

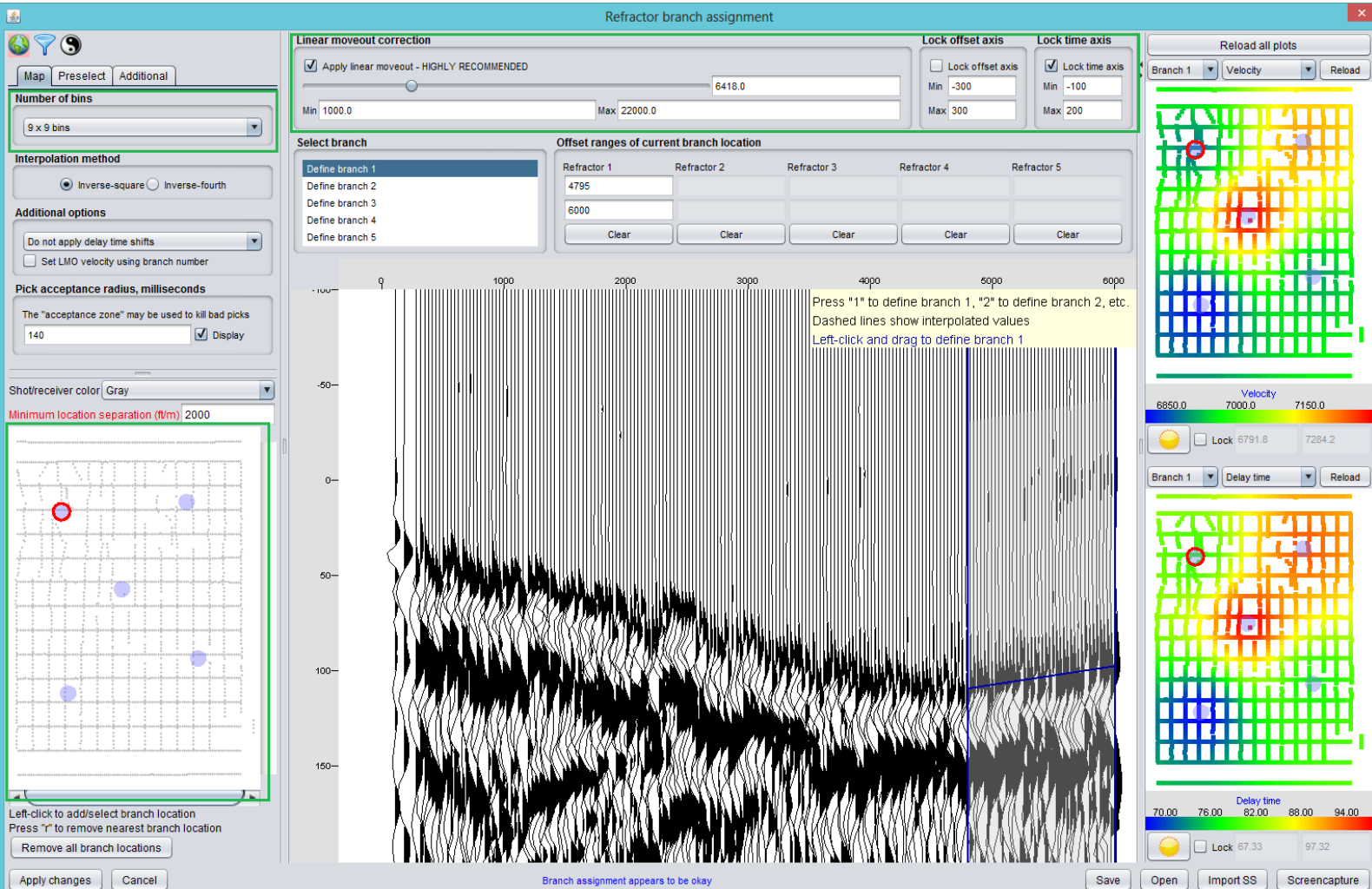
# **“Pick-Free” Delay Time Statics**

# Summary of Workflow

- Branch assignment using traces
- Shot/Receiver stack picking
- Generate picks using flattened gathers
- Run delay time analysis sequence
- Geometry/Pick QC
- Re-run delay time analysis sequence
- Create model
- Create statics

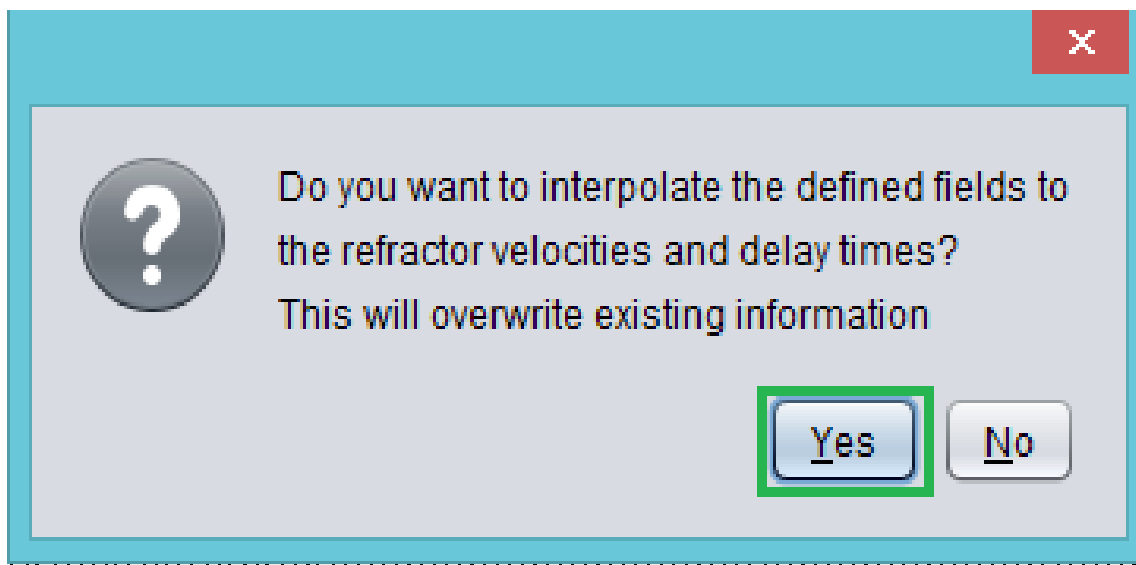
# Branch Assignment

- DelayTime menu → Branch assignment using traces
- Set linear moveout, time window
- Track the refractor(s) across the survey (multiple locations)



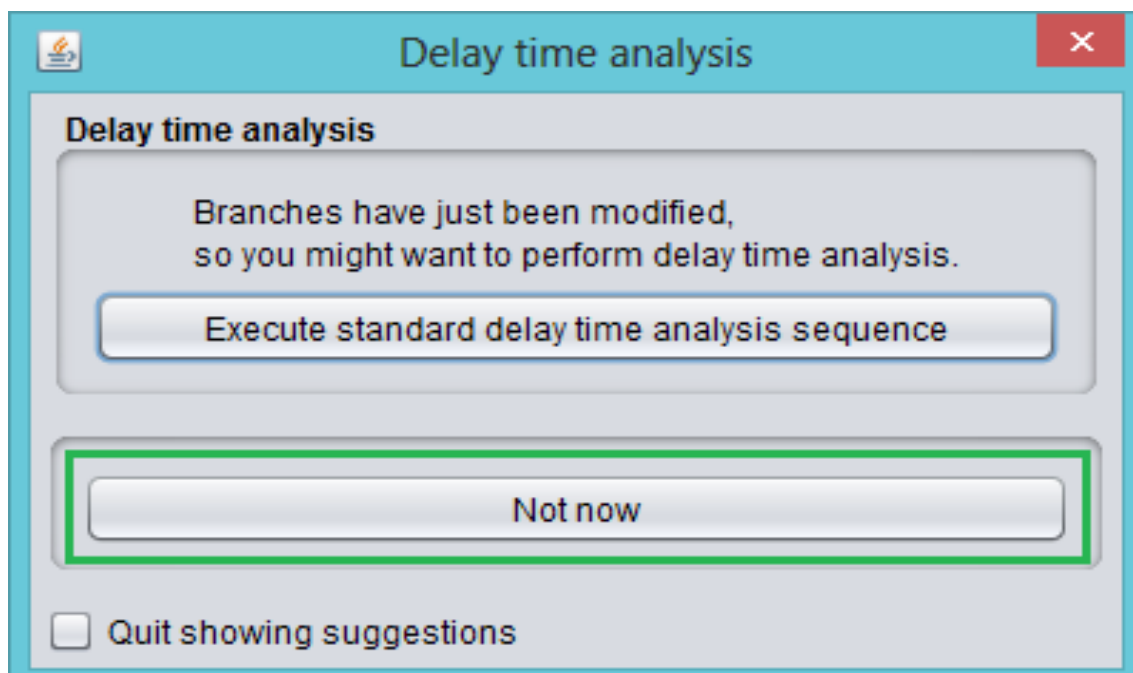
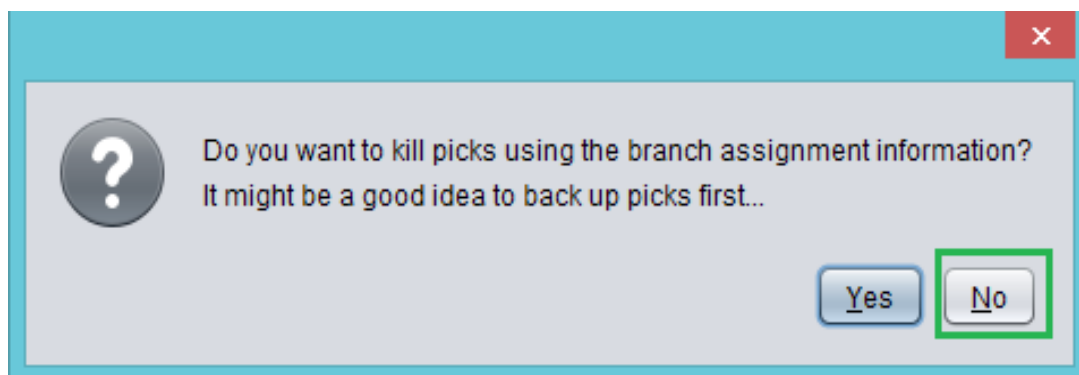
## Branch Assignment

- Click “Apply changes”
- Dialog will pop up asking if you should interpolate
- Click “Yes”



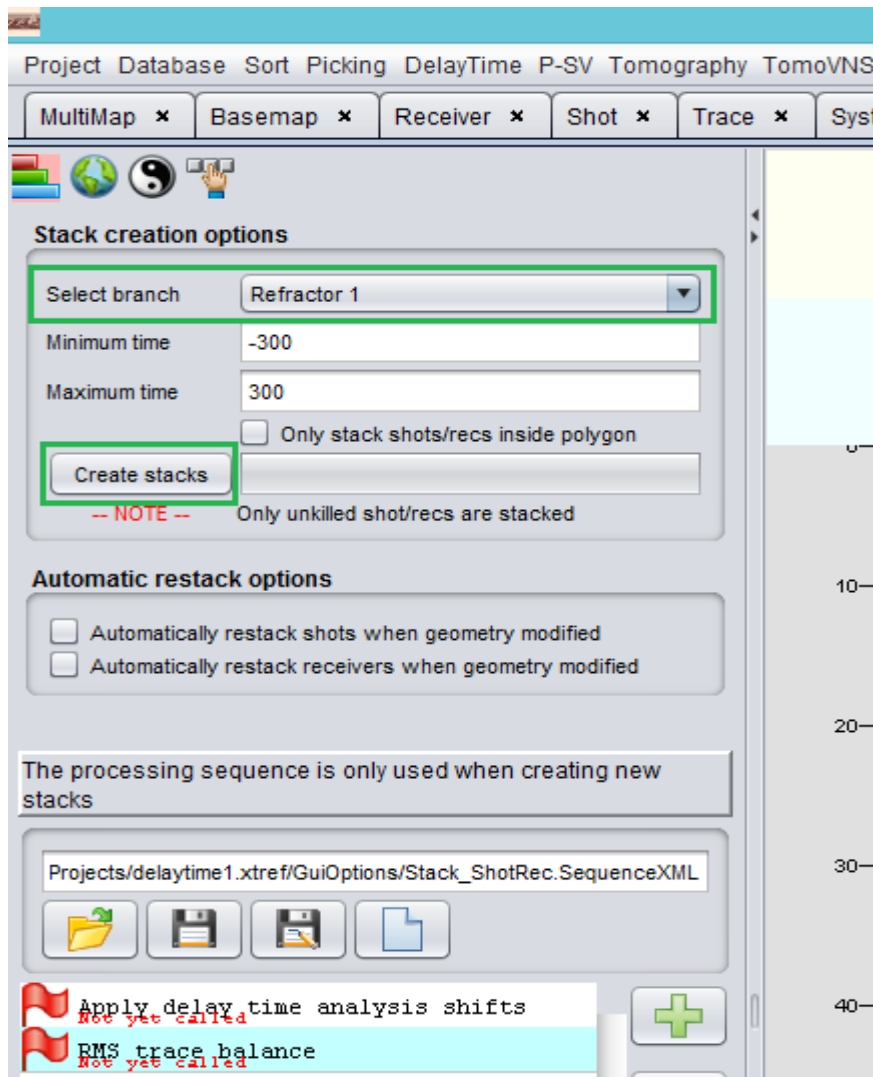
## Branch Assignment

- Program will then ask to kill picks, click “No” since you have no picks
- Program will ask to run Standard Analysis Sequence, click “Not now”, since you have no picks



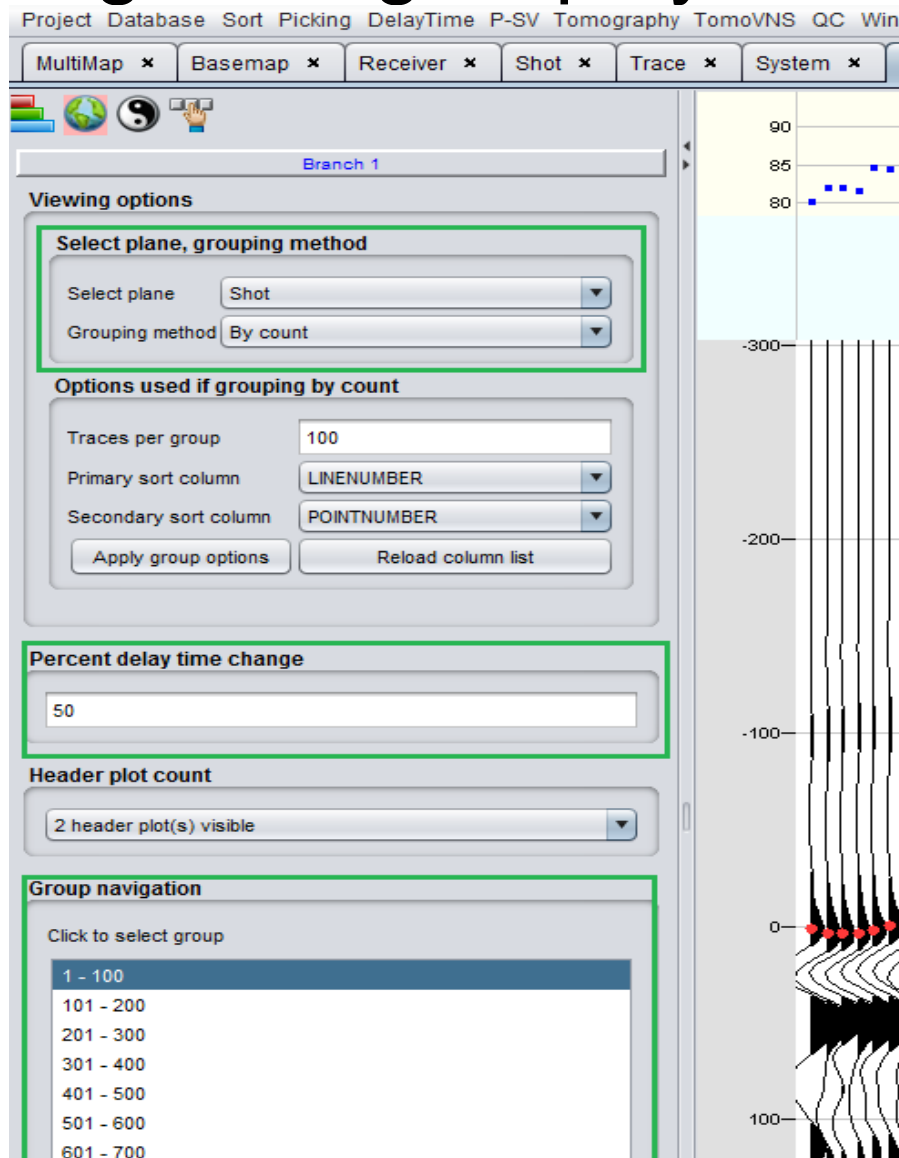
# Shot/Receiver Stack Picker

- DelayTime menu → Shot/Receiver stack picker
- Select the refractor to work on, then click “Create stacks” - we'll work through one refractor at a time, but you'll need to do them all



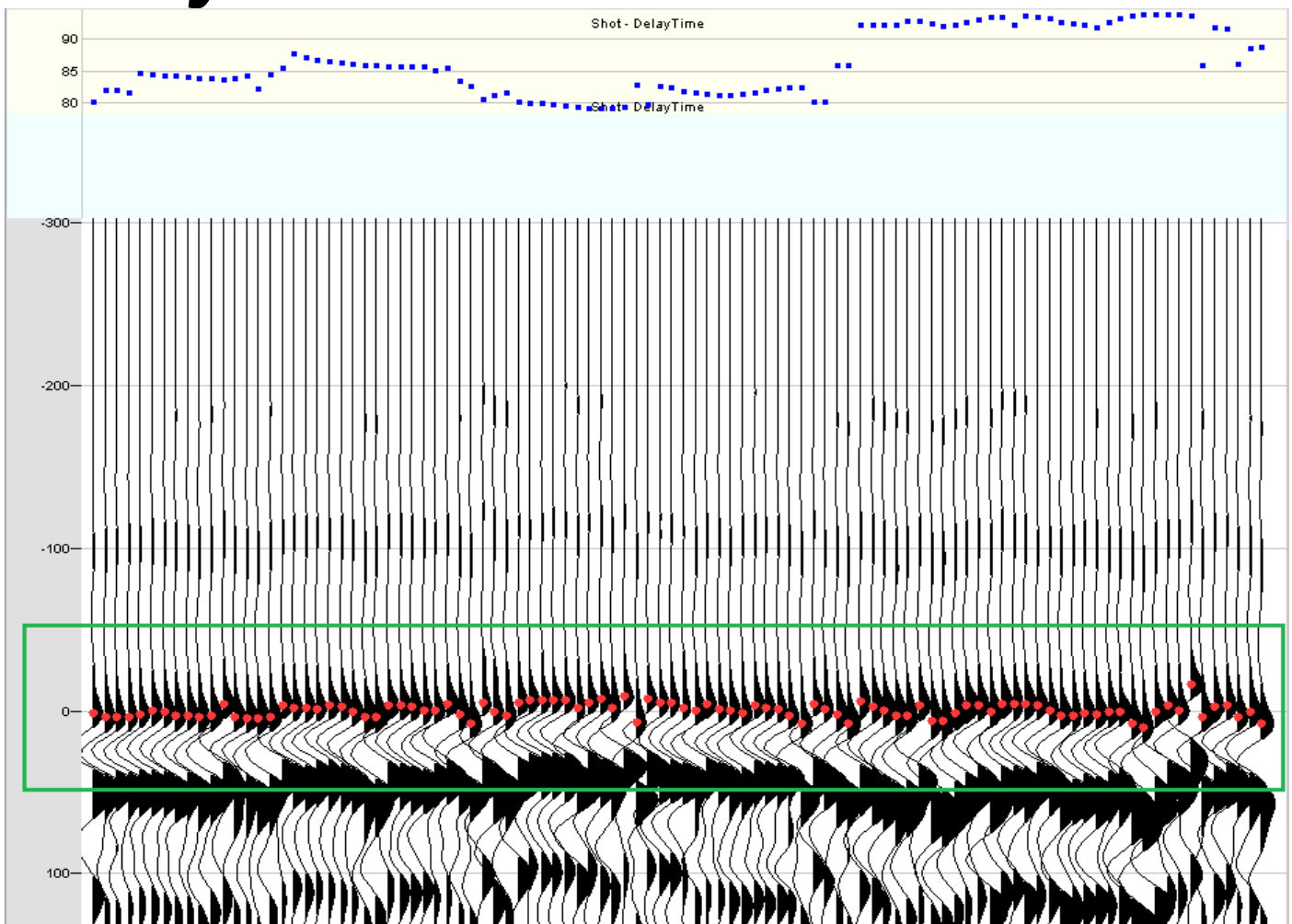
# Shot/Receiver Stack Picker

- Shots should be sorted by count
- Leave “Percent delay time change” at 50
- Group navigation shows the current shot range being displayed



# Shot/Receiver Stack Picker

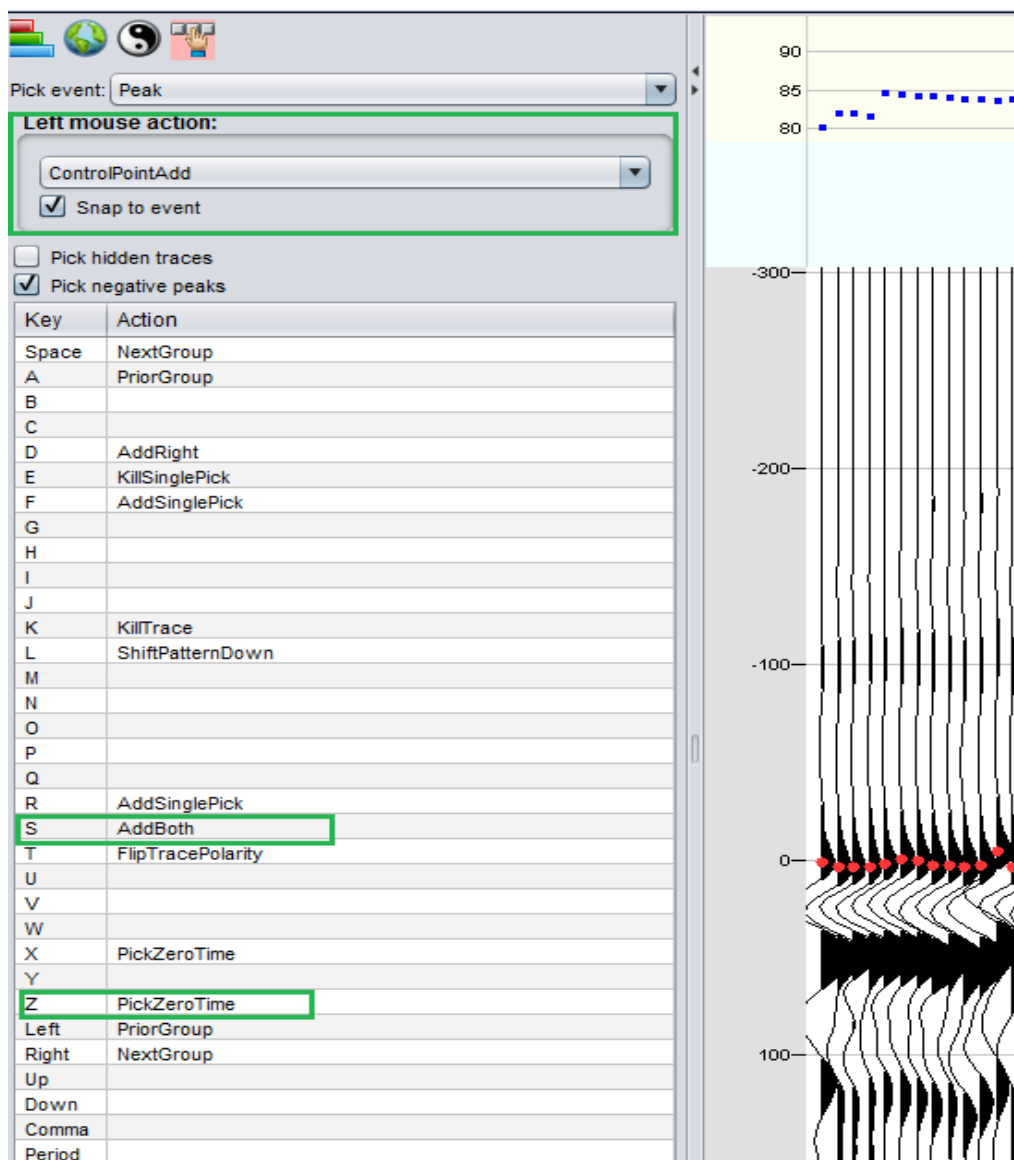
- Each one of these “traces” is a stack representing an entire shot/receiver, made of all the corresponding traces in that branch
- ***You are not picking first breaks; you are picking changes to the delay time for that shot/receiver***





# Shot/Receiver Stack Picker

- Some useful hotkeys: PickZeroTime (snaps to event closest to zero time), and AddBoth (combination of AddLeft and AddRight)



Pick event: Peak

Left mouse action:

ControlPointAdd

☒ Snap to event

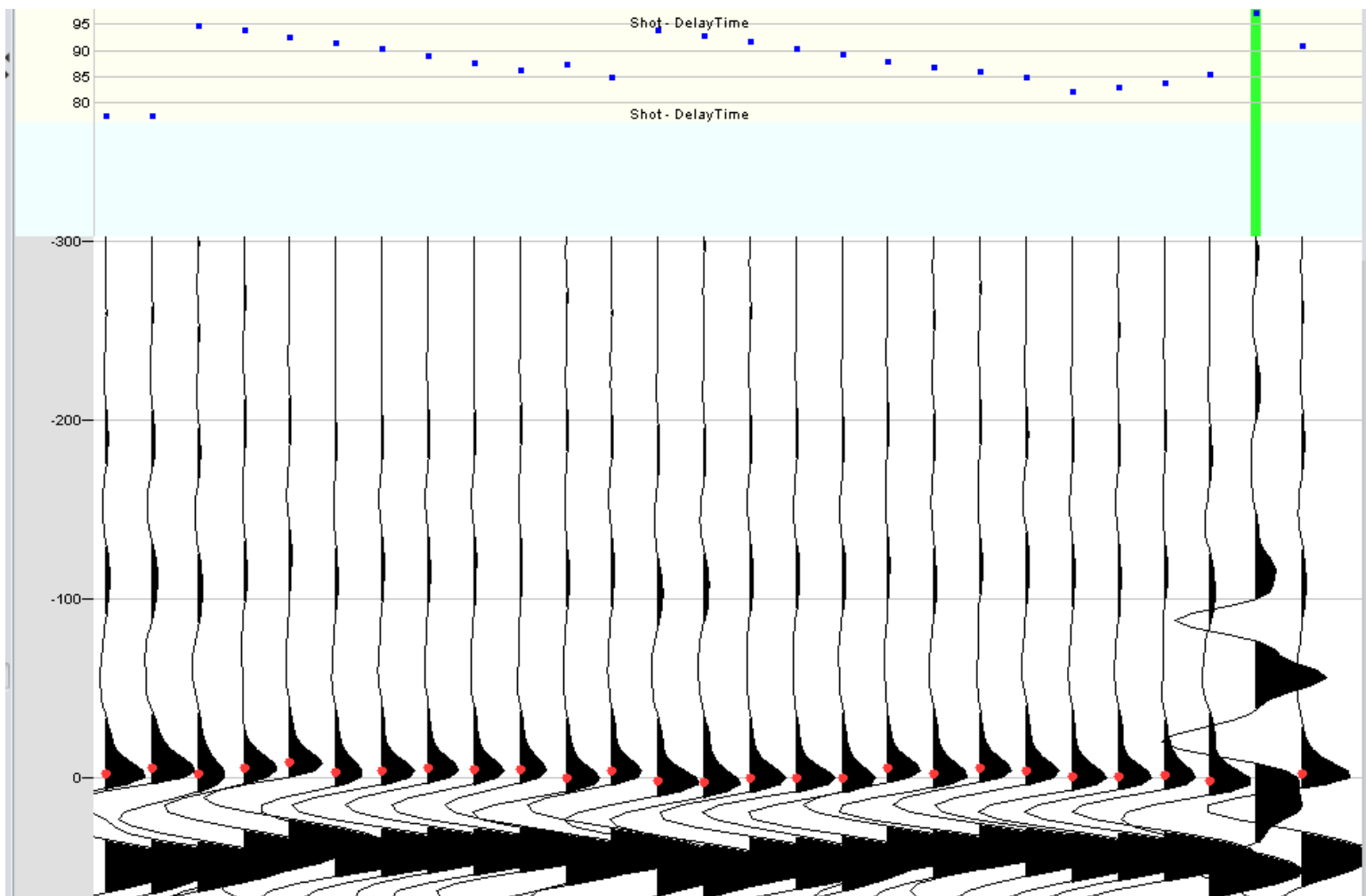
☐ Pick hidden traces

☒ Pick negative peaks

Key	Action
Space	NextGroup
A	PriorGroup
B	
C	
D	AddRight
E	KillSinglePick
F	AddSinglePick
G	
H	
I	
J	
K	KillTrace
L	ShiftPatternDown
M	
N	
O	
P	
Q	
R	AddSinglePick
S	AddBoth
T	FlipTracePolarity
U	
V	
W	
X	PickZeroTime
Y	
Z	PickZeroTime
Left	PriorGroup
Right	NextGroup
Up	
Down	
Comma	
Period	

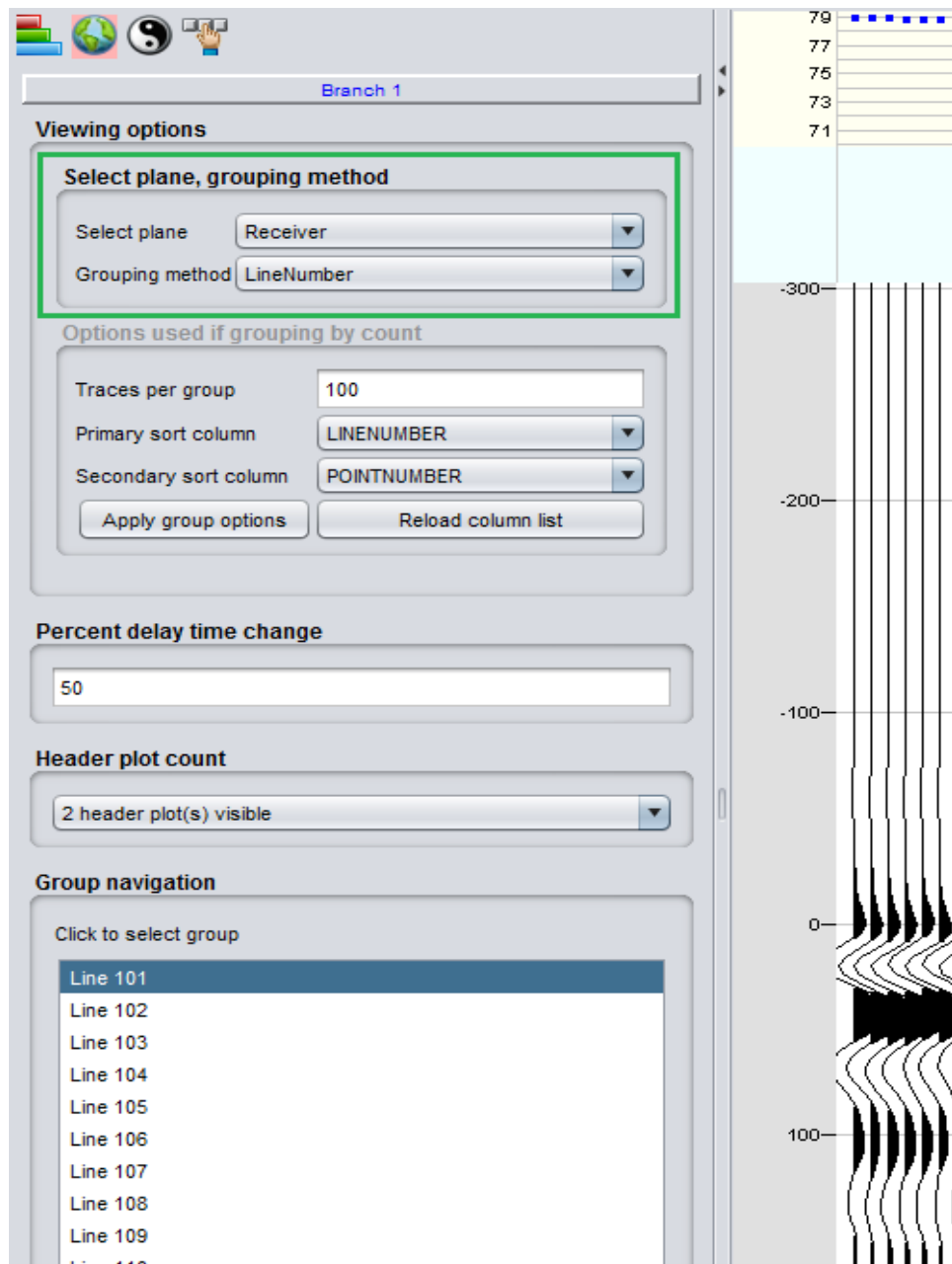
# Shot/Receiver Stack Picker

- While in the Stack Picker, you can select a shot/receiver in the normal Picker Window by mousing over the shot/receiver stack and hitting the “Esc” key. A green bar will highlight over the shot/receiver in the Stack Picker.



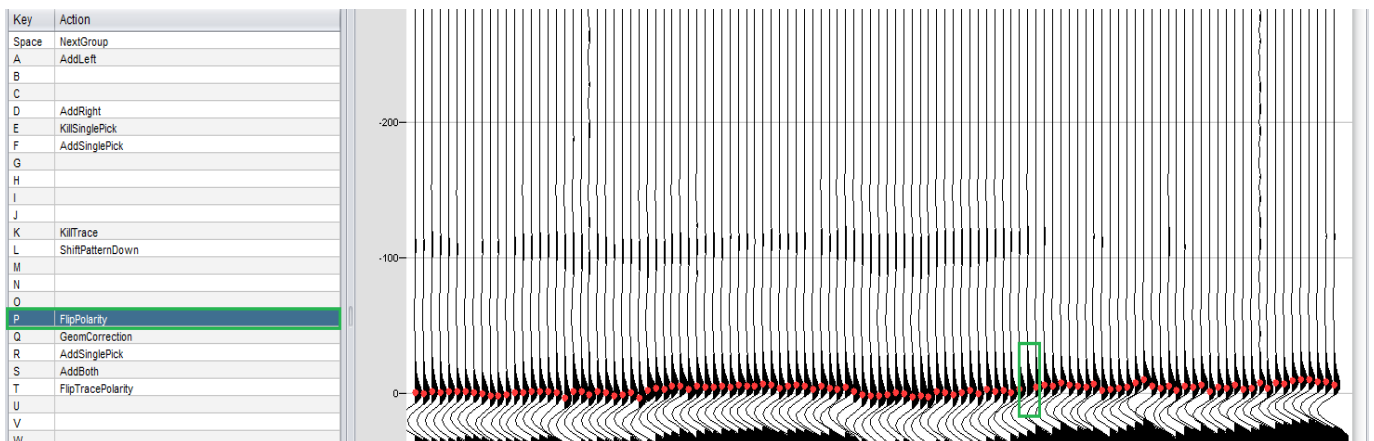
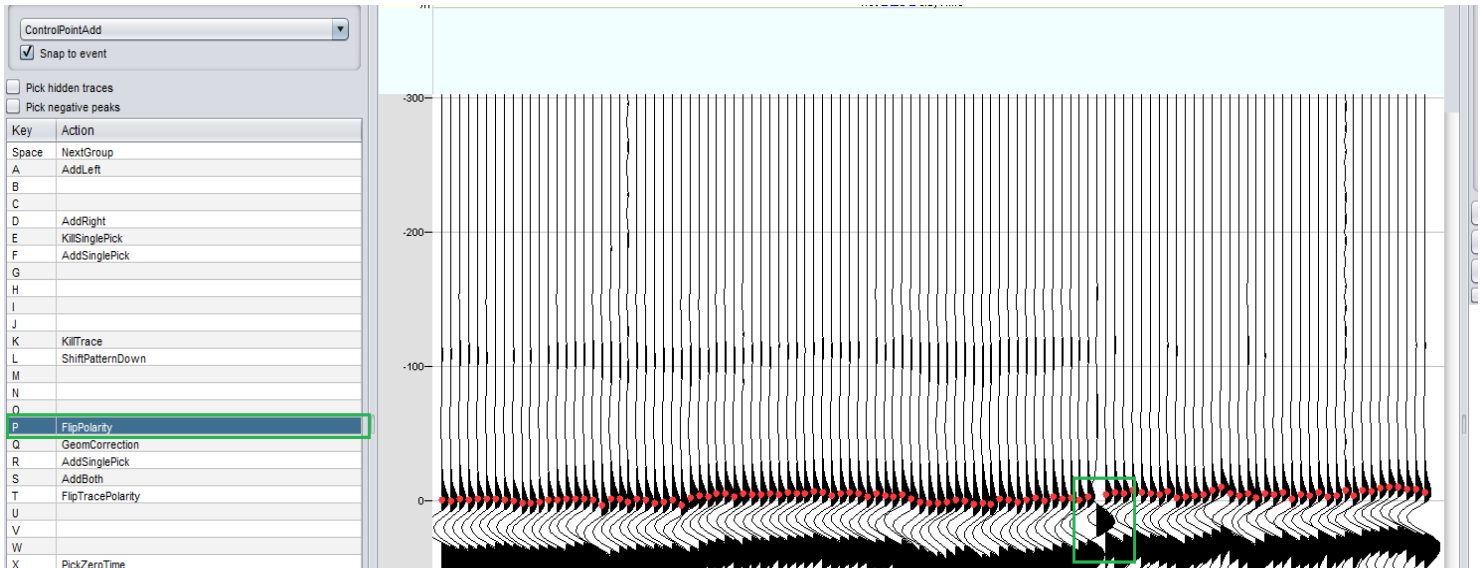
# Shot/Receiver Stack Picker

- Pick through all the shots. Then, switch to receivers...
- These should typically be sorted by “Line Number” rather than “Count”



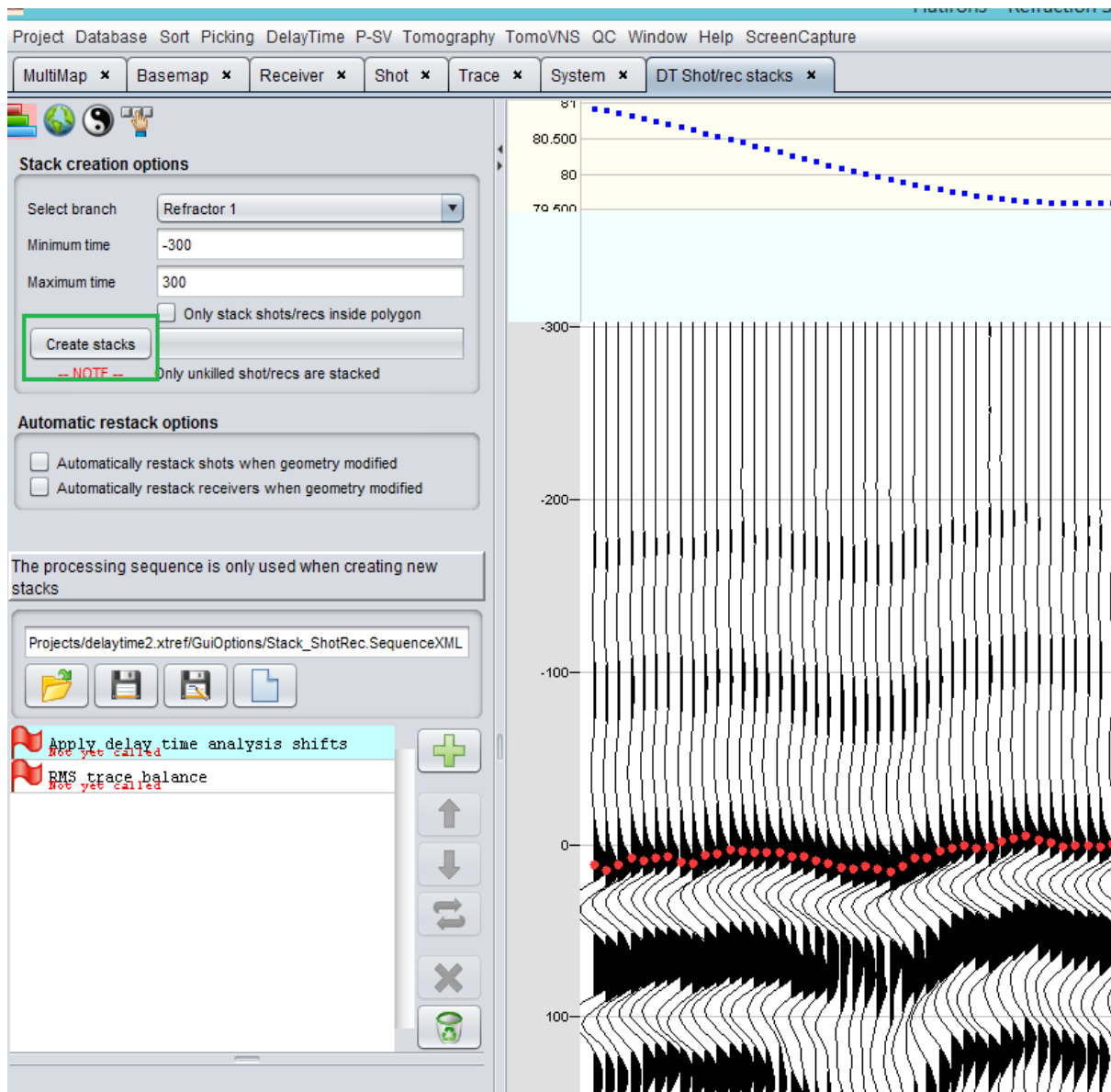
# Shot/Receiver Stack Picker

- You can flip the polarity of a receiver by setting a hotkey and mousing over the corresponding receiver stack:



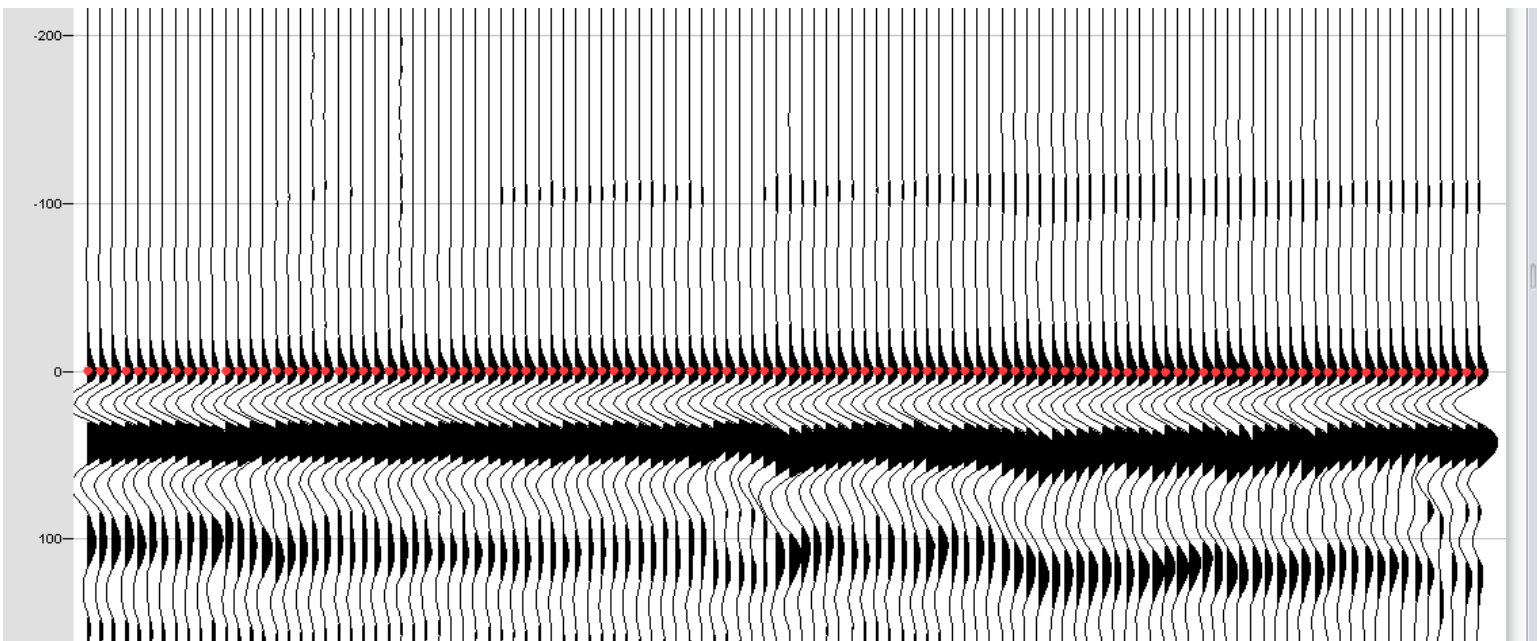
## Shot/Receiver Stack Picker

- Once you have picked all Shots and Receivers, go back and click “Create stacks” again
- Go through and pick Shots and Receivers again



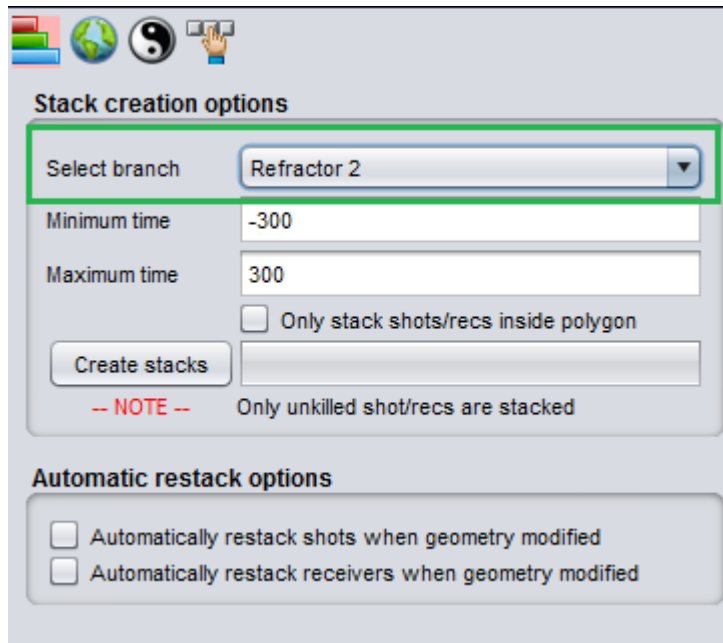
# Shot/Receiver Stack Picker

- Go through this 3-4 times – pick all Shots and Receivers, then re-stack
- You want the picks to line up as close to zero as possible



# Shot/Receiver Stack Picker

- If you have more than one Refractor, repeat this entire process for each one...

A screenshot of a software dialog box titled "Stack creation options". The dialog has a light gray background and a title bar with standard window controls. It contains several input fields and checkboxes. The "Select branch" dropdown is highlighted with a green border and shows "Refractor 2". Below it are "Minimum time" and "Maximum time" text boxes with values "-300" and "300" respectively. A checkbox labeled "Only stack shots/recs inside polygon" is unchecked. A "Create stacks" button is present. A red note states "Only unkilld shot/recs are stacked". The bottom section, "Automatic restack options", contains two unchecked checkboxes for automatic restacking of shots and receivers when geometry is modified.

**Stack creation options**

Select branch: Refractor 2

Minimum time:

Maximum time:

☐ Only stack shots/recs inside polygon

-- NOTE -- Only unkilld shot/recs are stacked

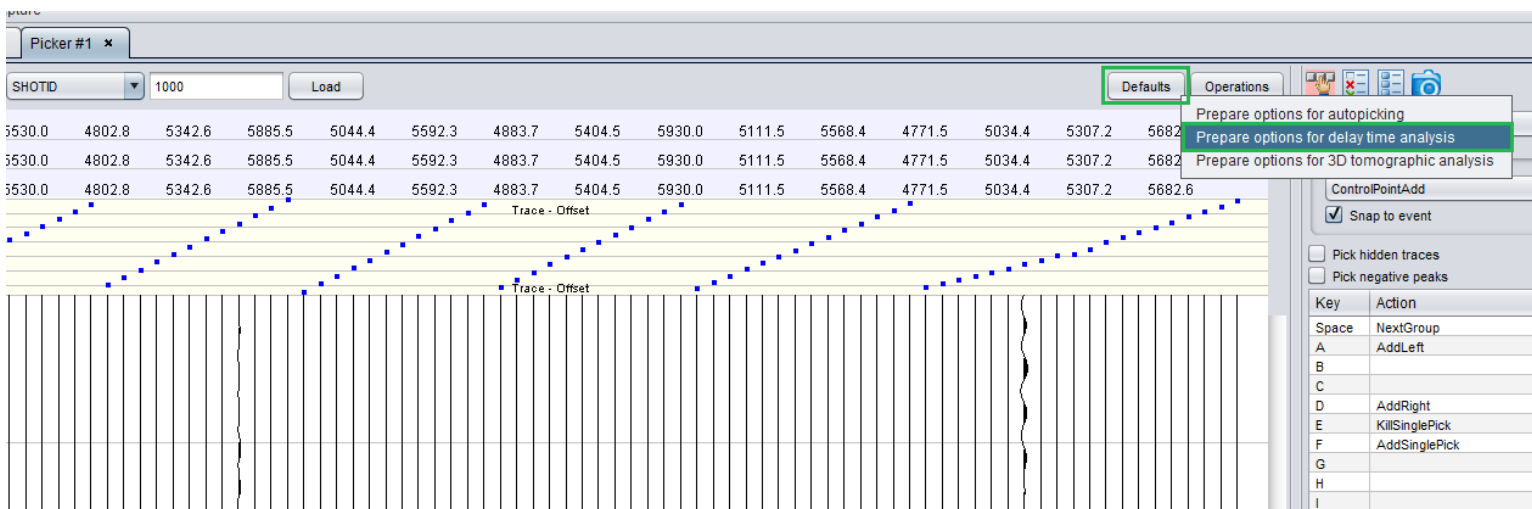
**Automatic restack options**

☐ Automatically restack shots when geometry modified

☐ Automatically restack receivers when geometry modified

# Generate Picks

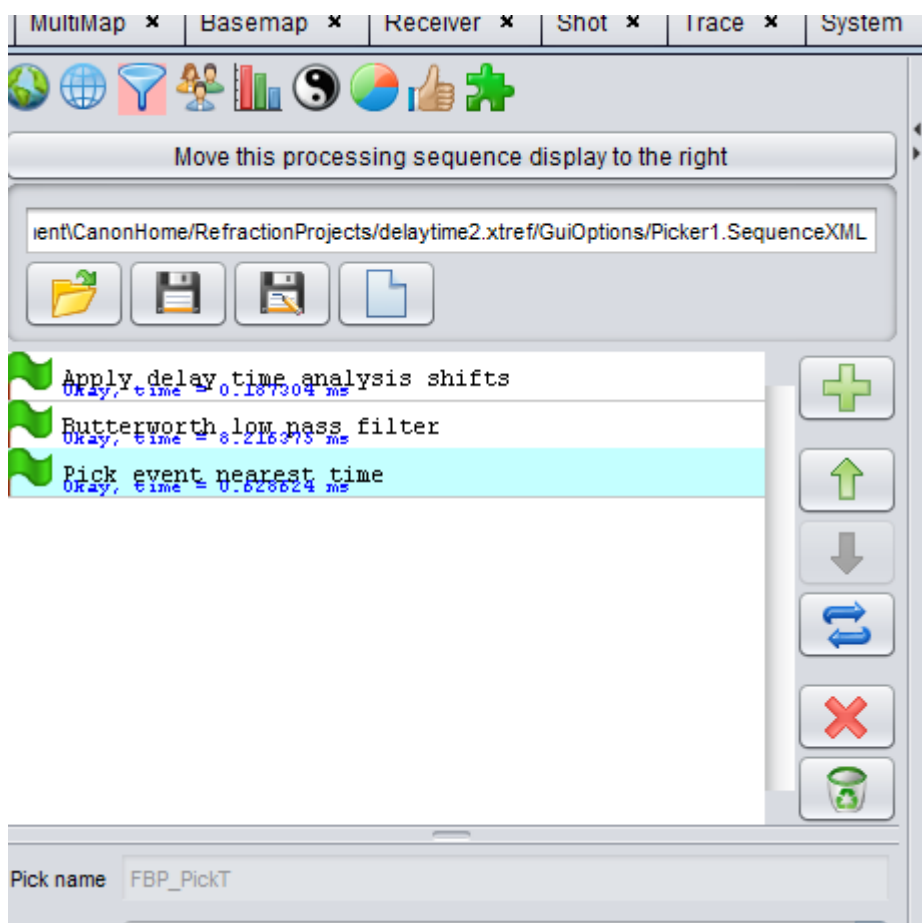
- Open the Picker Window – Picking menu → New picker window (shot/receiver/bin plane)
- Click Defaults → Prepare options for Delay Time Analysis





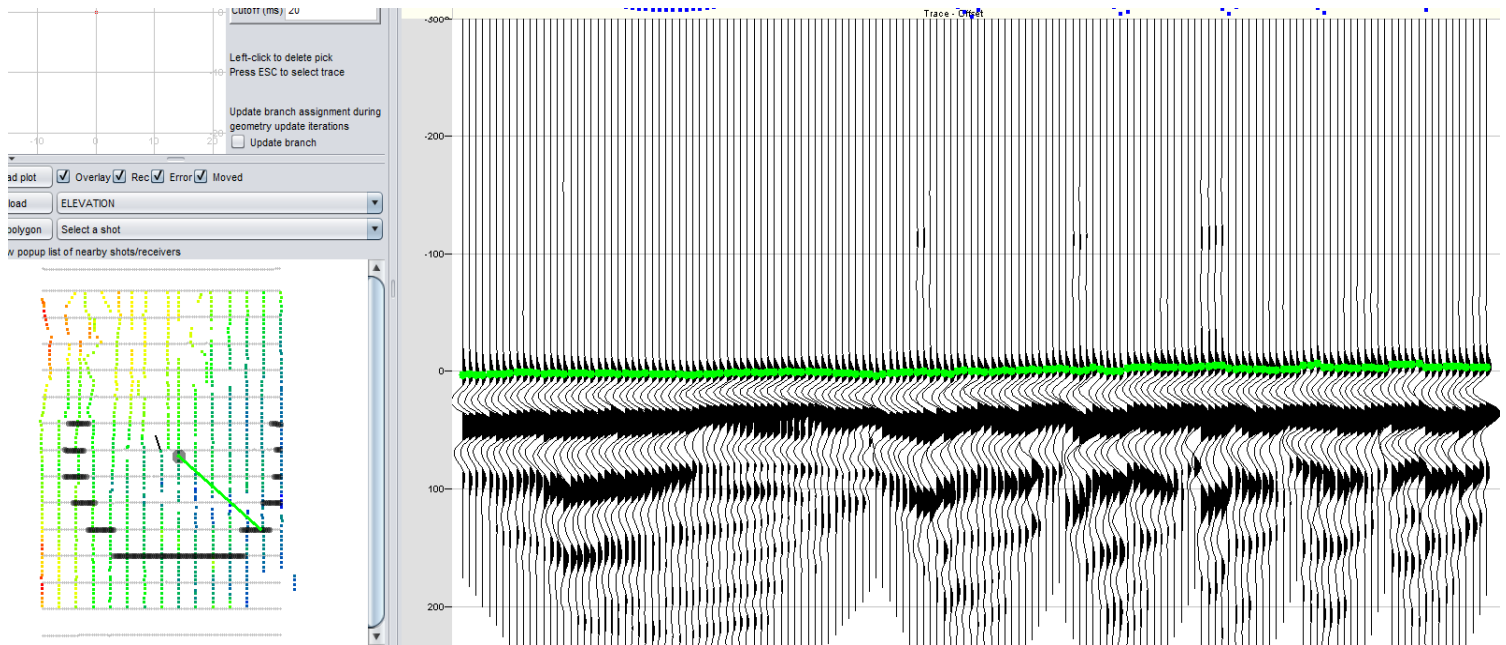
# Generate Picks

- This sets up a processing flow, as well as some display settings



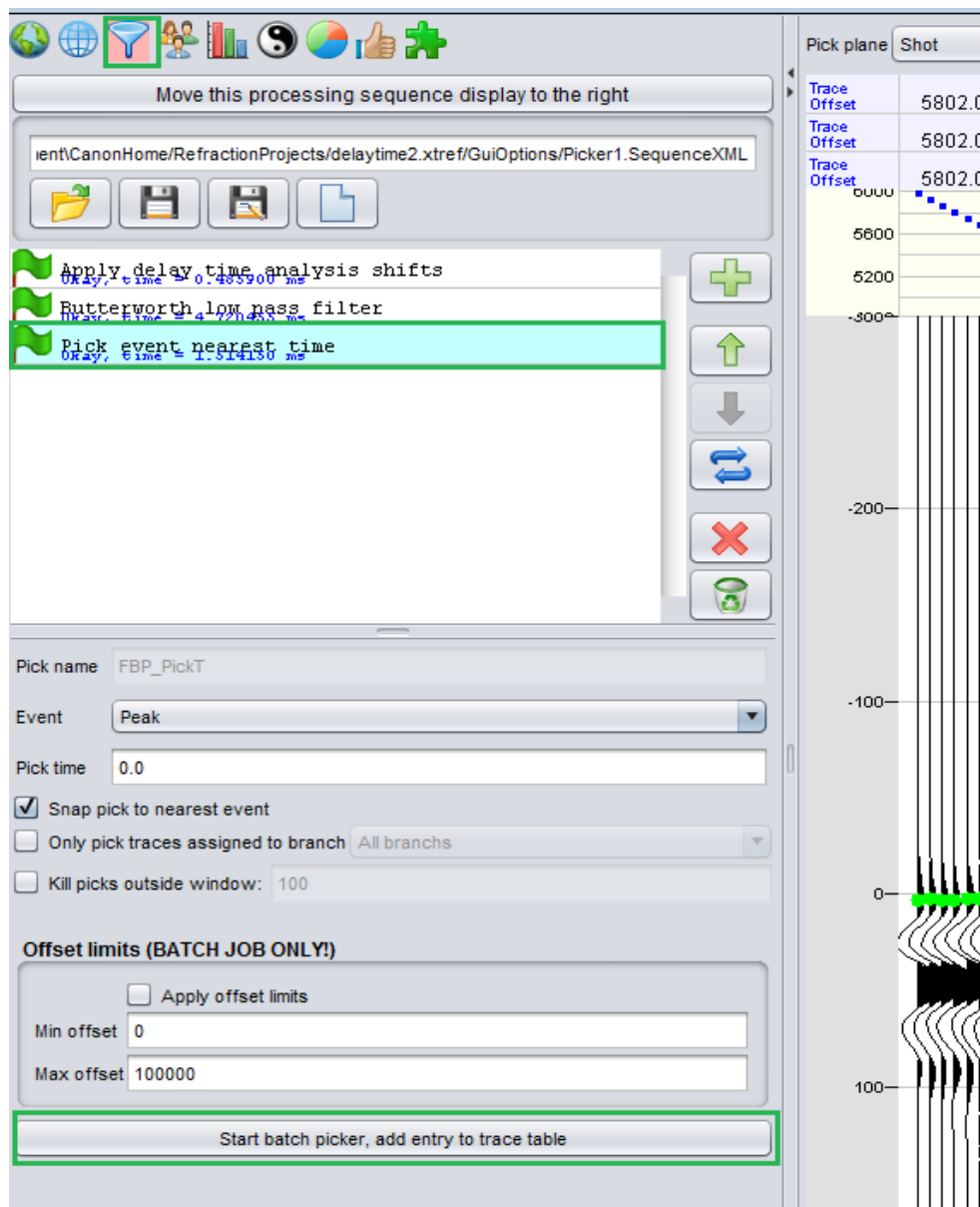
# Generate Picks

- Click around the survey and make sure the predicted picks look OK



## Generate Picks

- When ready to pick, go back to the processing flow (funnel icon), select the picker object, then click “Start batch picker” - ignore polygon limit dialog



# Generate Picks

- Autopicker will run and generate picks...

Description	Status	Message	Run time
Execute processing sequence	Running		

Current action: [Execute processing sequence](#)

Status:

Status: 190000 of 458469

Time, memory: Run time: 9 seconds Free memory (MB) = 5863

Estimated time left: 12 seconds for this task

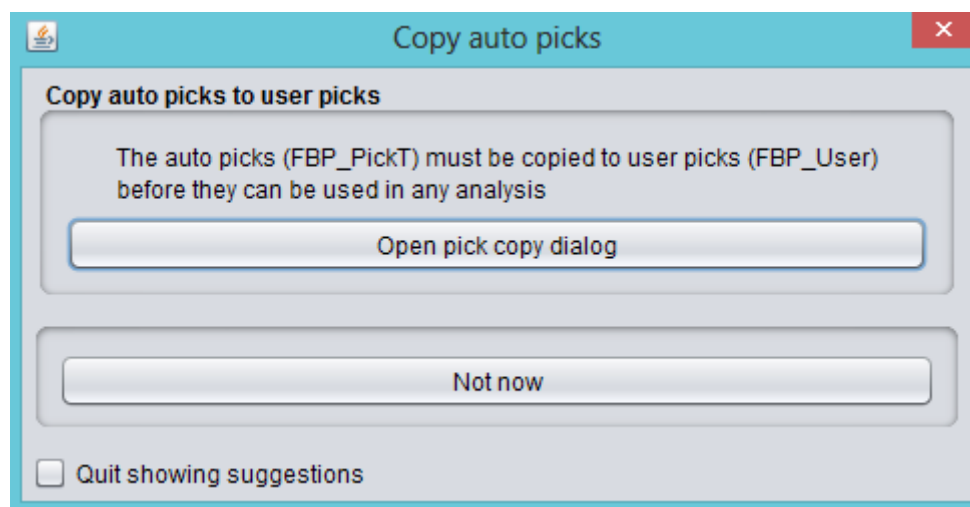
Progress:  41.4%

Subtask Progress:  0%

[Stop current action](#) [Stop all actions](#)

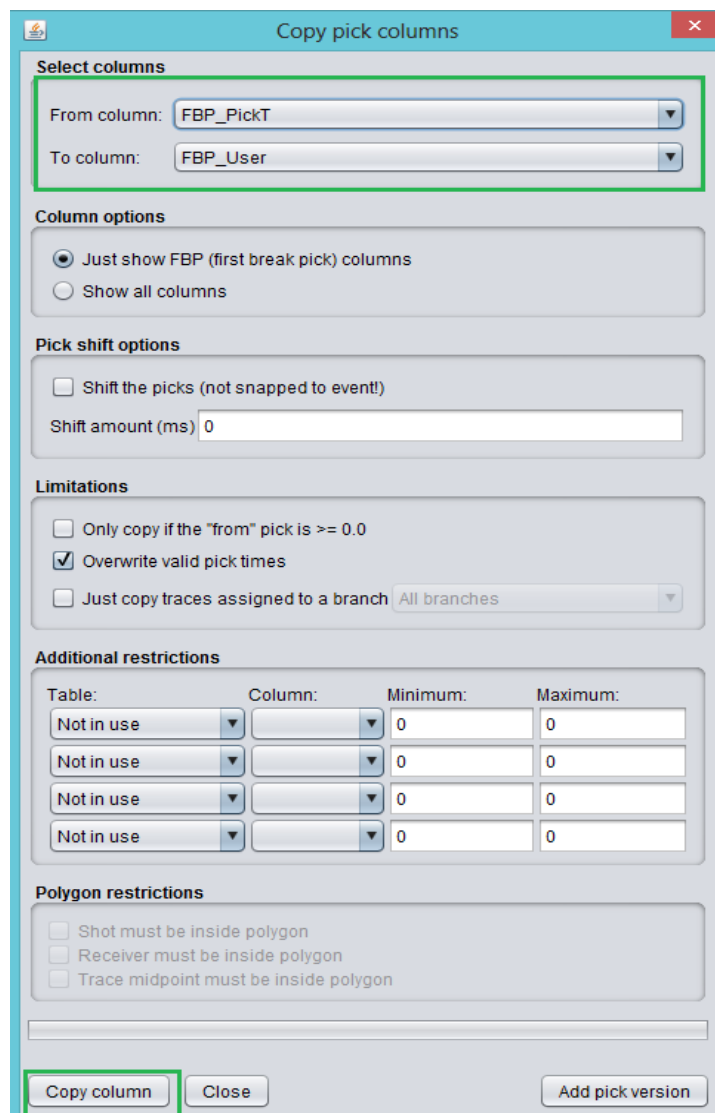
## Pick Copy

- Dialog will pop up asking to copy picks
- The picks generated by the autopicker are saved in the FBP\_PickT column
- They must be copied to FBP\_User column in order to be used in analysis



## Pick Copy

- Check the columns (they should be set already)
- Click “Copy column”
- Picks will copy very quickly, see progress bar at bottom
- Click “Close” when done

A screenshot of the "Copy pick columns" dialog box in a software application. The dialog has a light blue title bar with the text "Copy pick columns" and a close button. It contains several sections: "Select columns" with "From column:" set to "FBP\_PickT" and "To column:" set to "FBP\_User"; "Column options" with "Just show FBP (first break pick) columns" selected; "Pick shift options" with "Shift the picks (not snapped to event!)" unchecked and "Shift amount (ms)" set to 0; "Limitations" with "Overwrite valid pick times" checked; "Additional restrictions" with a table of four rows, each with "Not in use" in the "Table:" column and "0" in the "Minimum:" and "Maximum:" columns; and "Polygon restrictions" with three unchecked options. At the bottom, there are three buttons: "Copy column" (highlighted with a green box), "Close", and "Add pick version".

Copy pick columns

Select columns

From column: FBP\_PickT

To column: FBP\_User

Column options

☒ Just show FBP (first break pick) columns

☐ Show all columns

Pick shift options

☐ Shift the picks (not snapped to event!)

Shift amount (ms) 0

Limitations

☐ Only copy if the "from" pick is  $\geq 0.0$

☒ Overwrite valid pick times

☐ Just copy traces assigned to a branch All branches

Additional restrictions

Table:	Column:	Minimum:	Maximum:
Not in use		0	0
Not in use		0	0
Not in use		0	0
Not in use		0	0

Polygon restrictions

☐ Shot must be inside polygon

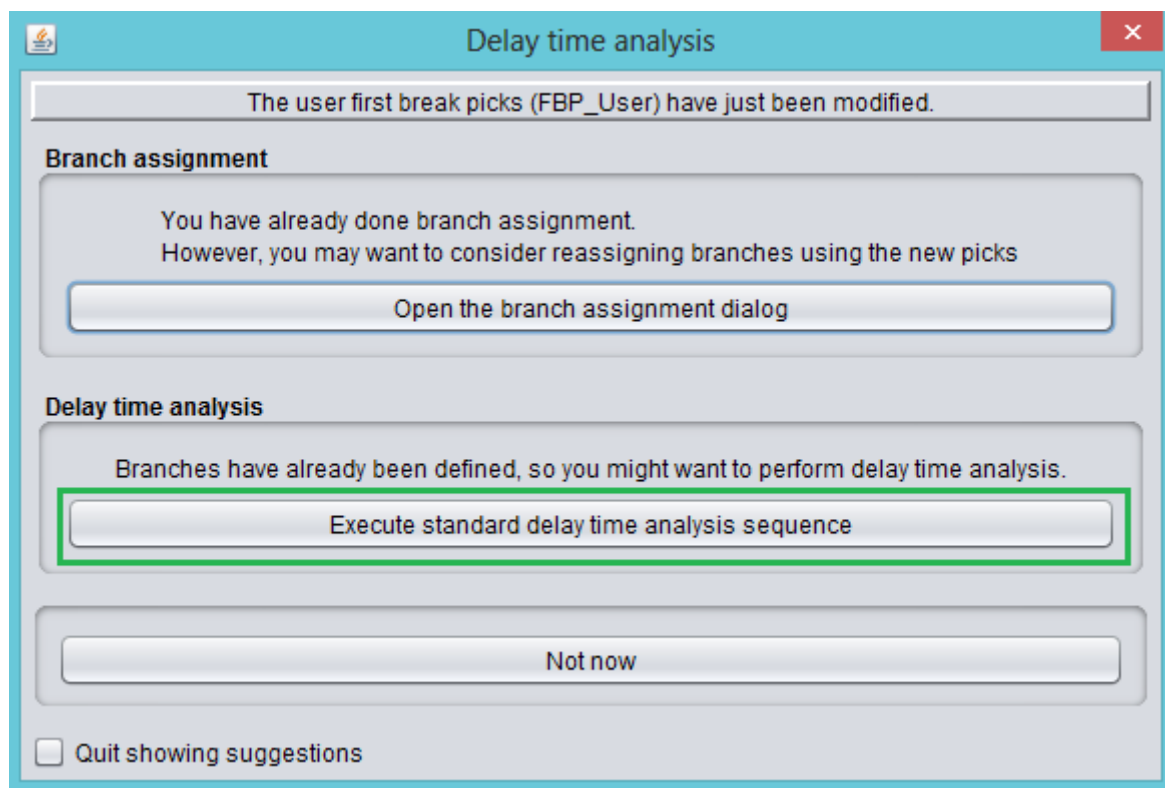
☐ Receiver must be inside polygon

☐ Trace midpoint must be inside polygon

Copy column Close Add pick version

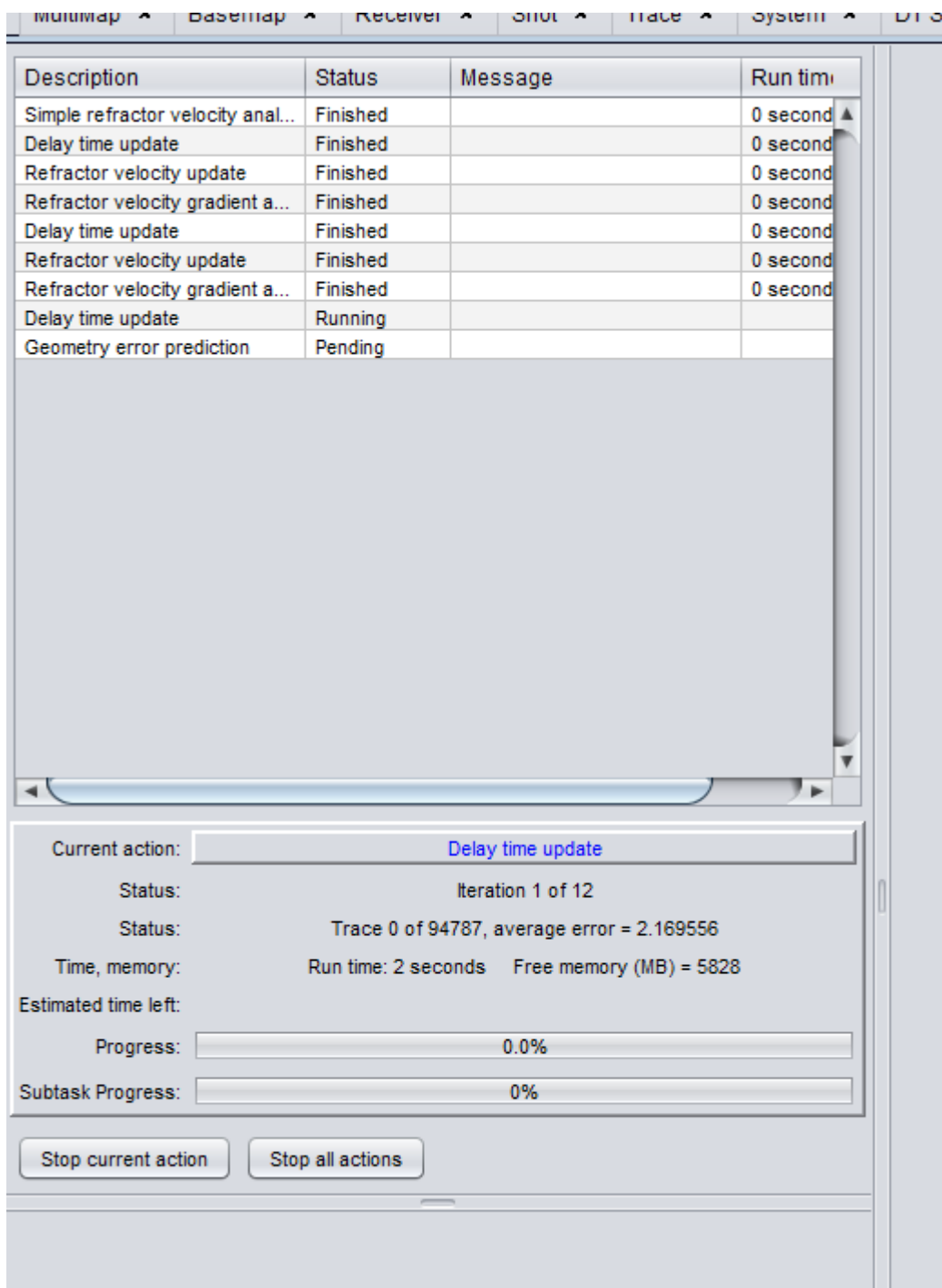
# Delay Time Analysis

- Dialog will pop up suggesting Standard Delay Time Analysis sequence
- You may check your Branch Assignment and refine it based on picks (optional)



# Delay Time Analysis

- Standard Delay Time Analysis sequence will run...



The screenshot displays the XtremeGeo software interface during a Delay Time Analysis sequence. The top menu bar includes options like Multimap, Basemap, Receiver, Shot, Trace, System, and DT. The main window features a table with the following data:

Description	Status	Message	Run time
Simple refractor velocity anal...	Finished		0 second
Delay time update	Finished		0 second
Refractor velocity update	Finished		0 second
Refractor velocity gradient a...	Finished		0 second
Delay time update	Finished		0 second
Refractor velocity update	Finished		0 second
Refractor velocity gradient a...	Finished		0 second
Delay time update	Running		
Geometry error prediction	Pending		










Below the table, the 'Current action' is 'Delay time update'. The status shows 'Iteration 1 of 12'. The progress bar indicates 0.0% completion. The subtask progress bar indicates 0% completion. The estimated time left is not specified. The time and memory usage are shown as 'Run time: 2 seconds' and 'Free memory (MB) = 5828'. At the bottom, there are buttons for 'Stop current action' and 'Stop all actions'.



## **Delay Time/Pick/Geom QC**

- Open Picker Window, click “Ensemble navigation” icon (second from left)
- Change the primary navigation order to “DTA\_Error\_1” - this is the Delay Time error term for Refractor 1
- Check the “Descend” box
- Click “Apply options”
- Shots are now ordered by highest error

# Delay Time/Pick/Geom QC

Shot

Receiver

Reload columns

Apply options

**Navigation order**

DTA\_ERROR\_1

POINTNUMBER

☒ DESCEND

**Skip interval**

Skip interval:

**Column filtering options**

	Column name:	Min value:	Max value:
<input type="checkbox"/> On	AZIMUTHMOVED	<input type="text" value="0"/>	<input type="text" value="100"/>
<input type="checkbox"/> On	AZIMUTHMOVED	<input type="text" value="0"/>	<input type="text" value="100"/>
<input type="checkbox"/> On	AZIMUTHMOVED	<input type="text" value="0"/>	<input type="text" value="100"/>

**Project polygon**

☒ Not used
 ☐ Inside
 ☐ Outside

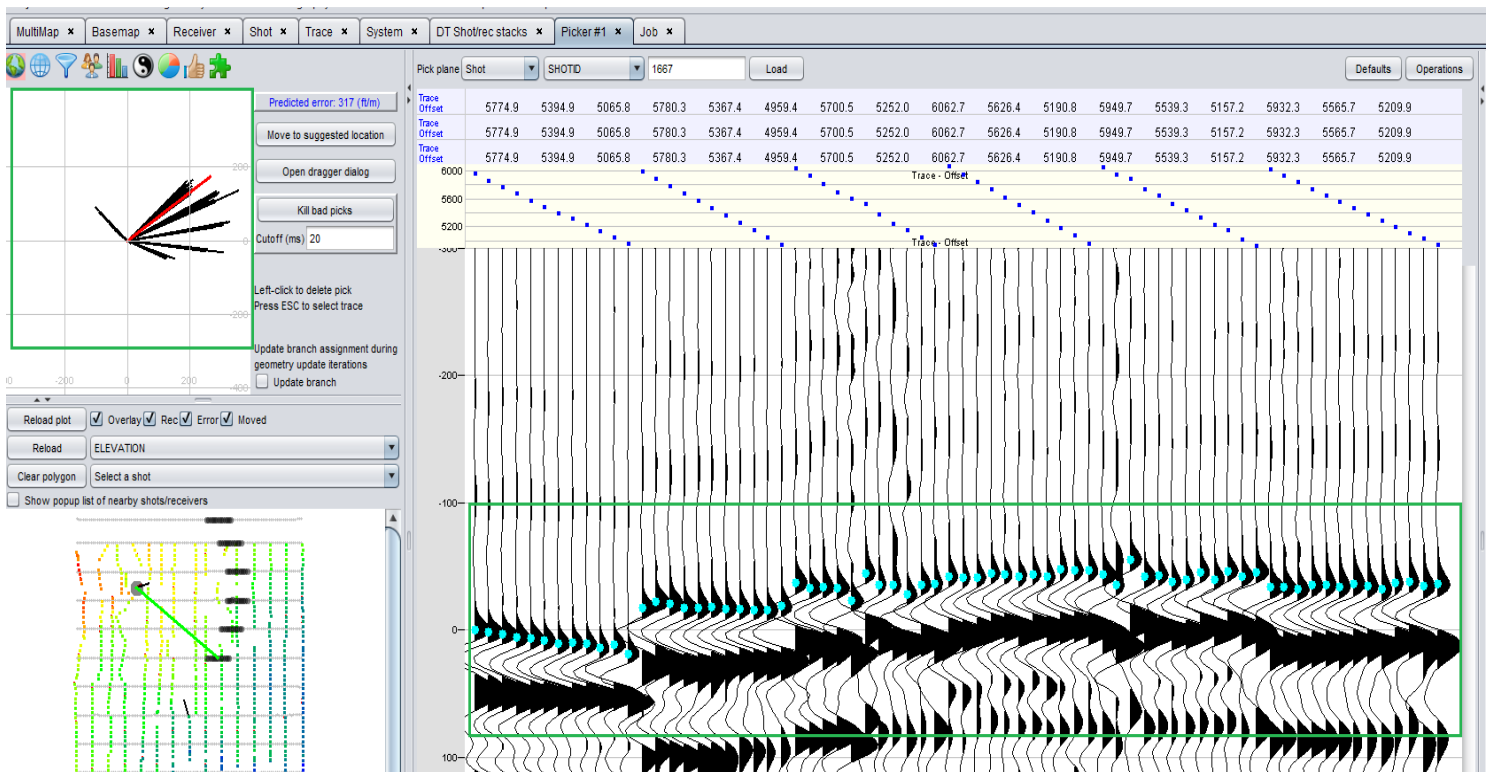
ShotID	DTA_ERROR_1	POINTNUMBER
1667	3.28569	576164
1616	3.16537	610164
1868	3.07809	540122
1326	2.95613	524922
1578	2.91464	596142
1473	2.84203	540138
1553	2.81524	572137
1325	2.65377	524122
1605	2.58111	612145
1231	2.55789	548121
1914	2.50680	500140
1562	2.48434	588152
1670	2.48368	576167
1619	2.46624	612169
1401	2.46228	500138
1939	2.45569	553137
1530	2.45029	570150
1668	2.44940	576165
1403	2.43409	500141

# Delay Time/Pick/Geom QC

- Fix any bad picks you see
- Generally, we want error term to be less than 5 if possible
- You might catch some geometry errors here, if so...

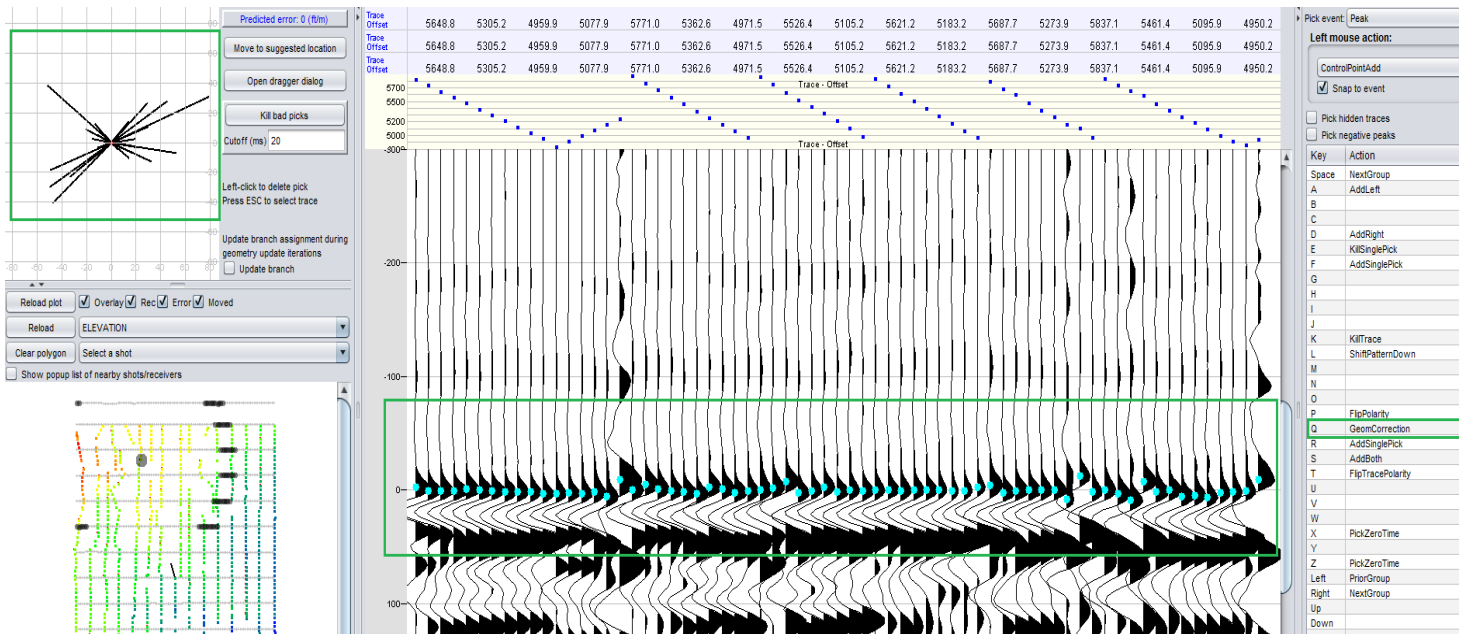
# Delay Time/Pick/Geom QC

- The spider plot in the left hand corner shows suggested move vectors
- In the case shown below, the shot is picked well – but picks are not lined up and it's clear from spider plot that we should move it



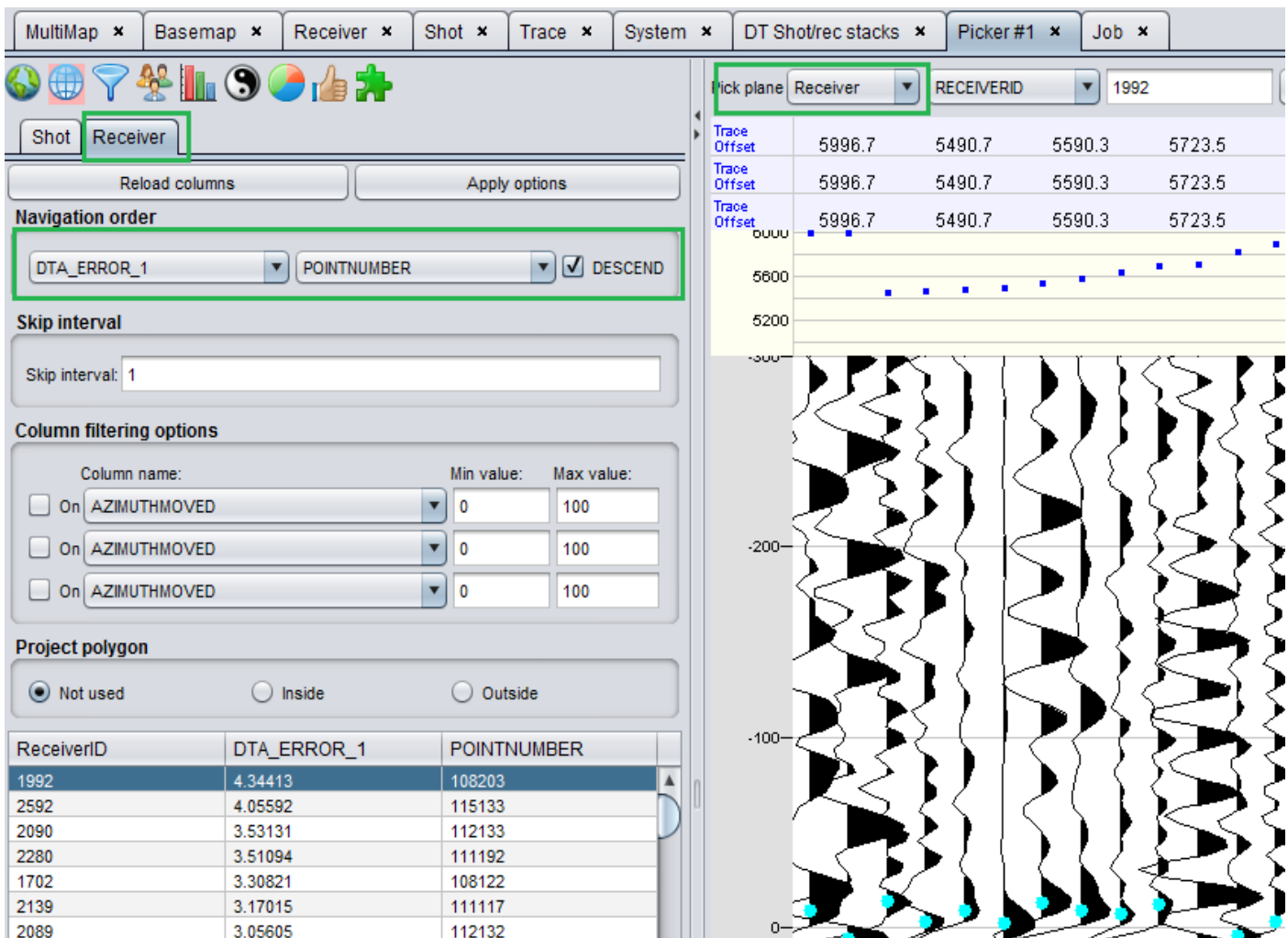
## Delay Time/Pick/Geom QC

- Set a hotkey for “GeomCorrection” - we use “Q”
- Mouse over trace display, then hit the hotkey – program will move shot
- You may have to do it several times, while fixing picks in between



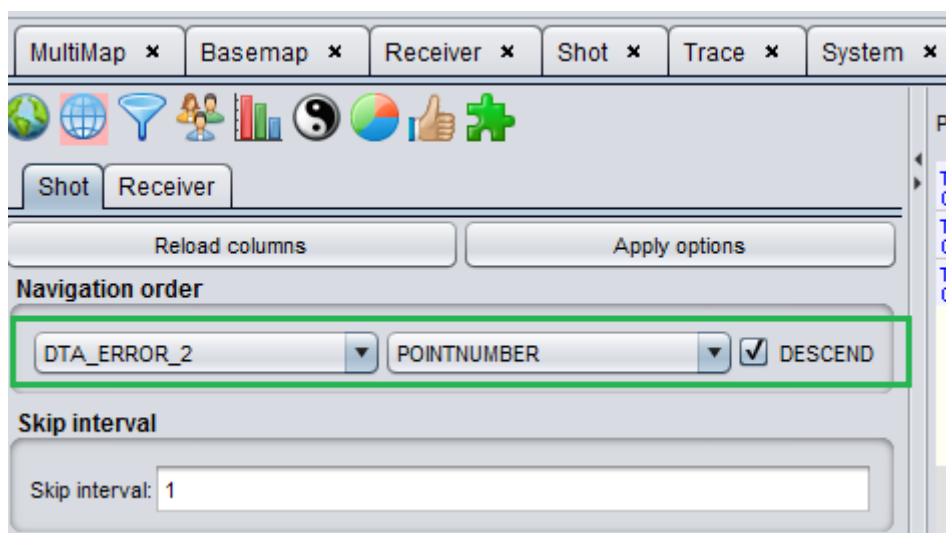
# Delay Time/Pick/Geom QC

- When done QC'ing Shots, switch to Receivers, and repeat
- Set navigation order, etc.
- In order to display Receiver gathers, you need to switch to “Receiver” plane in the trace display:



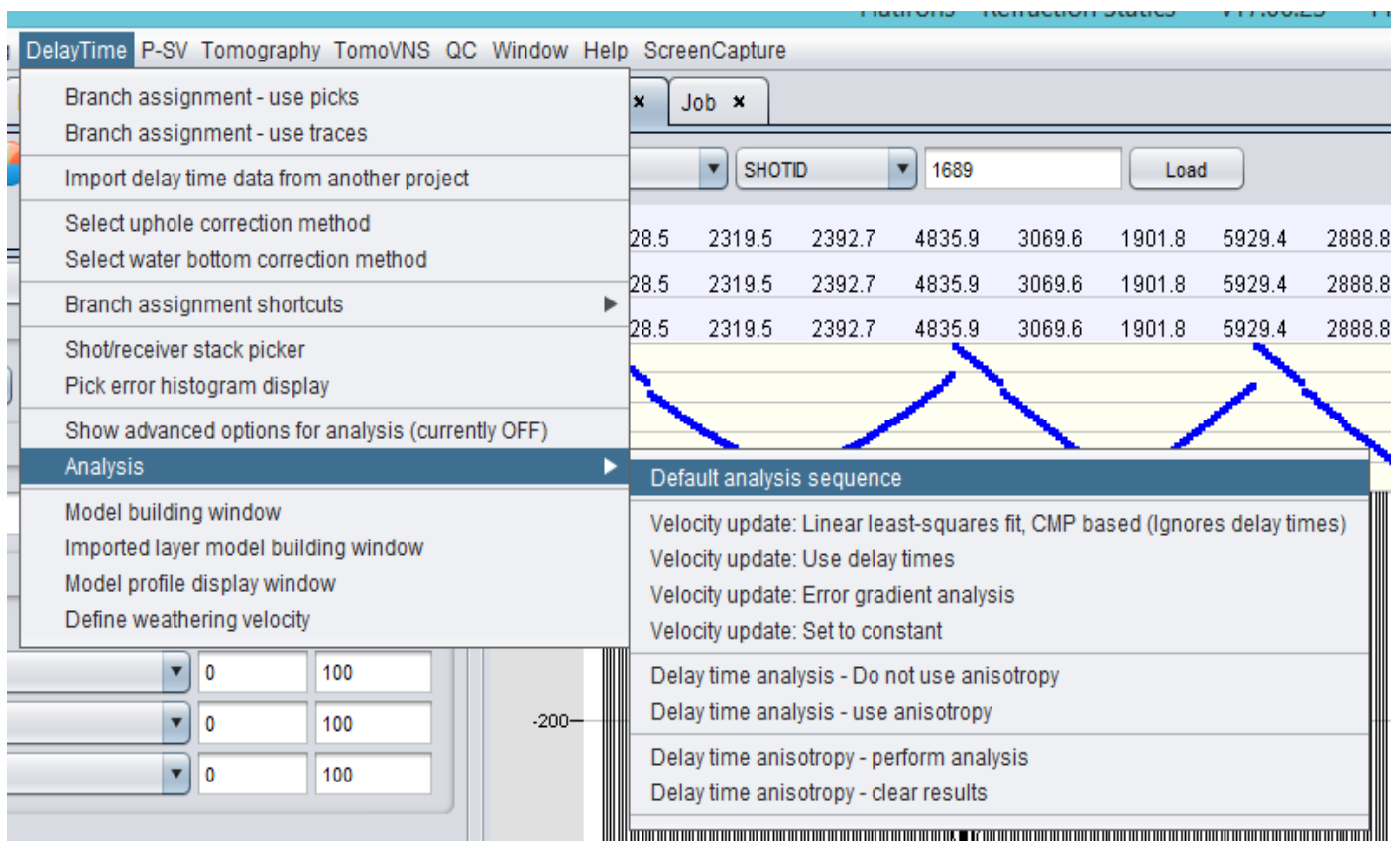
# Delay Time/Pick/Geom QC

- If you have more than one Refractor, repeat everything with the rest of your Refractors – use “DTA\_Error\_2”, etc.



# Delay Time Analysis

- If picks and geometry have been modified, then Delay Time Analysis sequence needs to be run again
- DelayTime menu → Analysis → Default analysis sequence



The screenshot shows the DelayTime software interface. The 'DelayTime' menu is open, and the 'Analysis' option is selected, which has opened a sub-menu. In the sub-menu, the 'Default analysis sequence' option is highlighted. The background window shows a data table with columns for SHOTID and various numerical values, and a plot area with blue lines.

SHOTID	2319.5	2392.7	4835.9	3069.6	1901.8	5929.4	2888.8
28.5	2319.5	2392.7	4835.9	3069.6	1901.8	5929.4	2888.8
28.5	2319.5	2392.7	4835.9	3069.6	1901.8	5929.4	2888.8
28.5	2319.5	2392.7	4835.9	3069.6	1901.8	5929.4	2888.8

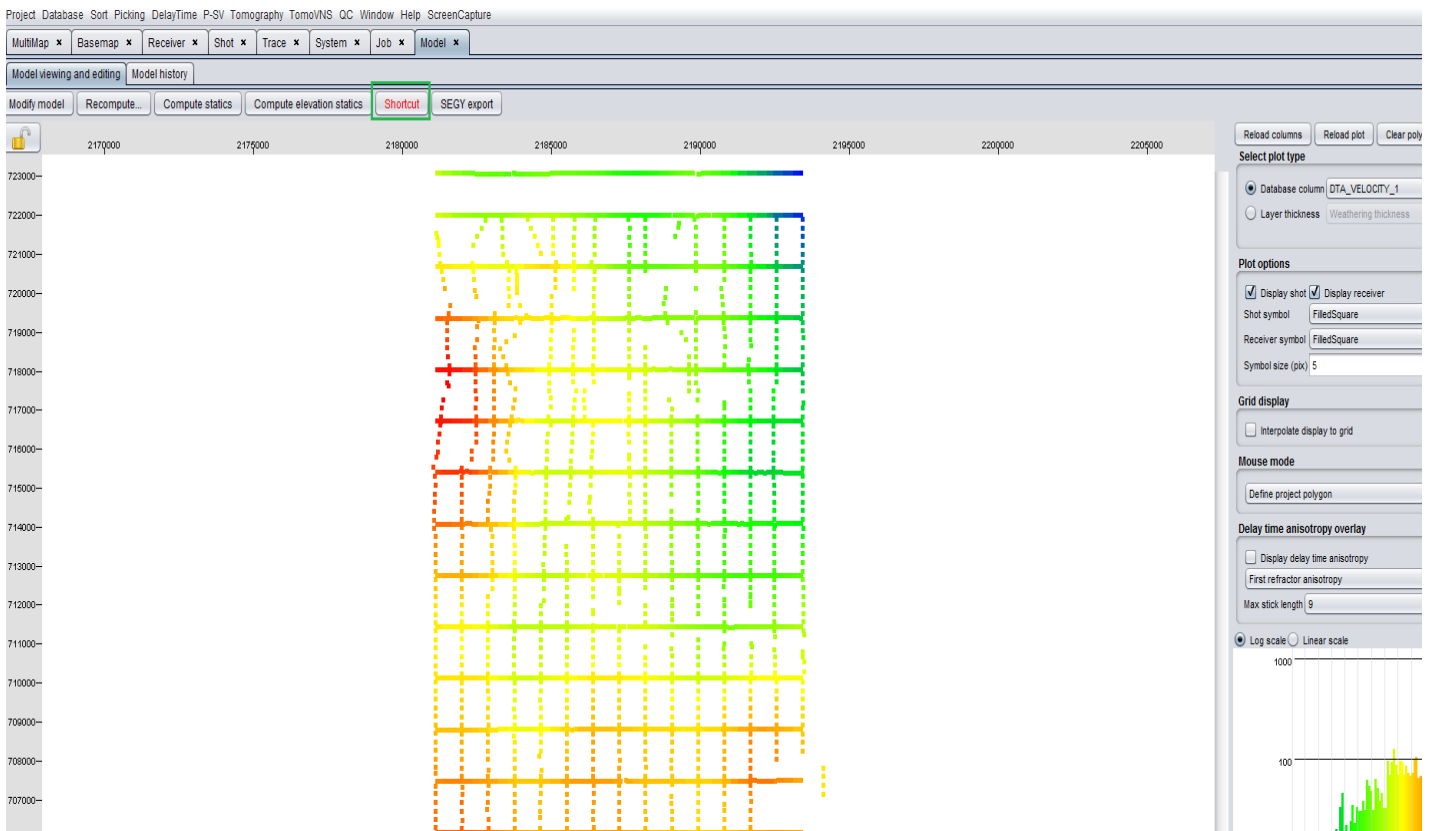
Analysis menu options:

- Branch assignment - use picks
- Branch assignment - use traces
- Import delay time data from another project
- Select uphole correction method
- Select water bottom correction method
- Branch assignment shortcuts
- Shot/receiver stack picker
- Pick error histogram display
- Show advanced options for analysis (currently OFF)
- Analysis**
  - Model building window
  - Imported layer model building window
  - Model profile display window
  - Define weathering velocity
  - Default analysis sequence**
    - Velocity update: Linear least-squares fit, CMP based (Ignores delay times)
    - Velocity update: Use delay times
    - Velocity update: Error gradient analysis
    - Velocity update: Set to constant
    - Delay time analysis - Do not use anisotropy
    - Delay time analysis - use anisotropy
    - Delay time anisotropy - perform analysis
    - Delay time anisotropy - clear results



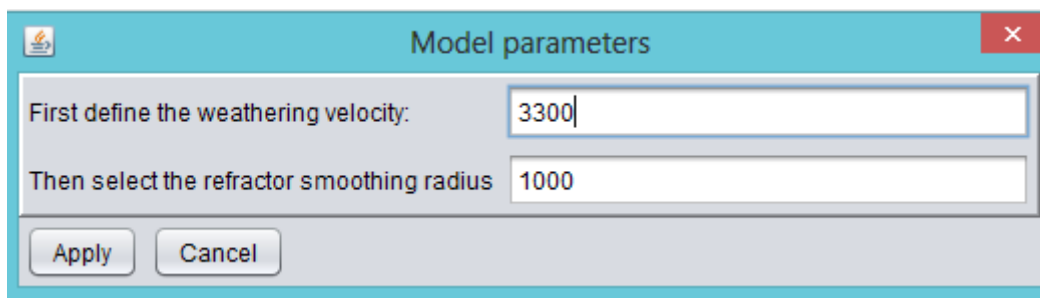
## Model Building

- DelayTime menu → Model building window
- Click “Shortcut” key – this will handle everything automatically



## Model Building

- Enter your desired weathering velocity (this needs to be lower than the first refractor velocity, which can be viewed under “DTA\_Velocity\_1”)
- Set smoothing radius – lower value means less smoothing (default is recommended)

A screenshot of a software dialog box titled "Model parameters". It has a light blue header bar with a small icon on the left and a red close button on the right. The main area is white and contains two input fields. The first field is labeled "First define the weathering velocity:" and contains the value "3300". The second field is labeled "Then select the refractor smoothing radius" and contains the value "1000". At the bottom, there are two buttons: "Apply" and "Cancel".

Model parameters

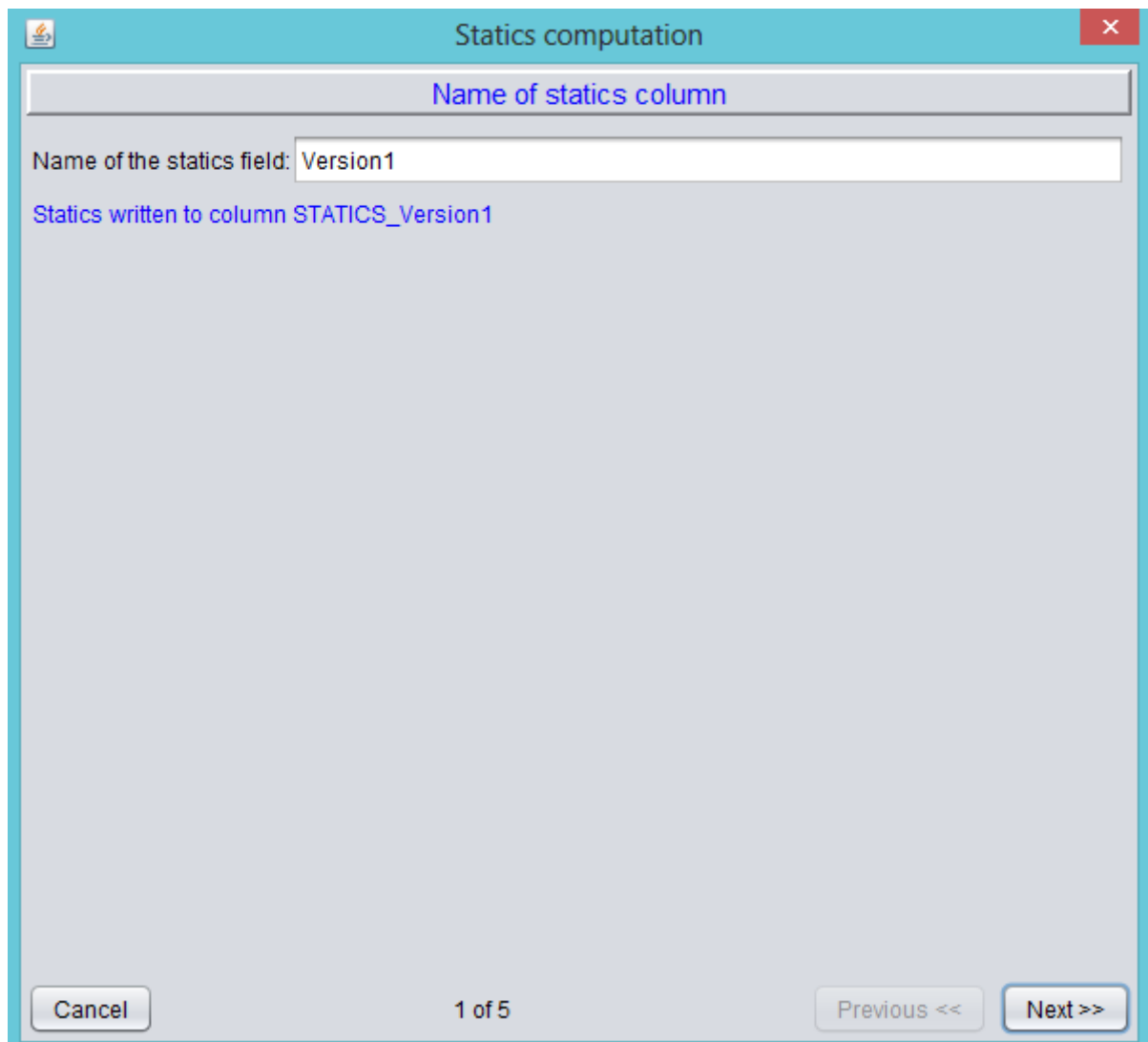
First define the weathering velocity: 3300

Then select the refractor smoothing radius 1000

Apply Cancel

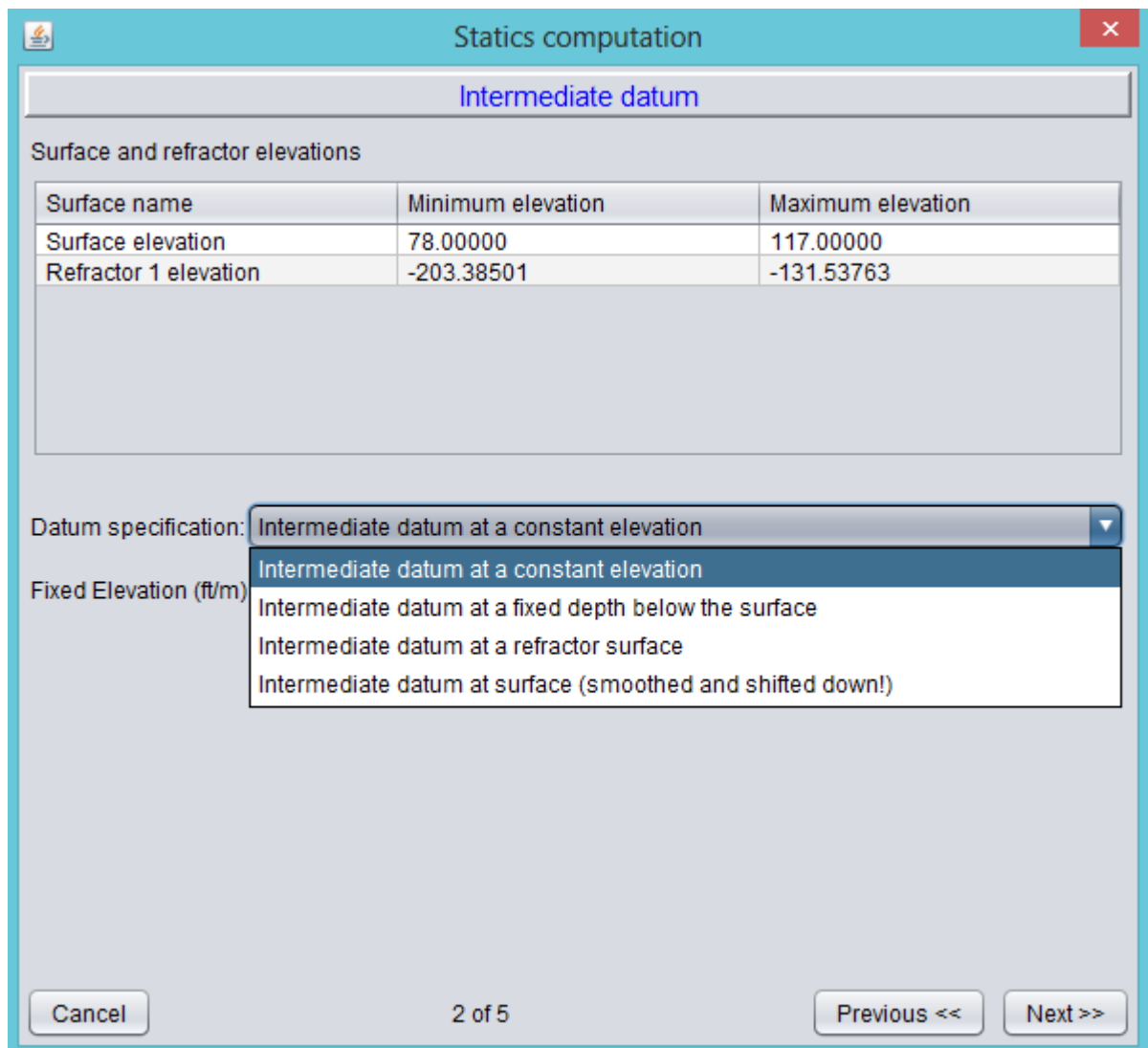
# Statics Computation

- In Model Building Window, click “Compute statics”
- Select a name for your set of statics

A screenshot of a software dialog box titled "Statics computation". The dialog has a light blue header bar with a close button (X) in the top right corner. Below the header, there is a section labeled "Name of statics column" in blue text. Underneath this, there is a text input field with the label "Name of the statics field:" and the text "Version1" entered. Below the input field, there is a line of blue text that reads "Statics written to column STATICS\_Version1". At the bottom of the dialog, there are three buttons: "Cancel" on the left, "1 of 5" in the center, and "Previous <<" and "Next >>" on the right.

# Statics Computation

- Select intermediate datum type, and set datum

A screenshot of a software dialog box titled "Statics computation". The dialog has a light blue header bar with a close button (X) in the top right corner. Below the header, there is a tab labeled "Intermediate datum". The main content area is divided into two sections. The first section, titled "Surface and refractor elevations", contains a table with three columns: "Surface name", "Minimum elevation", and "Maximum elevation". The table has two rows of data. The second section, titled "Datum specification:", features a dropdown menu with four options. The first option, "Intermediate datum at a constant elevation", is selected and highlighted. Below the dropdown, there is a label "Fixed Elevation (ft/m)" followed by a text input field. At the bottom of the dialog, there are three buttons: "Cancel" on the left, "2 of 5" in the center, and "Previous <<" and "Next >>" on the right.

Surface name	Minimum elevation	Maximum elevation
Surface elevation	78.00000	117.00000
Refractor 1 elevation	-203.38501	-131.53763

Datum specification: Intermediate datum at a constant elevation

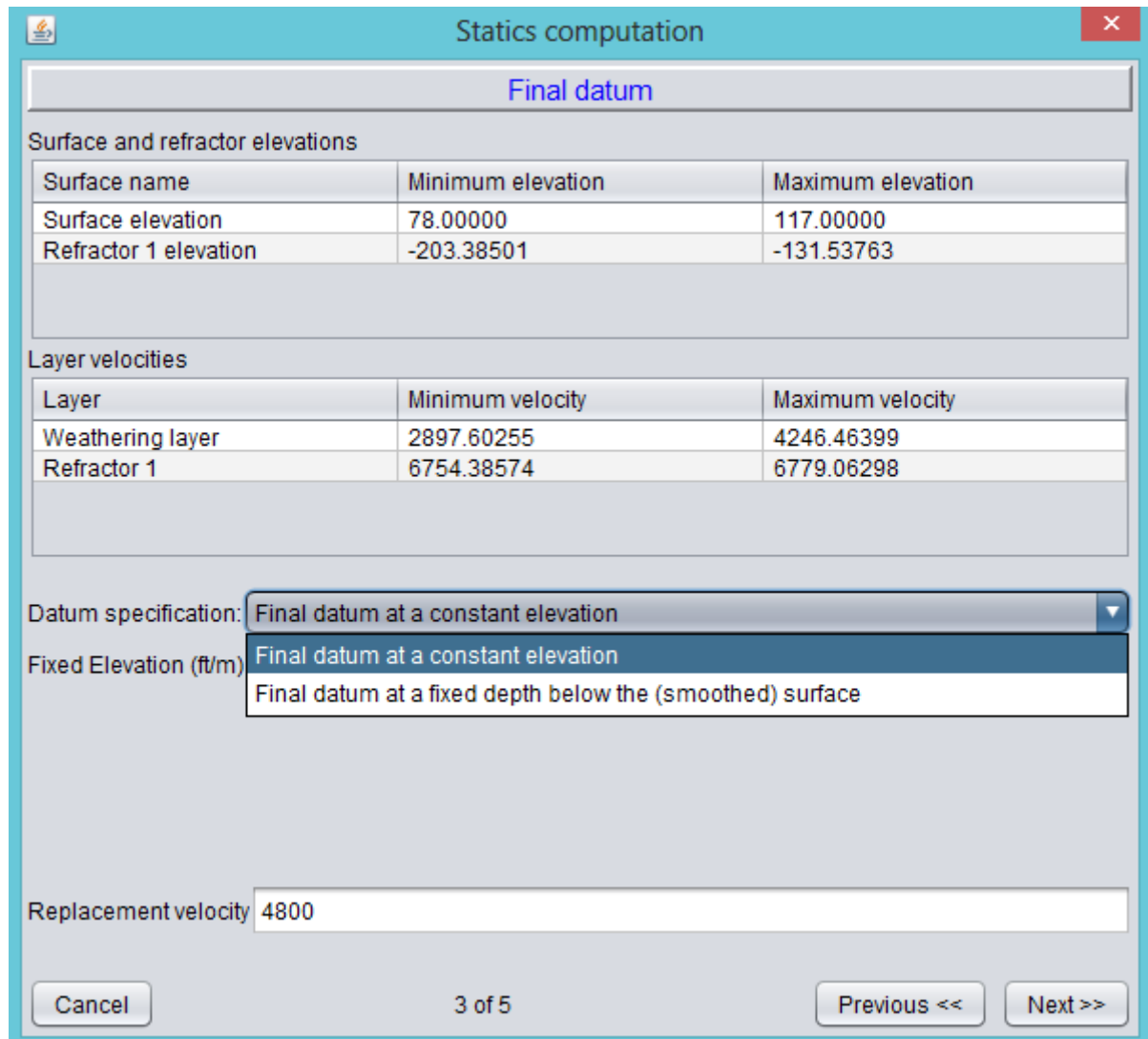
Fixed Elevation (ft/m)

Intermediate datum at a constant elevation  
Intermediate datum at a fixed depth below the surface  
Intermediate datum at a refractor surface  
Intermediate datum at surface (smoothed and shifted down!)

Cancel 2 of 5 Previous << Next >>

# Statics Computation

- Set final datum and replacement velocity

A screenshot of a software dialog box titled "Statics computation". The dialog has a light blue header bar with a close button (X) in the top right corner. Below the header, there is a section labeled "Final datum" in blue text. Underneath, there are two tables. The first table is titled "Surface and refractor elevations" and has three columns: "Surface name", "Minimum elevation", and "Maximum elevation". It contains two rows of data. The second table is titled "Layer velocities" and also has three columns: "Layer", "Minimum velocity", and "Maximum velocity". It contains two rows of data. Below the tables, there is a "Datum specification:" label followed by a dropdown menu. The dropdown is currently open, showing two options: "Final datum at a constant elevation" (which is highlighted) and "Final datum at a fixed depth below the (smoothed) surface". Below the dropdown, there is a "Fixed Elevation (ft/m)" label. At the bottom of the dialog, there is a "Replacement velocity" label followed by a text input field containing the value "4800". At the very bottom, there are three buttons: "Cancel", "3 of 5", and "Next >>".

Surface name	Minimum elevation	Maximum elevation
Surface elevation	78.00000	117.00000
Refractor 1 elevation	-203.38501	-131.53763

Layer	Minimum velocity	Maximum velocity
Weathering layer	2897.60255	4246.46399
Refractor 1	6754.38574	6779.06298

Datum specification: Final datum at a constant elevation

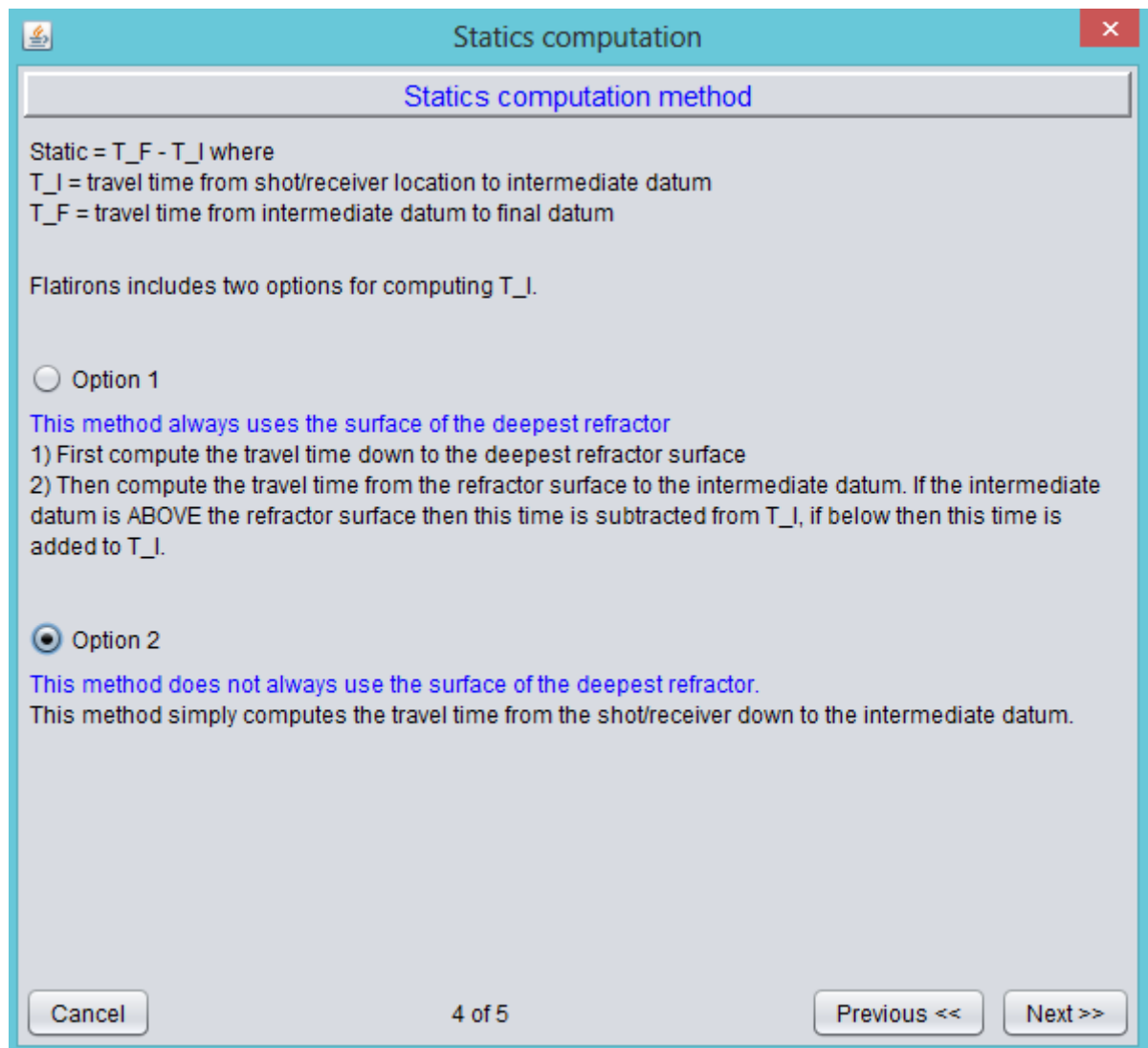
Fixed Elevation (ft/m): Final datum at a constant elevation

Replacement velocity: 4800

Buttons: Cancel, 3 of 5, Previous <<, Next >>

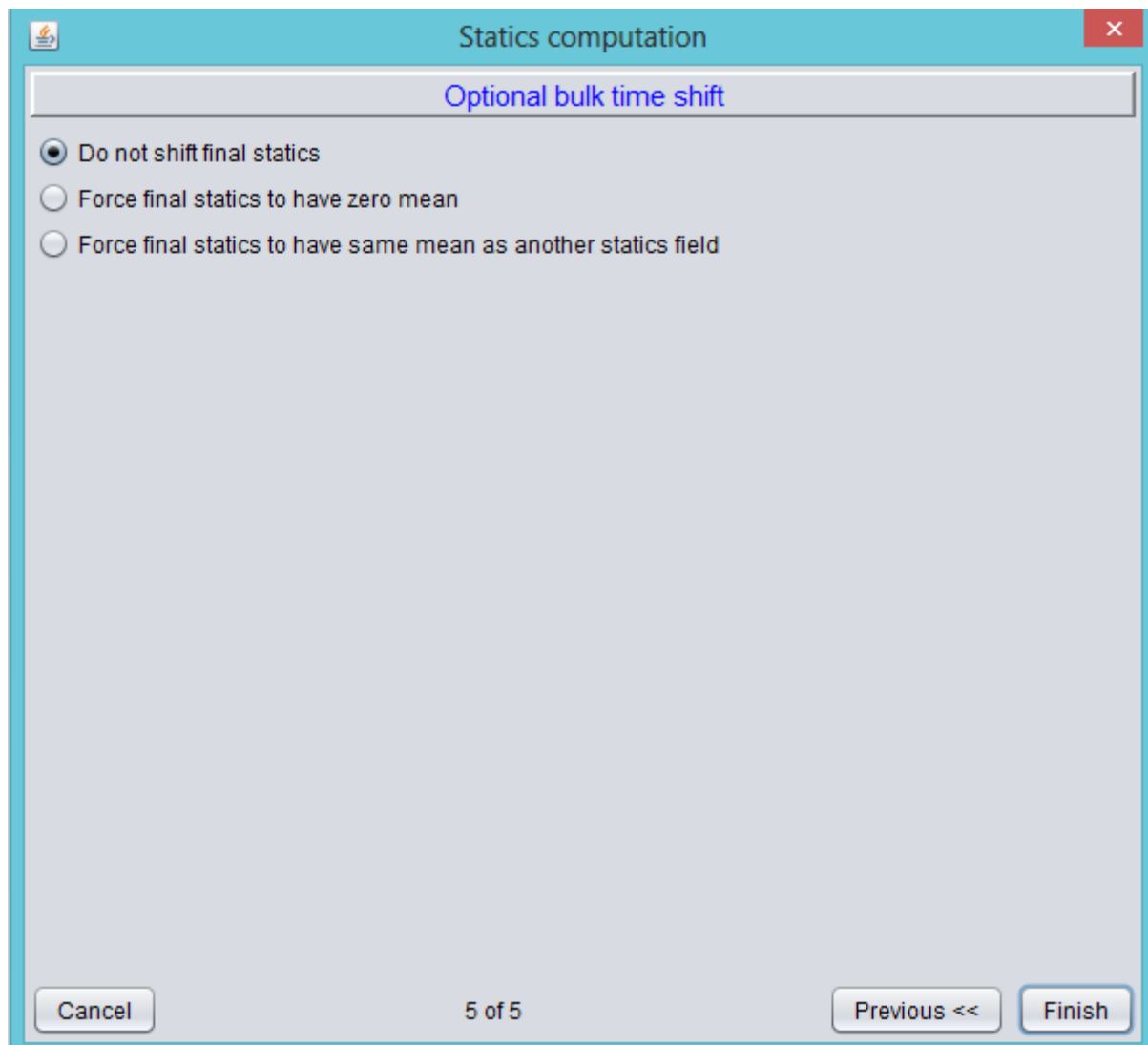
# Statics Computation

- Set computation method – differences between the methods are explained in the dialog box



# Statics Computation

- Select optional bulk shift – this is explained in further detail in the Stack QC tutorial

A screenshot of a software dialog box titled "Statics computation". The dialog has a light blue header bar with a close button (X) on the right. Below the header is a tab labeled "Optional bulk time shift". The main area contains three radio button options: "Do not shift final statics" (which is selected), "Force final statics to have zero mean", and "Force final statics to have same mean as another statics field". At the bottom, there are four buttons: "Cancel", "5 of 5", "Previous <<", and "Finish".

Statics computation

Optional bulk time shift

☒ Do not shift final statics

☐ Force final statics to have zero mean

☐ Force final statics to have same mean as another statics field

Cancel 5 of 5 Previous << Finish

# Statics Computation

- Statics will then show up in Shot/Receiver tables (you may need to reload list of columns) under the name “Statics\_” with the name you provided

Project Database Sort Picking DelayTime P-SV Tomography TomoVNS QC Window Help ScreenCapture

MultiMap x Basemap x Receiver x Shot x Trace x System x Job x Model x

Table Import conflicts Crossplots Duplicate entries

Reload list of columns

Clear selected columns (selects all)

Select visible columns:

- DTA\_DTANISAZ\_1
- DTA\_DTANISMAG\_1
- DTA\_ELEVATION\_1
- DTA\_ERROR\_1
- DTA\_MAXOFFSET\_0
- DTA\_VELOCITY\_0
- DTA\_VELOCITY\_1
- EASTING
- ELEVATION
- FFID
- FLAG
- FOLD
- GEOMERR\_AZ
- GEOMERR\_DIST
- INITIALEASTING
- INITIALELEVATION
- INITIALNORTHING
- KILLED
- LINENUMBER
- NORTHING
- PATTERNSHIFTTOTAL
- POINTDEPTH
- POINTINDEX
- POINTNUMBER
- POLARITY
- SHOTID
- STATICS\_VERSION1
- TIMESHIFT
- TOMO3D\_RESIDUALERROR
- TOMO3D\_STACKPICKTIME
- TOMO3D\_TOTALERROR
- TOMOVNS\_RESIDUALERROR

Sorting options

Primary: AZIMUTHMOVED Use Descend

Secondary: AZIMUTHMOVED Use Descend

Filtering options

Column: AZIMUTHMOVED

SELECT FFD, SHOTID, STATICS\_VERSION1 FROM Shot

Open saved SQL statement Save current query Prior queries dialog... Query returned 1027 rows

FFID	SHOTID	STATICS_VERSION1
5	1000	-44.31901
8	1001	-44.46284
10	1002	-46.00054
12	1003	-42.74460
13	1004	-42.39332
15	1005	-41.37421
16	1006	-43.10464
18	1007	-41.48562
20	1008	-42.59252
21	1009	-42.84130
23	1010	-45.72450
25	1011	-43.68343
26	1012	-43.40667
27	1013	-43.15189
28	1014	-43.19853
29	1015	-36.54941
30	1016	-36.79951
32	1017	-38.70427
34	1018	-39.42059
36	1019	-37.59206
38	1020	-39.34053
40	1021	-43.66083
42	1022	-42.24990
44	1023	-40.06201
46	1024	-38.82119
48	1025	-42.04554
50	1026	-42.43254
52	1027	-43.82445
53	1028	-44.45908
54	1029	-47.12727