

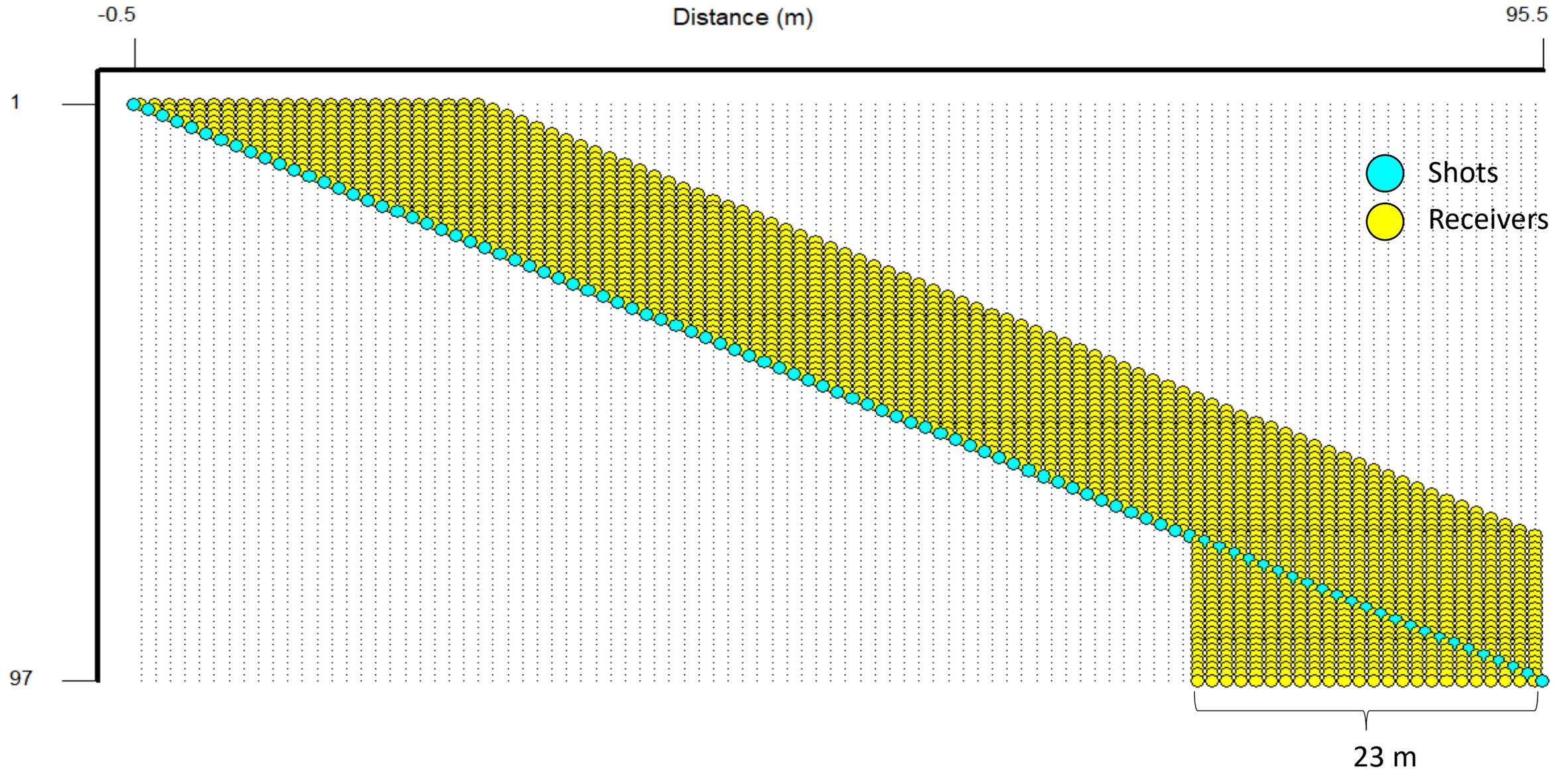
Tutorial for 2D MASW processing using SeisImager/SW-2D

- Processing 2D MASW data obtained by Geode.
- SeisImager/SW-2D license is required.
- Download the latest installer from :
<https://seisimager.com/download/SeisImager.zip>
- Download the example data from :
[https://seisimager.com/download/MASW\(2D\).zip](https://seisimager.com/download/MASW(2D).zip)
- Can be processed either using wizard or manually
- The tutorial summarize manual processing
- See *“SeisImager/SW™ Manual”*, *“SeisImager/SW-Pro™ Manual”* and *“GeoPlot™ Manual”* for more details

Acquisition geometry

- Source interval : 1 m
- 1st source position : -0.5 m
- Receiver interval : 1 m
- 1st receiver position : 0 m
- Survey line length : 95 m (0~95 m)

Acquisition geometry



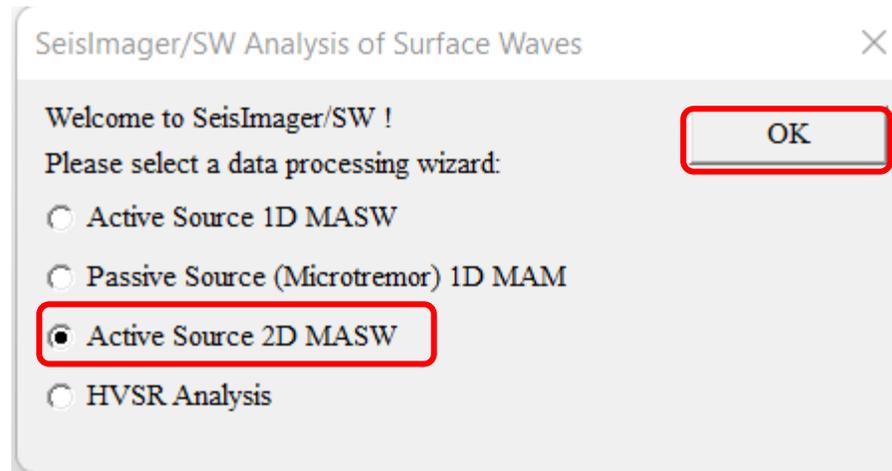
Processing with surface wave analysis wizard

Data can be processed almost automatically using the “Surface Wave Analysis Wizard”

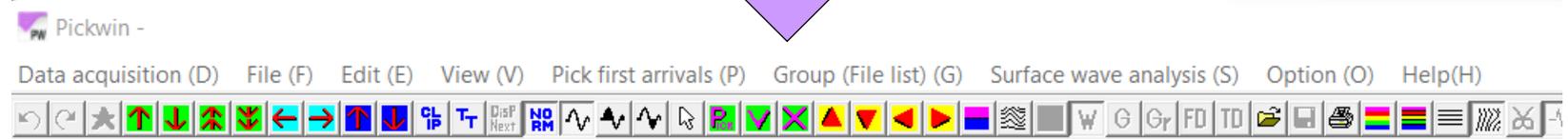
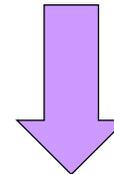
Click “Surface Wave Analysis Wizard” icon



Choose “Active Source 2D MASW” and click “OK”



Press “Enter” key to start processing



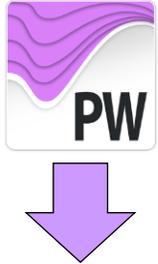
Wizard automatically selects processing menu describes below by pressing “Enter” key

Import Geode data files (SEG2 files : .dat or .sg2)

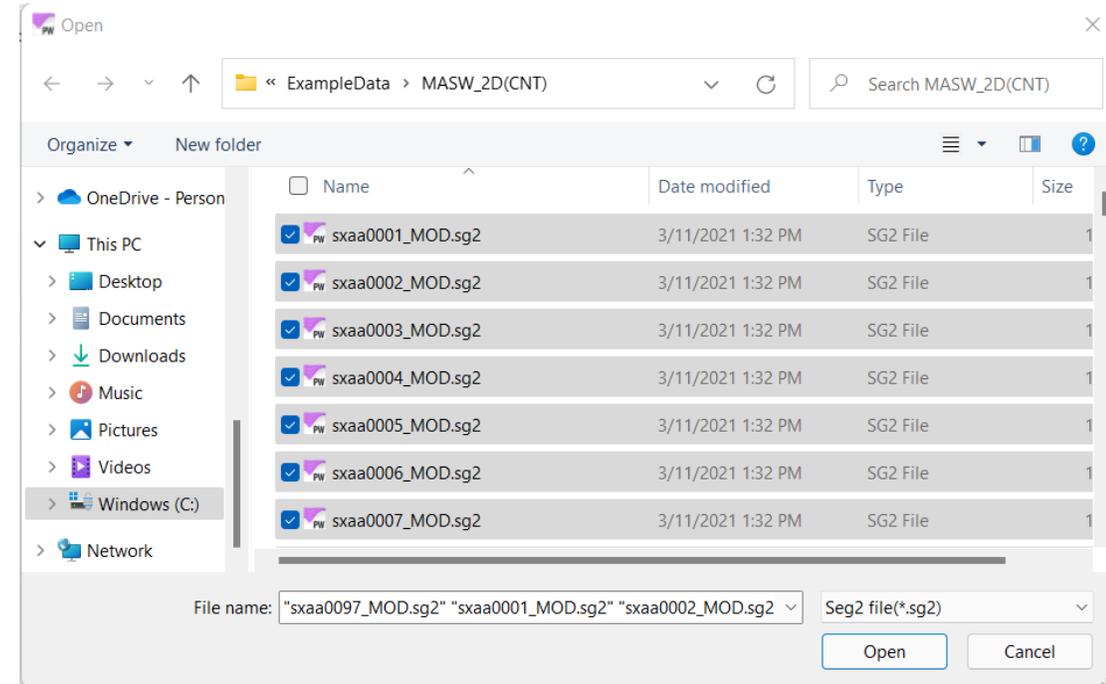
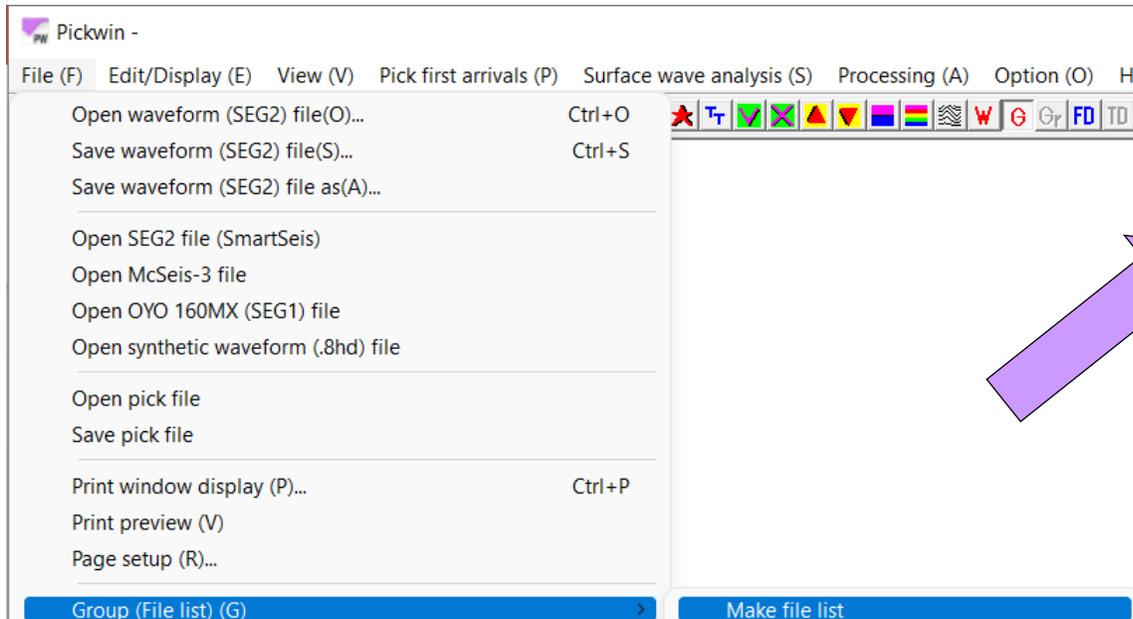
Hereafter, the tutorial describes manual processing without the wizard.

The wizard basically follow almost the same procedure by pressing “Enter” key.

Double click icon to launch Pickwin



Select “File”, “Group (file list)”, “Make file list”.



Select all SEG2 files.

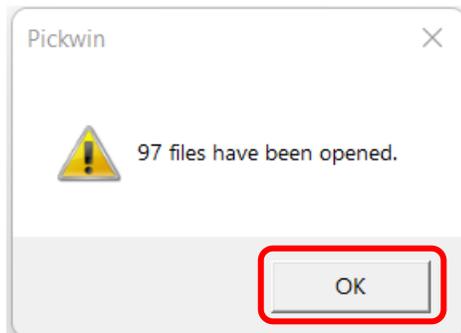
Use “File”, “Group (file list)”, “Make file list (select a folder)” if the number of files is more than 100.



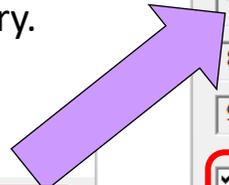
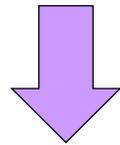
Import Geode data files (SEG2 files : .dat or .sg2)

If waveform data files contain correct source-receiver geometry.

Click "OK" to continue.



Check "Source position" and "Receiver position" if waveform data files contain correct source-receiver geometry.



File list

| Index | Edit | ID | Source (m) | 1st receiver (m) | Receiver int. (m) | # of aux. | |
|-------|--------------------------|----|------------|------------------|-------------------|-----------|--|
| 0 | <input type="checkbox"/> | 1 | 0 | 0 | 1 | 0 | |
| 1 | <input type="checkbox"/> | 2 | 0 | 0 | 1 | 0 | |
| 2 | <input type="checkbox"/> | 3 | 0 | 0 | 1 | 0 | |
| 3 | <input type="checkbox"/> | 4 | 0 | 0 | 1 | 0 | |
| 4 | <input type="checkbox"/> | 5 | 0 | 0 | 1 | 0 | |
| 5 | <input type="checkbox"/> | 6 | 0 | 0 | 1 | 0 | |
| 6 | <input type="checkbox"/> | 7 | 0 | 0 | 1 | 0 | |
| 7 | <input type="checkbox"/> | 8 | 0 | 0 | 1 | 0 | |
| 8 | <input type="checkbox"/> | 9 | 0 | 0 | 1 | 0 | |
| 9 | <input type="checkbox"/> | 10 | 0 | 0 | 1 | 0 | |

Apply source coordinates from file header Apply receiver coordinates from file header

Active data Passive data

Number of files: 97

OK

Cancel

Next

Back

Set up

Set # of aux.

Delete

Export

Import

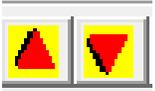
Check "Apply source coordinate from file header" and "Apply receiver coordinate from file header" if waveform data files contain correct source-receiver geometry.



Import Geode data files (SEG2 files : .dat or .sg2)

The 1st shot gather appears.

Use

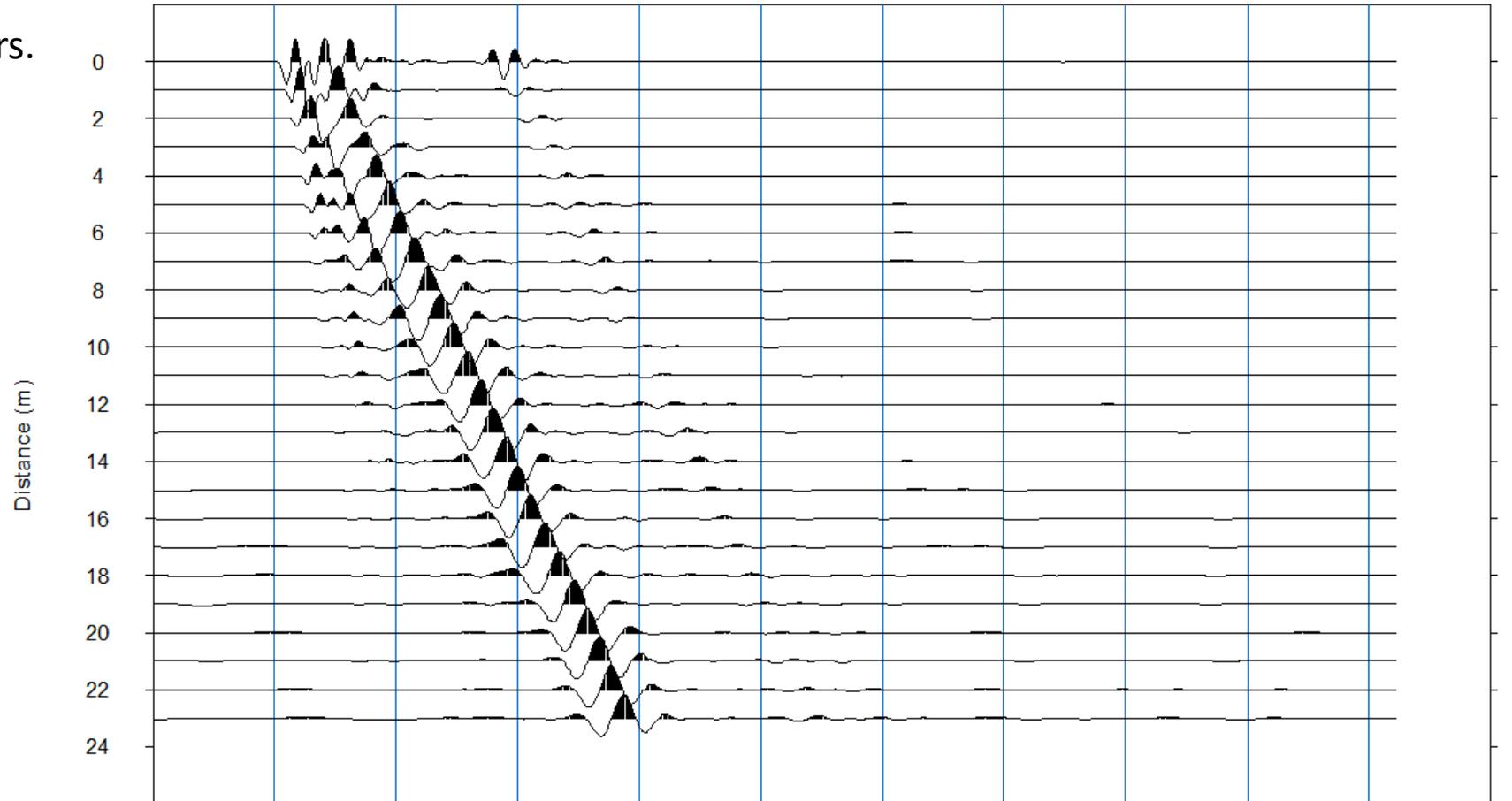


to scroll shot gathers.

Source= -0.5m

Time (ms)

0 100 200 300 400 500 600 700 800 900 1000 1100



C:\Koichi\SeisImagerManagement\TestProcedure\ExampleData\MASW_2D(CNT)\sxaa0001_MOD.sg2

Manually set up acquisition geometry (optional)

If waveform data files do not contain correct source-receiver geometry, the acquisition geometry can be set up manually.

The screenshot shows a 'File list' dialog box with a table of acquisition parameters. The table has columns for Index, Edit, ID, Source (m), 1st receiver (m), Receiver int. (m), and # of aux. The 'Set up' button is highlighted with a red box. At the bottom, there are checkboxes for 'Apply source coordinates from file header' and 'Apply receiver coordinates from file header', both of which are also highlighted with a red box. There are also radio buttons for 'Active data' and 'Passive data', and a 'Number of files' field with the value 97.

| Index | Edit | ID | Source (m) | 1st receiver (m) | Receiver int. (m) | # of aux. |
|-------|--------------------------|----|------------|------------------|-------------------|-----------|
| 0 | <input type="checkbox"/> | 1 | 0 | 0 | 1 | 0 |
| 1 | <input type="checkbox"/> | 2 | 0 | 0 | 1 | 0 |
| 2 | <input type="checkbox"/> | 3 | 0 | 0 | 1 | 0 |
| 3 | <input type="checkbox"/> | 4 | 0 | 0 | 1 | 0 |
| 4 | <input type="checkbox"/> | 5 | 0 | 0 | 1 | 0 |
| 5 | <input type="checkbox"/> | 6 | 0 | 0 | 1 | 0 |
| 6 | <input type="checkbox"/> | 7 | 0 | 0 | 1 | 0 |
| 7 | <input type="checkbox"/> | 8 | 0 | 0 | 1 | 0 |
| 8 | <input type="checkbox"/> | 9 | 0 | 0 | 1 | 0 |
| 9 | <input type="checkbox"/> | 10 | 0 | 0 | 1 | 0 |

Buttons: OK, Cancel, Next, Back, Set up, Set # of aux., Delete, Export, Import

Number of files: 97

Options: Apply source coordinates from file header, Apply receiver coordinates from file header, Active data, Passive data

Click "Set up" to set up geometry.

Uncheck "Apply source coordinate from file header" and "Apply receiver coordinate from file header" if waveform data files do not contain correct source-receiver geometry.



Manually set up acquisition geometry

If waveform data files do not contain correct source-receiver geometry, the acquisition geometry can be set up manually.

Enter the 1st source position, source interval, and receiver interval.

Choose “Variable receiver” or “Fixed receiver” and enter offset from source to 1st receiver or first receiver position respectively.

The 'Property' dialog shows the following settings:

- 1st source: -0.5 m
- Source interval: 1 m
- Variable receiver
 - Offset from source to 1st receiver: 0.5 m
- Fixed receiver
 - First receiver position: 0 m
- Receiver interval: 1 m

The 'File list' dialog shows a table of acquisition geometry for 10 sources:

| Index | Edit | ID | Source (m) | 1st receiver (m) | Receiver int. (m) | # of aux. |
|-------|--------------------------|----|------------|------------------|-------------------|-----------|
| | <input type="checkbox"/> | 1 | -0.5 | 0 | 1 | 0 |
| 1 | <input type="checkbox"/> | 2 | 0.5 | 1 | 1 | 0 |
| 2 | <input type="checkbox"/> | 3 | 1.5 | 2 | 1 | 0 |
| 3 | <input type="checkbox"/> | 4 | 2.5 | 3 | 1 | 0 |
| 4 | <input type="checkbox"/> | 5 | 3.5 | 4 | 1 | 0 |
| 5 | <input type="checkbox"/> | 6 | 4.5 | 5 | 1 | 0 |
| 6 | <input type="checkbox"/> | 7 | 5.5 | 6 | 1 | 0 |
| 7 | <input type="checkbox"/> | 8 | 6.5 | 7 | 1 | 0 |
| 8 | <input type="checkbox"/> | 9 | 7.5 | 8 | 1 | 0 |
| 9 | <input type="checkbox"/> | 10 | 8.5 | 9 | 1 | 0 |

Buttons in the 'File list' dialog include: OK, Cancel, Next, Back, Set up, Set # of aux., Delete, Export, Import, and Number of files (97).



Manually set up acquisition geometry

Geometry example 1 :
Variable receiver with sources behind receiver spread.

Property ✕

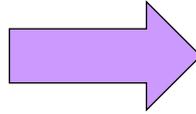
1st source m OK

Source interval m Cancel

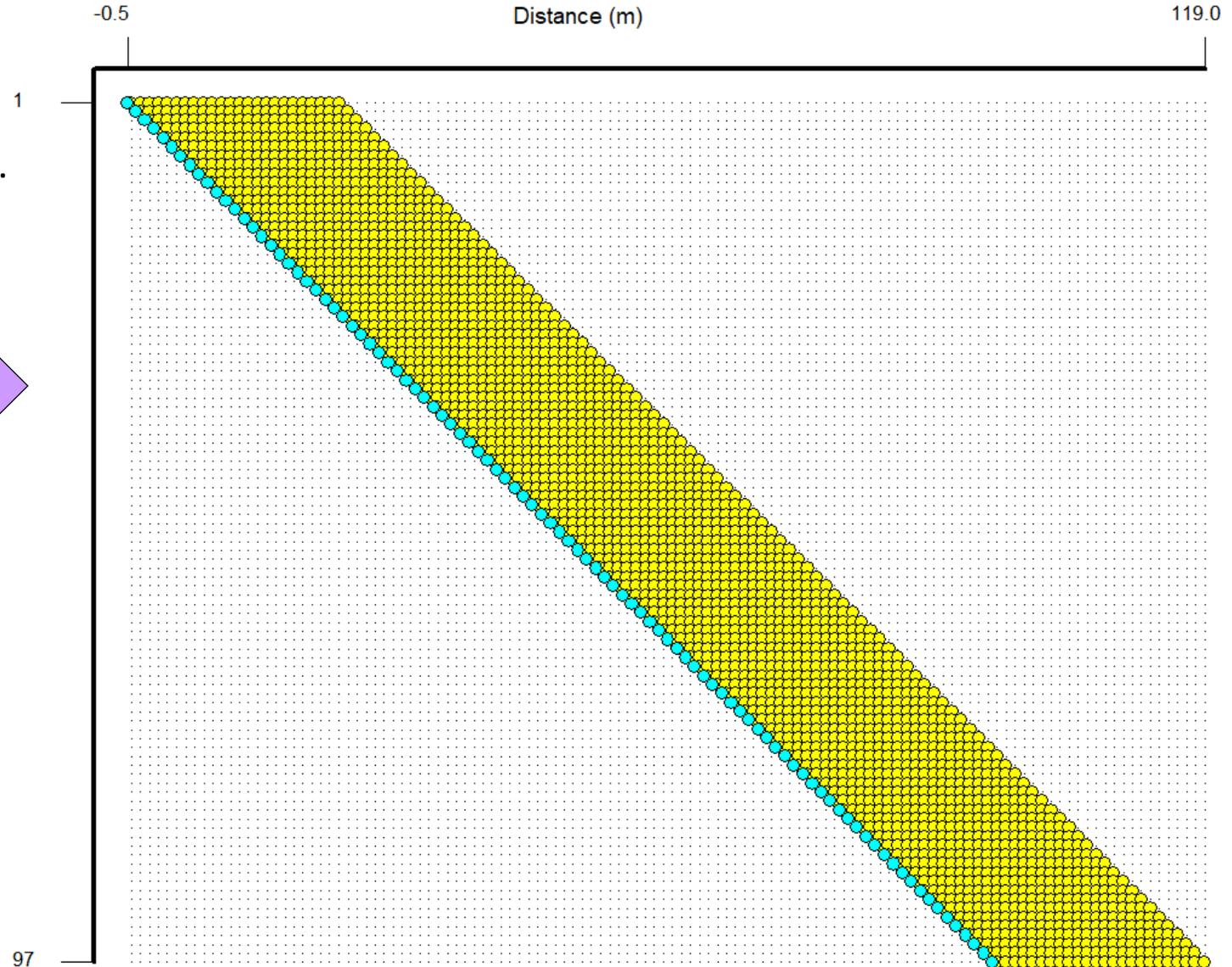
Variable receiver
Offset from source to 1st receiver m

Fixed receiver
First receiver position m

Receiver interval m



Shot No.



Manually set up acquisition geometry

Geometry example 2 :
Variable receiver with sources ahead of receiver spread.

Property ✕

1st source m OK

Source interval m Cancel

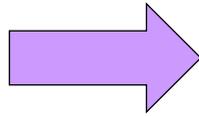
Variable receiver

Offset from source to 1st receiver m

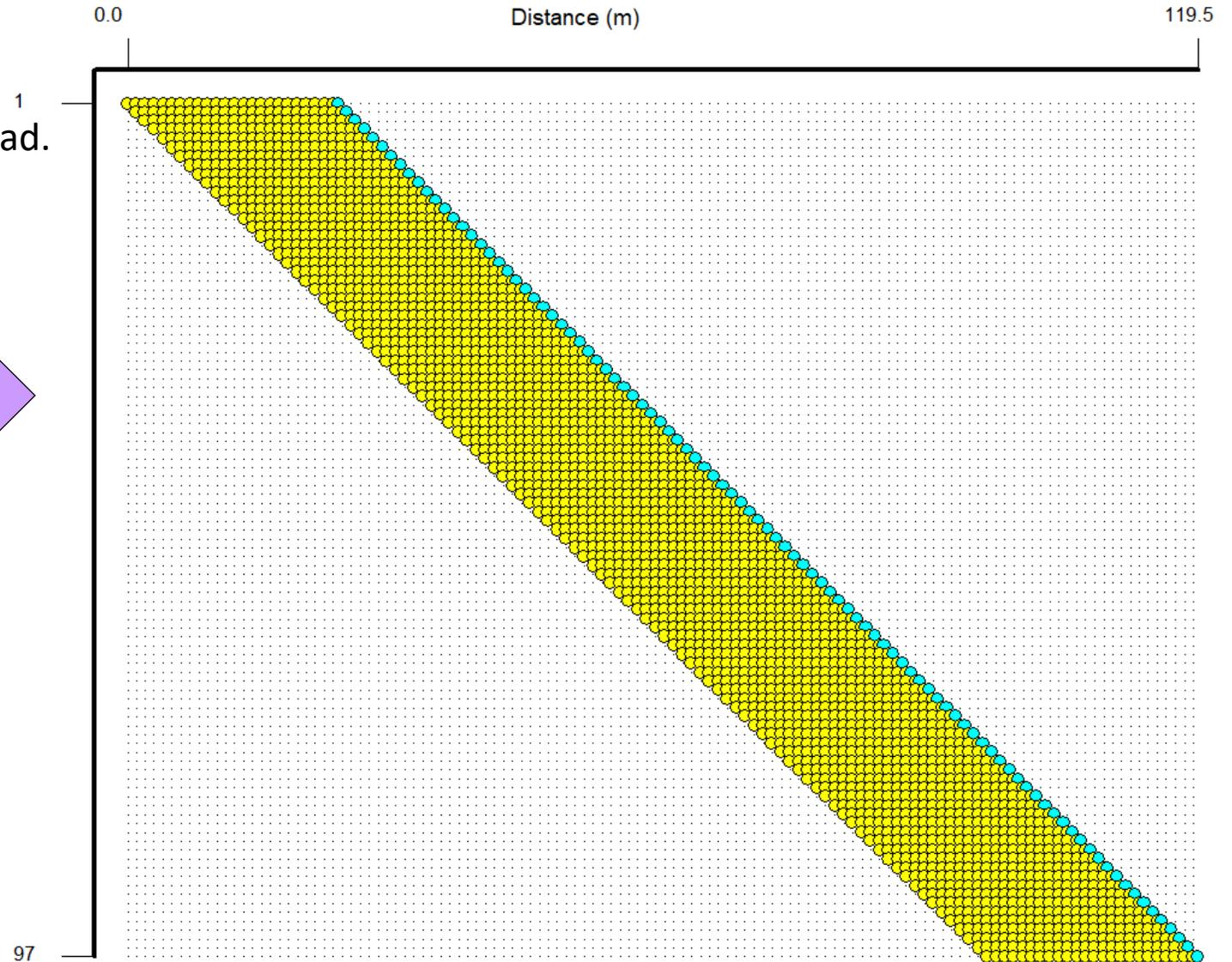
Fixed receiver

First receiver position m

Receiver interval m



Shot No.



Manually set up acquisition geometry

Geometry example 3 :
Fixed receiver spread.

Property ×

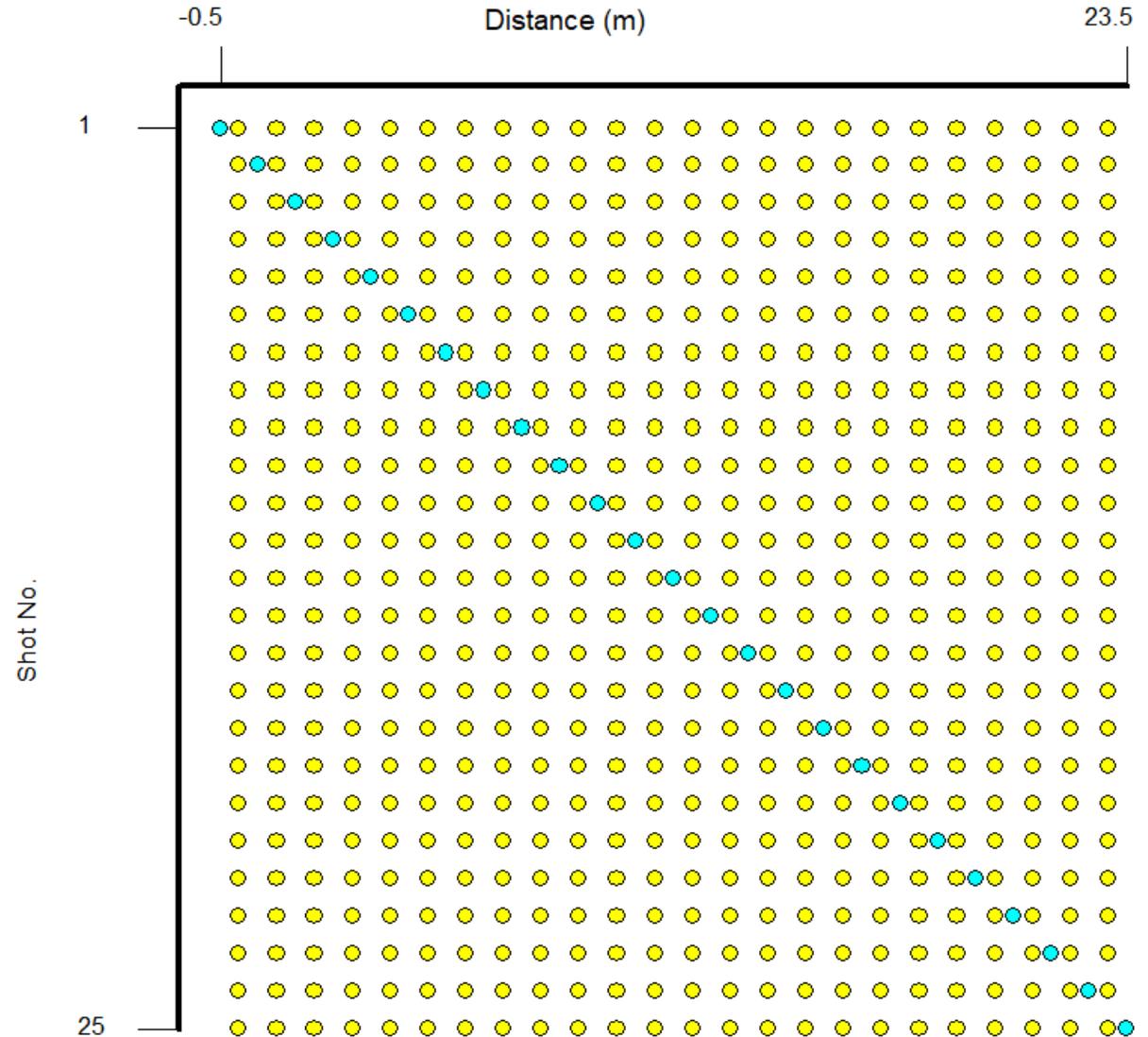
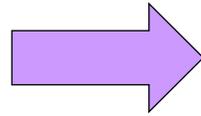
1st source m OK

Source interval m Cancel

Variable receiver
Offset from source to 1st receiver m

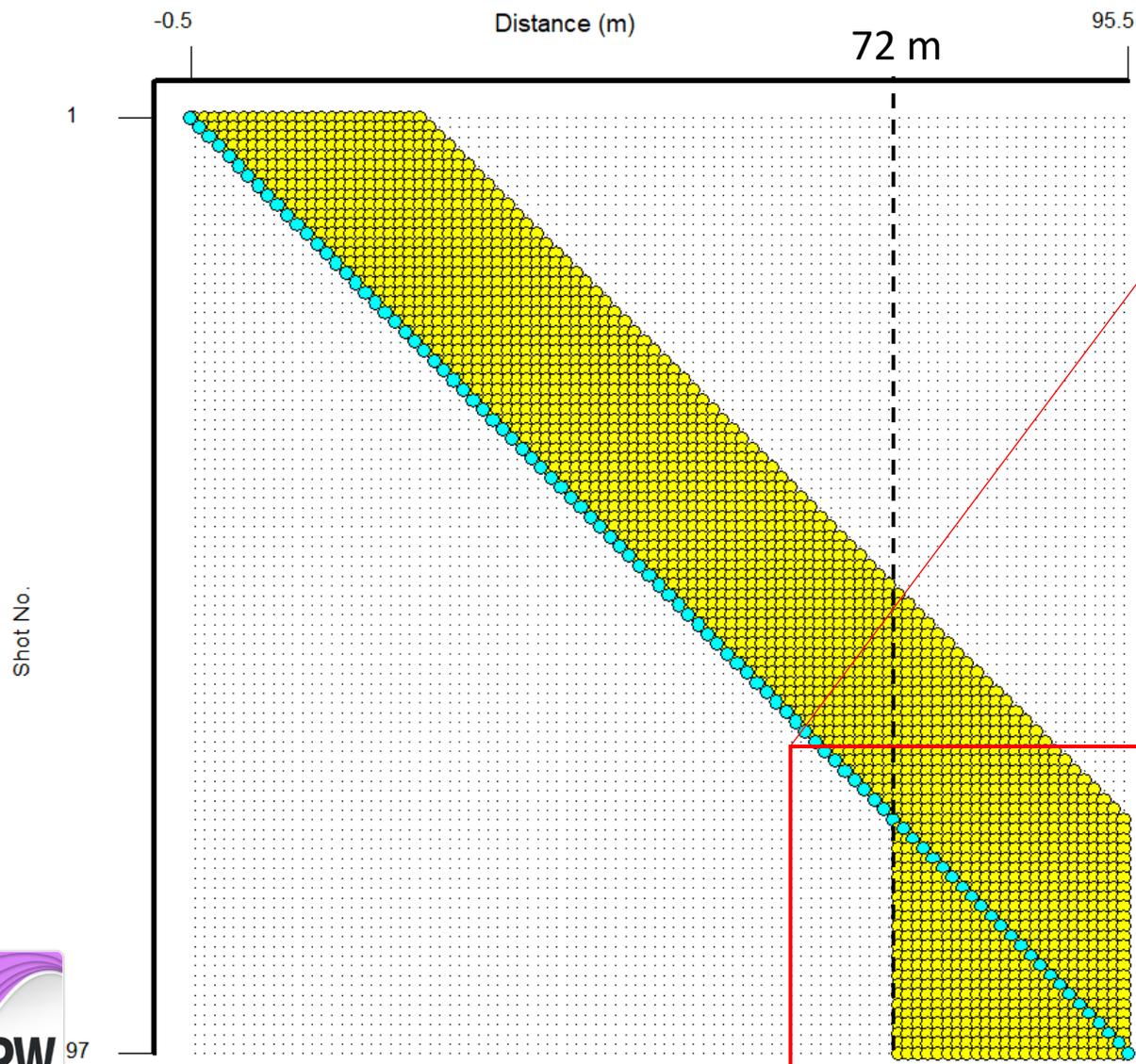
Fixed receiver
First receiver position m

Receiver interval m

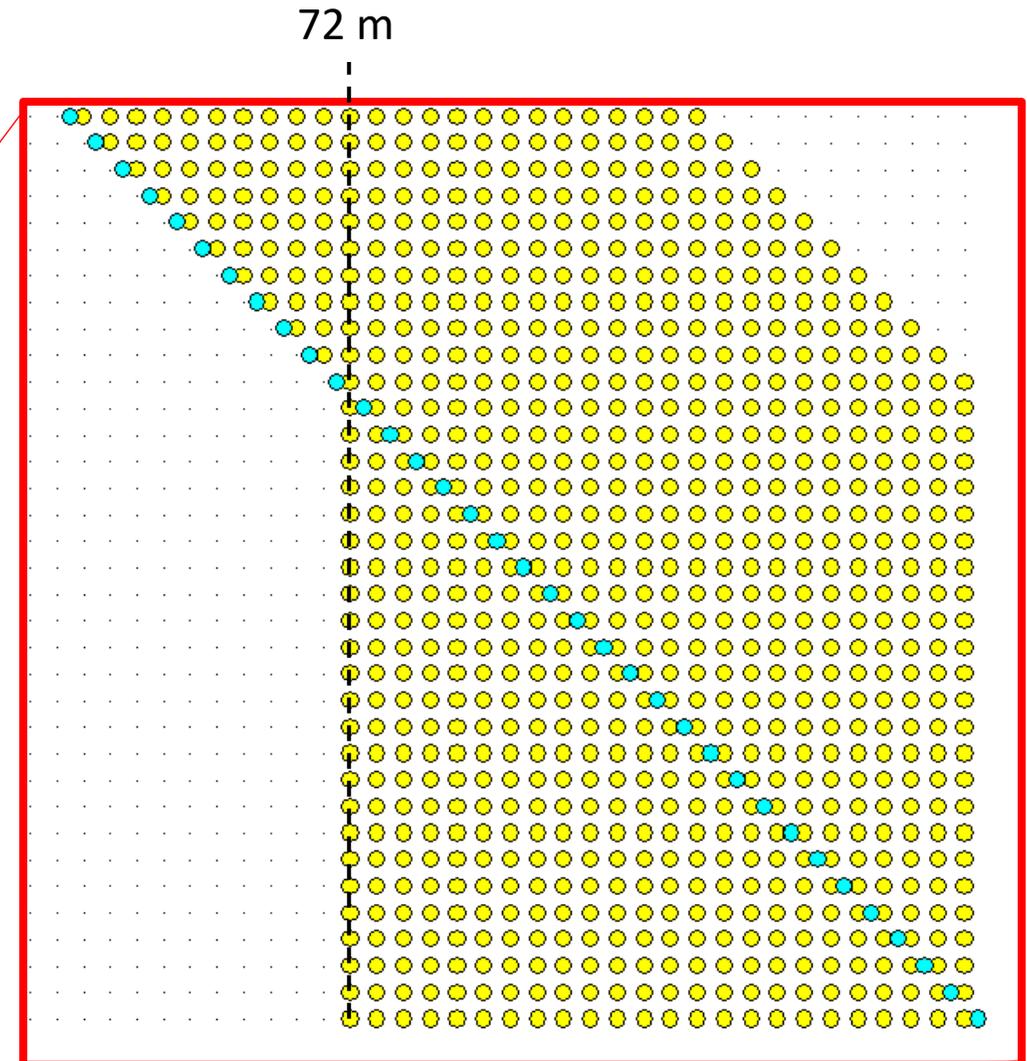


Manually set up acquisition geometry

Source and/or receiver location can be edited manually.



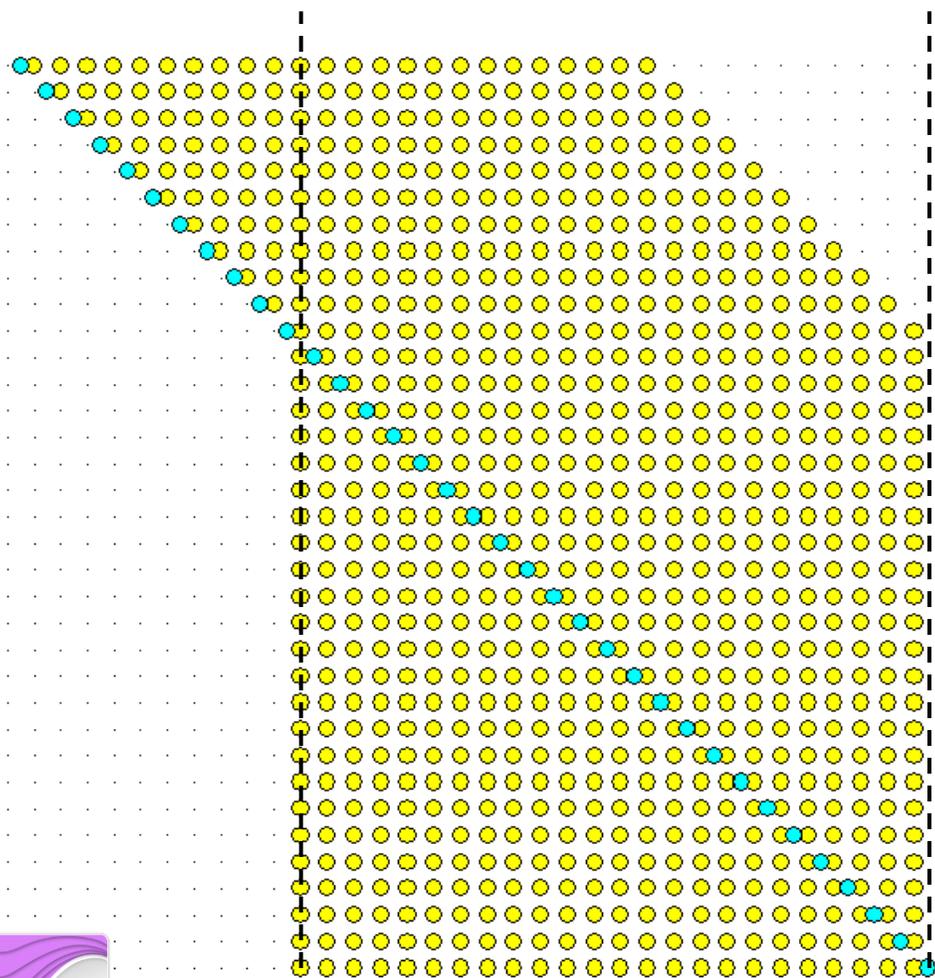
Receiver spreads were fixed after the shot of 71.5 m.



Manually set up acquisition geometry

72 m

95.5 m



File list

| Index | Edit | ID | Source (m) | 1st receiver (m) | Receiver int. (m) | # of aux. |
|-------|--------------------------|----|------------|------------------|-------------------|-----------|
| 70 | <input type="checkbox"/> | 71 | 69.5 | 70 | 1 | 1 |
| 71 | <input type="checkbox"/> | 72 | | | | |
| 72 | <input type="checkbox"/> | 73 | | | | |
| 73 | <input type="checkbox"/> | 74 | 72.5 | 72 | 1 | 1 |
| 74 | <input type="checkbox"/> | 75 | 73.5 | 72 | 1 | 1 |
| 75 | <input type="checkbox"/> | 76 | 74.5 | 72 | 1 | 1 |
| 76 | <input type="checkbox"/> | 77 | 75.5 | 72 | 1 | 1 |
| 77 | <input type="checkbox"/> | 78 | 76.5 | 72 | 1 | 1 |
| 78 | <input type="checkbox"/> | 79 | 77.5 | 72 | 1 | 1 |
| 79 | <input type="checkbox"/> | 80 | 78.5 | 72 | 1 | 1 |

Apply source coordinates from file header Active data
 Apply receiver coordinates from file header Passive data

Buttons: OK, Cancel, Next, Back, Set up, Set # of aux., Delete, Export, Import

Number of files: 97

Change 1st receiver distance

Use "Next" and "Back" to scroll shots

File list

| Index | Edit | ID | Source (m) | 1st receiver (m) | Receiver int. (m) | # of aux. |
|-------|--------------------------|----|------------|------------------|-------------------|-----------|
| 87 | <input type="checkbox"/> | 88 | 86.5 | 72 | 1 | 1 |
| 88 | <input type="checkbox"/> | 89 | 87.5 | 72 | 1 | 1 |
| 89 | <input type="checkbox"/> | 90 | 88.5 | 72 | 1 | 1 |
| 90 | <input type="checkbox"/> | 91 | 89.5 | 72 | 1 | 1 |
| 91 | <input type="checkbox"/> | 92 | 90.5 | 72 | 1 | 1 |
| 92 | <input type="checkbox"/> | 93 | 91.5 | 72 | 1 | 1 |
| 93 | <input type="checkbox"/> | 94 | 92.5 | 72 | 1 | 1 |
| 94 | <input type="checkbox"/> | 95 | 93.5 | 72 | 1 | 1 |
| 95 | <input type="checkbox"/> | 96 | 94.5 | 72 | 1 | 1 |
| 96 | <input type="checkbox"/> | 97 | 95.5 | 72 | 1 | 1 |

Apply source coordinates from file header Active data
 Apply receiver coordinates from file header Passive data

Buttons: Cancel, Next, Back, Set up, Set # of aux., Delete, Export, Import

Number of files: 97



Set up Geometry

Select "File", "Group (File list)", "Set up geometry"

The screenshot shows the Pickwin software interface. The 'File' menu is open, and the 'Group (File list) (G)' option is selected. A sub-menu is displayed, listing various file operations. The 'Set up geometry' option is highlighted at the bottom of this sub-menu. The background shows a seismic data plot with a time axis labeled 'Time (ms)' ranging from 400 to 700.

FileList.xml - Pickwin

File Edit/Display View Pick first arrivals Downhole seismic analysis Surface wave analysis Processing (A) Op

Open waveform (SEG2) file(O)... Ctrl+O

Save waveform (SEG2) file(S)... Ctrl+S

Save waveform (SEG2) file as(A)...

Open SEG2 file (SmartSeis)

Open McSeis-3 file

Open OYO 160MX (SEG1) file

Open synthetic waveform (.8hd) file

Open pick file

Save pick file

Print window display (P)... Ctrl+P

Print preview (V)

Page setup (R)...

Group (File list) (G)

Options

1 C:\Koichi\...\sxaa0002_MOD.sg2

2 atom_file_350048_20211028_2359_125182.atm

3 C:\Koichi\...\Midorino acc.sg2

4 C:\Koichi\...\Midorino.sg2

Make file list

Make file list(select a folder)

Open file list

Save file list(text)

Save file list(XML)

Show file list(G) Ctrl+G

Set up geometry

The sequence of dialog boxes shows the following steps:

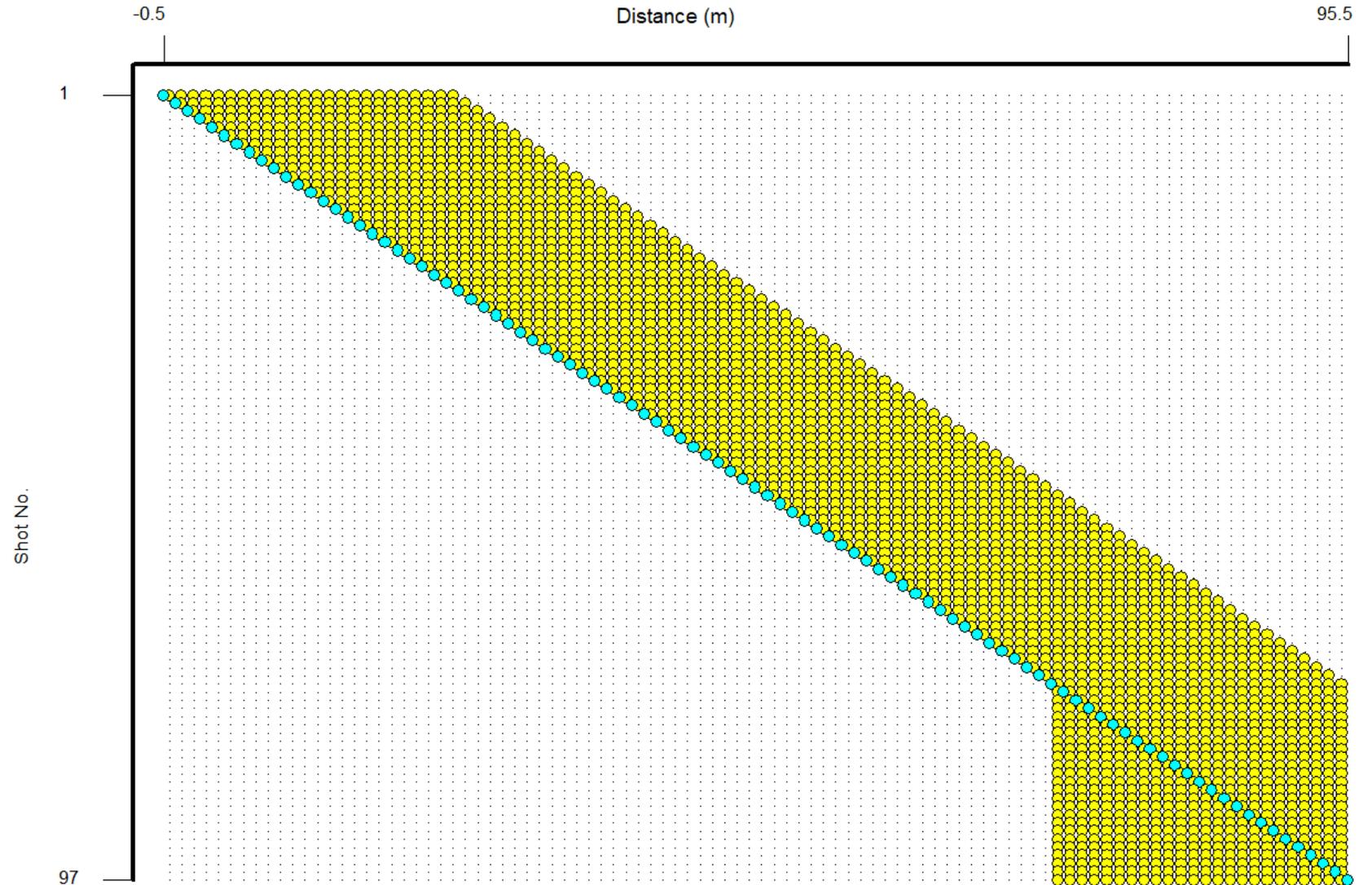
- Dialog 1:** Displays a warning icon and the text: "No. of sources = 97", "No. of receivers = 96", "No. of CMPs = 192". An "OK" button is at the bottom right.
- Dialog 2:** Displays a warning icon and the text: "Total number of shot gather traces = 2328", "Range of source/receiver geometry = -0.5 to 95.5 m". An "OK" button is at the bottom right.
- Dialog 3:** Displays a warning icon and the text: "Input waveform data?". It has "OK" and "Cancel" buttons. The "OK" button is highlighted with a red rectangle.
- Dialog 4:** Displays a warning icon and the text: "2328 of 2328 shot gather traces input". An "OK" button is at the bottom right.

Purple arrows indicate the flow from one dialog box to the next. The text "Select 'OK'" is placed to the right of the third dialog box.



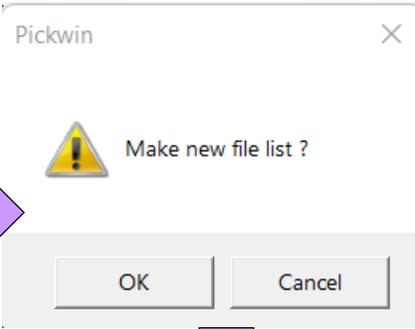
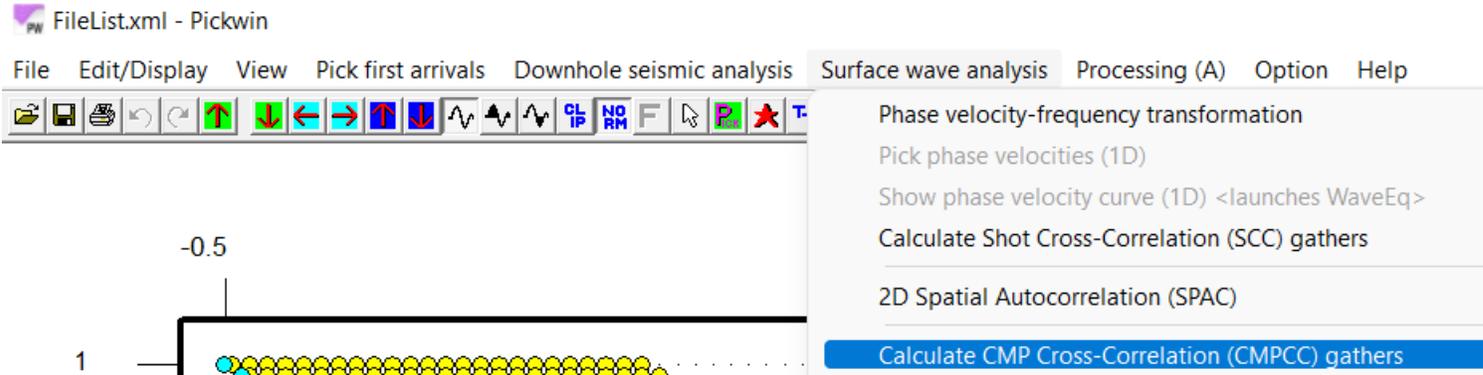
Set up Geometry

Confirm acquisition geometry



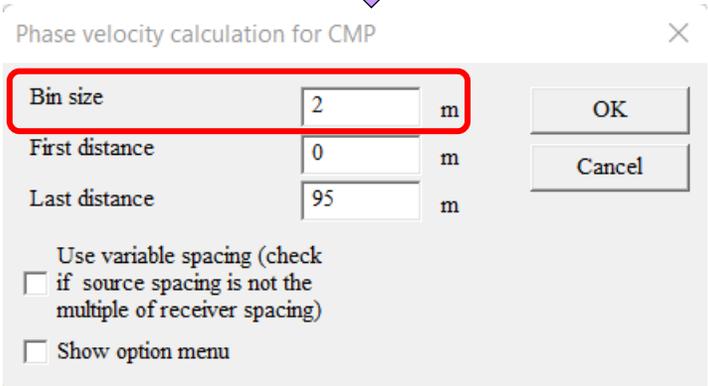
Calculate CMP Cross-Correlation (CMPCC) gathers

Select "Surface wave analysis", "Calculate CMP Cross-Correlation (CMPCC) gathers"



Click "OK"

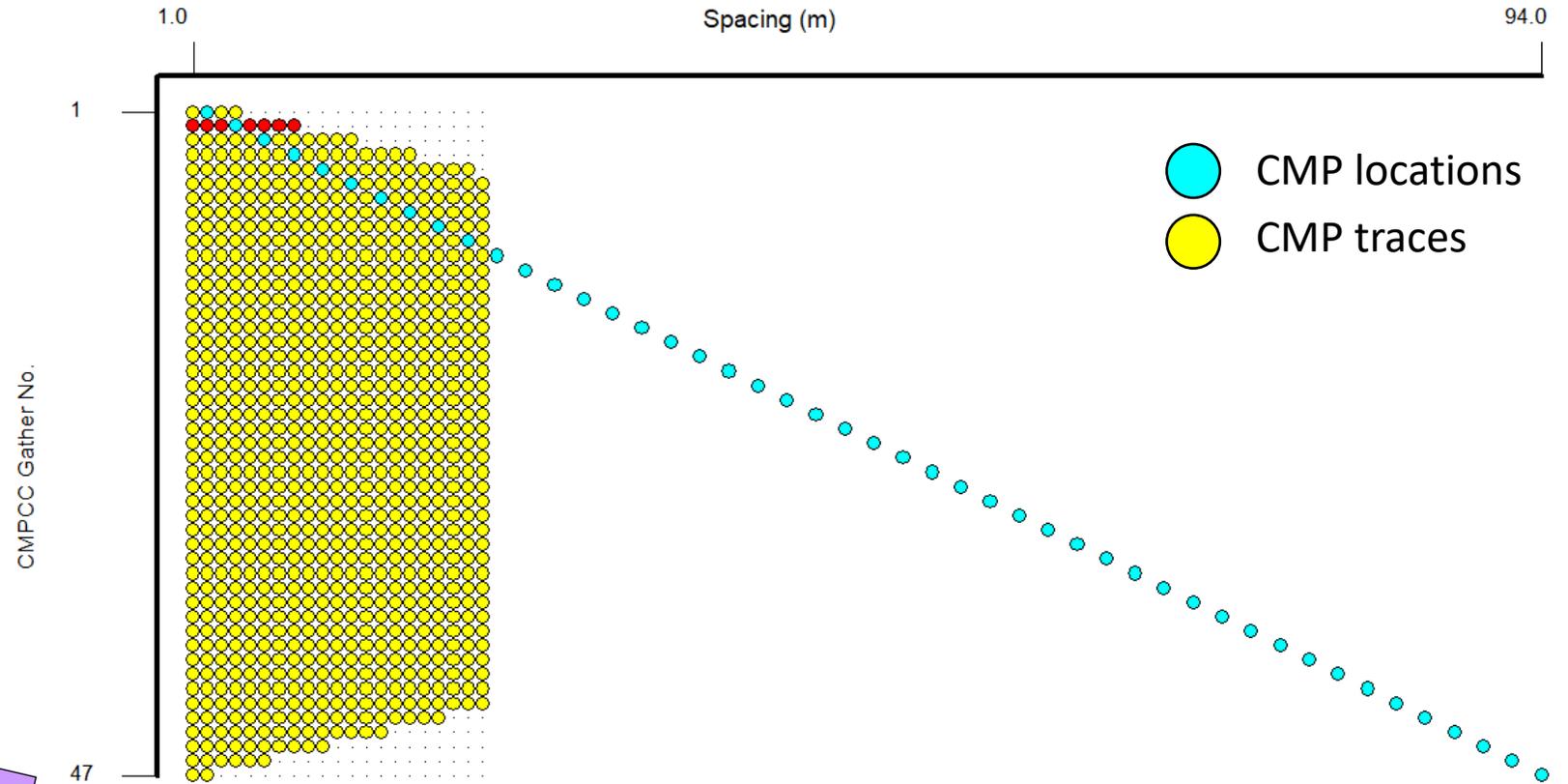
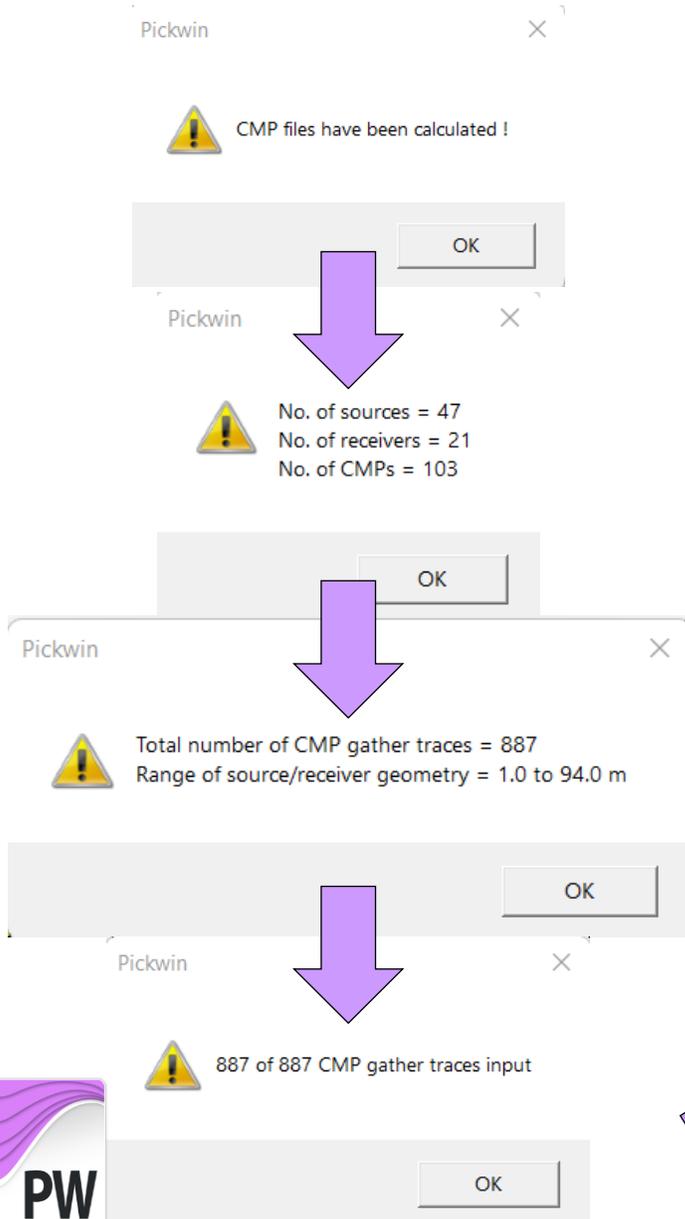
The bin size is interval of CMPCC gathers.
Default value is set to the double of receiver spacing.



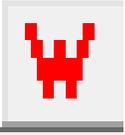
Click "OK"



Calculate CMP Cross-Correlation (CMPCC) gathers

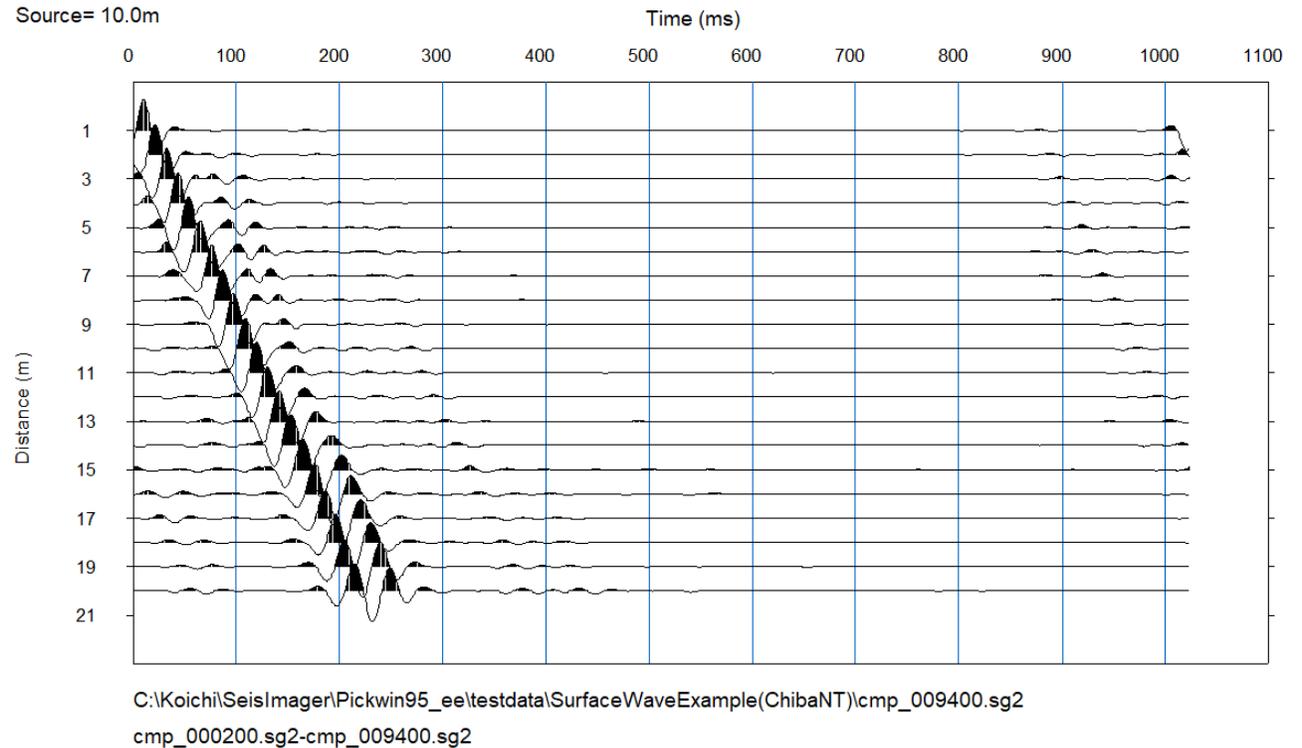
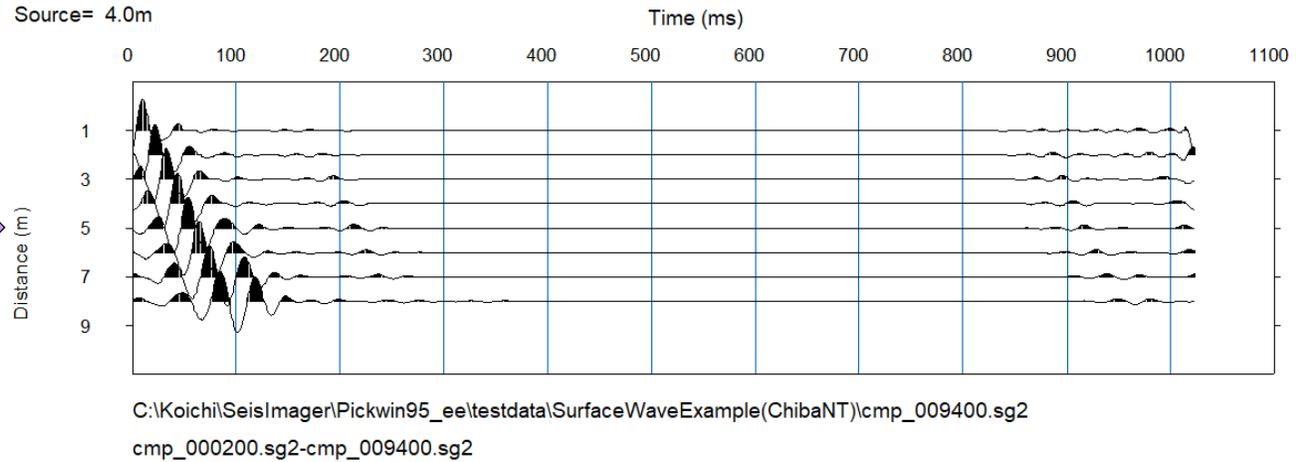


Examine CMP Cross-Correlation (CMPCC) gathers (not required)

Click  to show CMPCC traces

Click  to show CMPCC geometry

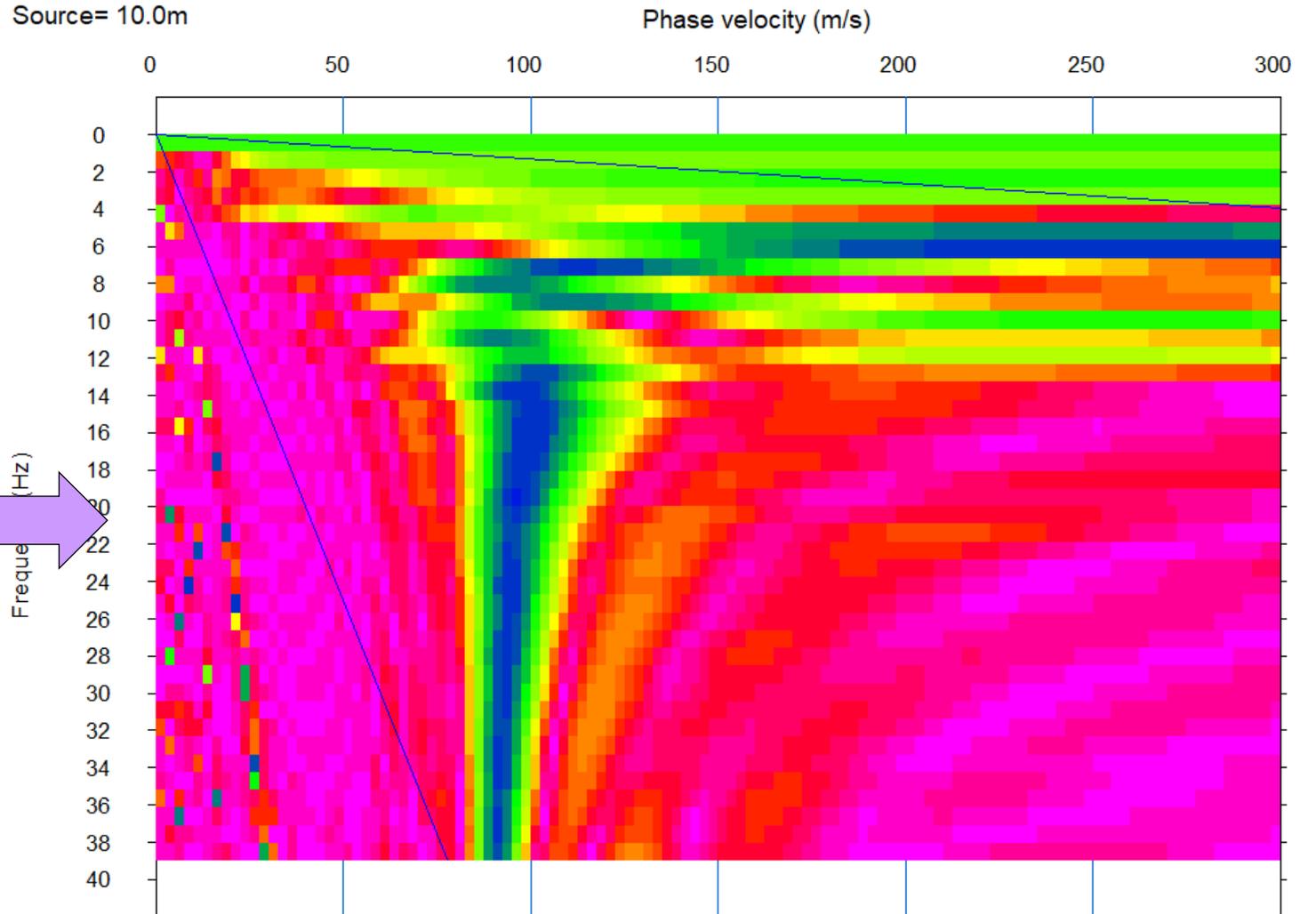
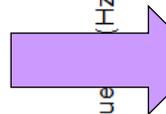
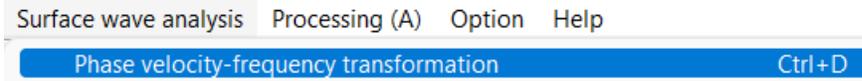
Use  to scroll CMPCC gathers



Examine CMP Cross-Correlation (CMPCC) gathers

It is strongly recommended to take a look several phase velocity images to decide phase velocity and frequency ranges, and minimum frequency to pick phase velocity before picking dispersion curves

Select "Surface wave analysis", "Phase velocity-frequency transformation" or press "Ctrl+D" to show a phase velocity image for each CMPCC gather.

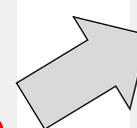
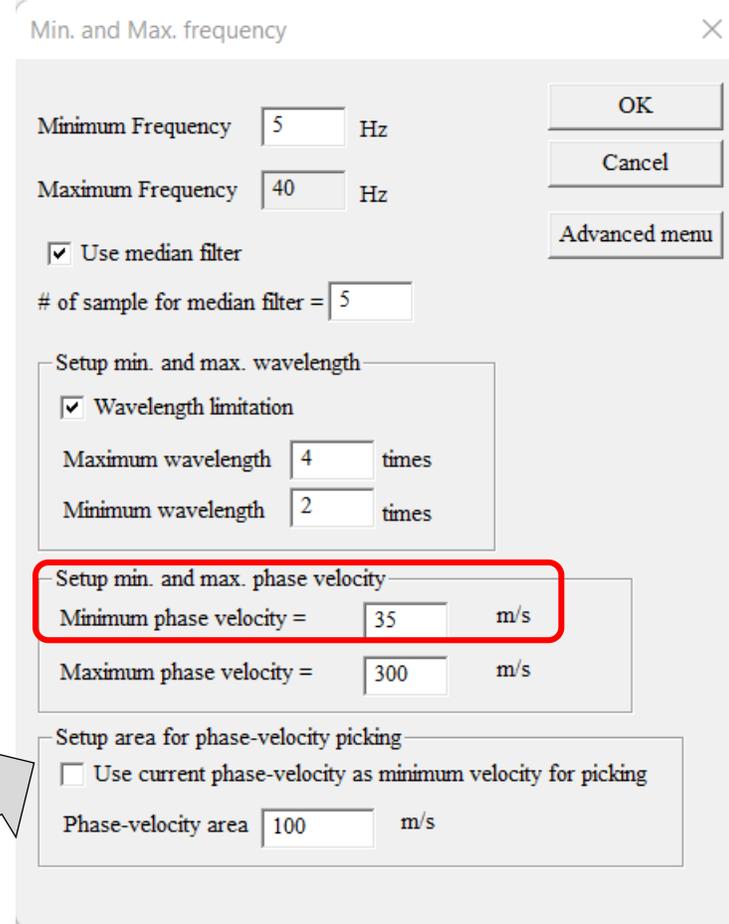
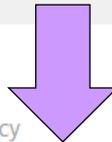
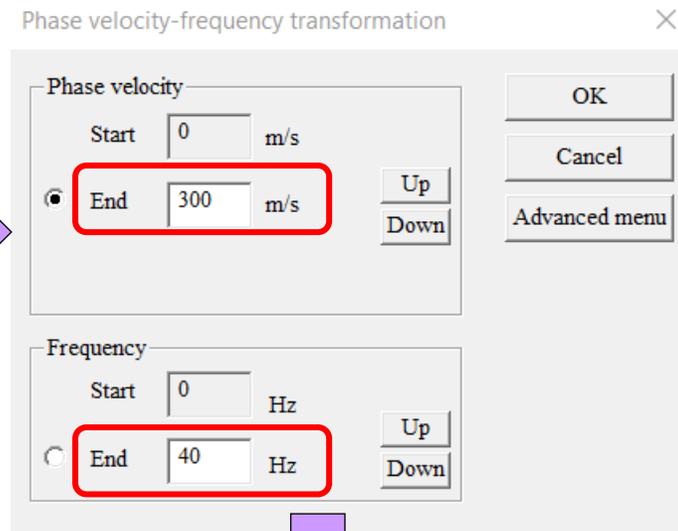
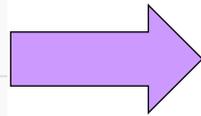
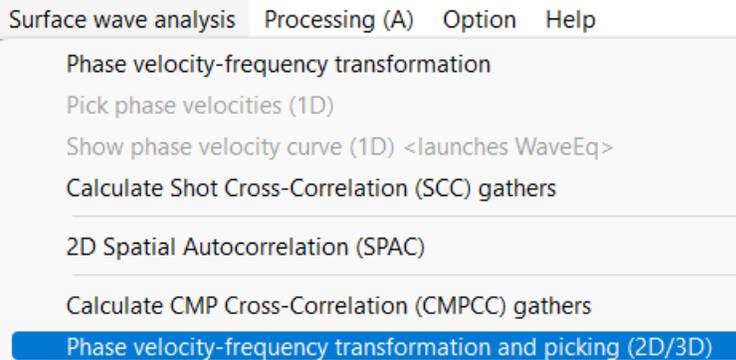


Calculate phase velocity images and pick dispersion curves for all CMPCC gathers

Select “Surface wave analysis”, “Phase velocity-frequency transformation and picking (2D/3D)”

Set up phase velocity and frequency range based on phase velocity image shown in previous page.

It is sometimes better to change “Minimum phase velocity”. Click “Advanced menu” to change it.

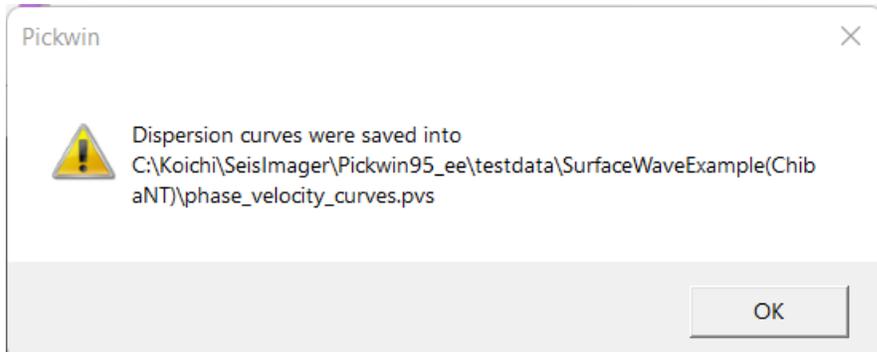


Change minimum frequency to pick dispersion curves based on the phase velocity image.

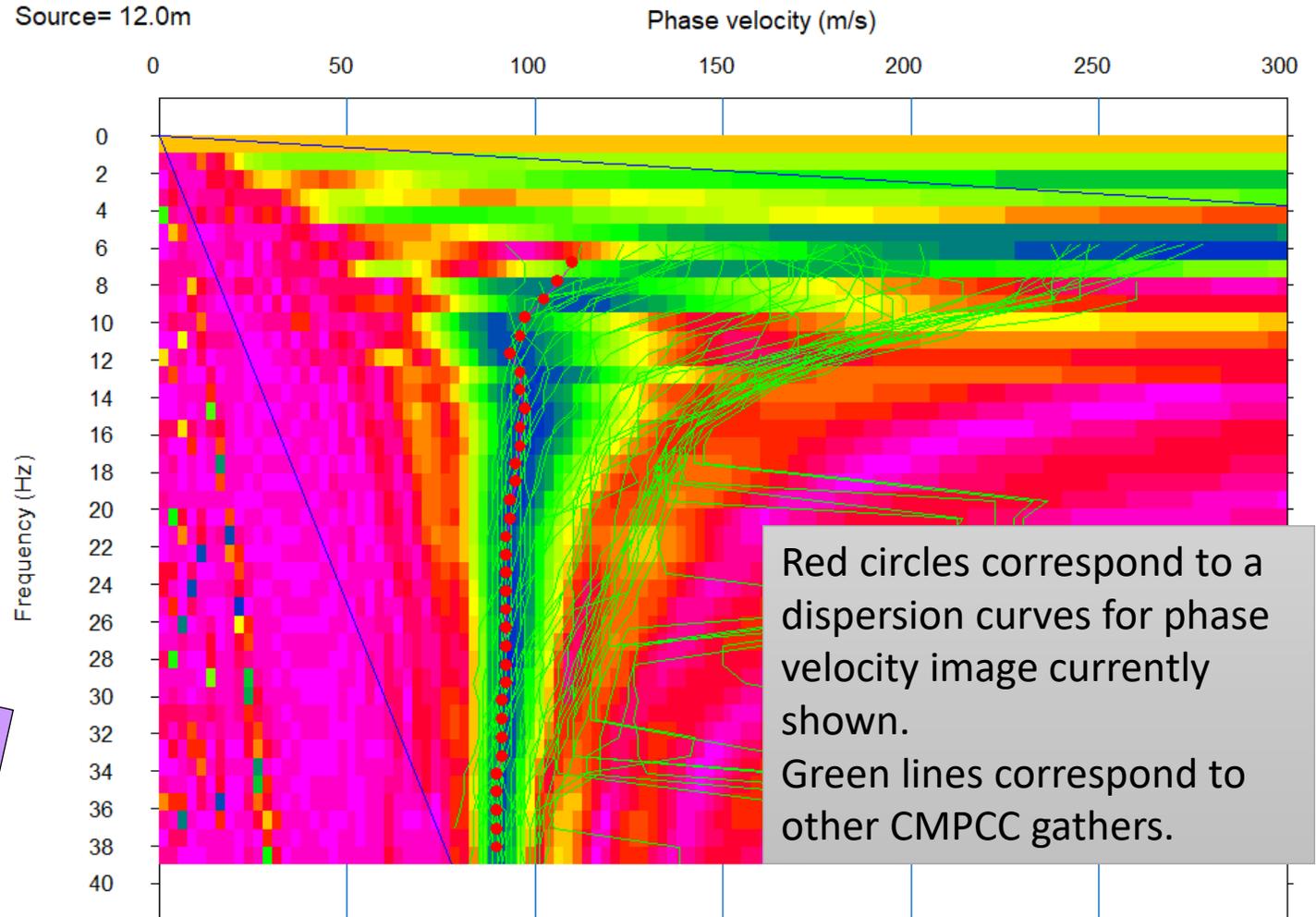
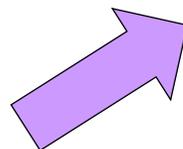
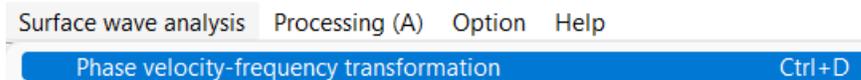


Calculate phase velocity images and pick dispersion curves for all CMPCC gathers

Picked dispersion curves were automatically saved in a .pvs file.



It is strongly recommended to take a look several phase velocity images. Select "Surface wave analysis", "Phase velocity-frequency transformation" or press "Ctrl+D" to show picked dispersion curves on a phase velocity image for each CMPCC gather.

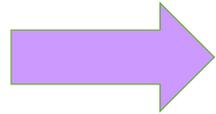
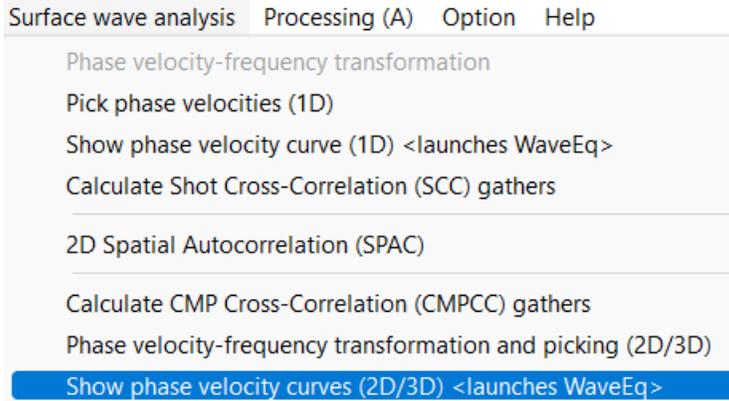


Red circles correspond to a dispersion curves for phase velocity image currently shown.
Green lines correspond to other CMPCC gathers.



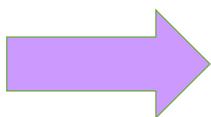
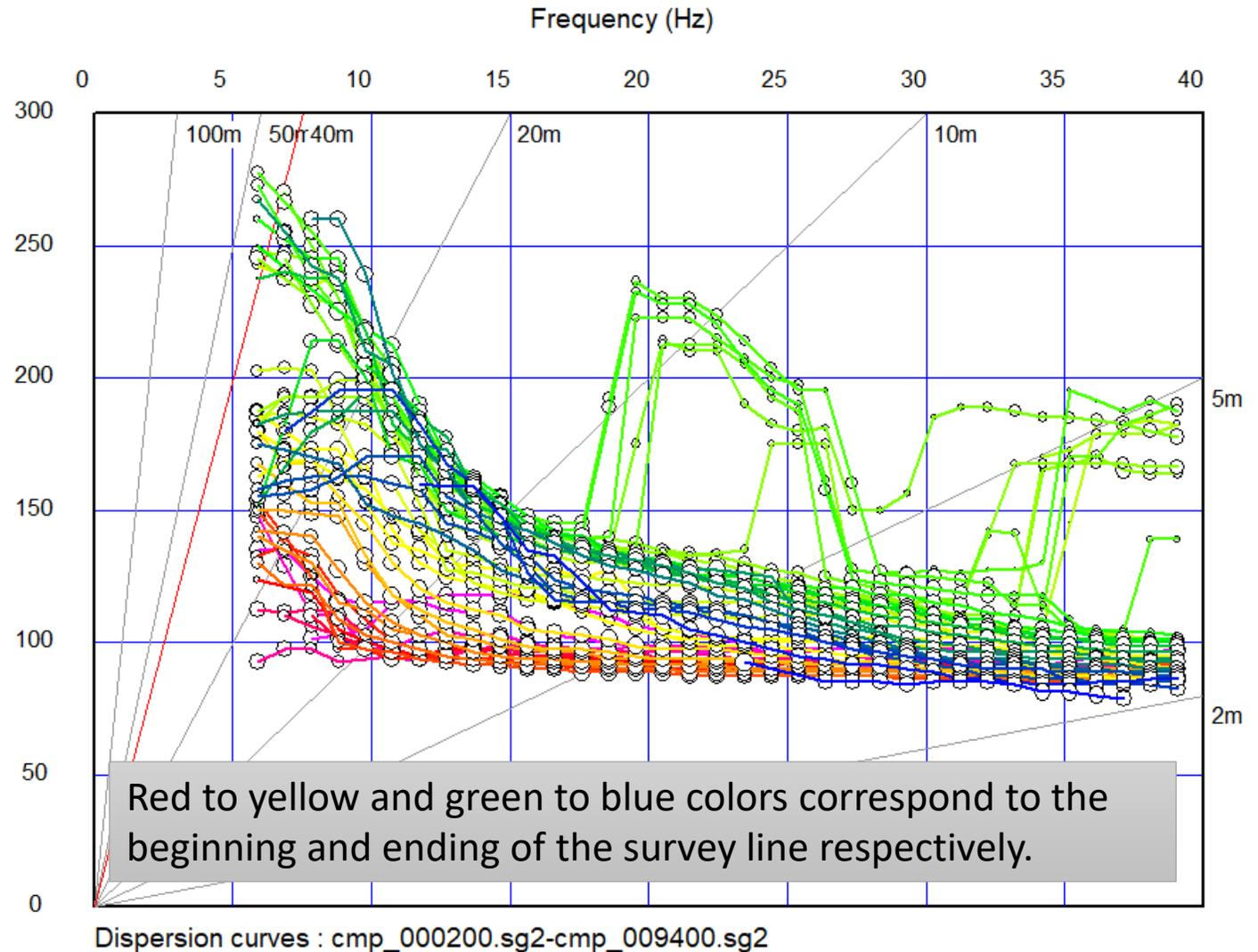
Show dispersion curves by WaveEq

Select “Surface wave analysis”, “Show Phase velocity curves (2D/3D)”.



Phase velocity (m/s)

WaveEq is automatically launched and phase velocity curves appears.



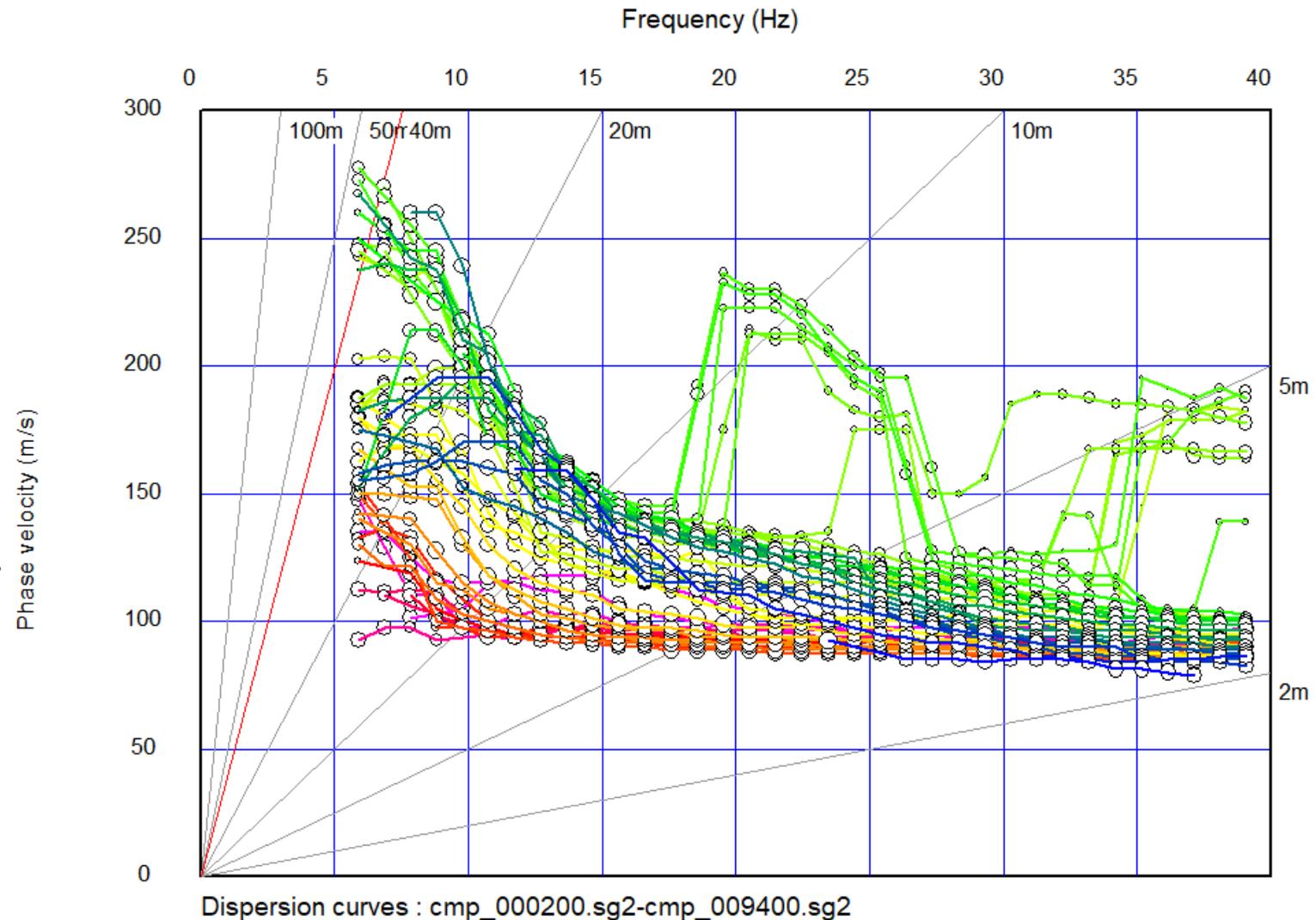
Show dispersion curves by WaveEq

Delete noises or unnecessary phase velocities like 1D processing.

Use  to scroll dispersion curves.

Use  to change how many dispersion curves are shown.

Use  to single and multi phase velocities.



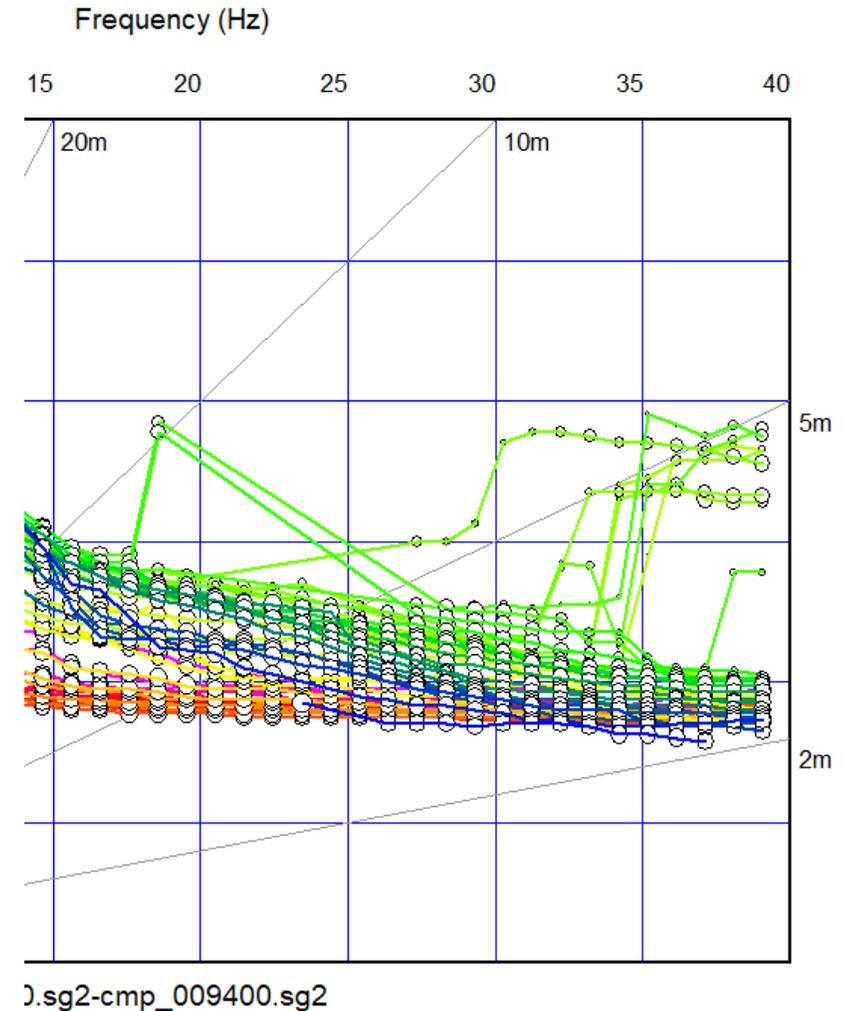
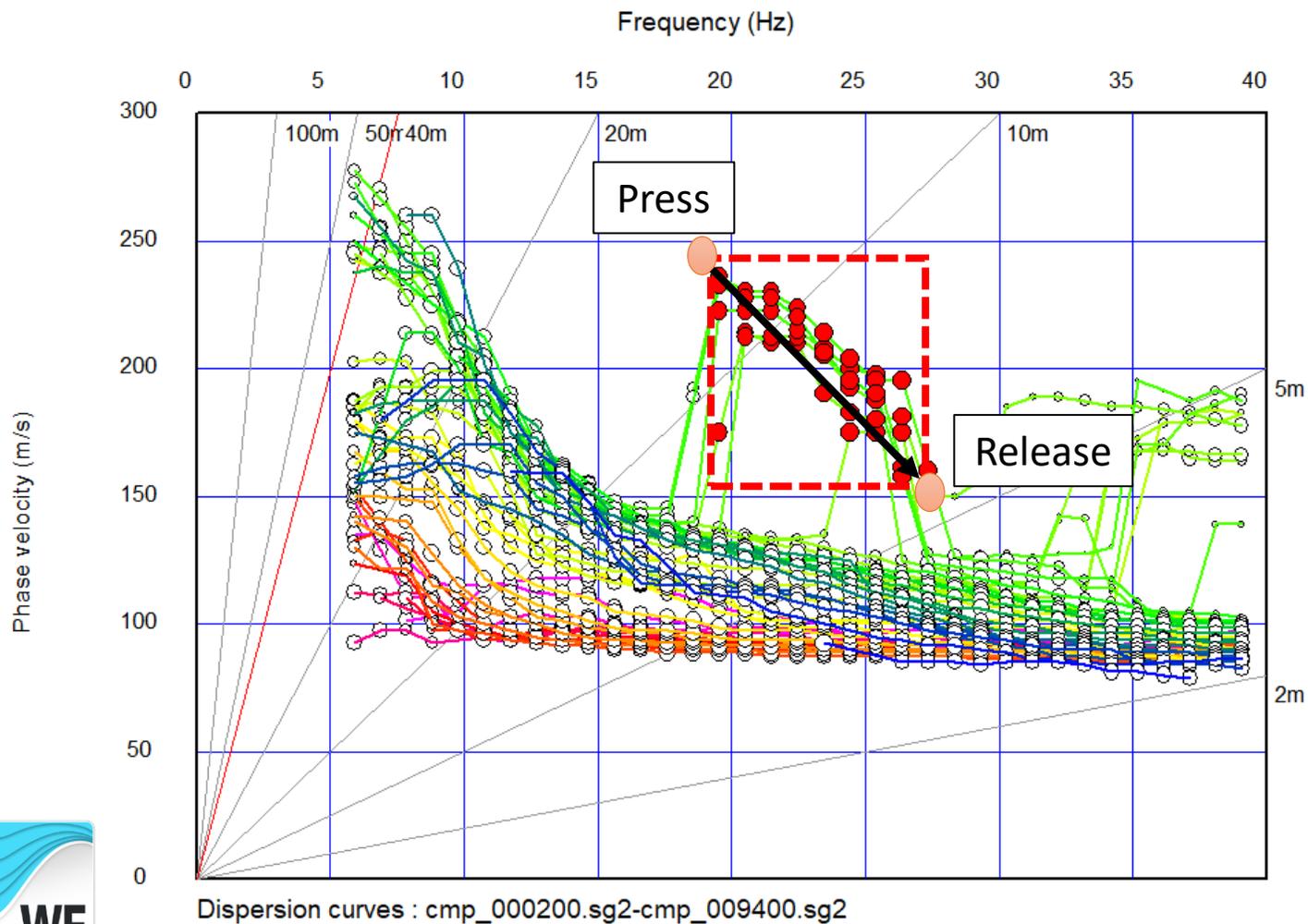
Edit dispersion curves

Click

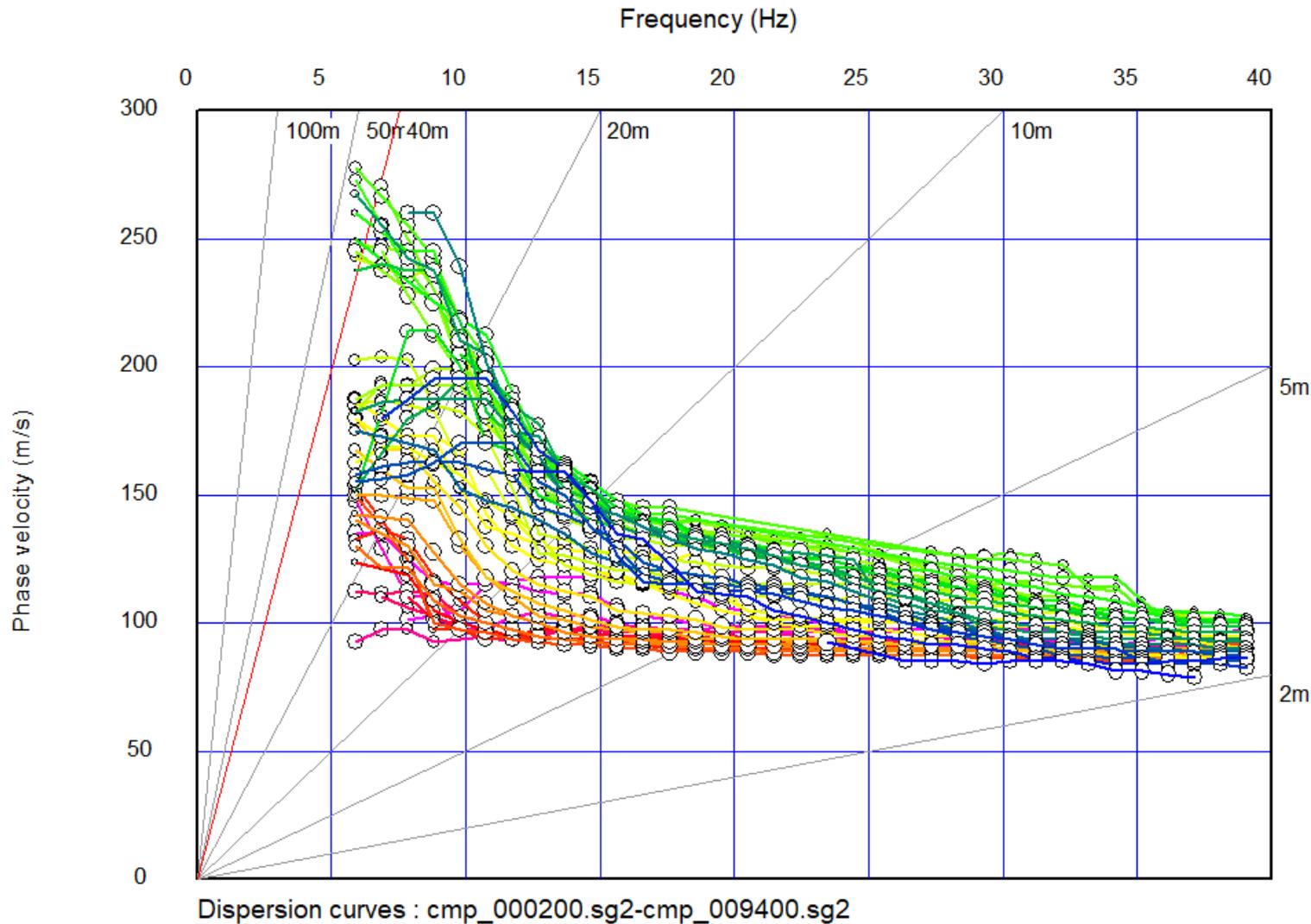


to select multi-phase velocities.

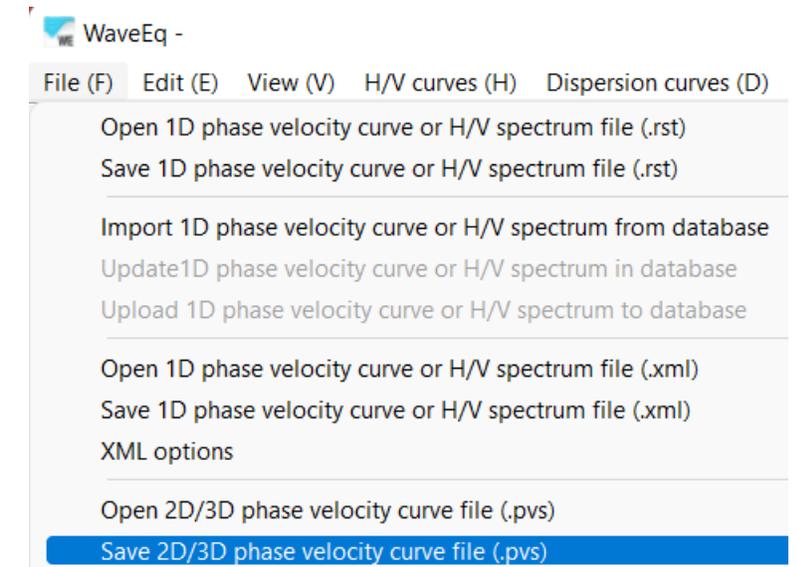
Hit "Delete" key to delete selected phase velocities.



Edit dispersion curves

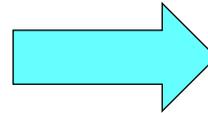
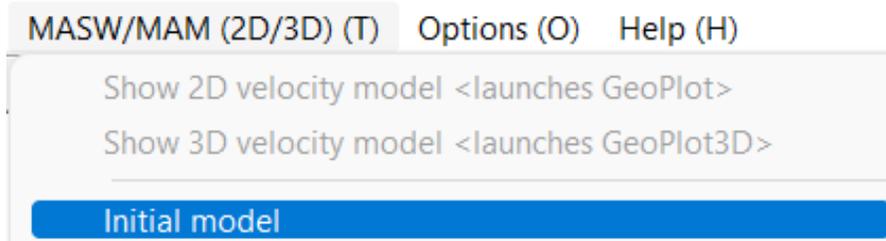


Select “File”, “Save 2D/3D phase velocity curve” to export all dispersion curves to an ASCII file (.pvs).

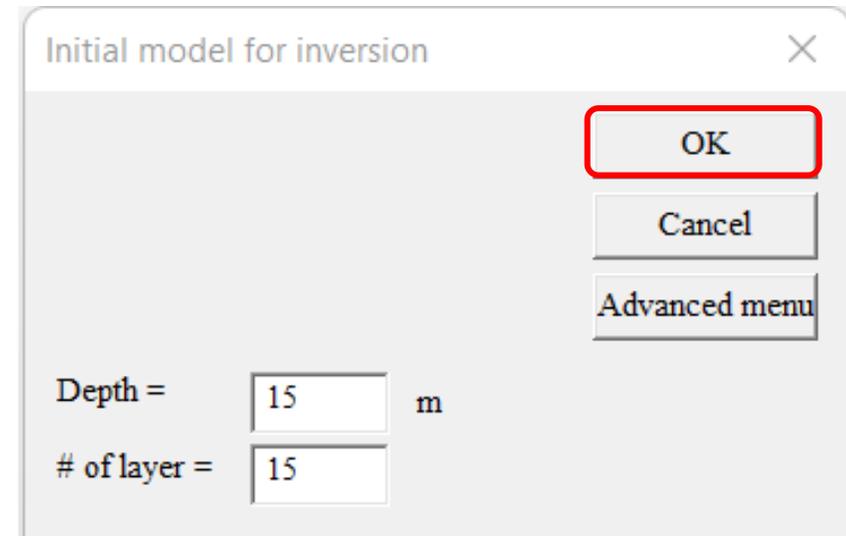


Create an initial velocity model

Select “MASW/MAM (2D/3D)”, “Initial model” to create an initial velocity model.



Set depth and the number of layers of model and click “OK”.

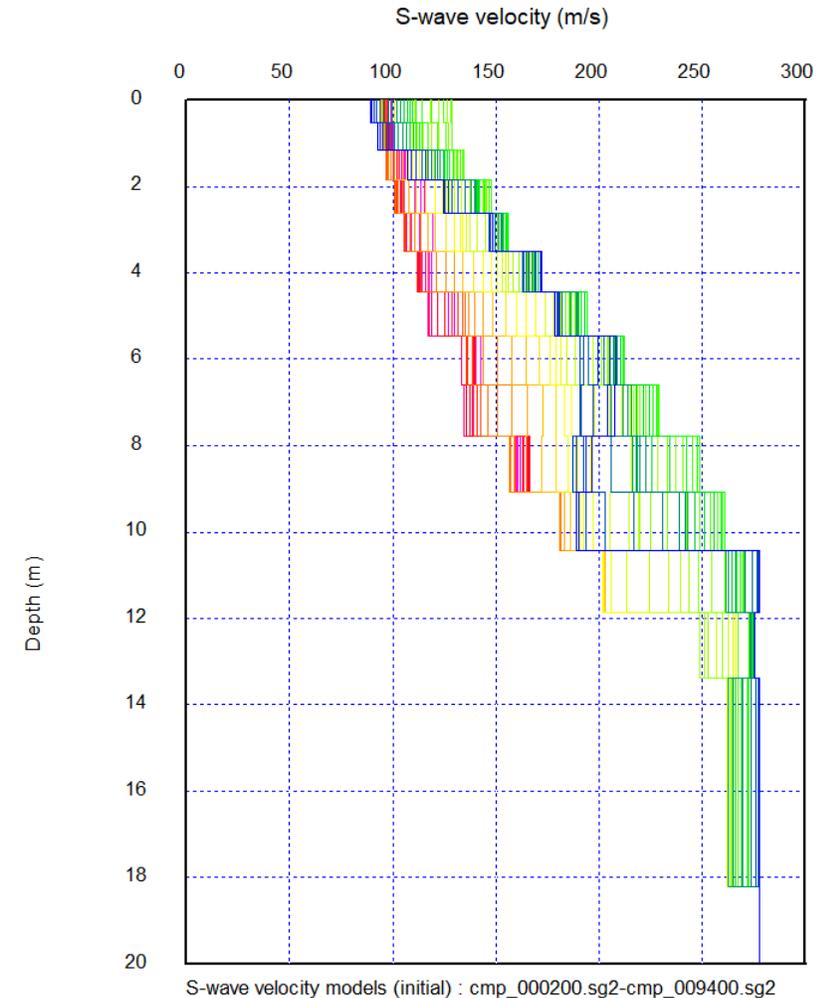
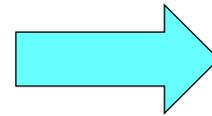
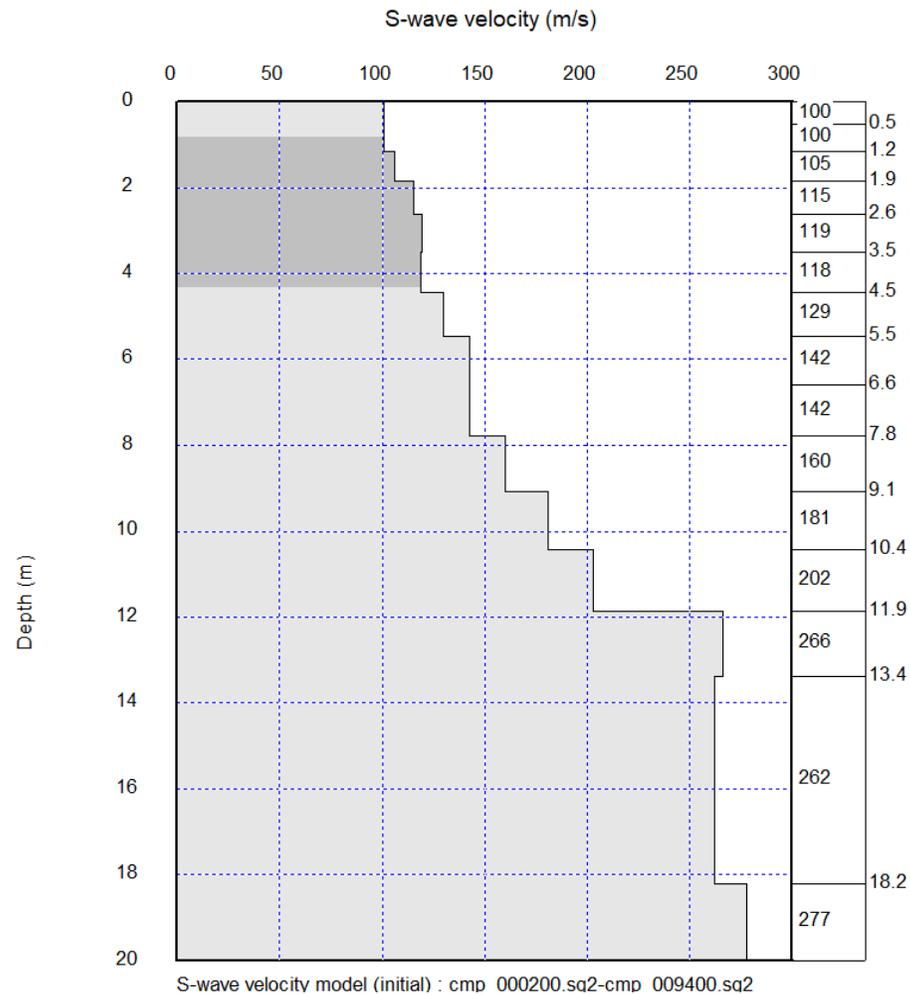


Create an initial velocity model

Initial velocity model appears.

Use  to change how many velocity profiles are shown like dispersion curves.

Index=0 Distance=2.00m

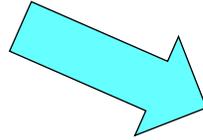


Show 2D velocity model by GeoPlot3D

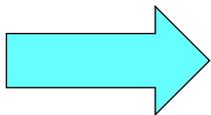
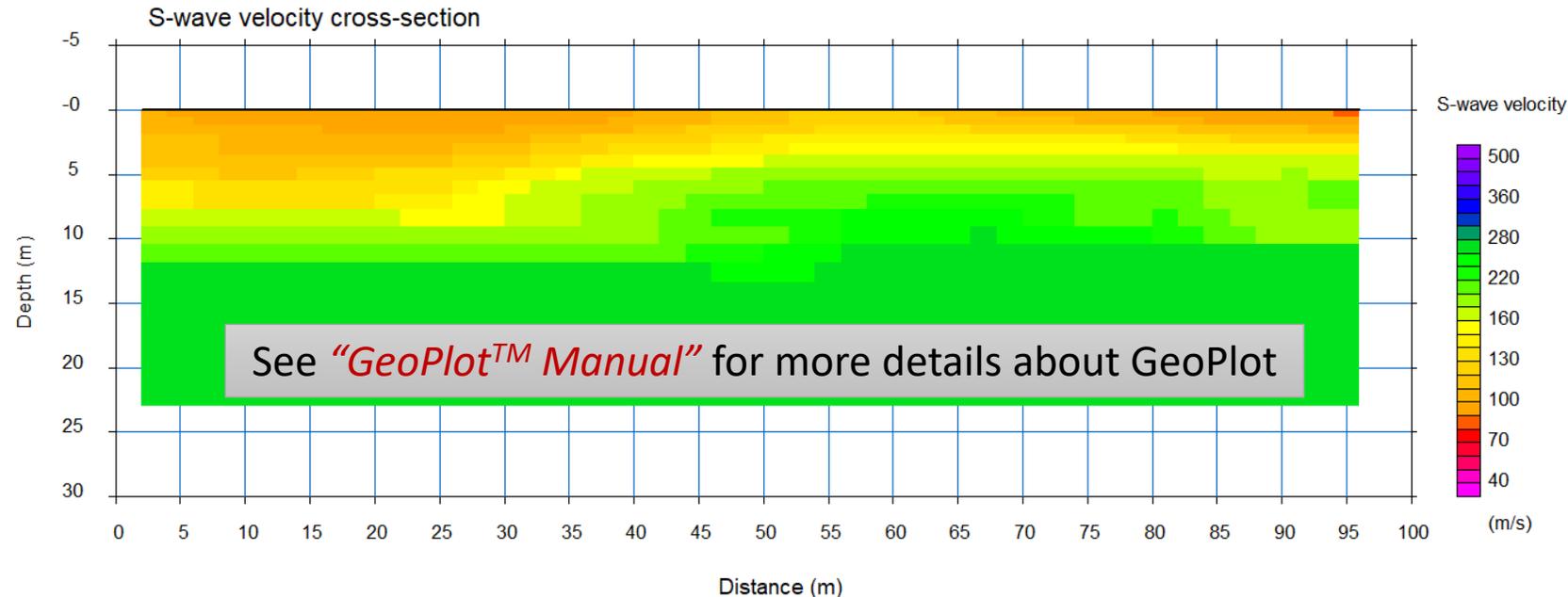
Select “MASW (2D/3D)”, “Show 2D velocity model <launches GeoPlot>”. Note that you can apply inversion before showing 2D velocity model.

MASW/MAM (2D/3D) (T) Options (O) Help (H)

Show 2D velocity model <launches GeoPlot>

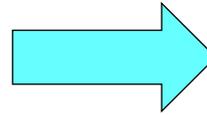
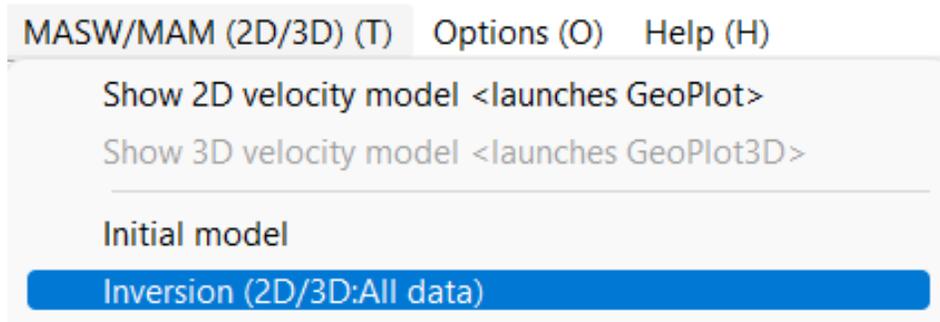


GeoPlot launches and velocity model appears.

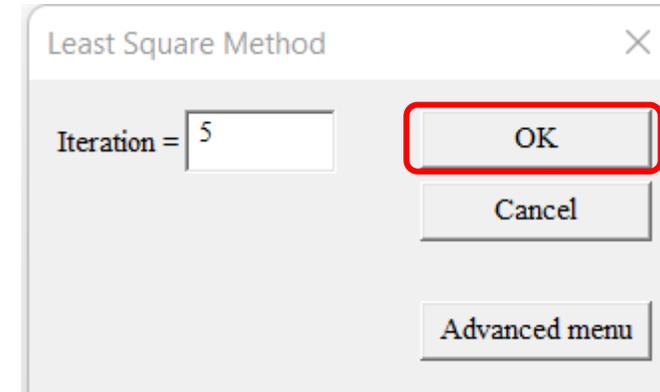


Apply inversion

Select “MASW (2D/3D)”, “Inversion (2D/3D:All data)” to apply inversion to all dispersion curves at once.



Set the number of iteration for inversion and click “OK” to start the inversion.



See *“SeisImager/SW-ProTM Manual”* for more details about various inversion.