SeisImager/2D

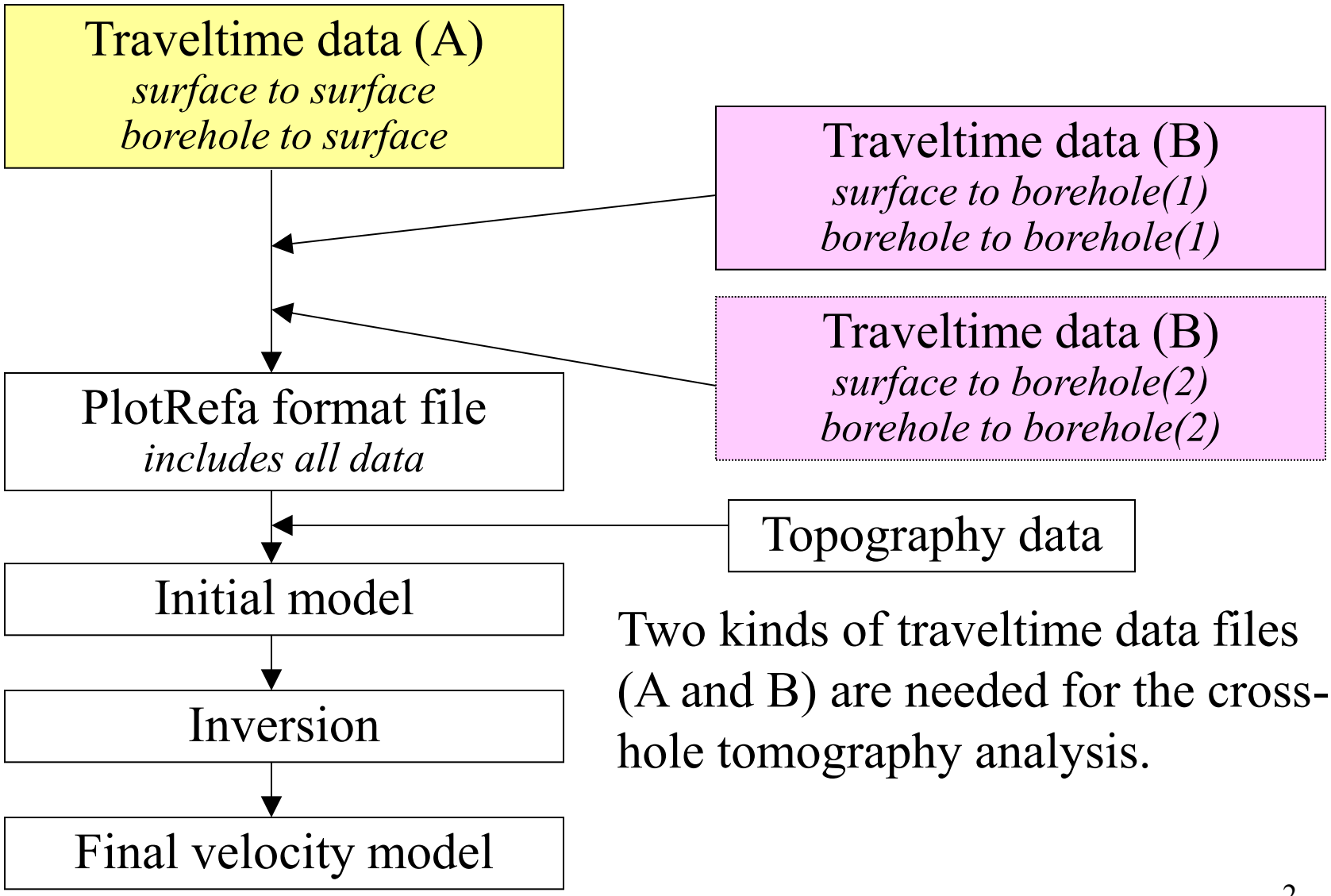
Step 4

PlotRefa Tutorial 3

（Cross-hole tomography analysis）

- Processing flow
- Model used in the tutorial
- Traveltime data file
- Initial model
- Inversion

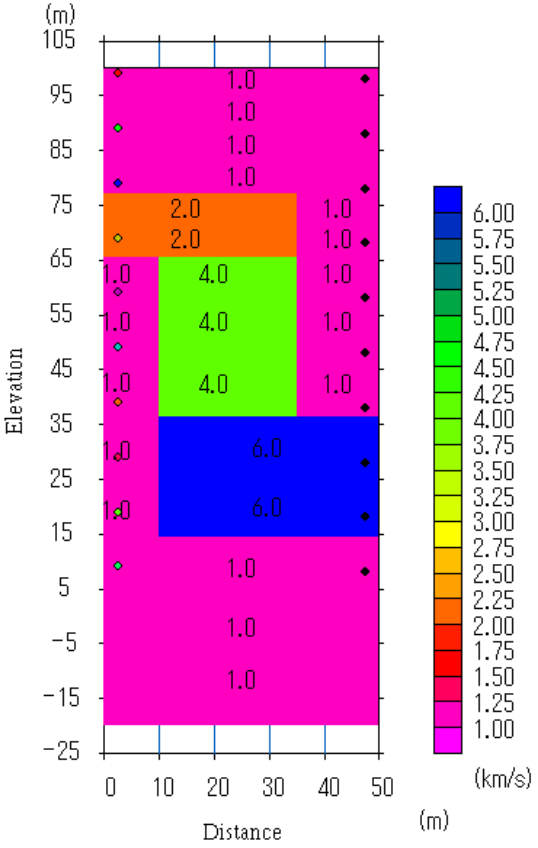
Processing flow



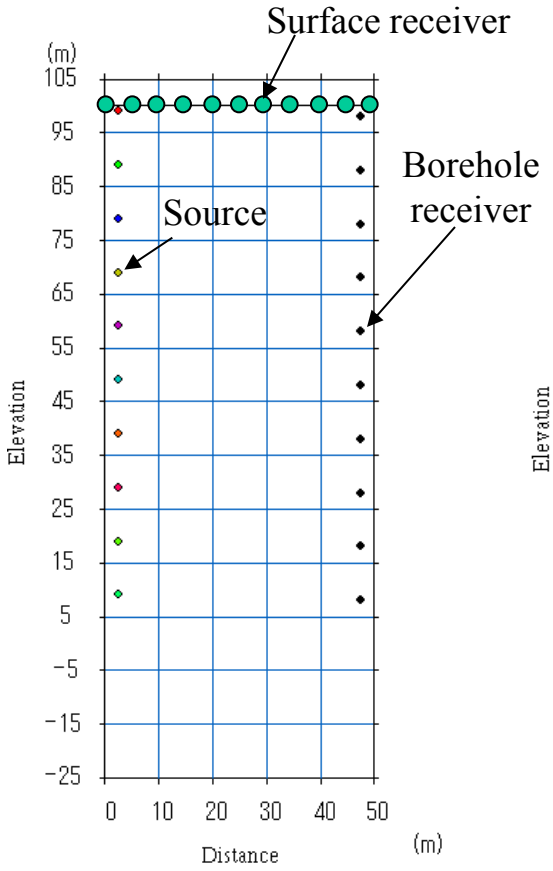
Two kinds of traveltime data files (A and B) are needed for the cross-hole tomography analysis.

Model used in the tutorial

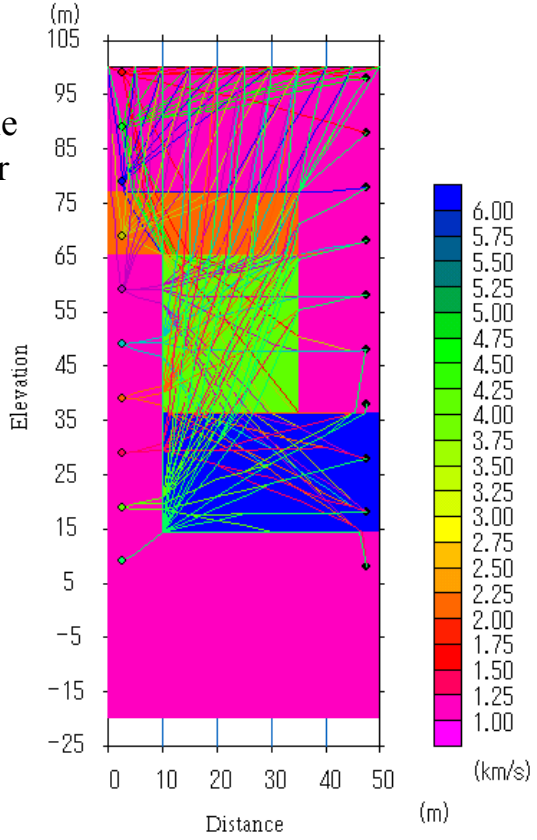
Velocity model



Source-receiver configuration

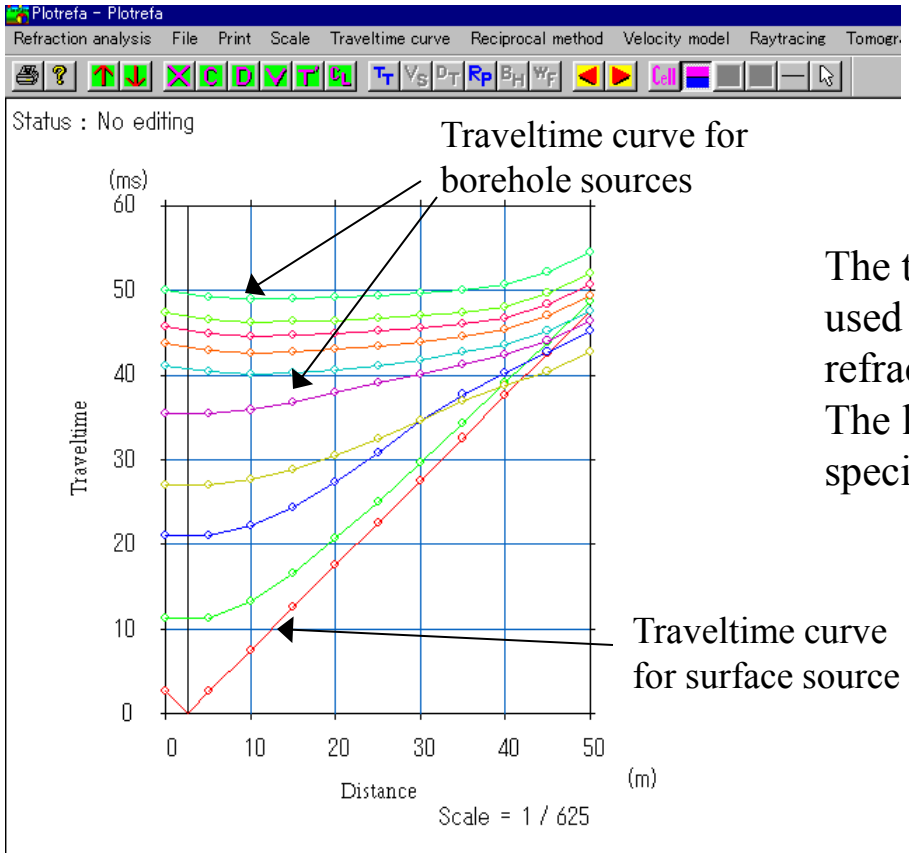


Ray-paths



Traveltime data file (A)

Borehole to surface and surface to surface data

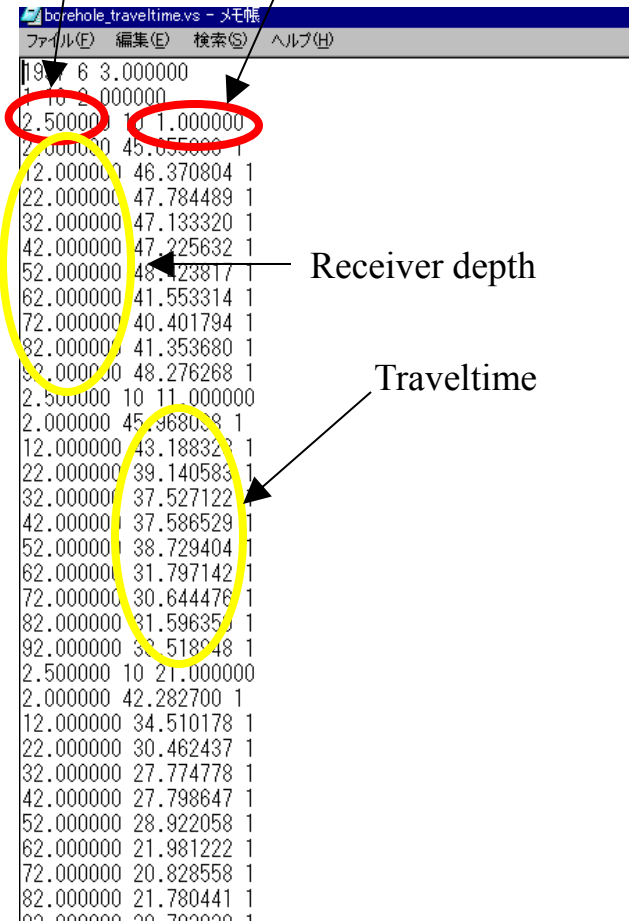


The traveltime data file (A) is the same file used in the normal surface to surface refraction analysis.
The location of sources in boreholes can be specified by the depth of the sources.

Traveltime data file (B)

Borehole to borehole and surface to borehole data

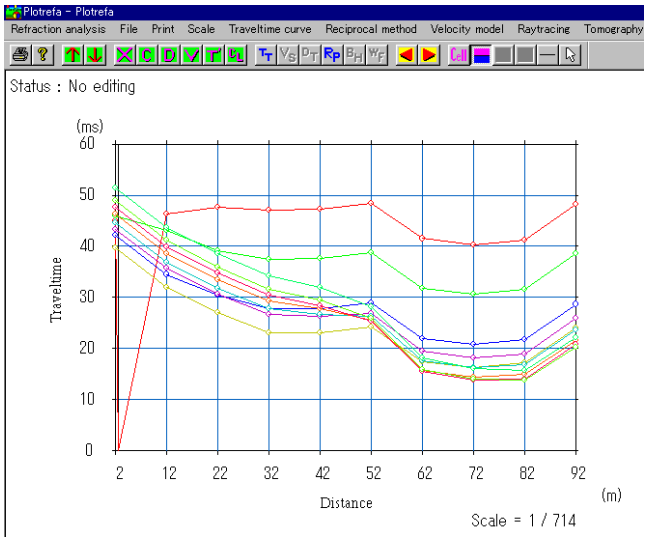
Source distance Source depth



Receiver depth

Traveltime

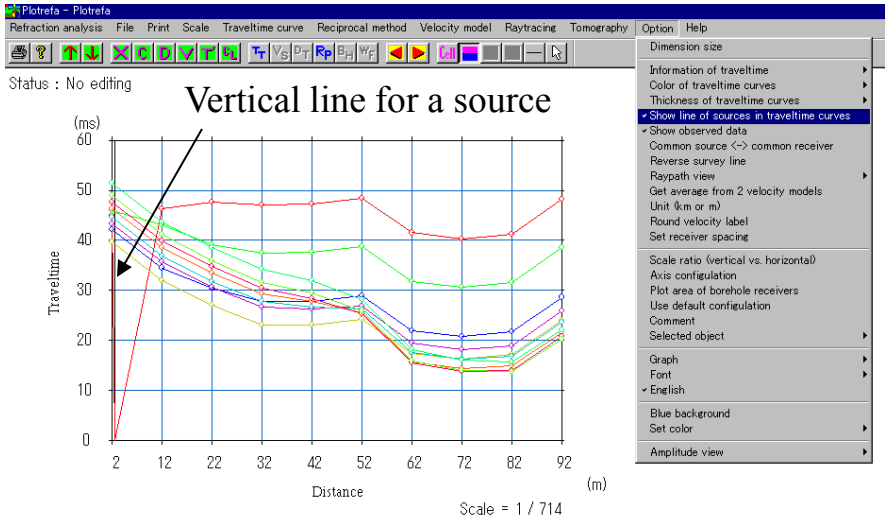
For the receivers in boreholes, other files are needed (the format of the file is same as file (A)). In the file, source location is specified by distance and depth. Receiver location is, however, specified by only depth. The distance of the receiver is identical through the file and will be given later. Therefore, one borehole needs one file.

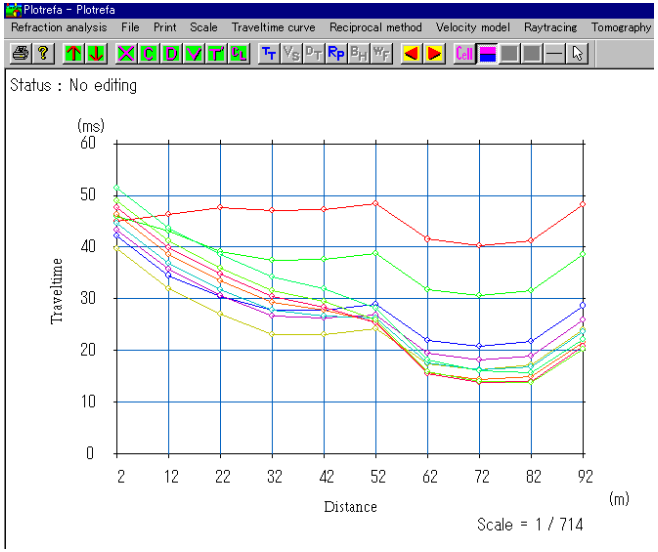


Horizontal axis indicates the depth of receivers !

Traveltime data file (B)

Borehole to borehole and surface to borehole data





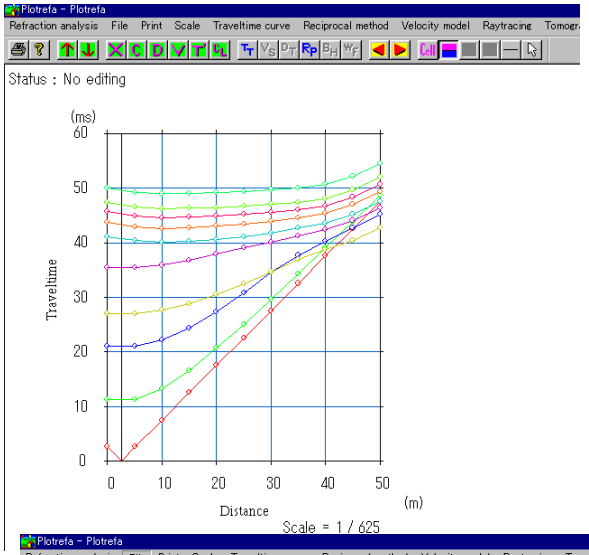
Normally, the vertical line is shown for source location, and traveltime curves goes to zero at the source location. If you handle the borehole receiver, this vertical line for sources can be hidden.

In order to hide the vertical line for source location, select ‘Option’, ‘Shoe line of sources in traveltime curves ’.

Traveltime data file

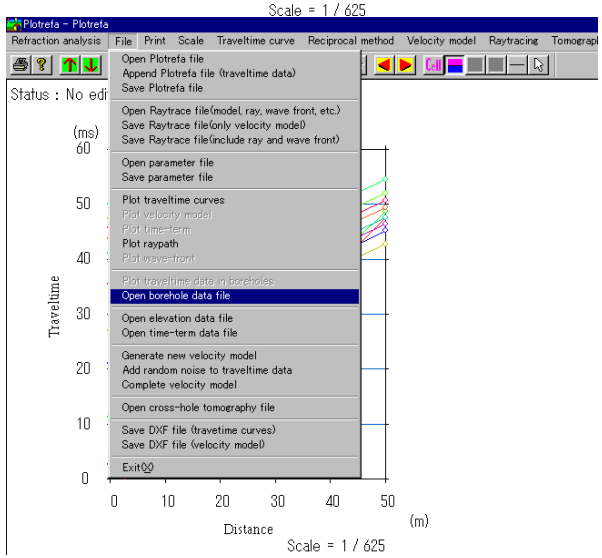
Gather two files

1



Before tomographic inversion, you have to gather two (or more) traveltime data files (A and B files).

2

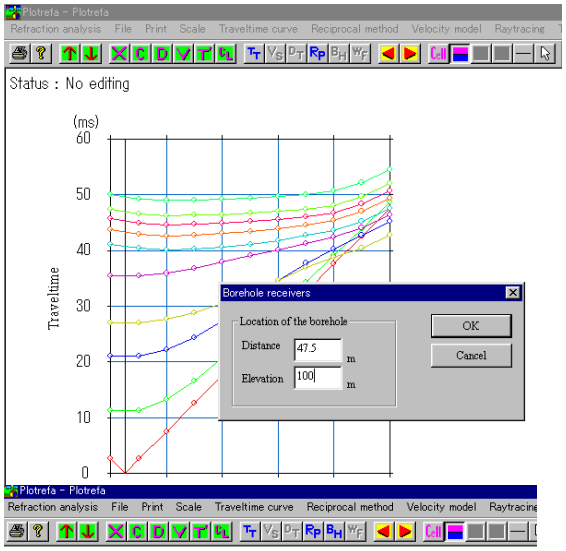


At first, open traveltime data files for Borehole to surface and surface to surface data by ‘File’, ‘Open Plotrefa file’.

Next, open traveltime data files for Borehole to borehole and surface to borehole data by ‘File’, ‘Open borehole data file’.

Traveltime data file
Gather two files

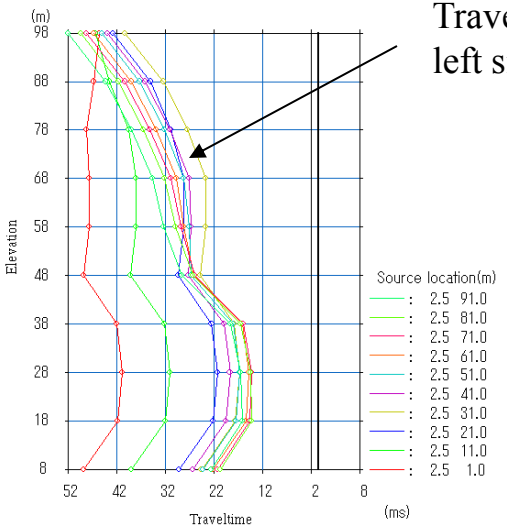
3



Enter the distance and elevation of borehole top in the dialog box.

Traveltime curves are shown. The vertical axis indicates elevation and horizontal axis indicates traveltime.

4



Traveltime curves for the sources placed left side of the borehole.

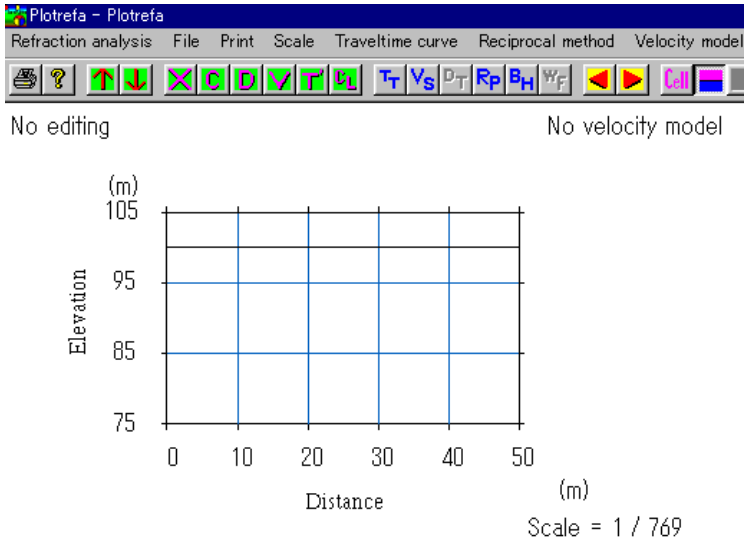
Traveltime curves for the sources placed left side of the borehole are shown in left side and traveltime curves for the sources placed right side of the borehole are shown in right side.

Show traveltime curves for surface receivers

Show traveltime curves for borehole receivers

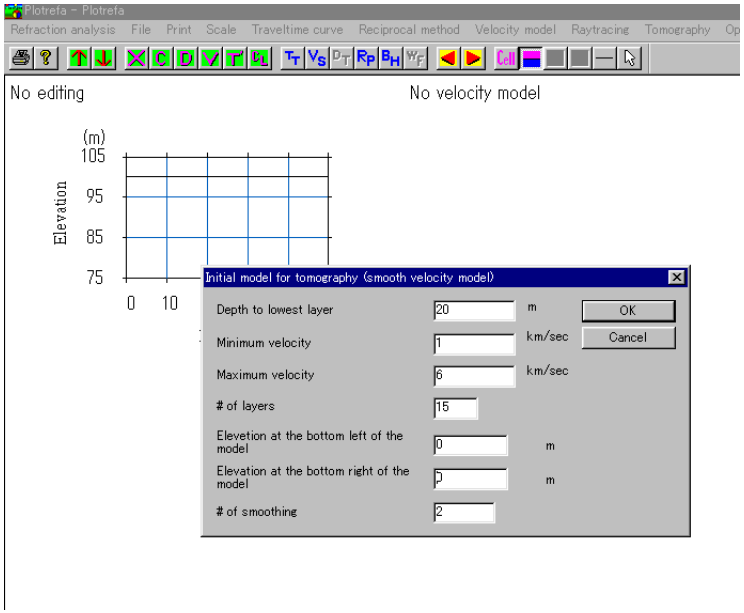
Initial model

1



Open topographic data by ‘File’, ‘Open elevation data file’. If the surface is flat, you can use ‘Refraction analysis’, ‘Topography’, ‘Flat surface’ for the convenience.

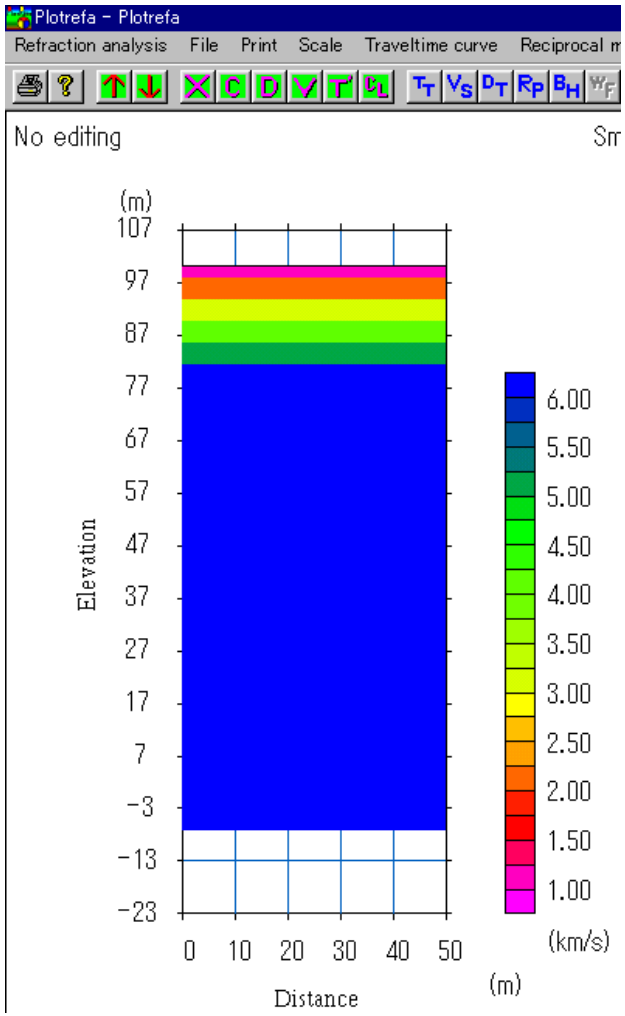
2



Select ‘Tomograph’, ‘Generate initial model’ for building initial velocity model for tomographic reconstruction. Enter the appropriate parameter in the dialog box.

Initial model

3



Initial velocity model is shown.

- Show traveltime curves for surface receivers
- Show traveltime curves for borehole receivers
- Show a velocity model

Initial model

Modify velocity model by a mouse

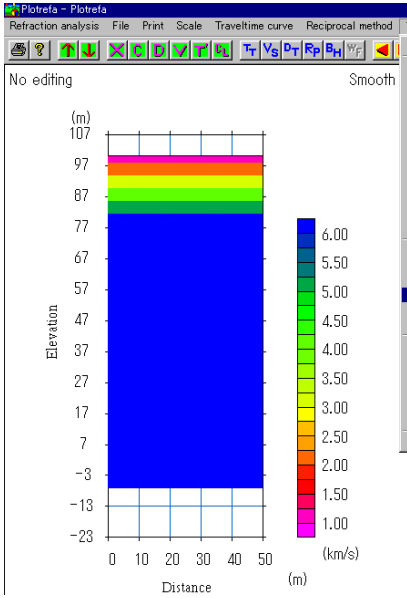
You can modify the initial velocity model manually. For example homogeneous velocity model can be generated as following..

1: Select ‘Velocity model’, ‘Correct velocity value’

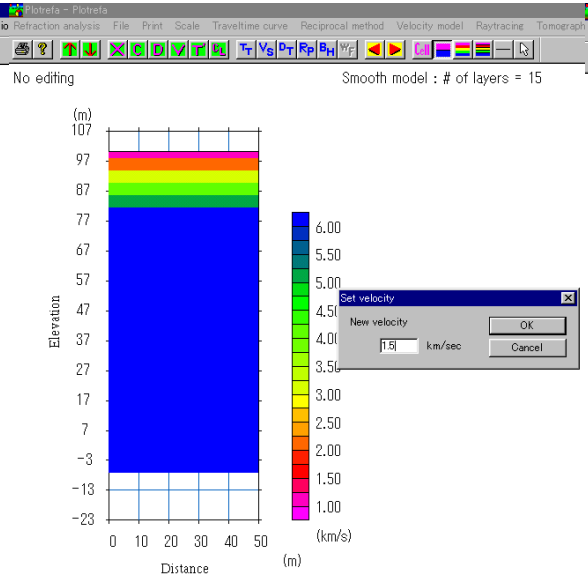
2: Enter new velocity value in dialog box.

3: Select the area in which velocity is changed by a mouse.

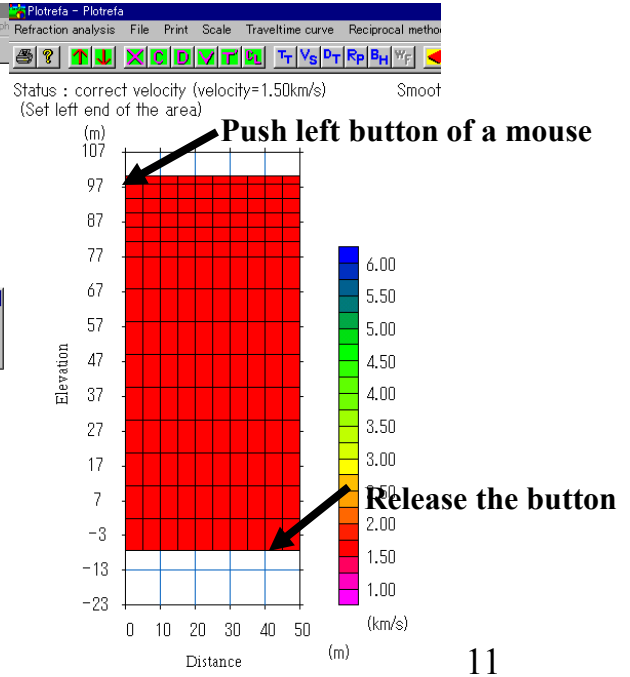
1



2



3



Initial model

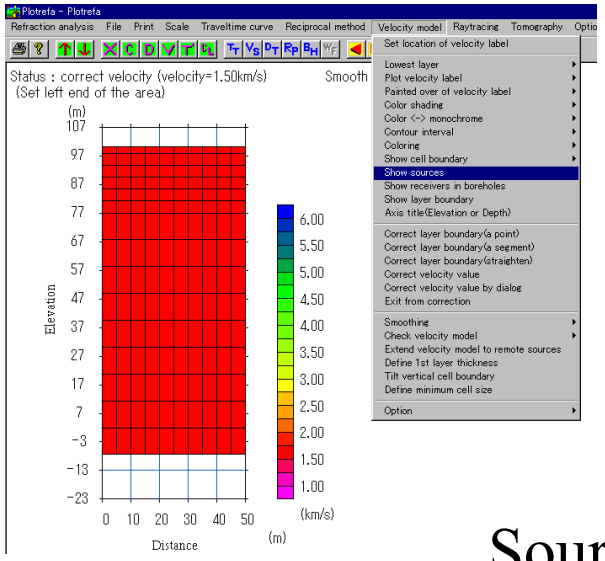
Show sources and receivers

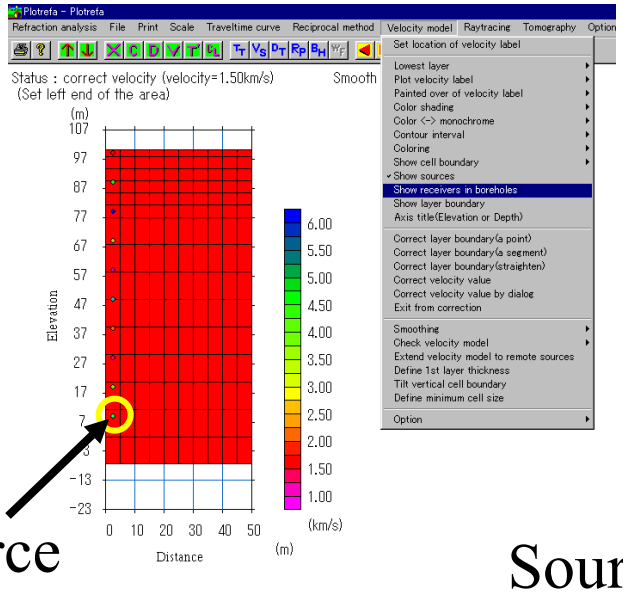
Sources:

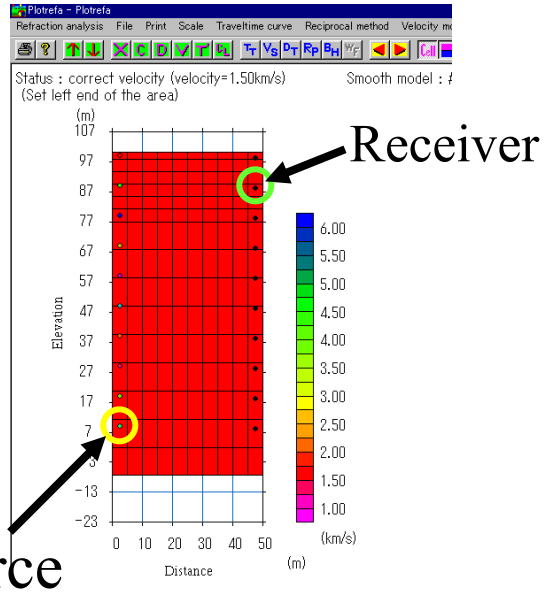
Select ‘Velocity model’, ‘Show sources’ for showing source locations.

Receivers in boreholes :

Select ‘Velocity model’, ‘Show receivers in boreholes’ for showing borehole receiver locations.

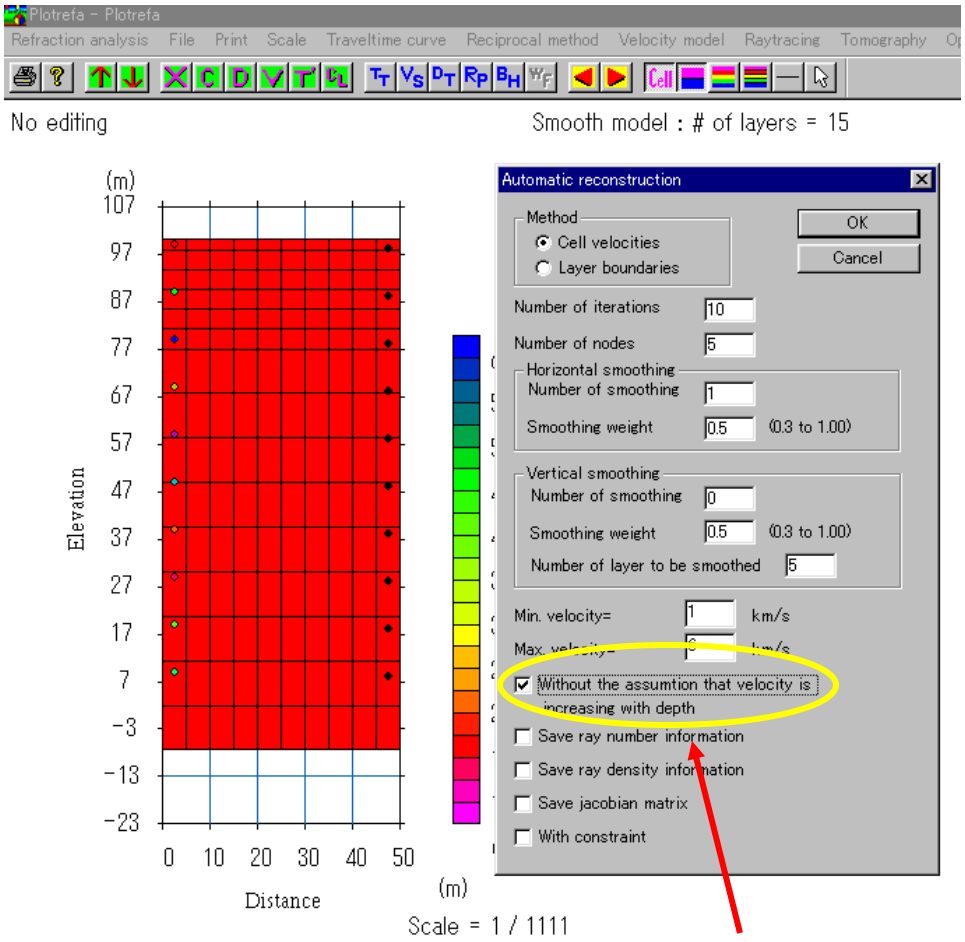






Inversion

1



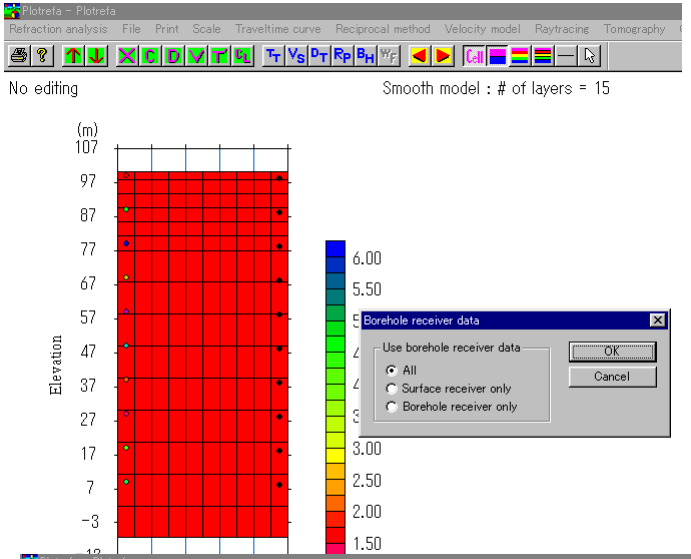
Important !

1: Select ‘Tomography, ‘Inversion’ in the menu for performing inversion. Enter the appropriate parameter in the dialog box.

You should be careful about **‘Without the assumption that velocity is increasing with depth’**. In the default setting, inversion assume that velocity is increasing with depth. In the normal seismic refraction analysis in which only sources and receivers on the surface are used, this assumption is preferable for stable conversion. However, in the cross-hole tomography, you don’t need to use this assumption. Check the **‘Without the assumption that velocity is increasing with depth’** for the inversion with no assumption.

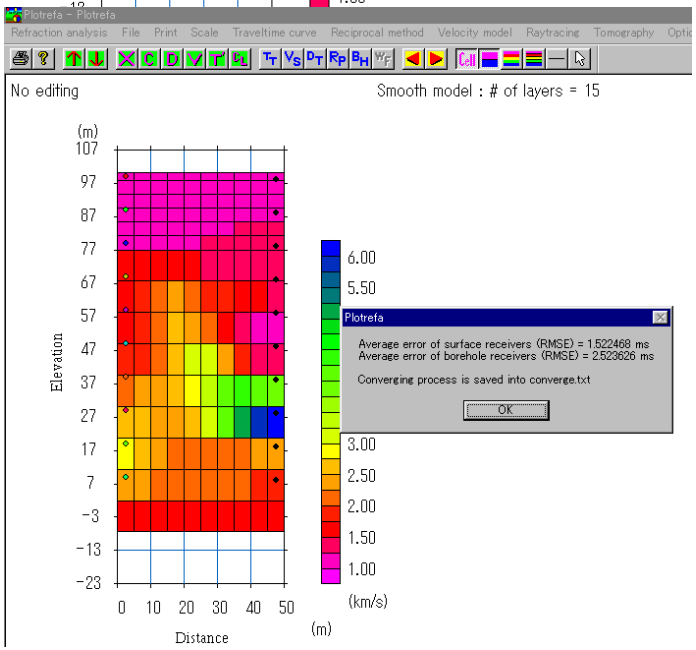
Inversion

2



2: Next, another dialog box is appeared. You can choose which traveltimes are used in the inversion. Usually ‘All’ will be OK.

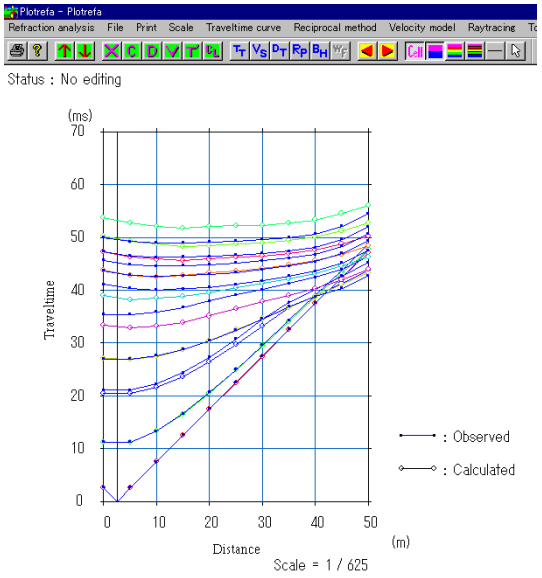
3



3: Average error (RMSE) and the corrected velocity model is shown after calculation has been completed.

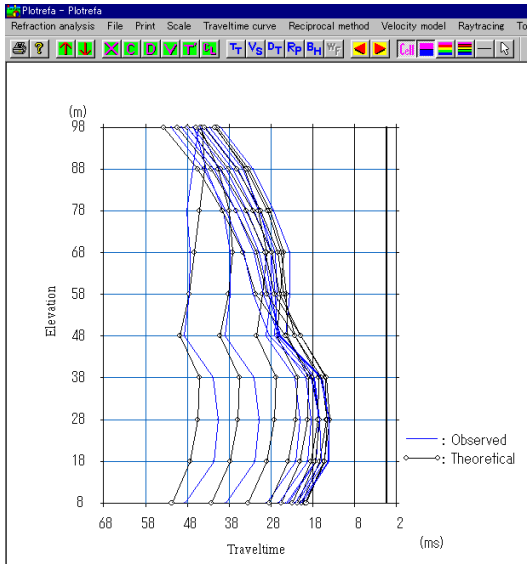
Inversion

4



4 : Select ‘File’, ‘Plot traveltime curves’, and the comparison of observed and calculated traveltime curves is shown.

5

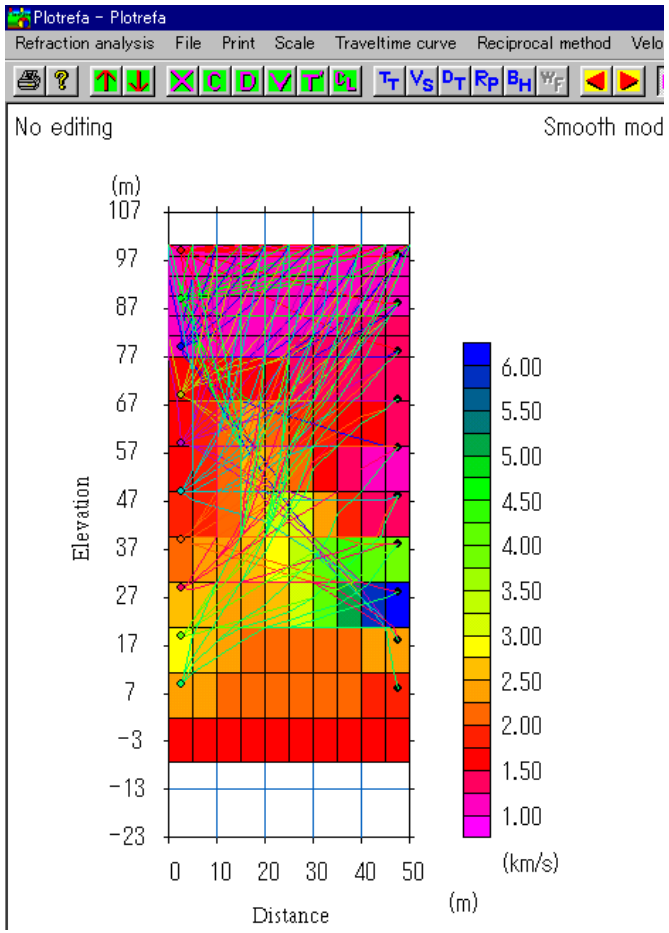


5 : Select ‘File’, ‘Plot traveltime data in boreholes’, and the comparison of observed and calculated traveltime curves for borehole receivers is shown.

- Show traveltime curves
- Show raypaths
- Show a velocity model
- Show traveltime curves for borehole receivers

Inversion

6



6 : Select ‘File’, ‘Plot raypath’, and the velocity model and raypaths are shown.

- Show traveltime curves
- Show raypaths
- Show a velocity model
- Show traveltime curves for borehole receivers