

WET tomographic inversion and dynamic Poisson's ratio imaging for data sets WAVE_P and WAVE_SH as sent by Dr. Anibaldi, Geomethodo s.r.l. :

Data import into Rayfract™ profile database

Download ASCII .ASC formatted files WAVE_P.ASC and WAVE_SH.ASC from our web site :

<https://rayfract.com/tutorials/poisson.zip> .

Now create two new Rayfract™ profile databases named WAVE_P and WAVE_SH, as described in our manual as available at

<https://rayfract.com/help/manual.pdf> . Specify a station spacing of 5 meters, in Header|Profile.

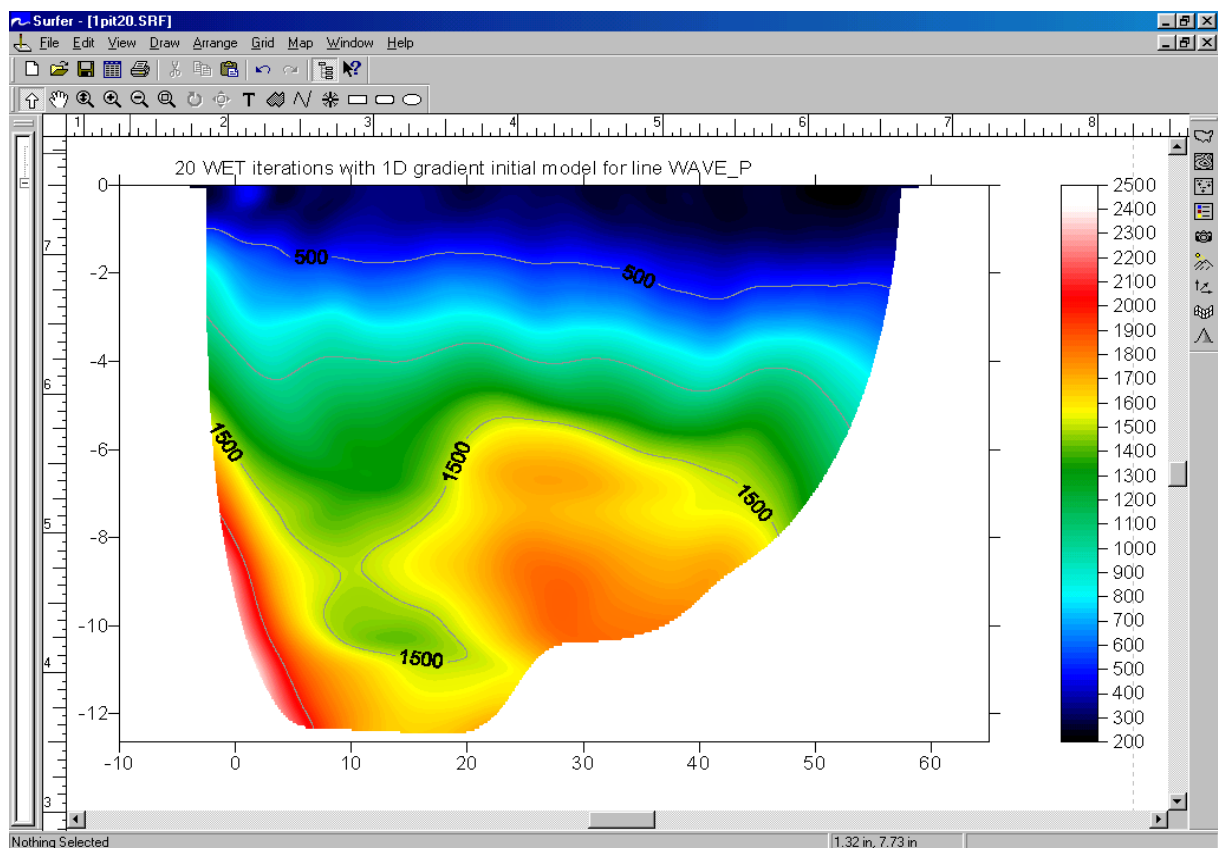
Then copy file WAVE_P.ASC into directory \RAY32\WAVE_P\INPUT, and copy WAVE_SH.ASC into directory \RAY32\WAVE_SH\INPUT.

Now import these ASCII .ASC files into their respective profile databases, as described in above manual. Specify import data type ASCII column format, and use the default receiver spread type 01: 24 channels. Check option "Batch import", so you don't need to confirm layout start and shot position etc. for each individual shot. To define the topography (all elevations 0.0) select Header|Station, enter value 0.0 into Station Coordinate field z for one station and hit RETURN key. The elevation 0.0 will be extrapolated to all stations automatically.

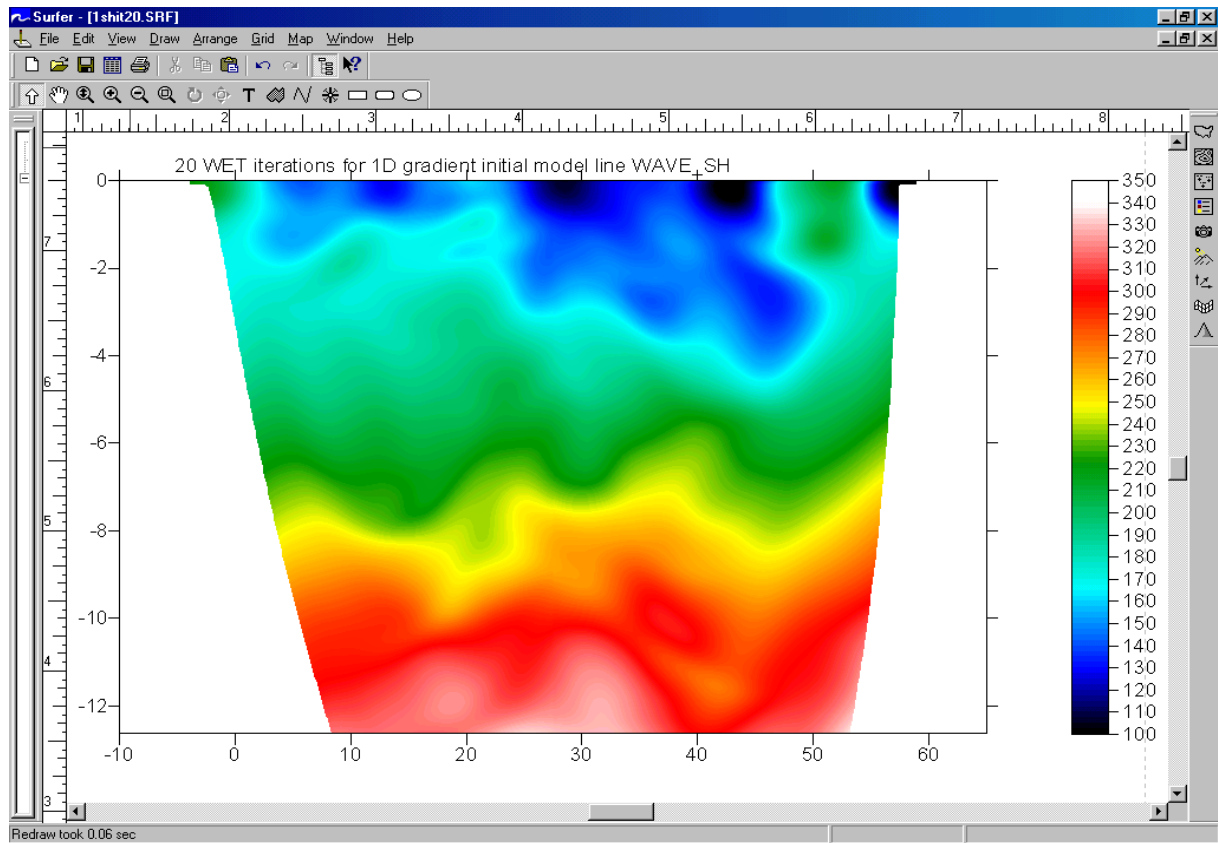
WET tomography processing with 1D gradient initial model and 20 WET iterations

Select Smooth invert|WET with 1D gradient initial model. Confirm the following prompts, to obtain default interpretations based on 10 WET iterations. Now select WET Tomo|Interactive WET tomography... and set parameter „Number of WET tomography iterations“ to 20. Then redo the WET interpretation by clicking on button „Start tomography processing“. You will obtain the following two tomograms :

20 WET iterations with 1D gradient initial model for line WAVE_P :



20 WET iterations with 1D gradient initial model for line WAVE_SH :

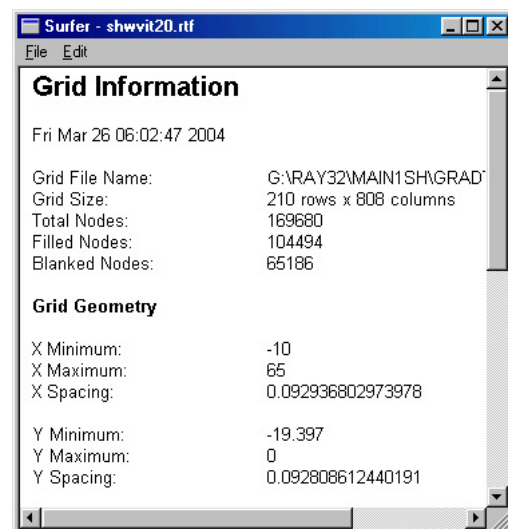
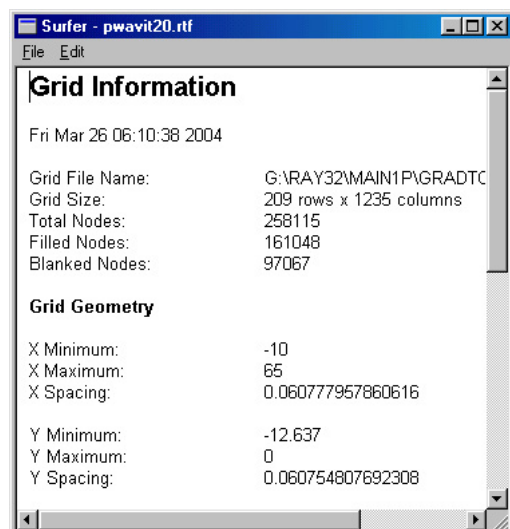


Construction of dynamic Poisson's ratio image map for lines WAVE_P and WAVE_SH

Here we show how to image dynamic Poisson's ratio with Surfer 8 operations Grid Extract, Grid Mosaic and Grid Math. See your Surfer 8 manual chapter 18, for more details on these grid operations.

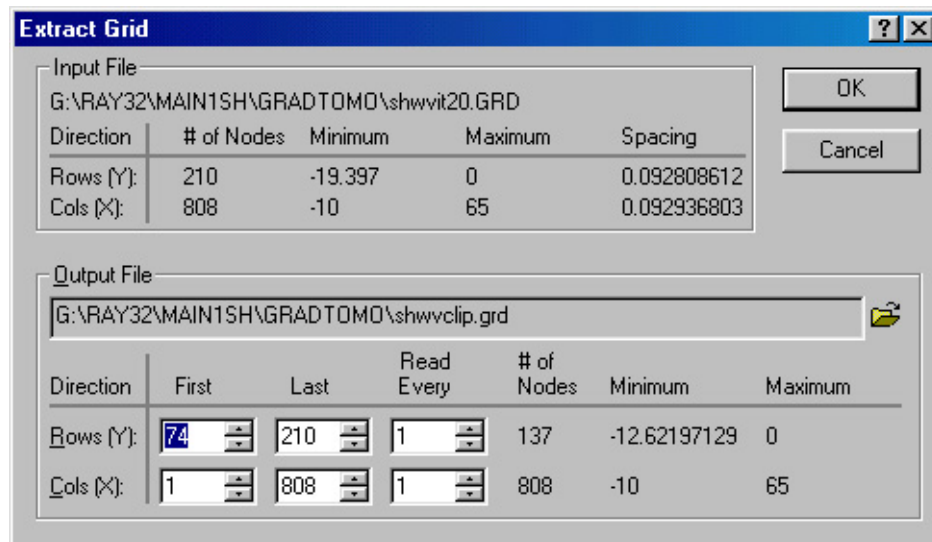
Open a Windows Explorer window with Start|Run... explorer.exe. Now change into directory \RAY32\WAVE_P\GRADTOMO, and rename file VELOIT20.GRD to PWAVIT20.GRD. Change into directory \RAY32\WAVE_SH\GRADTOMO, and rename file VELOIT20.GRD to SHWVIT20.GRD.

Start up Surfer 8, and open above two files PWAVIT20.GRD and SHWVIT20.GRD with File|Open... Display grid header information for these two files with Options|Grid Info... , as shown below :



To be able to carry out Grid Math operations based on above two grids, we first need to resize and resample SHWVIT20.GRD to the size and density (row, column count and cell size) of PWAVIT20.GRD.

Select Window|Plot1 and Grid|Extract... . Now select SHWVIT20.GRD and edit field „First row“ to 74, as shown below. I.e. vary this field until „Minimum row“ optimally fits the minimum y value of PWAVIT20.GRD amounting to -12.63. Click on the Folder icon to the right of edit field Output File, and enter file name SHWVCLIP.GRD. Click on Save, and then click on OK to generate the clipped grid file :



Extract Grid

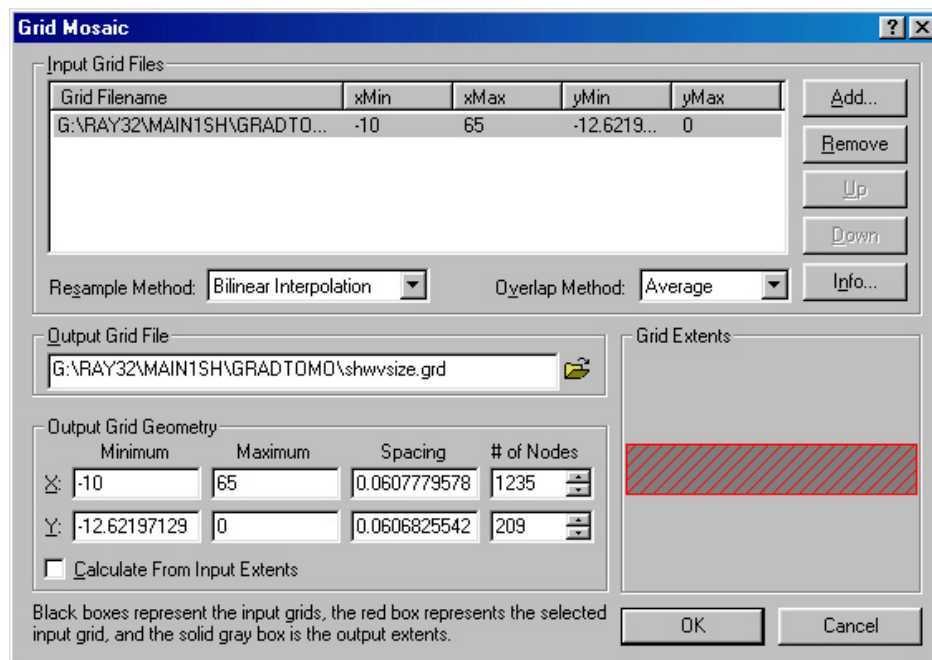
Input File
G:\RAY32\MAIN1SH\GRADTOMO\shwvit20.GRD

Direction	# of Nodes	Minimum	Maximum	Spacing
Rows (Y):	210	-19.397	0	0.092808612
Cols (X):	808	-10	65	0.092936803

Output File
G:\RAY32\MAIN1SH\GRADTOMO\shwvclip.grd

Direction	First	Last	Read Every	# of Nodes	Minimum	Maximum
Rows (Y):	74	210	1	137	-12.62197129	0
Cols (X):	1	808	1	808	-10	65

Now select Grid|Mosaic... and SHWVCLIP.GRD. Edit the following dialog as shown below : set Output File to SHWVSIZE.GRD. Set X # of Nodes to 1235, and set Y # of Nodes to 209, i.e. to the same values as for PWAVIT20.GRD. Then click on OK to generate the resampled grid file :



Grid Mosaic

Input Grid Files

Grid Filename	xMin	xMax	yMin	yMax
G:\RAY32\MAIN1SH\GRADTOMO...	-10	65	-12.6219...	0

Resample Method: Bilinear Interpolation Overlap Method: Average

Output Grid File
G:\RAY32\MAIN1SH\GRADTOMO\shwvsize.grd

Output Grid Geometry

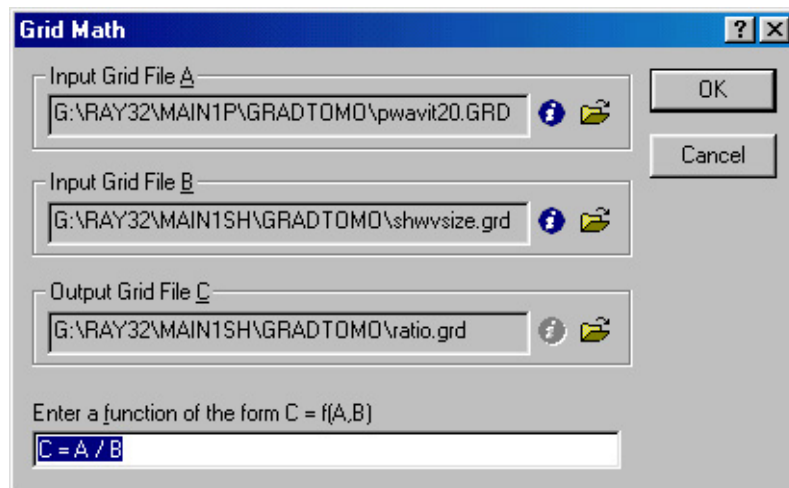
	Minimum	Maximum	Spacing	# of Nodes
X:	-10	65	0.0607779578	1235
Y:	-12.62197129	0	0.0606825542	209

☐ Calculate From Input Extents

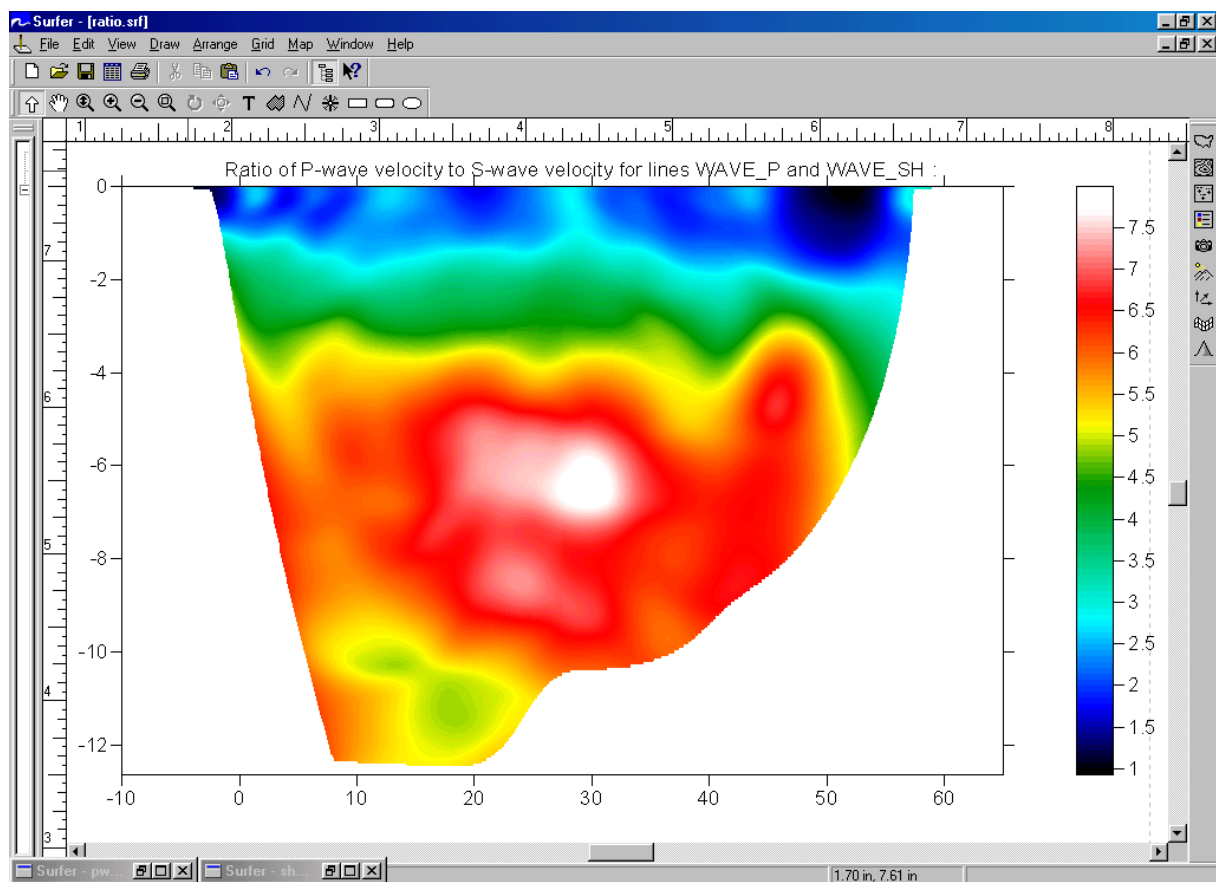
Grid Extents

Black boxes represent the input grids, the red box represents the selected input grid, and the solid gray box is the output extents.

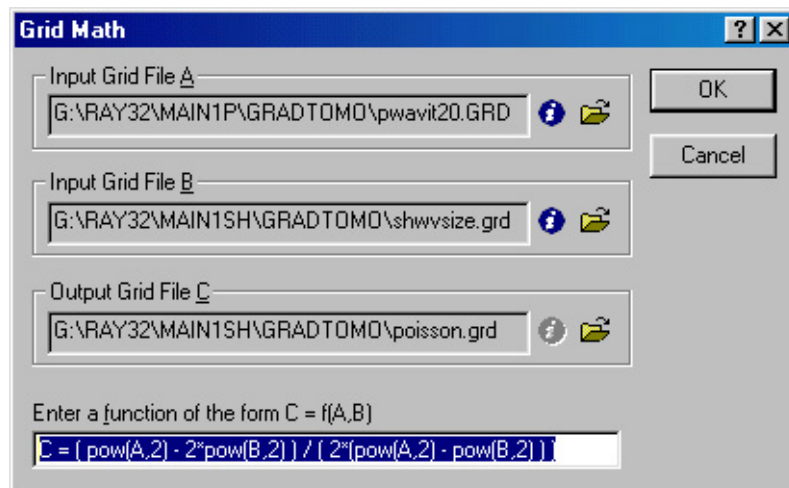
Now select Grid|Math... and \RAY32\WAVE_P\GRADTOMO\PWAVIT20.GRD. Edit the following dialog as shown below : set Input Grid File B to \RAY32\WAVE_SH\GRADTOMO\SHWVSIZE.GRD. Set Output Grid File C to \RAY32\WAVE_SH\GRADTOMO\RATIO.GRD. Set “Enter a function of the form $C=f(A,B)$ “ to $C = A/B$ and click on OK. Confirm the following prompt to generate a grid containing the ratio of P-wave velocity to S-wave velocity :



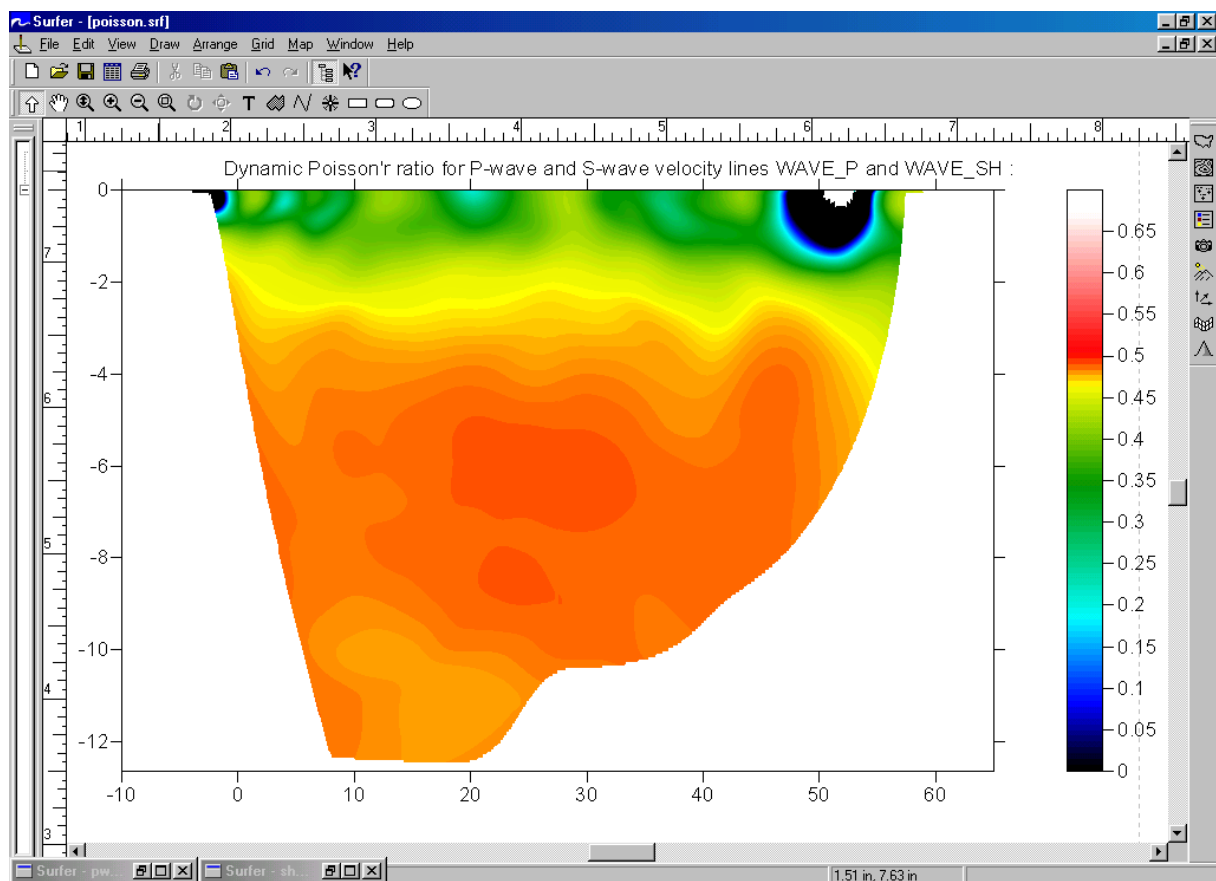
Now select Map|Image Map... and RATIO.GRD as generated above. Double-click with the left mouse key on the obtained plot, to bring up the “Image Map Properties” dialog. Click on “Missing Data” and select the white square. Click on “Colors” and “Load” and select RAINBOW2.CLR as contained in your Surfer 8 program directory, e.g. C:\PROGRAM FILES\SURFER 8\SAMPLES\RAINBOW2.CLR. Click on OK and check options “Interpolate Pixels” and “Show Color Scale”. Click on tab “Scale” and uncheck “Proportional XY Scaling”. Set “Y Scale Length” to 4 inches and click on Apply. Now click on OK, select File|Save As and specify file name RATIO.SRF. Select View|Fit to Window to obtain the following plot :



Now select Grid|Math... and \RAY32\WAVE_P\GRADTOMO\PWAVIT20.GRD. Edit the following dialog as shown below : set Input Grid File B to \RAY32\WAVE_SH\GRADTOMO\SHWVSIZE.GRD. Set Output Grid File C to \RAY32\WAVE_SH\GRADTOMO\POISSON.GRD. Set “Enter a function of the form $C=f(A,B)$ “ to $C = (\text{pow}(A,2) - 2*\text{pow}(B,2)) / (2*(\text{pow}(A,2) - \text{pow}(B,2)))$ and click on OK. Confirm the following prompt to generate a grid containing the Dynamic Poisson’s ratio :



Now select Map|Image Map... and POISSON.GRD as generated above. Customize the image map display as described above. Then double-click the resulting plot again with your left mouse key, and click on "Colors". Uncheck option "Use data limits". Set Minimum to 0 and Maximum to 0.7. Of course the maximum value is 0.5, but the display looks better with 0.7. Now move the "Color spectrum" nodes for yellow and red closer together, to obtain the following display :



Move the yellow and red color spectrum nodes, until the Poisson's ratio is shown with optimum contrast, in the deeper half of above plot. Note the similarity of above dynamic Poisson's ratio plot to the simple P-wave to S-wave velocity ratio plot, as shown earlier. When you are done, select File|Save As and specify file name POISSON.SRF. The abnormally low Poisson's ratio (approaching 0) just below the topography at the right end of the section can be explained by too early picks for traces 10 & 11 of shot nr. 5 of line WAVE_SH. The corresponding high velocity anomaly is clearly visible in the earlier S-wave velocity tomogram.