ERIGRAPH – USER GUIDE

2007-10-18

Introduction

Erigraph is primarily designed to facilitate graphical presentation of 2D resistivity imaging (CVES) data and associated inverted model sections. It also supports time domain IP data. Measured apparent resistivities and chargeabilities can be plotted as pseudosections in colour or grey scale. Inverted sections can be plotted as continuous (smooth) plots or as rectangular blocks. 2D inversion must be carried out using a separate inversion program, such as for example Res2dinv.

Pseudosection Plotting

Pseudosection plotting is useful for getting a first rough idea of the resistivity of an investigated site, and for data quality assessment purposes. An example of a pseudosection plot of a Wenner array data set is shown in Figure 1. A number of buttons along the top panel of the software window can be used to control the plots, and the palette can be changed via "Diagram/Palette".
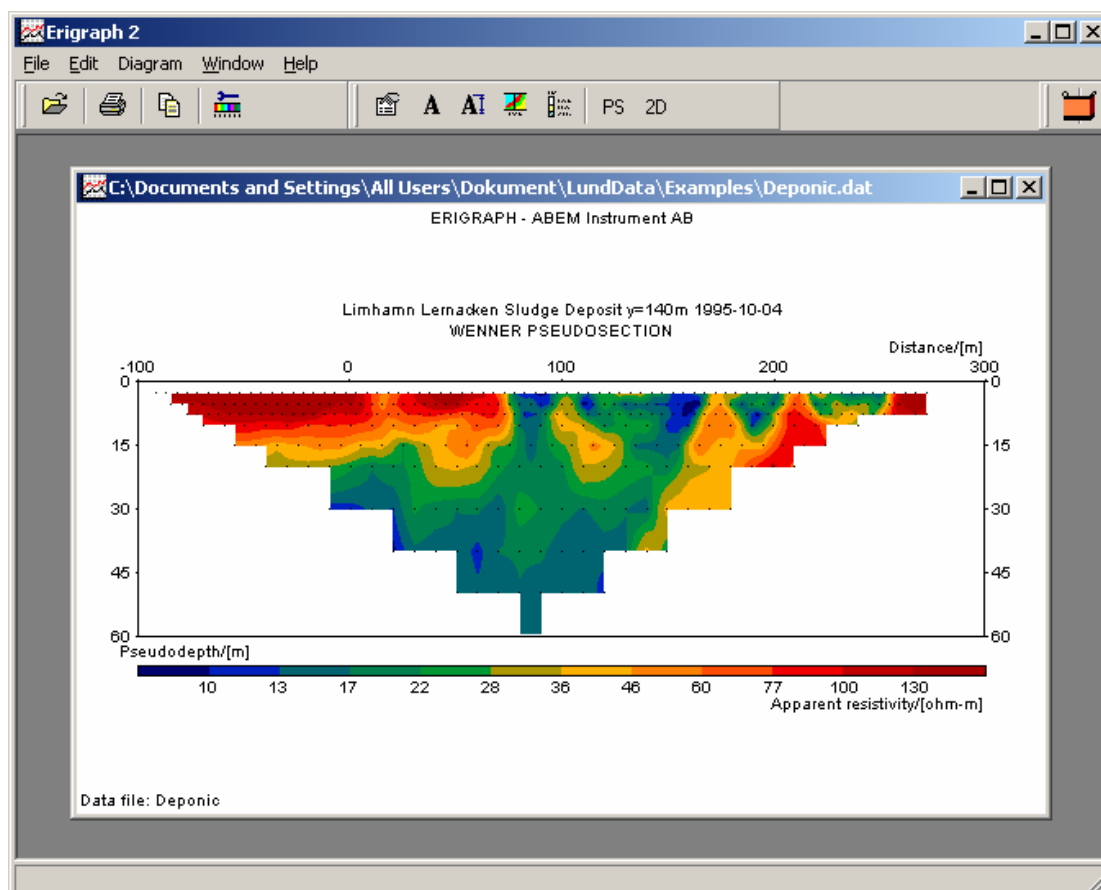

Figure 1. Example of pseudosection plot of a Wenner array data set.

In all cases the pseudodepth used is equal to the median depth of current penetration, i.e. the level at which half the current passes above and below. For simple array types like Wenner and pole-pole array one pseudosection plot of the data is enough to give

a complete picture. When using arrays like Schlumberger, pole-dipole, dipole-dipole and multiple gradient array several different a-spacings and n-factors can be combined in a data file. In such cases all data may not be visible in the same plot as data points fall on top of each other, and the mixing of different electrode geometries may give a noisy appearance of good quality data.

An example of a pseudosection plot of a multiple gradient array data set is shown in Figure 2. In such cases it is useful to make separate plots for either each a-spacing or n-factor, as shown in Figure 3. For this data set eight different pseudosections can be plotted, one for each of the n-factors ranging from -4 to 4. Alternatively one pseudosection can be plotted for each of the electrode spacings, but all data points will then not be visible since data measured with the same potential electrode location but mirrored current electrode layouts fall on top of each other in the pseudosections.
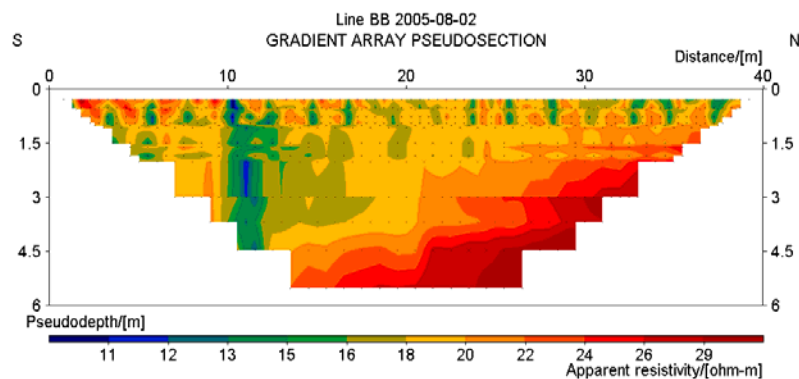

Figure 2.   Example of pseudosection plot of a multiple gradient array data set.
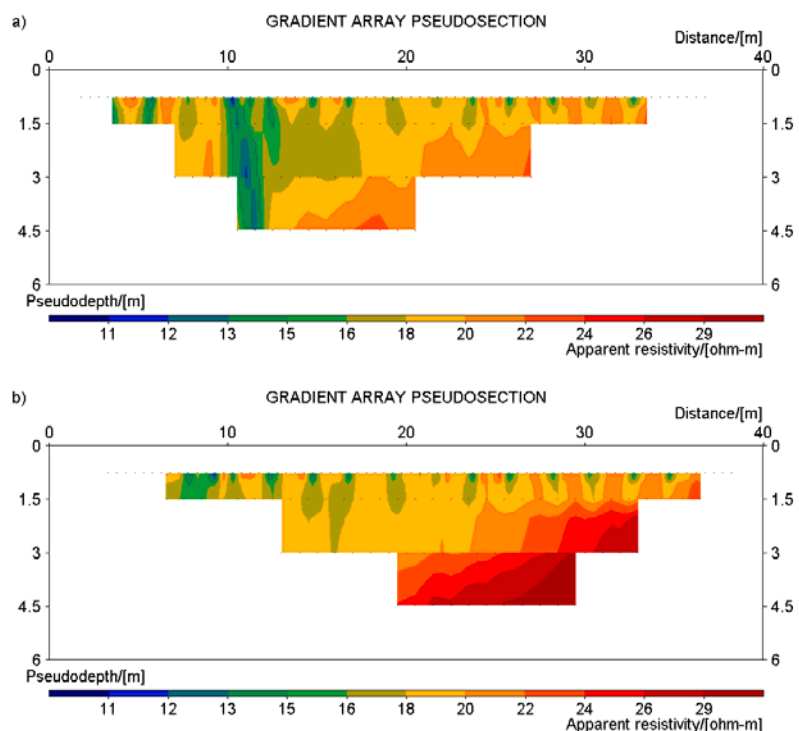

Figure 3.   Examples of pseudosection plots for a couple of different n-factors from the same data set; a) n = 3, b) n = -3.

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To change the diagram settings, open the settings menu by right clicking on the diagram or by clicking ▣. The a-spacings and n-factors to plot for a pseudosection are controlled at the bottom of the settings menu. Depending on the data set this may make sense or not. For example, if only one a-spacing was used in the survey in a dipole-dipole data set, it is not possible to make a pseudosection for any single n-factor.
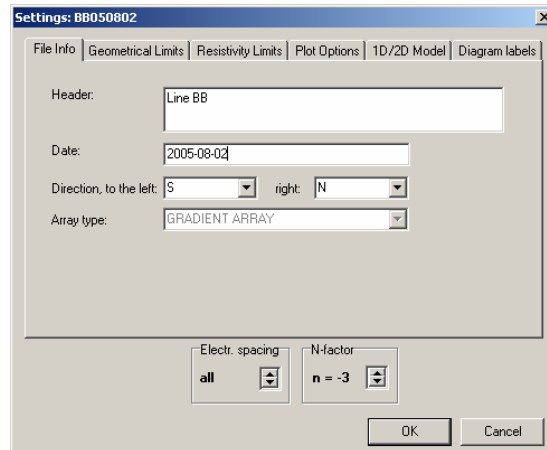

Figure 4. Plot settings menu.

A variety of different properties of the plot can be modified from the different tabs of the settings menu, e.g. geometrical limits, resistivity limits etc. Please play around and try out the different options.

The apparent resistivity data can be stored either in a conventional ASCII format with one set of x, a, rho-a on each line or in the format used by Res2dinv (in both cases DAT filename extension is assumed). For the latter format please refer to the manual of Res2dinv.

Field data files from the ABEM Lund Imaging System can be converted into DAT-files using ERIGRAPH or the Terrameter SAS1000 / SAS4000 Utility Software. The topography can be automatically incorporated in the DAT file, if it is saved in an ASCII file in the same directory as the OHM file to be converted. The topography file is automatically recognised if saved with the same filename as the data but with ALT extension. The topography file format is as follows:

```
x(1) alt(1)
x(2) alt(2)
...
...
x(n) alt(n)
```

In addition to the .DAT file the program searches for a file with .INF extension, which is created automatically when data is converted with Erigraph or when a data file is first opened (see appendix for details).

IP Data

Induced polarisation (IP) data can be plotted as pseudosections either as chargeability or normalised chageability, via selection on the "Settings" form.

Merging Data Files

Erigraph has a function for merging two or more DAT files into one via the meny choice "File/Merge/Data Files", to be used for example for combining two data files measured with different electrode arrays on the same layout. In the present version there is no option for automatic exclusion of duplicate data points.

Merging Time-lapse Data Files

Two DAT files can be merged into a time-lapse DAT file via the menu choice "File/Merge/Time-lapse". The two DAT files must of course be measured over the same line using the same measurement protocol(s). The data points need not be saved in the same order, and if data points are missing in either of the data files they will be omitted automatically. If IP data is present in the input data files it will not included in the time-lapse DAT file.

Difference Plotting

For time-lapse data files there are options for plotting either of the time step data sets as a pseudosection, or to plot the difference between the files calculated as:

$$Diff = \frac{rho_0 - rho_1}{(rho_0 + rho_1)/2}$$

Inverted Model Plotting

Erigraph can plot inverted models saved in RHO-format (Figure 5), and it has built-in conversion tools for converting from INV files created by Res2dinv. If IP data is available the inverted chargeability model can be plotted as well. An inverted model can be associated with a pseudosection data file if the DAT file is first opened and then "2D model section plot" is selected. If the inverted model is saved with the same filename as the DAT file it will automatically be associated with it, otherwise the model file in question has to be selected.

By default the models are plotted in smooth style (Figure 5a), but an option is to plot the inverted model in rectangular block style (Figure 5b). The latter shows the actual model cells as defined in the inversion software.
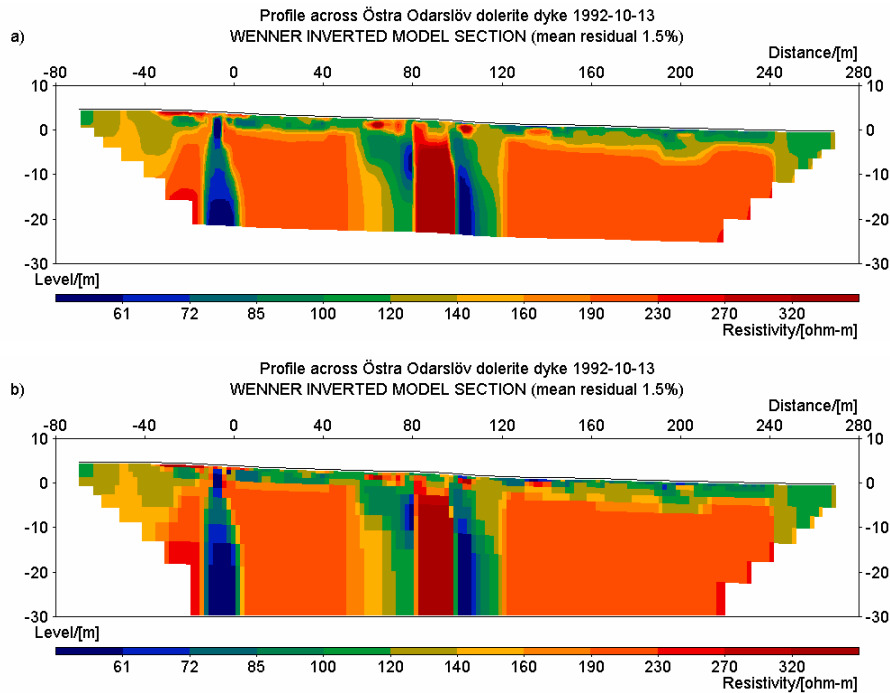
Figure 5. Example plots of inverted data set plotted in; a) smooth style, b) rectangular block style.

The RHO-1 format is used when converting directly from the INV file, and it works well in cases without topography of with smoothly varying topography. Res2dinv has an option for exporting inverted models in Lund-format, however in some versions of Res2dinv there is a bug so it will export non-sense models. Furthermore, topography will not be included in the converted model.

If a data file is opened and an associated inverted model is plotted selecting "2D section", the models saved in RHO-1 format will be plotted with topography provided the DAT-file contains topography (please consult the Res2dinv manual for details). Alternatively, the topography may be saved in a file with ALT extension. However, in any case it is necessary to open a data file and then plot the associated 2D section since the RHO-1 model file does not contain any topography information. The RHO-2 format includes topography in the model file.

The RHO-2 format is better in cases with strong gradients in the topography (see example in Figure 6). The depth is in this case the bottom of each layer. There is a built-in RHO-2 format conversion tool in Erigraph for conversion from XYZ files saved by Res2dinv (do not use negative depths). This conversion tool is only designed for models inverted with topography.
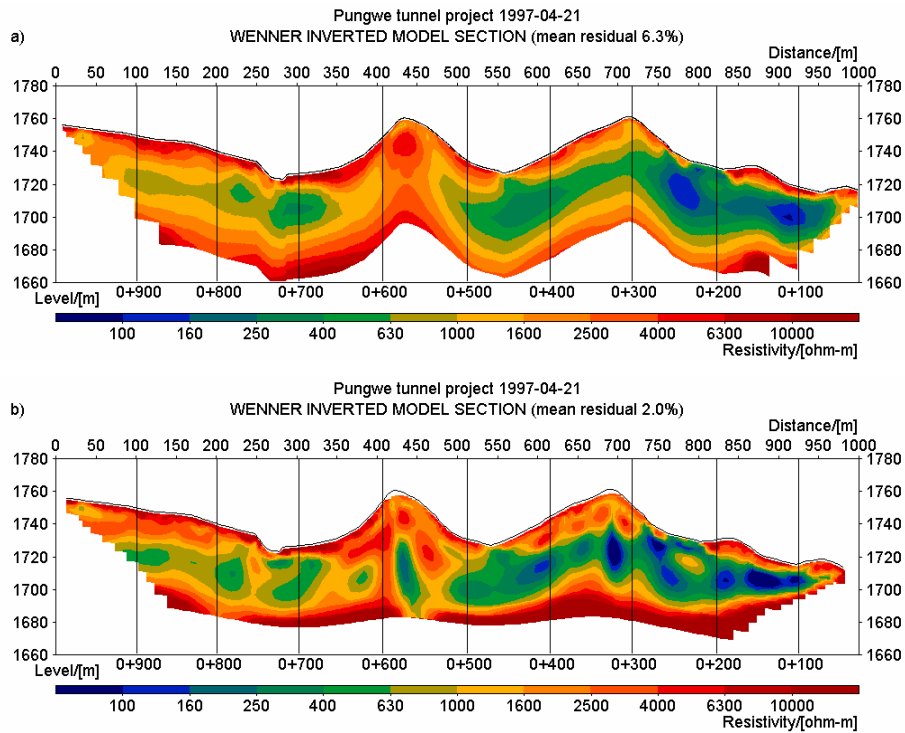
Figure 6. **Example plots of inverted data set from line with steep topography; a) inverted model converted directly from INV file, b) inverted model converted from XYZ file saved with topography.**

User Defined Text

The text strings on the axes of the diagrams can be customised via the menu "Settings/Diagram Labels".

Distance Markers

Distance markers (Figure 7) can be added to the plots by clicking , for example to mark out where a perpendicular line crosses. The vertical line type (Figure 8) will be plotted on pseudosections as well as inverted sections, whereas the other types only apply to inverted sections.
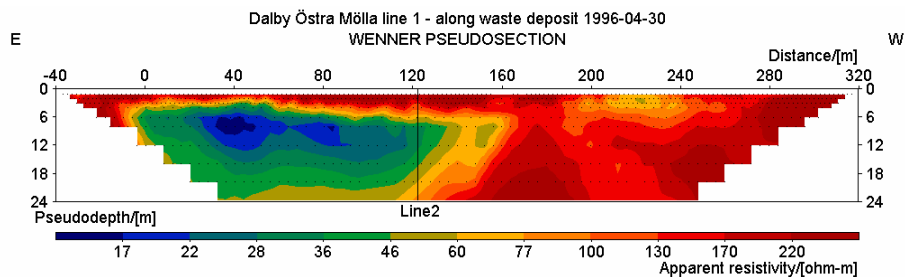

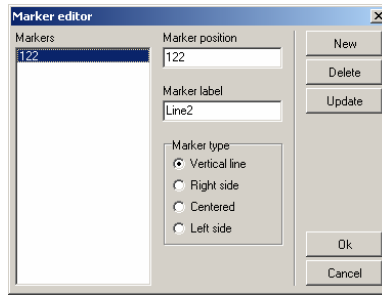**Figure 7.** **Distance markers with labels can be added.**

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Figure 8. Distance markers edit menu.

Level Markers

Level markes can be included in the model plots by saving the level marker data in an ASCII file with MRK extension in the data/model directory (see appendix for file format).

Reference Data

Drilling reference data can be included in the model plots by clicking . The available fill patterns are for plotting the layers are shown in Figure 11, with corresponding material codes.
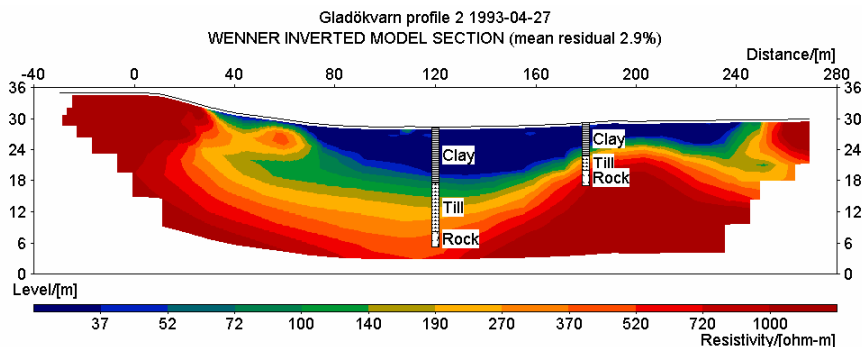

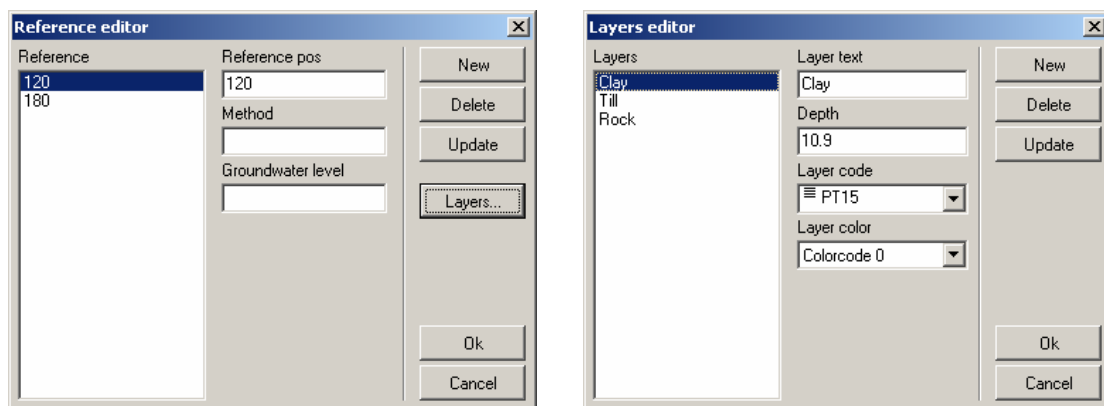**Figure 9. Inverted model section with drilling reference data.**

Figure 10. Menus used for adding and specifying reference data from e.g. drilling.

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The text strings for the layer materials are by default written in black with white label background. Select transparent labels under "Settings/Plot Options/Transparent layer labels" if preferred.
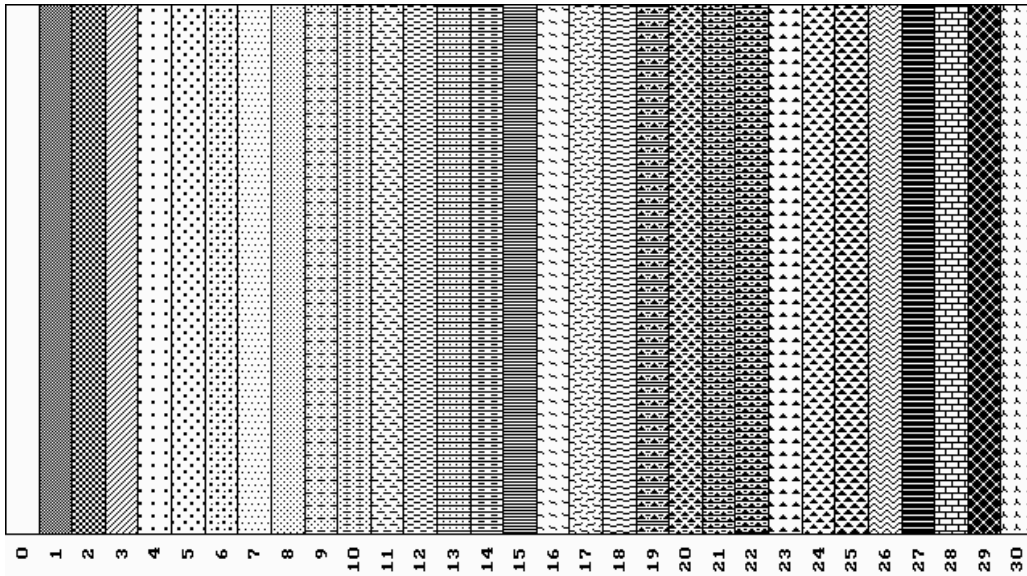

Figure 11. Availble rasters for drilling reference data.

Appendix: File Formats

Pseudosecion Data

The apparent resistivity data can be stored either in a conventional ASCII format with one set of x, a, rho-a on each line or in the format used by Res2dinv (in both cases DAT filename extension is assumed). For the latter format please refer to the manual of Res2dinv. Field data files from the ABEM Lund Imaging System can be converted into DAT-files using ERIGRAPH or the Terrameter SAS1000 / SAS4000 Utility Software.

In addition to the .DAT file the program searches for a file with .INF extension, which holds information in the following format:

```
comment string
date of measurement
array type
blank  (line contents not used)
direction label left side                    (optional)
direction label right side                   (optional)
nₗ      no of marker labels (optional)
x[1]  flag[1]  marker text string[1]         distance, type flag, text string (optional)
x[2]  flag[2]  marker text string[2]
...
x[nₗ]  flag[nₗ]  marker text string[nₗ]
```

The topography can be automatically incorporated in the DAT file, if it is saved in an ASCII file in the same directory as the OHM file to be converted. The topography file should have the same filename as the data but with ALT extension. The file format is as follows:

```
x(1) alt(1)
x(2) alt(2)
...
...
x(n) alt(n)
```

Inverted Models

Erigraph can plot inverted models in RHO-files (ASCII files) with the following format:

```
RHO-1 [IP]
nd Depth(1) Depth(1) ... Depth(nd)
x(1)  rho(1,1)  rho(1,2) ... rho(1,nd) [ip(1,1)  ip(1,2) ... ip(1,nd)]
x(2)  rho(2,1)  rho(2,2) ... rho(2,nd) [ip(2,1)  ip(2,2) ... ip(2,nd)]
...
...
x(nx)  rho(nx,1)  rho(nx,2) ... rho(nx,nd) [ip(nx,1)  ip(nx,2) ... ip(nx,nd)]
/Model residuals:
[optional]
/Inversion type header:
[optional]
/IP parameter/unit
[optional]
```

The specified depth is in this case the midpoint of each layer. Blank model cells should be entered as asterisks (*). If IP data is available it can be included as indicated, the square parantheses [] indicate that it is optional. The IP parameter/unit line would similar to the corresponding line in the DAT files.

Alternatively the RHO-2 format can be used:

```
RHO-2 [IP]
x(1) alt(1)
nd(1)
rho(1,1)  Depth(1,1) [ip(1,1)]
rho(1,2)  Depth(1,2) [ip(1,2)]
...
rho(1,nd-1)  Depth(1,nd-1) [ip(1,nd-1)]
rho(nd)  [ip(nd)]
x(2)  alt(2)
nd(2)
rho(2,1)  Depth(2,1) [ip(2,1)]
rho(2,2)  Depth(2,2) [ip(2,2)]
...
rho(2,nd-1)  Depth(2,nd-1) [ip(2,nd-1)]
rho(2,nd) [ip(2,nd)]
...
...
...
...
x(nx)  alt(nx)
nd(nx)
rho(nx,1)  Depth(nx,1) [ip(nx,1)]
rho(nx,2)  Depth(nx,2) [ip(nx,1)]
...
rho(nx,nd-1)  Depth(nx,nd-1) [ip(nx,nd-1)]
rho(nx,nd). [ip(nx,nd)]
/Model residuals:
[optional]
/Inversion type header:
[optional]
/IP parameter/unit
[optional]
```

The RHO-2 format is better in cases with strong gradients in the topography (see example in Figure 6). The depth is in this case the bottom of each layer. There is a built-in RHO-2 format conversion tool in Erigraph for conversion from XYZ files saved by Res2dinv (do not use negative depths). This conversion tool is only designed for models inverted with topography.

For both model formats an unlimited number of comment lines may be added at the end of the file, where each comment line should start with a slash (/). This can be useful for saving information on e.g. inversion parameters together with the model.

User Defined Text

For the model sections the file must be named MODSEC.TXT and have the following structure:

```
Header
Distance label
Depth scale label
```

```
         Topography scale label
         Resisitivity legend label
```

Example of a MODSEC.TXT file:

```
2D INVERTED SECTION
Distance/[m]
Depth/[m]
Level/[m]
Resistivity/[ohm-m]
```

Level Markers

Level markes can be included in the model plots by saving the level marker data in an ASCII file with MRK extension in the data/model directory. Use the following format:

```
"comment" "comment"   / first marker line
x(1,1) depth(1,1)
x(1,2) depth(1,2)
...
...
x(1,n) depth(1,n)
"comment" "comment" / second marker line
x(2,1) depth(2,1)
x(2,2) depth(2,2)
...
...
x(2,n) depth(2,n)
```

Reference Data

Drilling reference data file format:

```
x(1)    / distance
id(1)  / reference point id text string (optional)
gwl(1)/ groundwater level (optional)
nl(1)   / no of layers
x(1,1) d(1,1) code(1,1) col(1,1) txt(1,1)   / dist, depth, materialcode, textcolour, text lable
x(1,2) d(1,2) code(1,2) col(1,2) txt(1,2)...
...
x(1,nl) d(1,nl) code(1,nl) col(1,nl) txt(1,nl)
x(2)    / distance
id(2)  / reference point id text string (optional)
gwl(2)/ groundwater level (optional)
nl(2)   / no of layers
x(2,1) d(2,1) code(2,1) col(2,1) txt(2,1)   / dist, depth, materialcode, textcolour, text lable
x(2,2) d(2,2) code(2,2) col(2,2) txt(2,2)...
...
x(2,nl) d(2,nl) code(2,nl) col(2,nl) txt(2,nl)
```

The text strings for the layer materials are written in black if the text colour is set to 0, and white is set to 1 (in the latter case select transparent labels under "Settings/Plot Options/Transparent layer labels" in order to see the text).