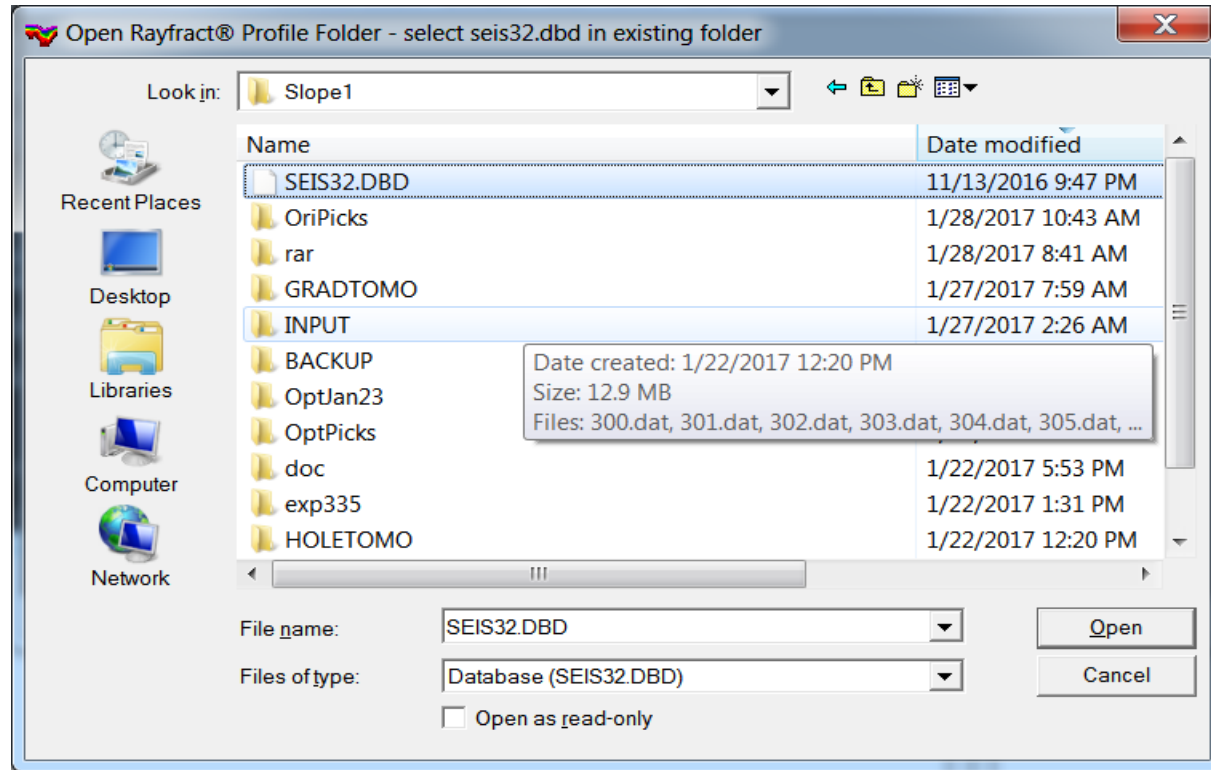


Tutorial : improving first break picks for profile SLOPE1

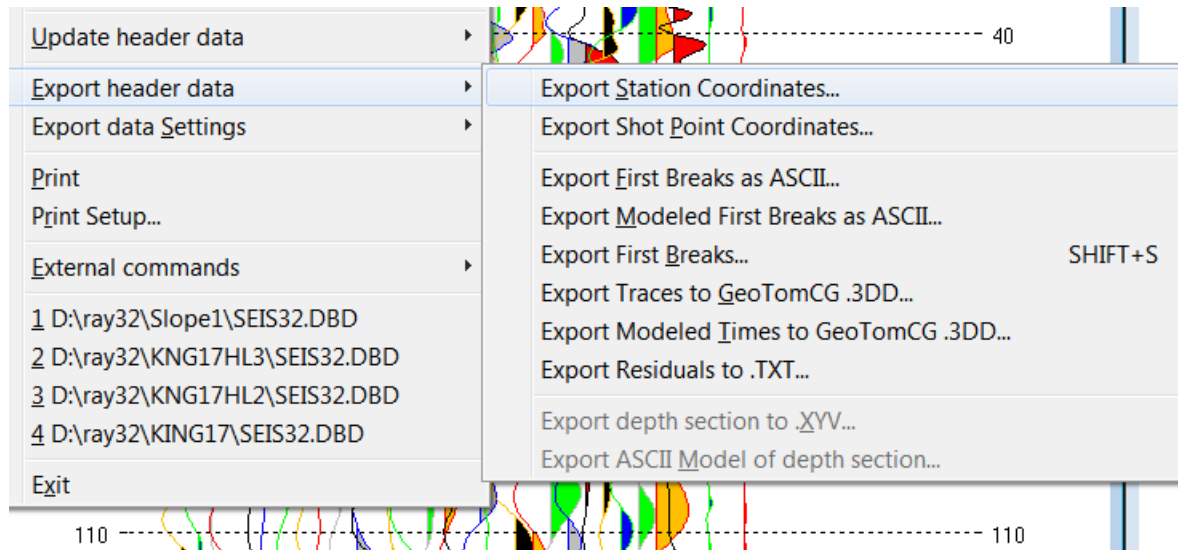
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Download database and open profile



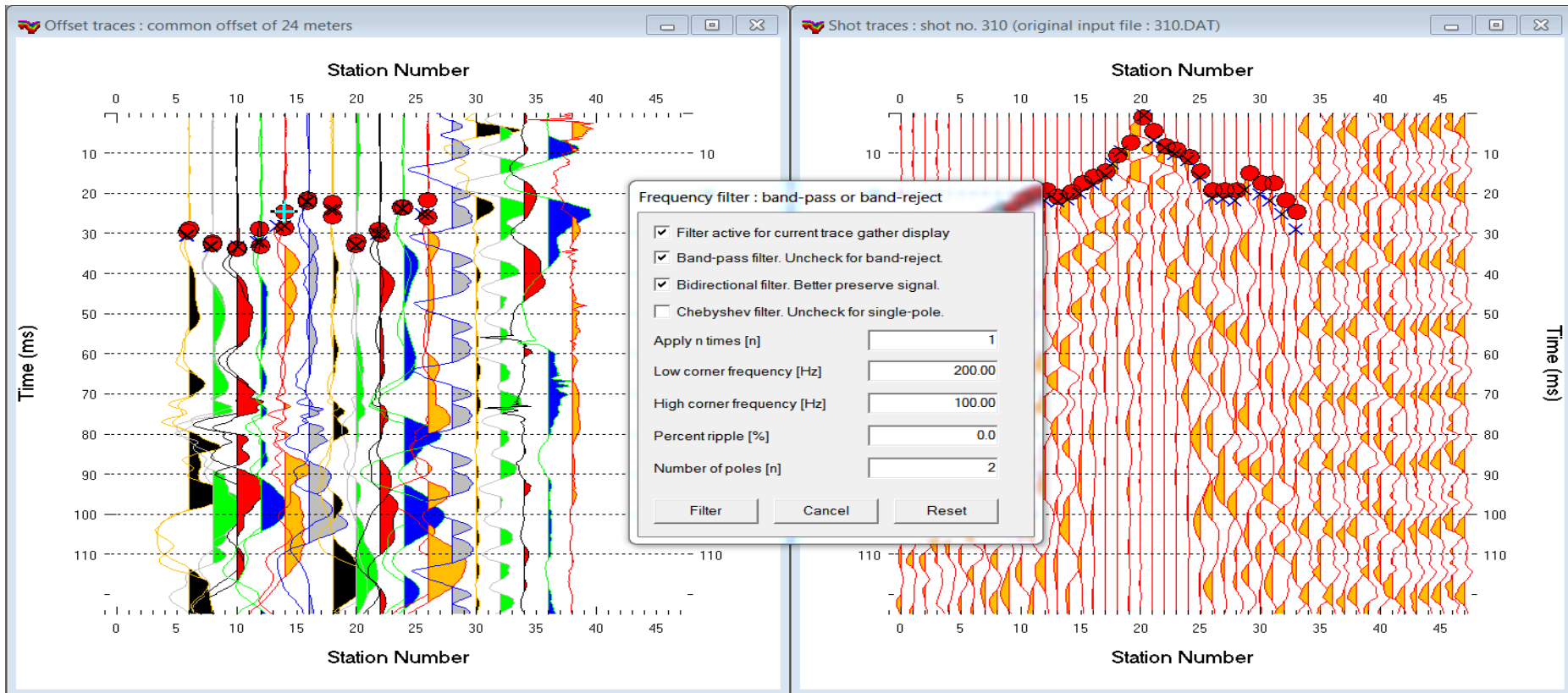
- 1 Download archive http://rayfract.com/tutorials/SLOPE1_SEIS32.ZIP
- 2 In Windows Explorer create directory C:\RAY32\SLOPE1
- 3 Copy SLOPE1_SEIS32.ZIP into C:\RAY32\SLOPE1 and unzip
- 4 Startup Rayfract® by double-clicking desktop icon
- 5 Select *File/Open Profile...* and navigate into C:\RAY32\SLOPE1
- 6 Click SEIS32.DBD and click *Open button*

Export header data



- 1 Select *File/Export header data/Export First Breaks...*
- 2 Click on yellow *Create New Folder icon* at top-right
- 3 Create `EXP335` subdirectory and open with double-click
- 4 Click on *Save button* to store file `BREAKS.LST` into directory
`C:\RAY32\SLOPE1\EXP335`
- 5 Select *File/Export header data/Export Station Coordinates...* and
save to `C:\RAY32\SLOPE1\EXP335\COORDS.COR`
- 6 Select *File/Export header data/Export Shot Point Coordinates...*
and save to `C:\RAY32\SLOPE1\EXP335\SHOTPOTS.SHO`

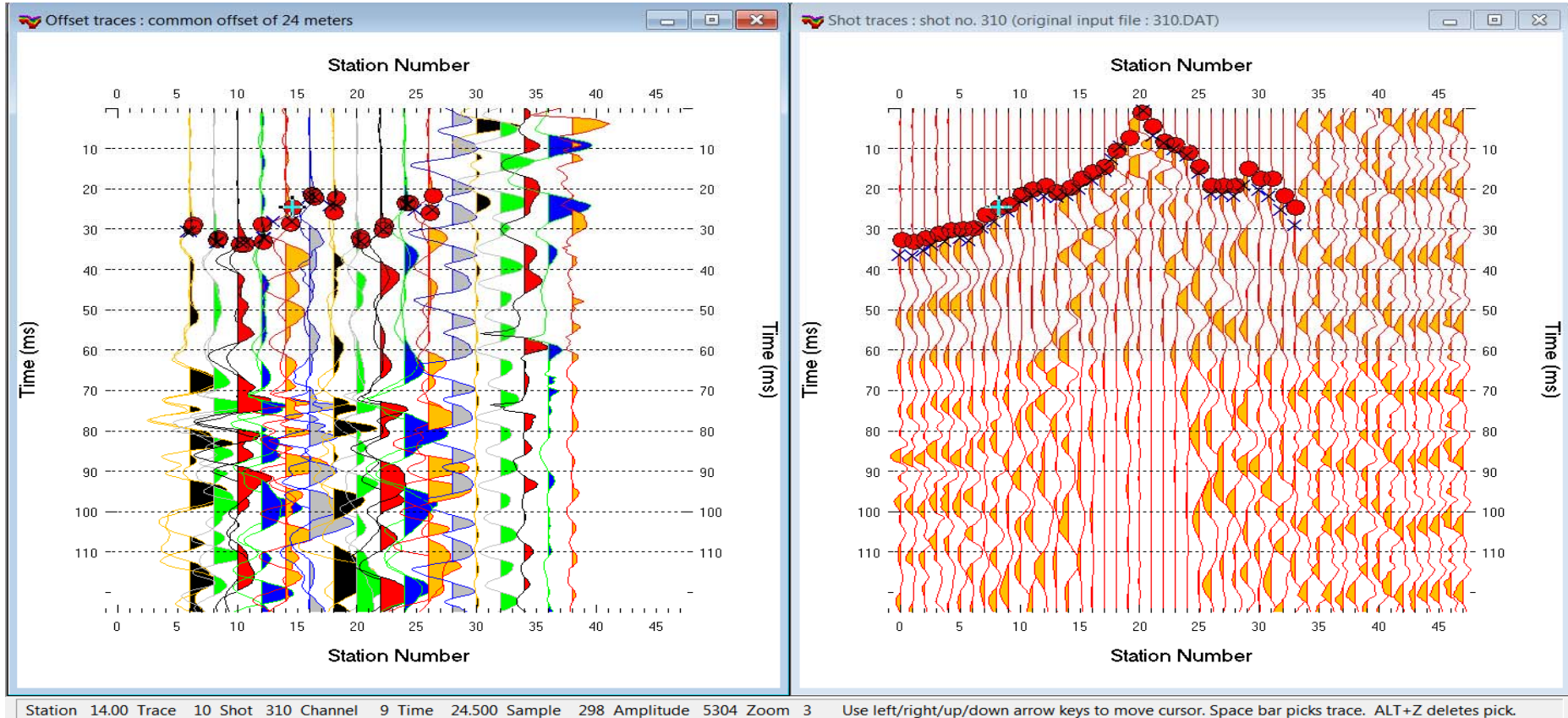
Frequency filter traces with single-pole filter



For online help please select a dialog field with TAB or mouse and press function key F1. Abort dialog with ESC key. Confirm dialog with ENTER key.

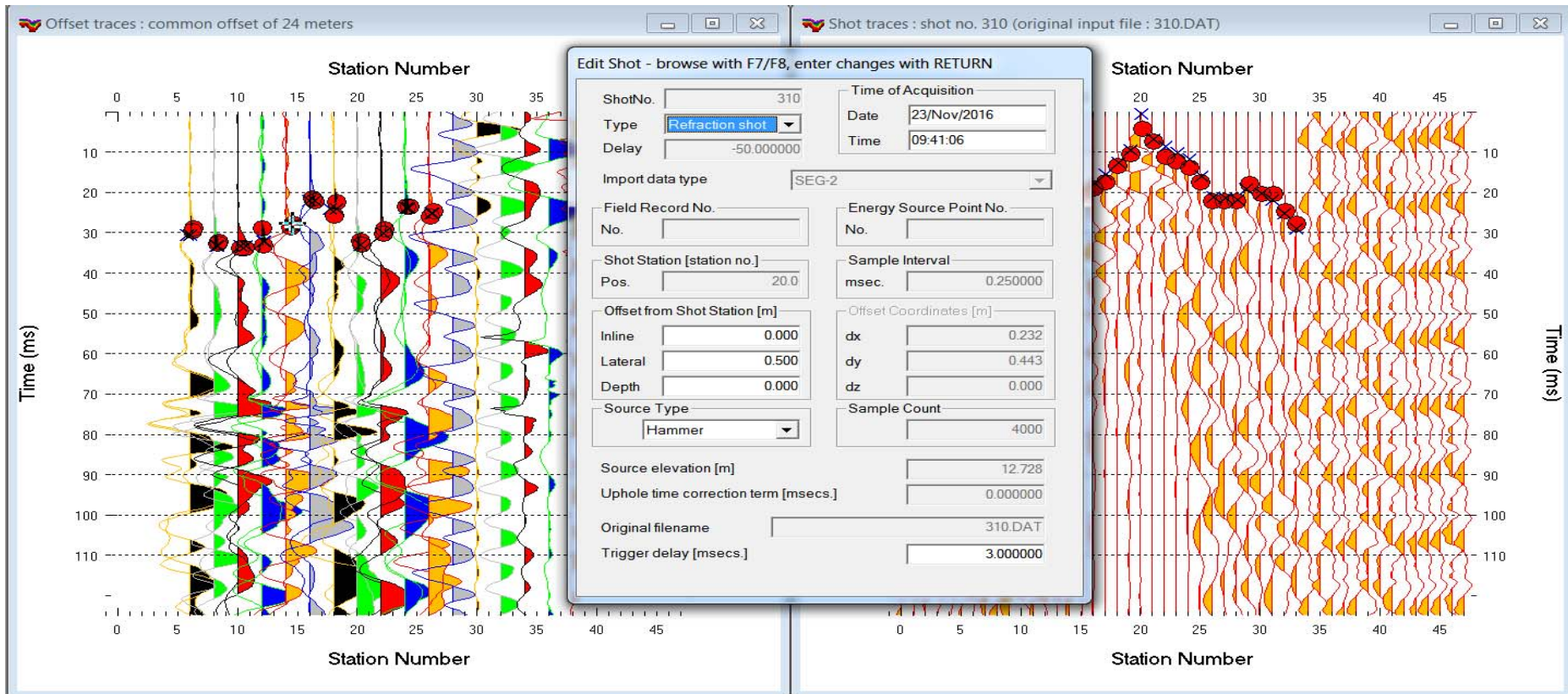
- 1 Select *Trace/Shot* gather and *Window/Tile*. Close *Shot breaks* window
- 2 Browse to shot 310 with F7/F8 . Zoom amplitude with CTRL-F1
- 3 Select *Trace/Offset* gather & *Window/Tile*. Browse with F8 to common offset 24m
- 4 Zoom time scale with F1 to max. 125ms in both windows
- 5 Use CTRL-F1 to zoom amplitude, CTRL-F3 to toggle trace fill mode
- 6 Click left window title. Press SHIFT+Q. Set *Lower corner frequency* to 200 Hz
- 7 Check boxes *Filter active* and *Bidirectional filter*. Click button *Filter*.

Identify inconsistent picks in Trace|Offset gather



- 1 Click on left window title bar. At left bottom shows CMP (Common MidPoint) Station
- 2 Move trace cursor with arrow-right key to CMP Station 14.00
- 3 Navigate two traces at CMP Station 14.00 with arrow-right & arrow-left keys
- 4 Shot 310 Channel 9 pick is too early compared to Shot 304 Channel 21
- 5 Move trace cursor with arrow-right key to Station 26.00
- 6 Shot 310 Channel 33 pick is too early compared to Shot 316 Channel 21
- 7 **Traveltime reciprocity** : swapping source & receiver should give same traveltimes

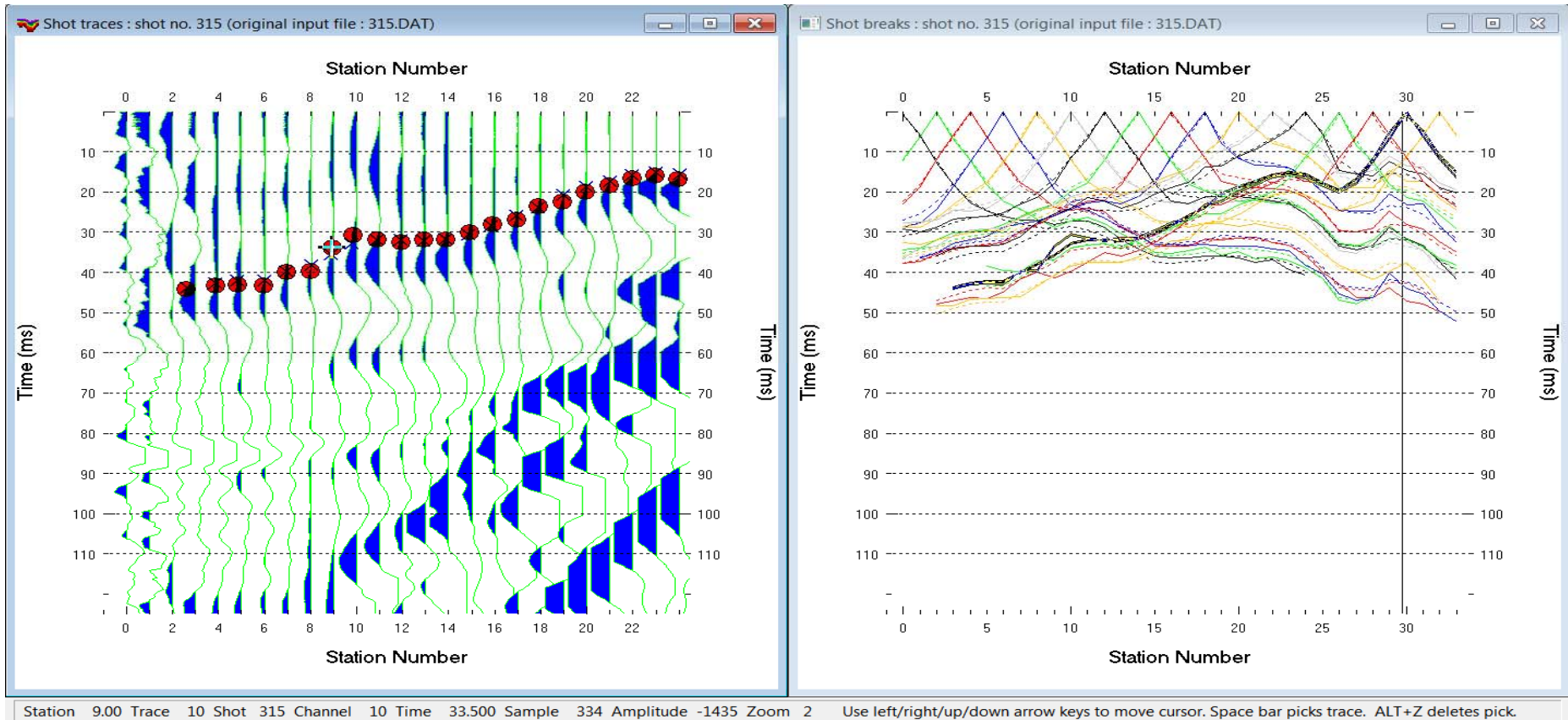
Correct trigger delay for shot 310 in Header|Shot



For online help please select a dialog field with TAB or mouse and press function key F1. Abort dialog with ESC key. Confirm dialog with ENTER key.

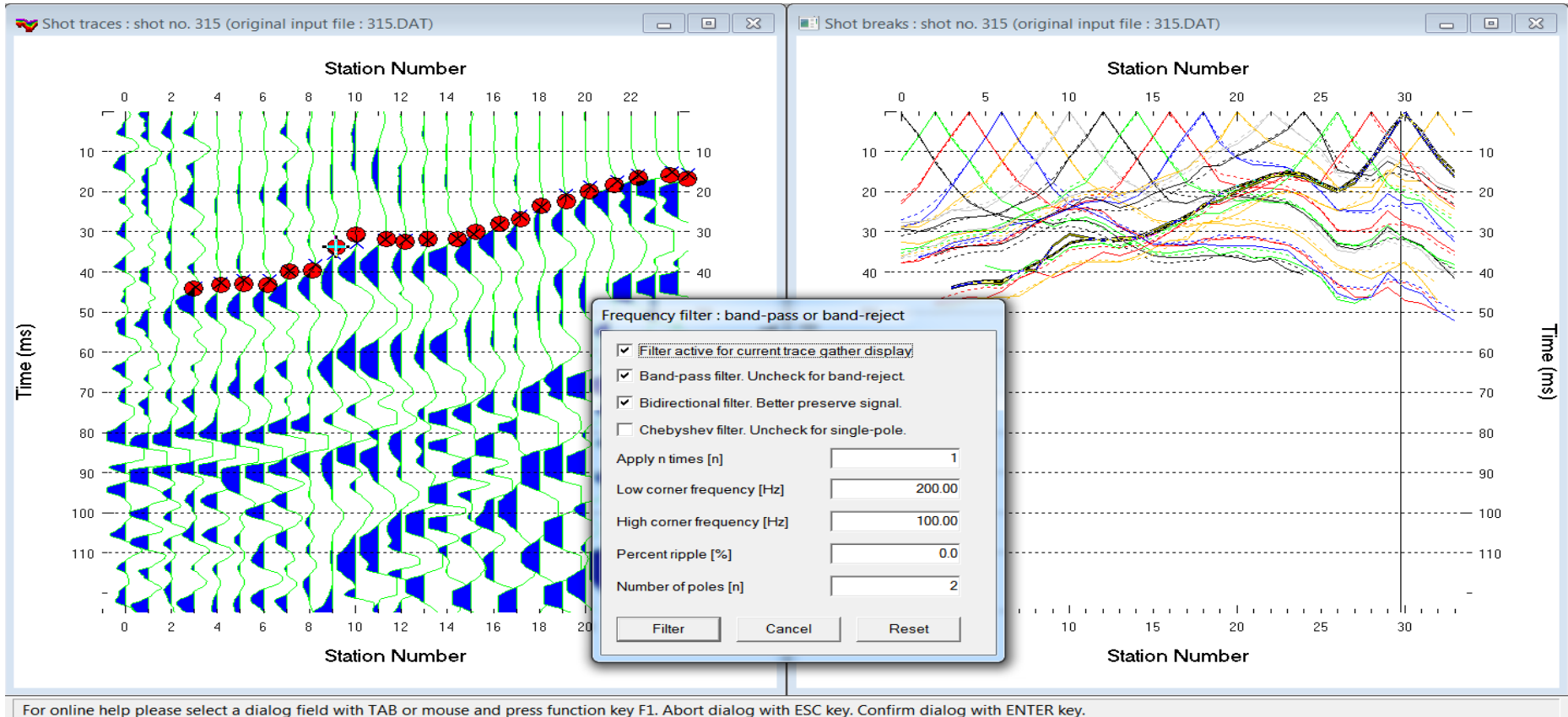
- 1 Select *Header|Shot*. Browse to shot 310. Set *Trigger delay* to 3ms and hit ENTER
- 2 Yellow traces and picks for shot 310 are shifted down 3ms in both windows
- 3 Click on title bar of left window showing common offset of 24m
- 5 Move trace cursor with arrow-right key to Station 14.00
- 6 Shot 310 Channel 9 pick is now at same level as Shot 304 Channel 21
- 7 Move trace cursor with arrow-right key to Station 26.00
- 8 Shot 310 Channel 33 pick is now at same level as Shot 316 Channel 21

Review picks for Shot 315 unfiltered



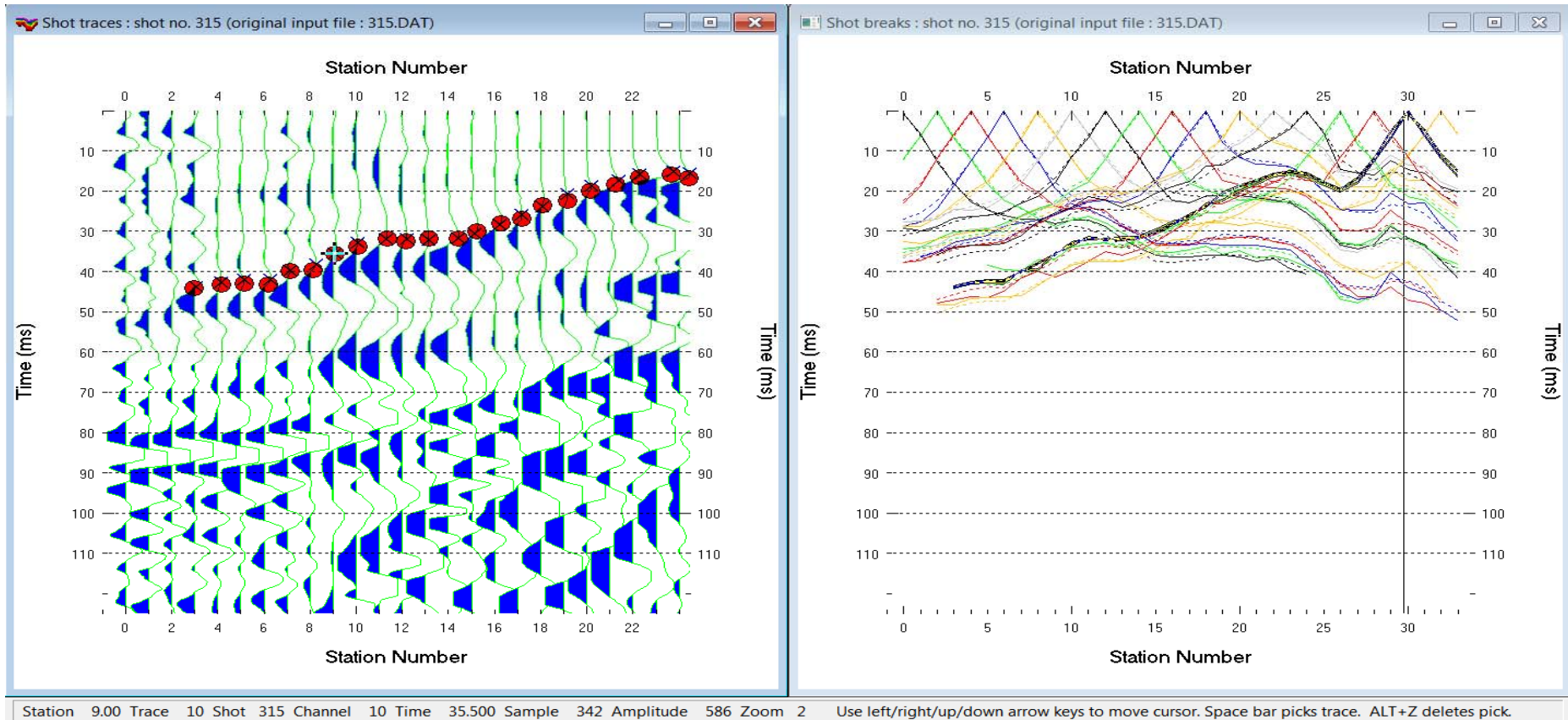
- 1 Select *Trace/Shot gather & Window/Tile*
- 2 Click on title bar of left window and browse to Shot 315 with F7/F8 function keys
- 3 Move trace cursor with arrow-right key to Channel 10 at Station 9.00
- 4 Note in right window picks are too early for Stations 9&10 compared to other shots
- 5 Traveltime curves in *Shot breaks window* should be similar for adjacent shots at same stations

Review picks for Shot 315 filtered



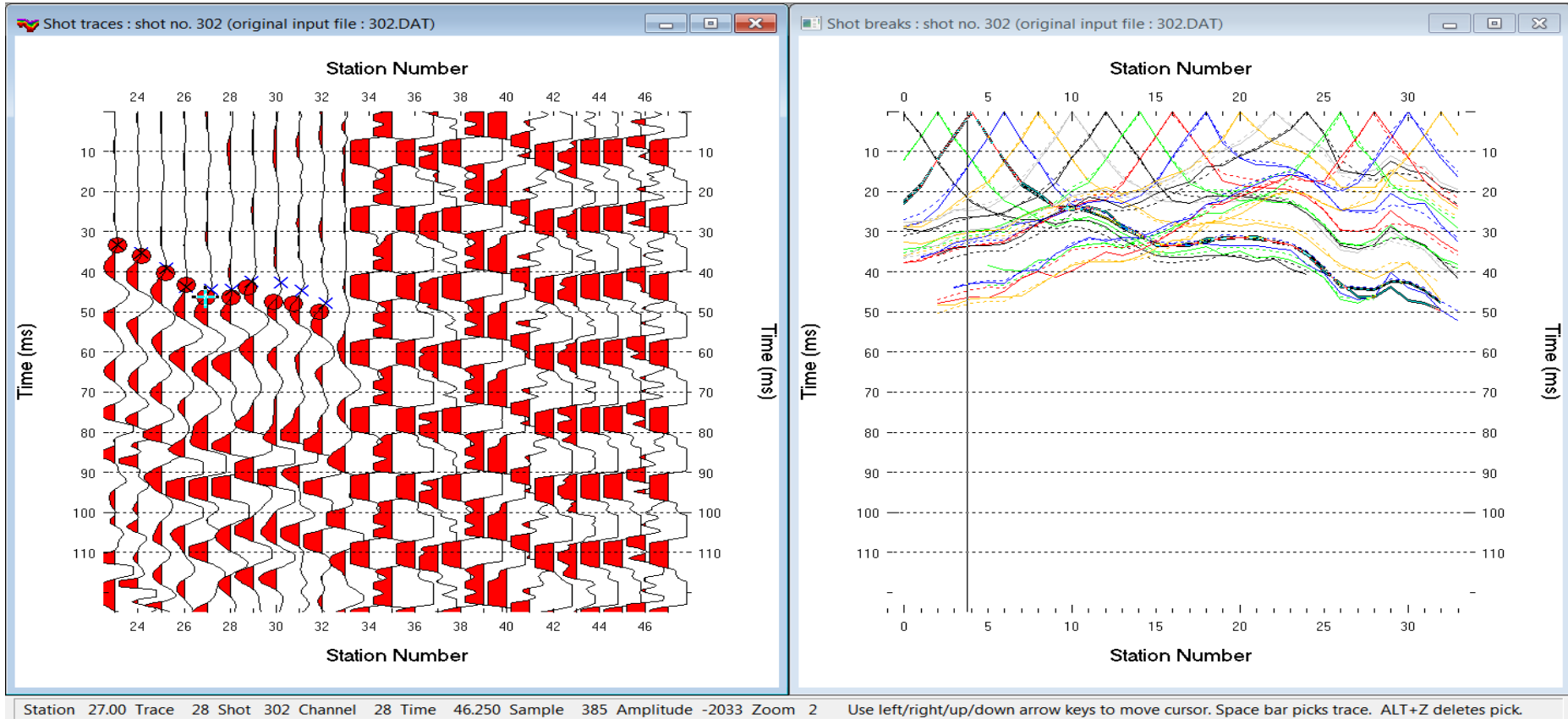
- 1 Press SHIFT+Q and set *Lower corner frequency* to 200Hz. Check *Filter active box*
- 2 Click *Filter button*
- 3 Now it becomes more evident that channels 10&11 of Shot 315 are picked too early

Move picks down for channels 10&11 of Shot 315



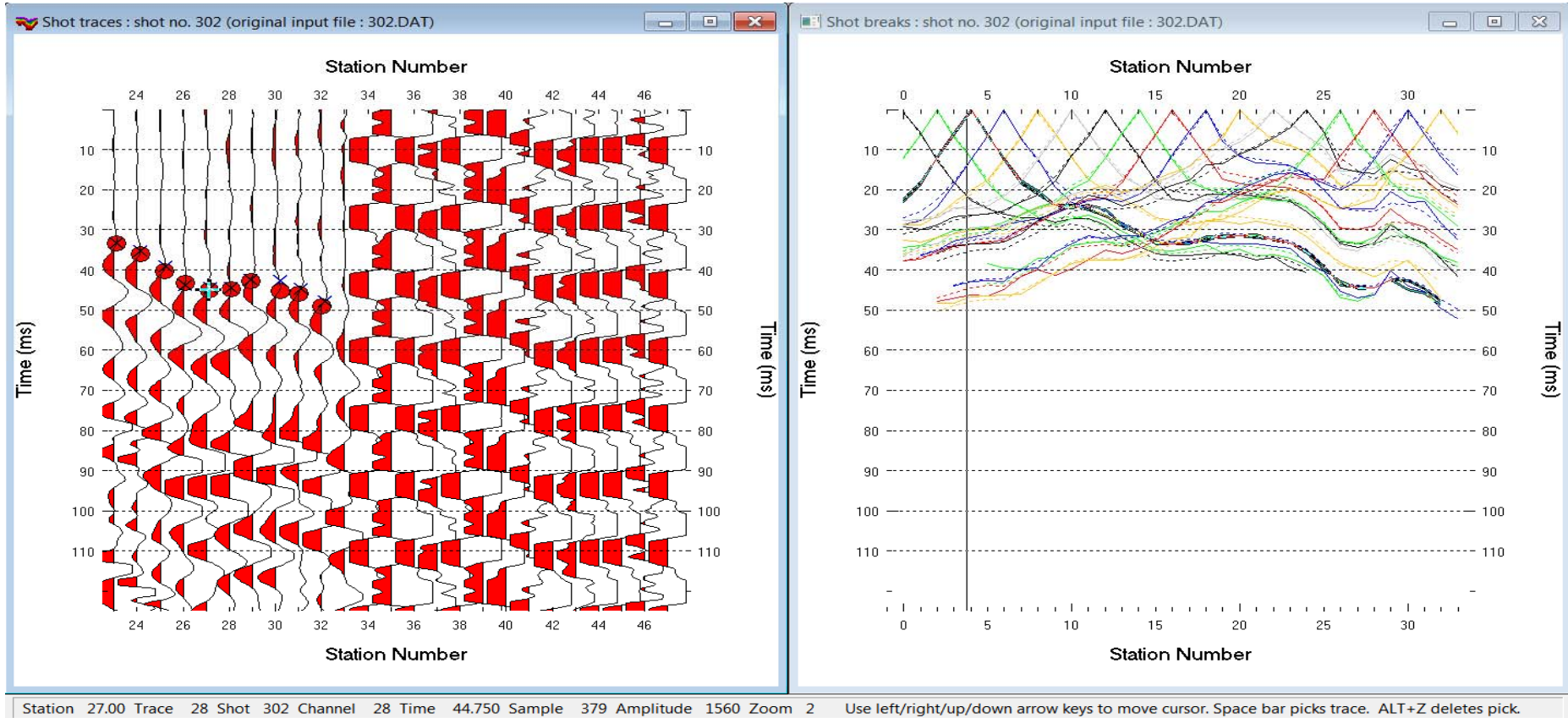
- 1 Navigate with arrow-left or arrow-right key to Channel 10 of Shot 315
- 2 Use arrow-down key to move down pick cursor (plus symbol) to Time 35.500 ms
- 3 Hit space bar to repick Channel 10 at current pick cursor location
- 4 Navigate to Channel 11 of Shot 315 with arrow-right key
- 5 Move down pick cursor to Time 33.500 ms. Hit space bar to repick Channel 11
- 6 Press ALT+Y to update *Shot breaks window* on right
- 7 Now picks for Shot 315 at Channels 10&11 are more consistent with adjacent shots

Review filtered traces of Shot 302



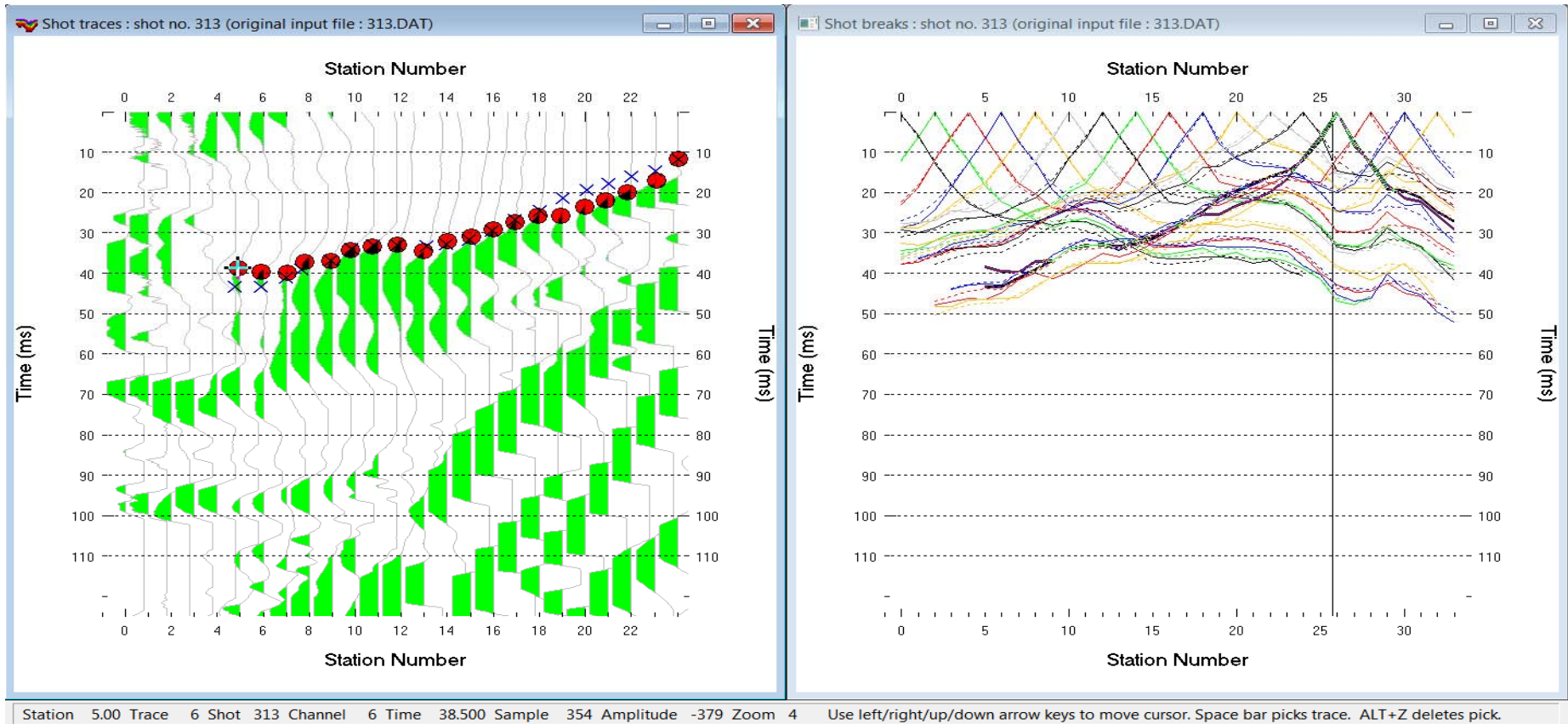
- 1 Browse with F7/F8 to Shot 302.
- 2 Note too late picks for Channels 28 to 33 compared to blue crosses (modelled times)
- 3 Also note too late picks in right window at Stations 29 to 34 for Shot 302
- 4 Traveltime curves for adjacent shots should be similar at same stations

Move up picks for Channels 28 to 33 of Shot 302



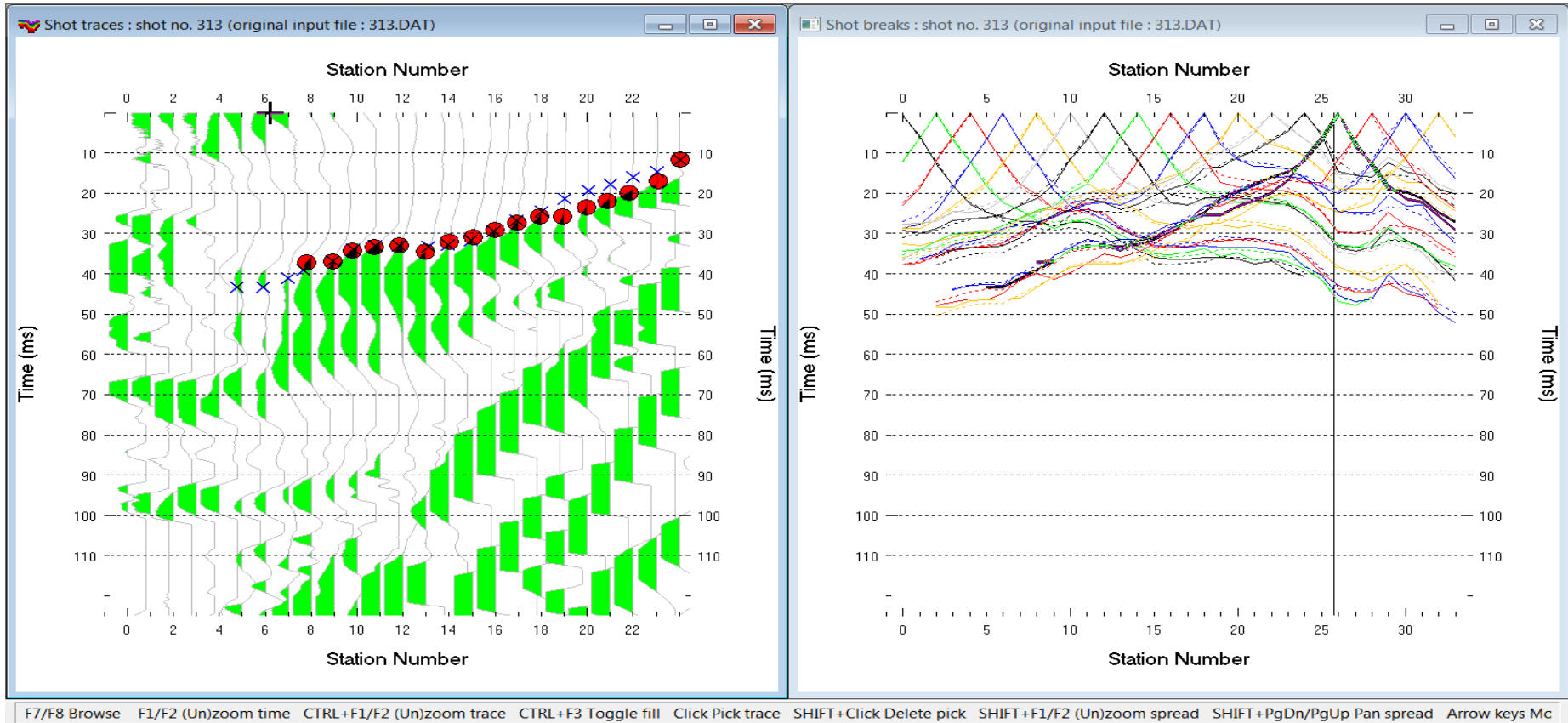
- 1 Move up pick for Channel 28 of Shot 302 from Time 46.250 to 44.750
- 2 Move up picks for Channels 29 to 33 as shown above
- 3 Press ALT+Y to refresh *Shot breaks window* on right
- 4 Note how the traveltime curve for Shot 302 is more similar to adjacent shot curves

Review unfiltered picks for Shot 313 Channels 6,7,8



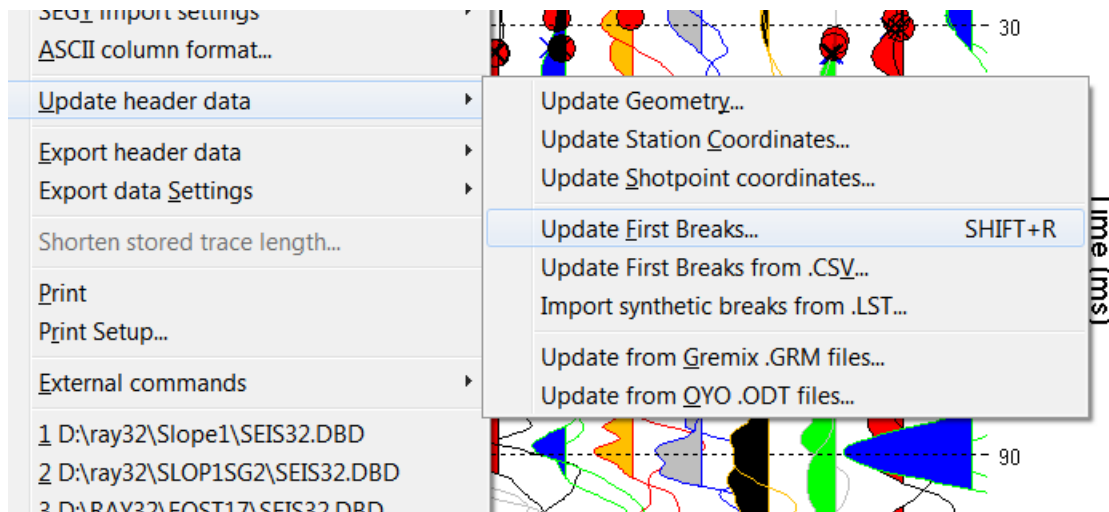
- 1 Browse with F7/F8 to Shot 313 in left window
- 2 Press SHIFT+Q. Uncheck box *Filter active* and click *Filter button*
- 3 Navigate pick cursor (plus symbol) to Channel 6 of Shot 313 with arrow-right key
- 4 Picks for Channels 6, 7 and 8 are too early compared to modeled blue picks
- 5 These picks are also too early compared to adjacent shot curves in right window

Delete picks for Channels 6,7,8 of Shot 313



- 1 Navigate with arrow-left or arrow-right key to Channel 6 of Shot 313
- 2 Press ALT+Z keys to delete pick
- 3 Do the same for Channels 7 and 8 of Shot 313
- 4 Press ALT+Y to refresh *Shot breaks* display in right window
- 5 Note how traveltide curve for Shot 313 is more consistent with adjacent curves

Download and import good picks and trigger delays



- 1 Download archive http://rayfract.com/tutorials/SLOPE1_GOODPICK.ZIP
- 2 Create folder C:\RAY32\SLOPE1\GOODPICK in Windows Explorer
- 3 Copy SLOPE1_GOODPICK.ZIP into C:\RAY32\SLOPE1\GOODPICK and unzip
- 4 *File|Update header data|Update Shotpoint coordinates* with SHOTPTS.SHO
- 5 *File|Update header data|Update First Breaks* with BREAKS.LST
- 6 *Trace|Shot gather & Window|Tile* to redisplay Shot gather and Breaks window

Increase cell size in Header|Profile to speedup WET

Edit Profile

Line ID:

Line type:

Job ID:

Instrument:

Client:

Company:

Observer:

Note:

Time of Acquisition: Date Time

Time of Processing: Date Time

Units:

Sort:

Const:

Station spacing [m]:

Min. horizontal separation [%]:

Profile start offset [m]:

Cell size [m]:

☐ Left handed coordinates

☒ Force grid cell size

Add borehole lines for WET tomography

Borehole 1 line:

Borehole 2 line:

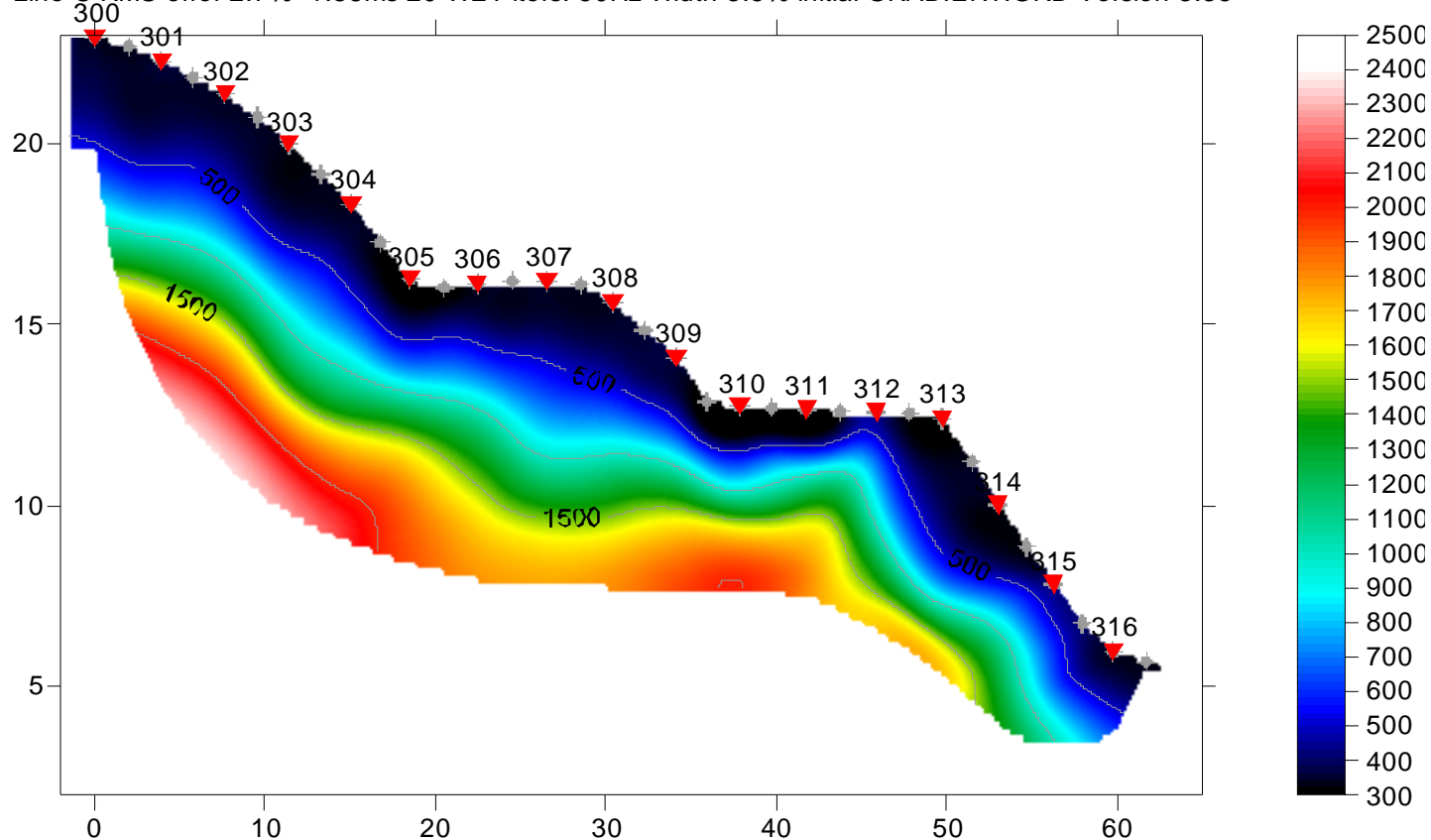
Borehole 3 line:

Borehole 4 line:

- 1 Select *Header|Profile*. Check box *Force grid cell size*.
- 2 Set field *Cell size* to 0.2m
- 3 Click *button OK* and confirm prompts

Smooth inversion of first breaks

Line C RMS error 2.7%=1.38ms 20 WET iters. 50Hz Width 3.5% initial GRADIENT.GRD Version 3.35



- 1 Check *DeltatV|DeltatV Settings|Suppress velocity artefacts*
- 2 Check *DeltatV|DeltatV Settings|Smooth CMP traveltime curves*
- 3 Select *Smooth invert|WET with 1D gradient initial model*
- 4 Once the 1D gradient model is shown in Surfer™ click Rayfract prompt and *Yes button* to continue with 2D WET inversion

Force Surfer plot limits with our Grid|Surfer plot Limits

Edit Surfer plot limits

☒ Plot limits active

Min. offset: -2.000 [m]
Max. offset: 65.000 [m]
Min. elevation: 2.000 [m]
Max. elevation: 23.000 [m]
Min. velocity: 300 [m/sec.]
Max. velocity: 2500 [m/sec.]

Plot Scale

☐ Proportional XY Scaling
☐ Page unit is centimeter. Uncheck for inch.

X Scale length: 6.000 [inch]
Y Scale length: 4.000 [inch]

Color Scale

☐ Adapt color scale

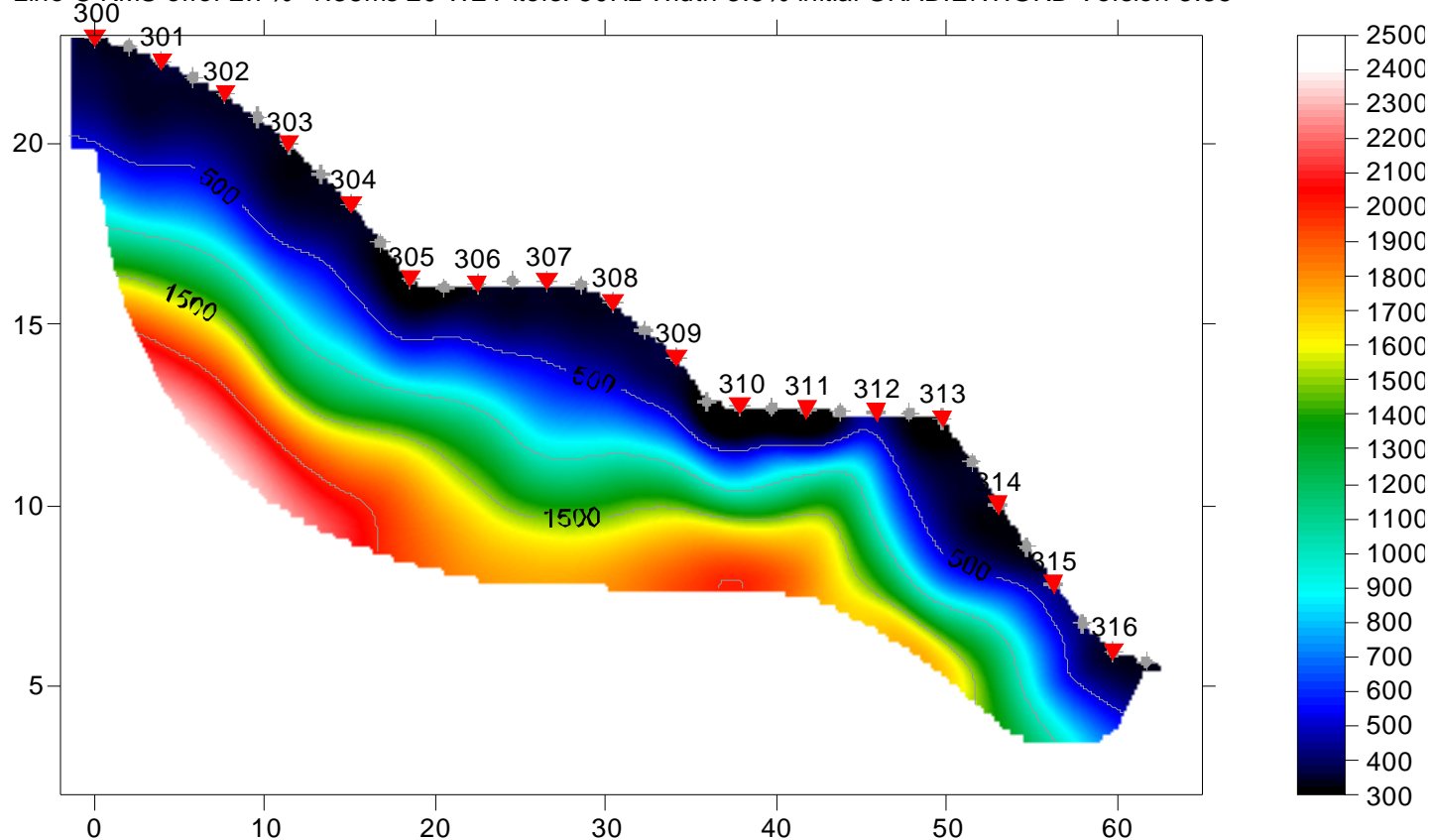
Scale height: 4.000 [inch]
Velocity interval: 500 [m/sec.]
Coverage interval: 5 [paths/pixel]

OK
Cancel
Reset
Reset to grid

- 1 Select *Grid|Surfer plot Limits*
- 2 Click *Reset to grid* and select ...\\GRADTOMO\\VELOIT20.GRD
- 3 Set *Min. offset* to -2.0m, *Max. offset* to 65.0m
- 4 Set *Min. elevation* to 2.0m, *Max. elevation* to 23.0m
- 5 Set *Min. velocity* to 300 m/s, *Max. velocity* to 2500 m/s.
- 6 Check box *Plot limits active* and click *OK button*

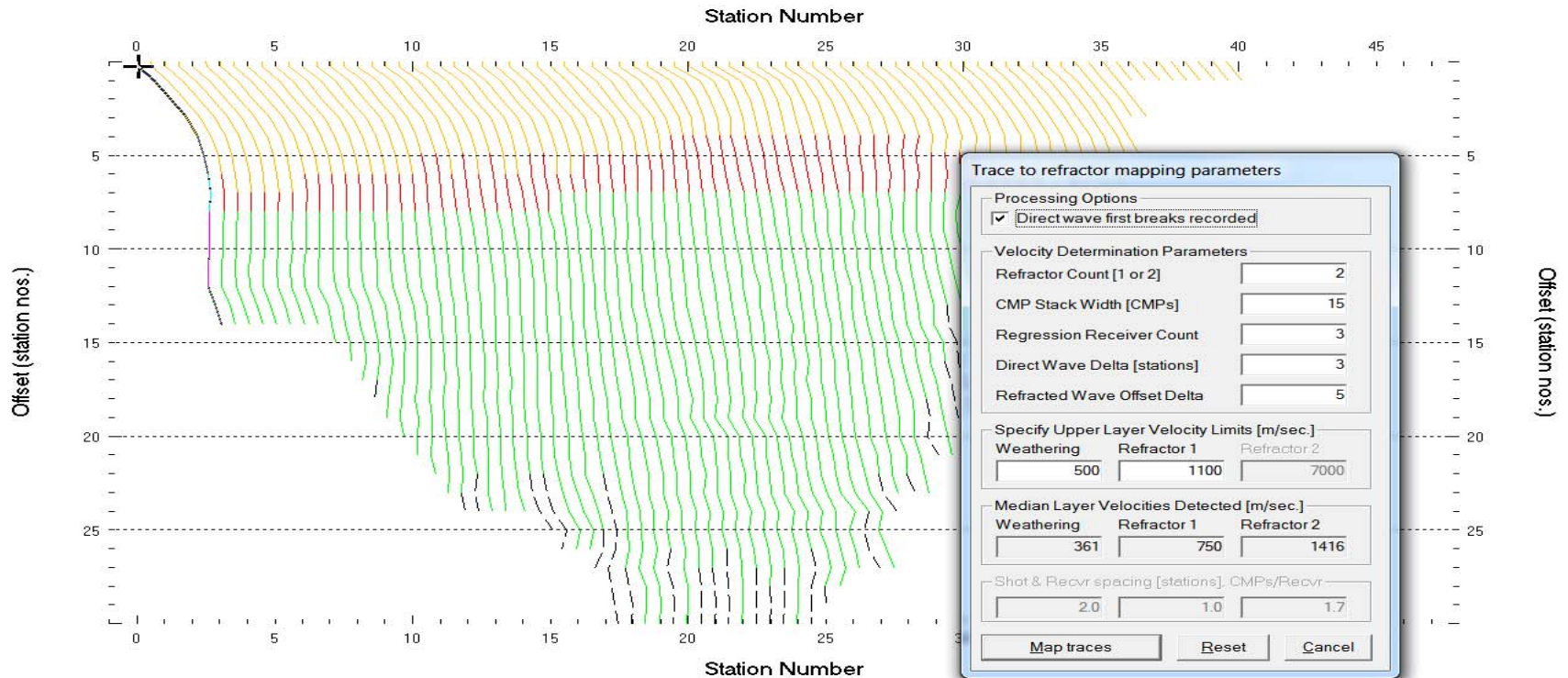
Redisplay tomogram with updated plot limits

Line C RMS error 2.7%=1.38ms 20 WET iters. 50Hz Width 3.5% initial GRADIENT.GRD Version 3.35



- 1 Select *Grid/Image and contour velocity and coverage grids*
- 2 Select ...\\GRADTOMO\\VELOIT20.GRD.

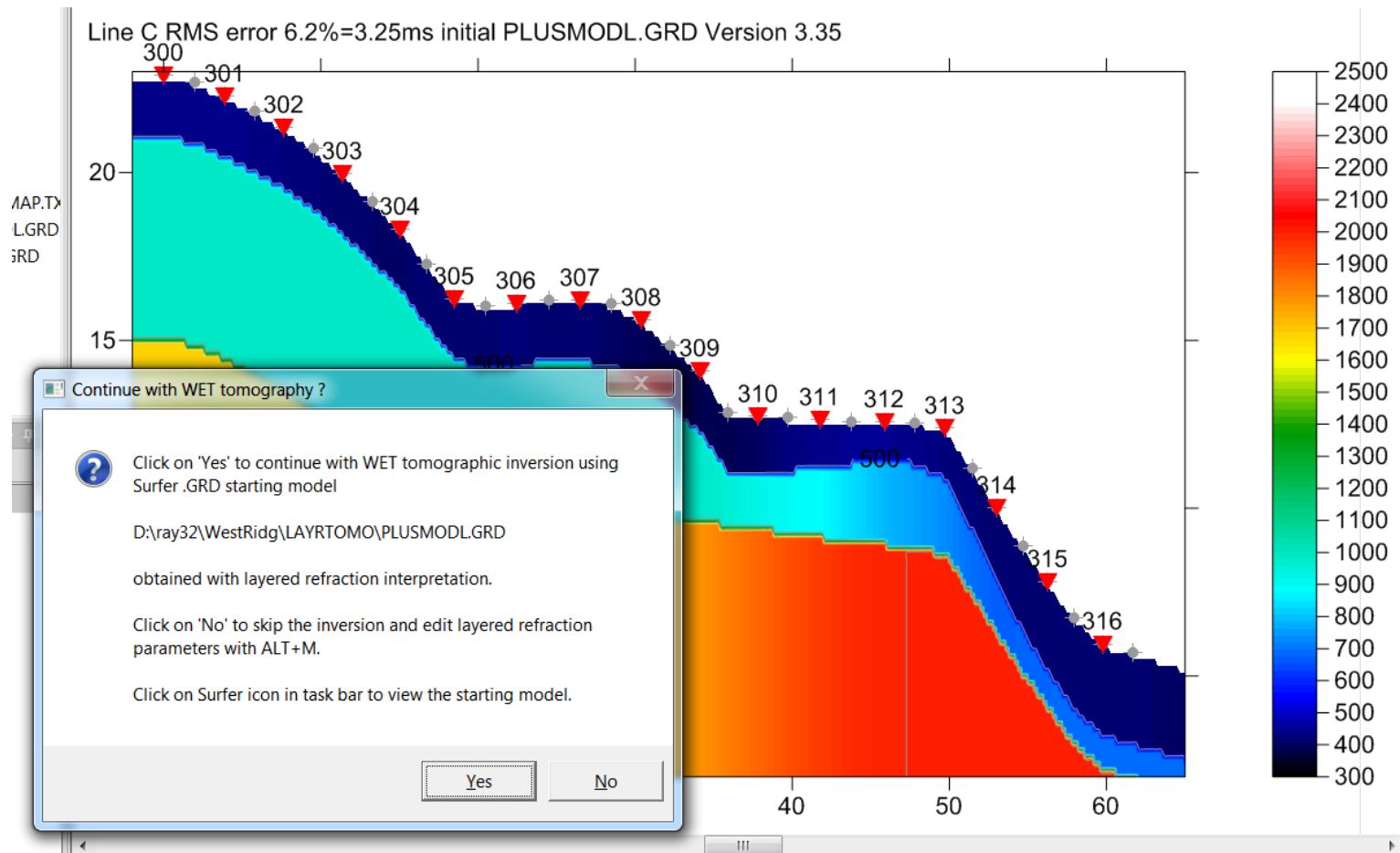
Map traces to refractors in Refractor|Midpoint breaks



ine help please select a dialog field with TAB or mouse and press function key F1. Abort dialog with ESC key. Confirm dialog with ENTER key.

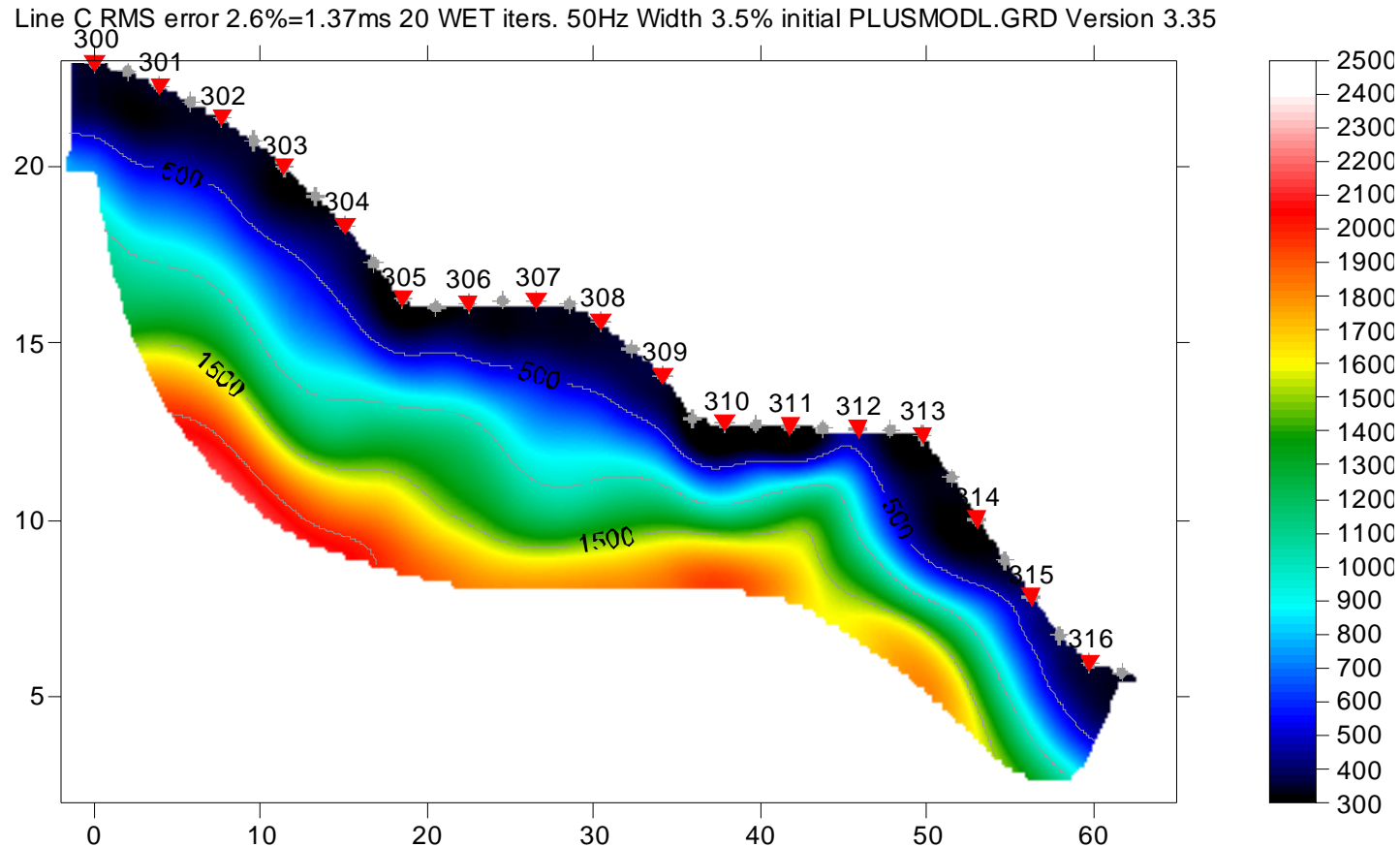
- 1 Select *Refractor|Midpoint breaks*
- 2 Set *Weathering limit* to 500 m/s. Set *Refractor 1 limit* to 1100 m/s.
- 3 Click *button Map traces* and confirm prompt
- 4 Press ALT+G to show *Crossover distance smoothing* dialog
- 5 Leave *Overburden filter* at 5 and *Basement filter* at 10 stations
- 6 Click *Accept button* to smooth crossover distances along profile

Run WET with layered Plus-Minus starting model



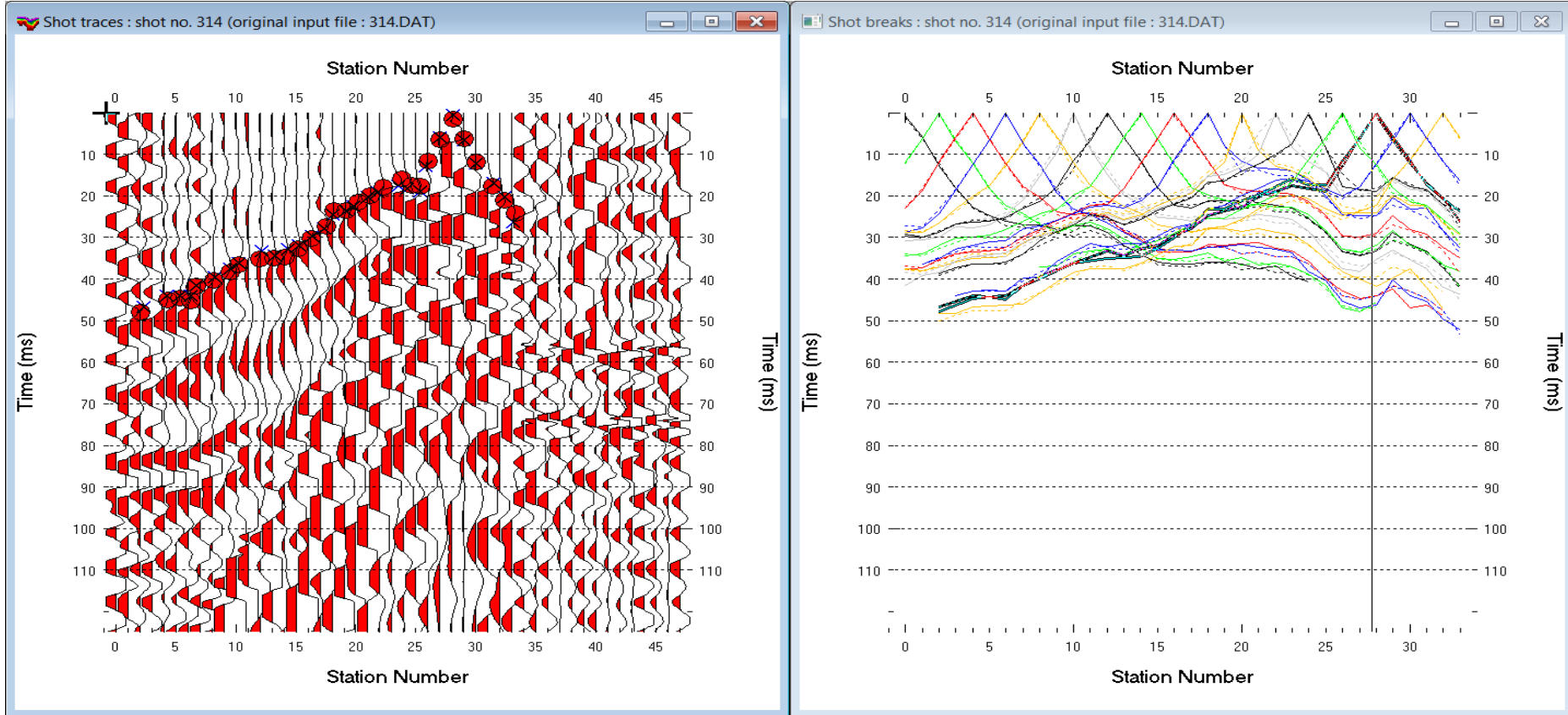
- 1 Select *Depth/Plus-Minus* and confirm prompts
- 2 When Plus-Minus starting model is shown in Surfer confirm our prompt to continue with 2D WET inversion

Compare tomograms obtained with different starting models



- 1 Compare above tomogram with PLUSMODL.GRD starting model to
- 2 Previous tomogram with GRADIENT.GRD starting model
- 3 The WET inversion output is almost independent of starting model
- 4 This should reinforce trust in reliability of WET output

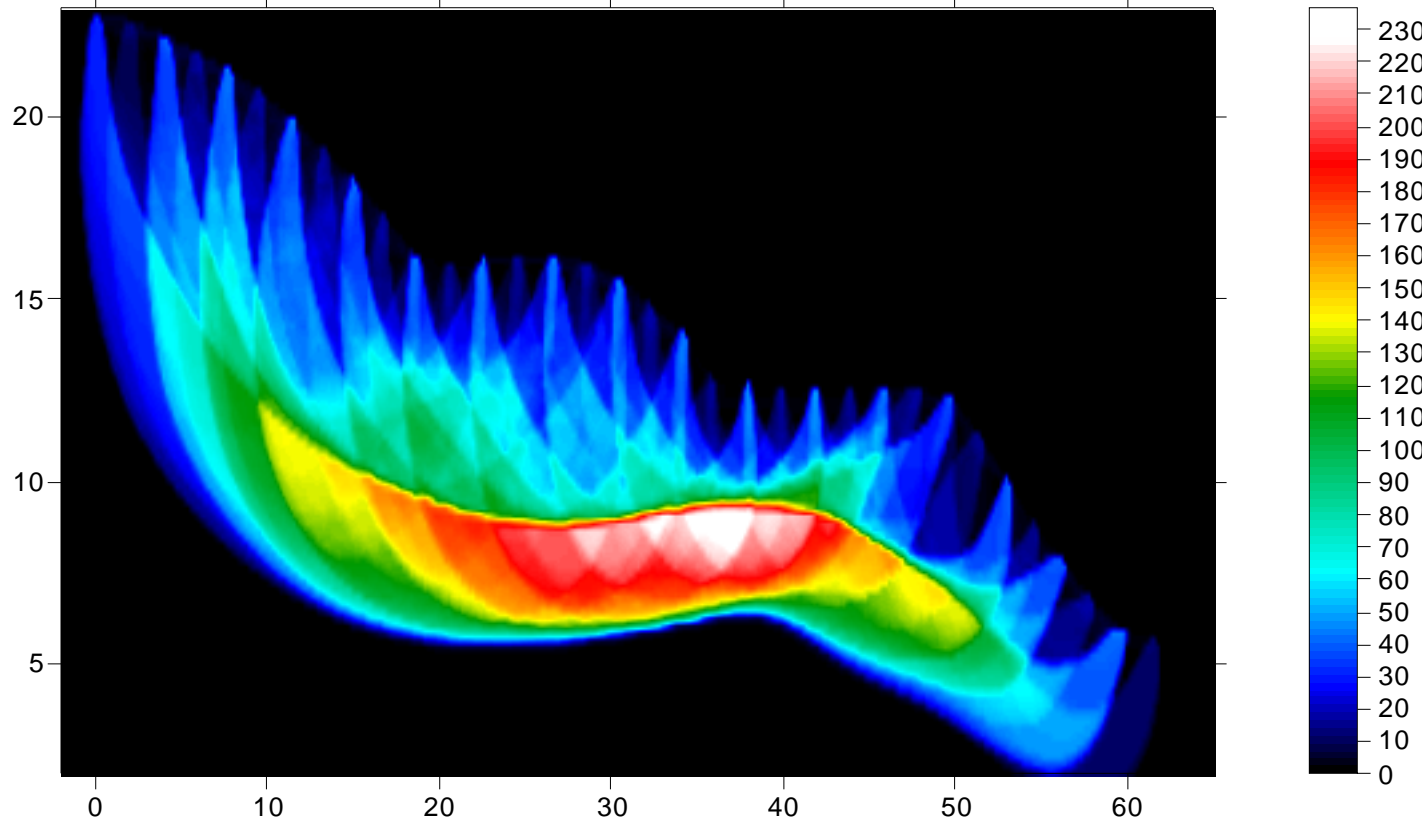
Display modeled picks and traveltime curves



- 1 Select *Trace/Shot gather* to view picked red and modeled (blue) times
- 2 Click on right *window Shot breaks*
- 3 Uncheck *Mapping/Display raytraced traveltimes*
- 4 Check *Mapping/Display synthesized traveltime curves*
- 5 Check *Mapping/Color picked traveltime curves*

Display WET wavepath coverage

Line C RMS error 2.6%=1.38ms 20 WET iters. 50Hz Width 3.5% initial PLUSMODL.GRD Version 3.35



- 1 Click on *Surfer icon* at bottom of screen
- 2 Click tab COVERG20.SRF to show wavepath coverage plot
- 3 Click tab VELOIT20.SRF to show WET tomogram
- 4 Click tab PLUSMODL.SRF to show Plus-Minus layered starting model
- 5 Click tab GRADIENT.SRF to show 1D-gradient smooth starting model

Multiscale tomography with 1D-gradient starting model

Line C RMS error 1.8%=0.96ms 20 WET iters. 50Hz Width 3.0% initial RUN7IT20.GRD Version 3.35

