows „X Direction“ / „Y Direction“ to 600 / 255. Now click on the OK button, of the „Scattered Data Interpolation“ dialog. Surfer will now generate a DELTATV.GRD grid file.

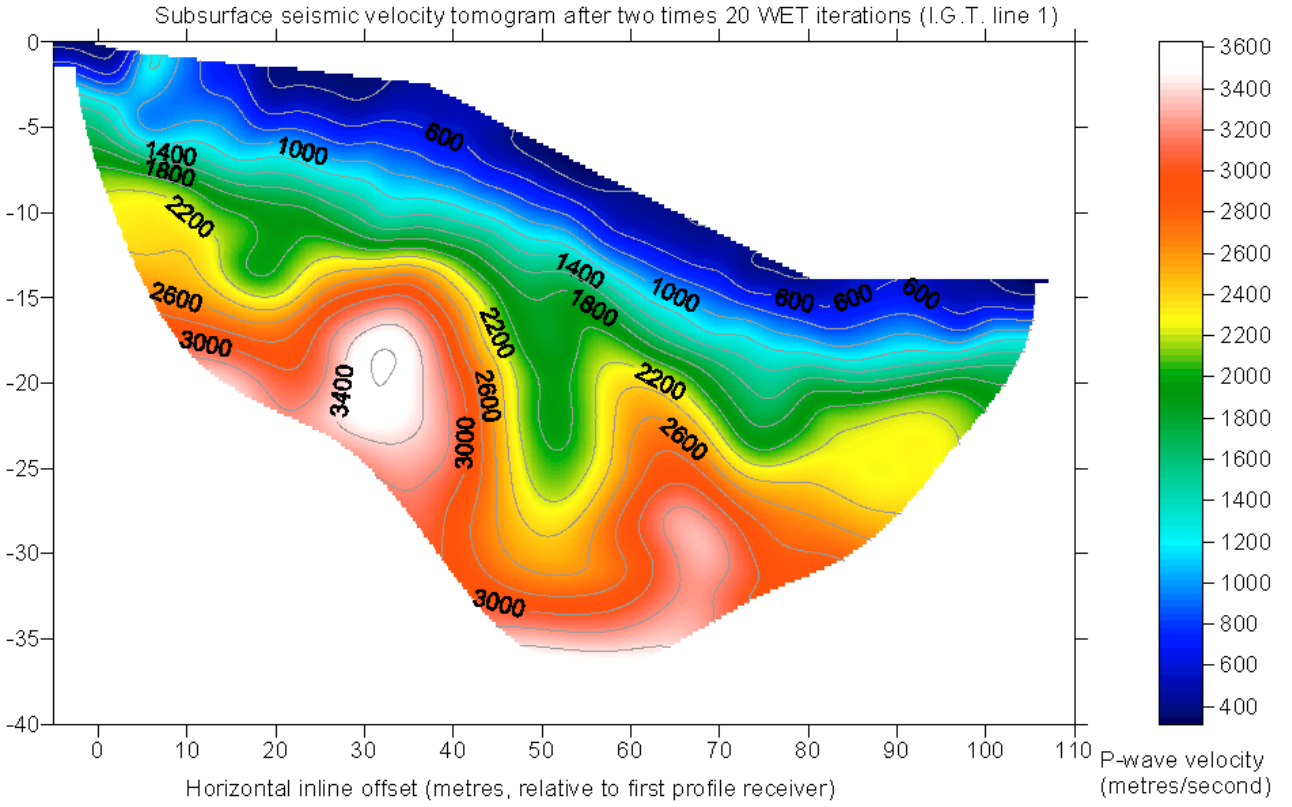
Refining Delta-t-V velocity model with tomography processing

Now select Depth|Tomography processing of traveltimes ... . Then click on button „Select“ and specify the DELTATV.GRD file as generated above. Click on button „Accept parameters“. Then change parameter „Number of WET tomography iterations“ to 20. 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“. Click on „Accept parameters“. Now click on button „Start tomography processing“.

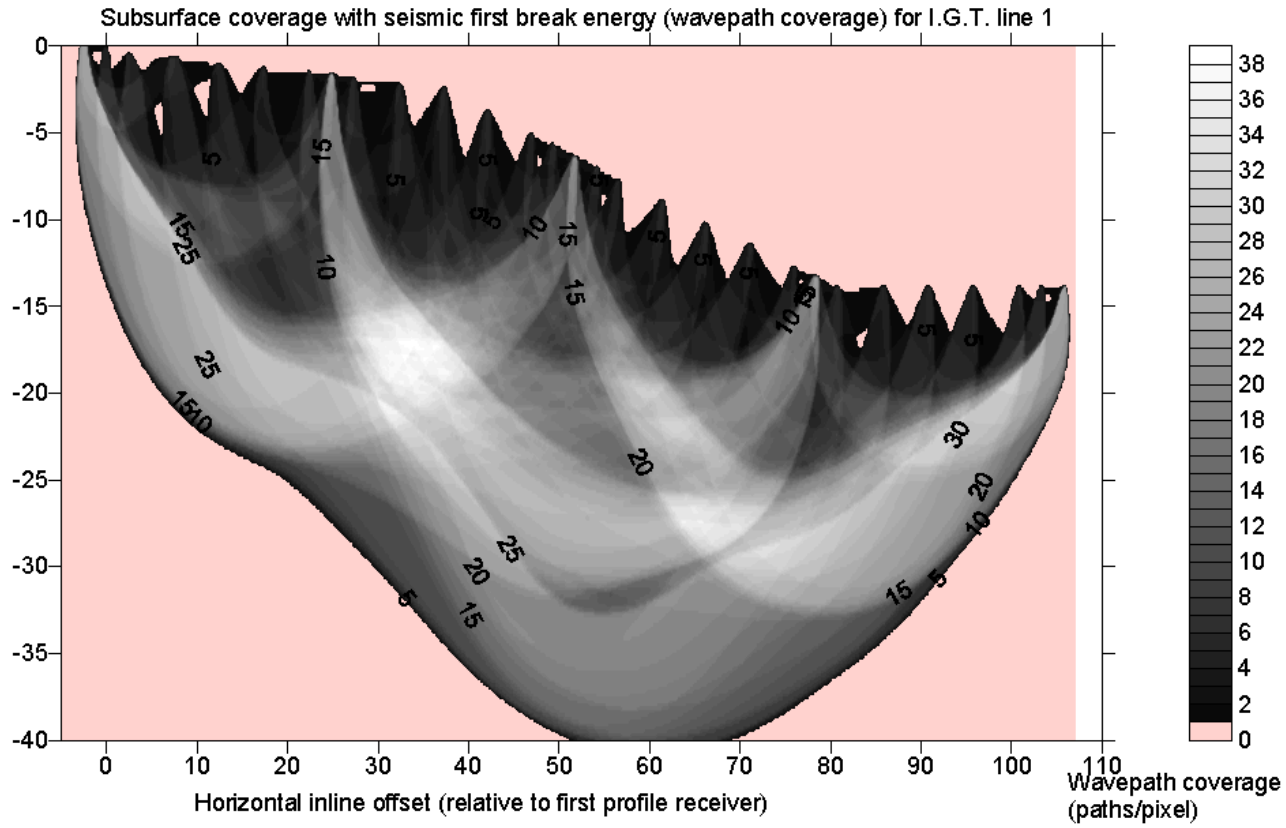
Once the tomography processing has terminated after 20 iterations and about ten minutes of processing time (on Pentium III processor at 500 MHz), you will want to refine the output obtained from this first run. To do so, reselect Depth|Tomography processing of traveltimes ... . Now click on button „Select“ and specify the VELOIT20.GRD as obtained from the previous tomography run. Uncheck check box „Correct all velocities for Delta-t-V systematic error“. Click on button „Accept parameters“. Now 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 :



Note the good match between measured and picked traveltimes (colored solid traveltime curves) and synthesized times (blue dashed curves, blue crosses) as obtained by raytracing through the tomography output. Now contour the output of the final tomography iteration as stored in file VELOIT20.GRD (as lined out in e.g. tutorial line14.pdf) :



To obtain a 2D vertical subsurface section showing the coverage of each 2D pixel with ray paths, just contour the file COVERG20.GRD. In the Surfer 7 Contour Map Properties dialog (displayed when double clicking on the plot), click on tab „Levels“ and then on column header „Level“. Now set parameter „Minimum“ to 0 and „Interval“ to 1. 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 Interpex Gremix .GRM file used to import first breaks as described above is available on the web :

http://rayfract.com/tutorials/line1.zip

For theoretical background of our new tomography algorithm, see

Wavepath eikonal traveltime inversion: Theory (Gerard T. Schuster and Aksel Quintus-Bosz 1993, GEOPHYSICS VOL. 58 NO. 9 September 1993, P. 1314 – 1323) .

Enter these web addresses into the address URL field on top of your web brower display and hit RETURN.