Reducing Well Logs in IX1D v 3 – A Tutorial

Version 1.0

Reducing Well Logs

Keller and Frischknecht* show how to characterize a geoelectric section and reduce many layers to a single equivalent layer using the concept of cumulative longitudinal conductance and cumulative transverse resistance.

In this analysis, a well log with many, many layers (hundreds or thousands) can be effectively reduced to a few equivalent layers. EM methods are only sensitive to conductors, so only the cumulative conductance needs to be used. Resistivity methods are sensitive to both, but this gives rise to layers with intrinsic anisotropy and the forward algorithms in IX1D do not address anisotropic models. For these reasons we will limit our well log reduction to the use of cumulative longitudinal conductance.

*Keller and Frischknecht, 1966, Electrical Methods in Geophysical Prospecting, Pergamon Press, pp. 33-35. Keller and Frischknecht, 1966, Electrical Methods in Geophysical Prospecting, Pergamon Press, 99 33-35.

Import the Well Log
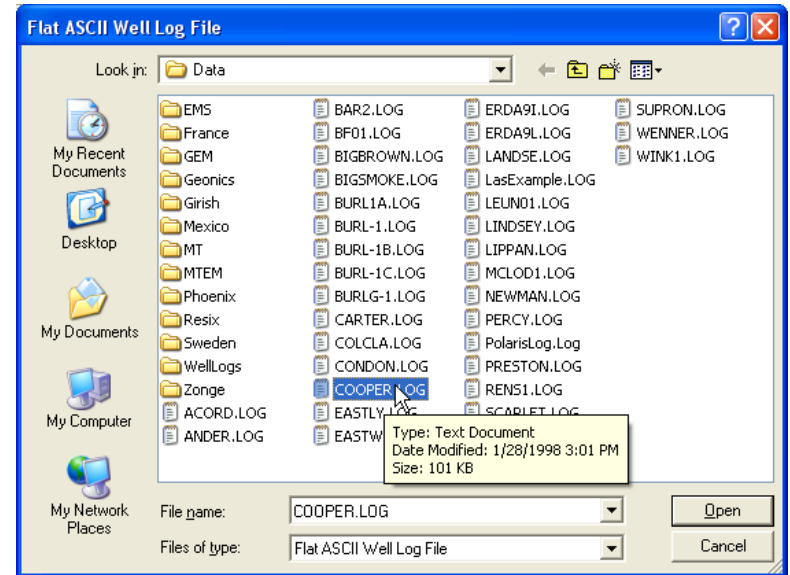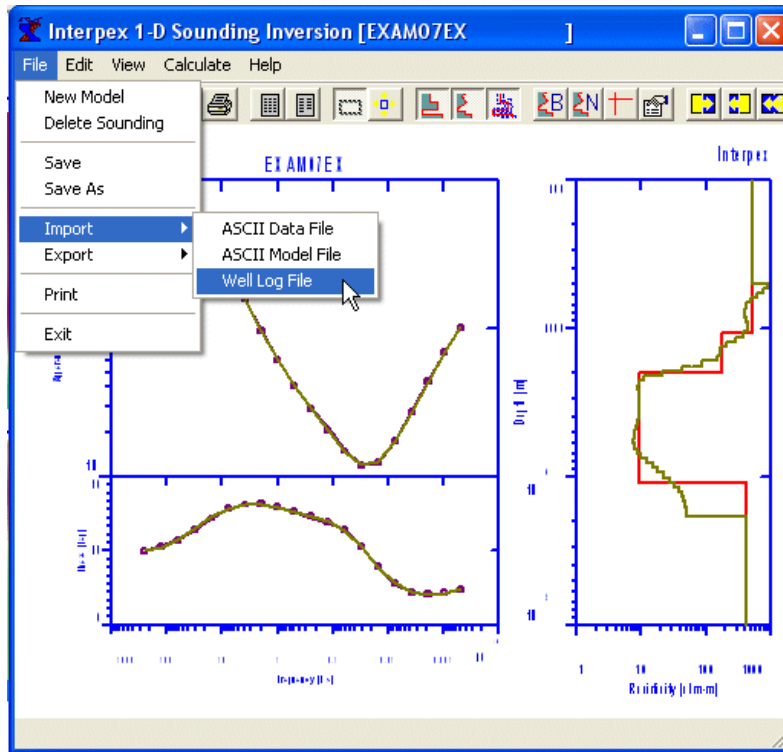
Use the menu command File/Import/Well Log File to start the well log import and select the file from the file selection dialog.

Select Depth and Resistivity Columns
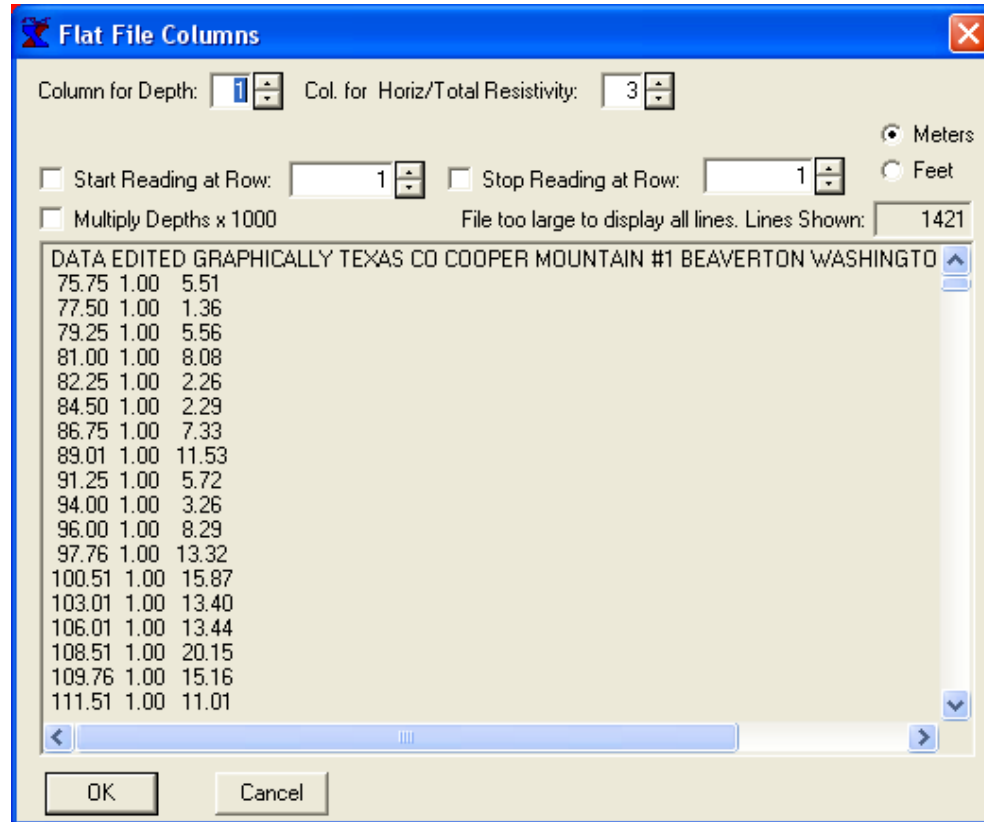
There are two columns that need to be read: Depth and Resistivity. In this case, column 1 is Depth and column 2 is Resistivity. For files too large to display, the number of lines shown is displayed. Select units m or feet. Press OK to continue.

# Select Slope Breaks in the Cumulative Conductance Curve
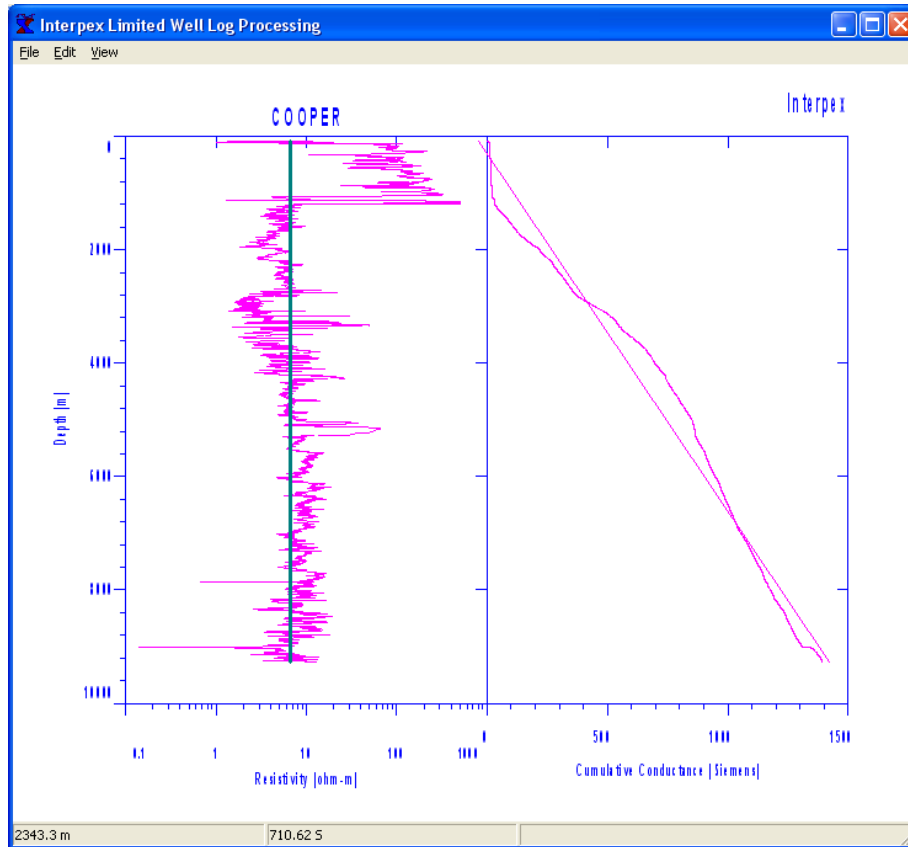
The jaggedness of the log makes it difficult to pick out the layer boundaries. The cumulative conductance on the left makes it quite easy.

While some layering is apparent on the left graph, much more is apparent on the right graph.

The straight lines on displayed on each graph is the best fit to a single layer.

The well log itself is displayed on the left graph, with depth as the vertical axis and resistivity as the horizontal axis. The vertical line represents the average over the entire log. Cumulative conductance is displayed on the right graph.

# Select Slope Breaks in the Cumulative Conductance Curve
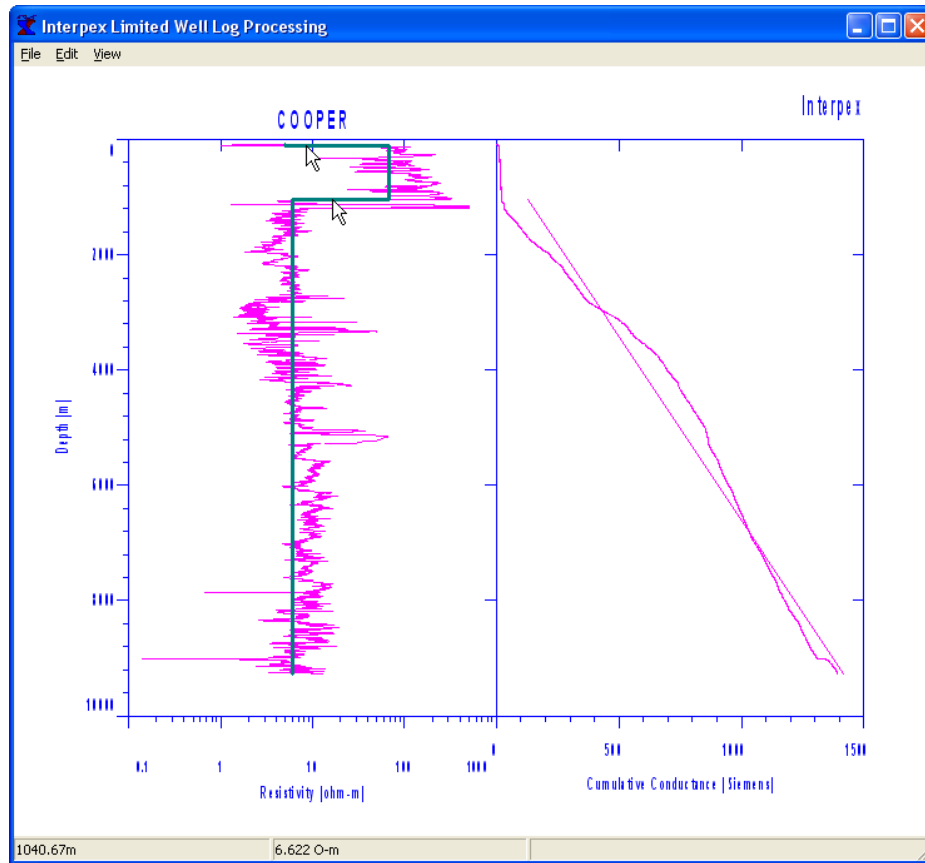
The cumulative conductance curve will be relatively straight in areas where the resistivity is relatively uniform. The object is to use the mouse to pick points where relatively straight sections are joined together and the slope of the line changes abruptly.

You can point at a feature on the log itself, or on the cumulative conductance curve.

Here we have picked out the relatively easy boundaries on the log itself.

Right-Clicking at a segment boundary will remove that boundary. Remember, only the vertical position of the mouse cursor is important.

# Select Slope Breaks in the Cumulative Conductance Curve
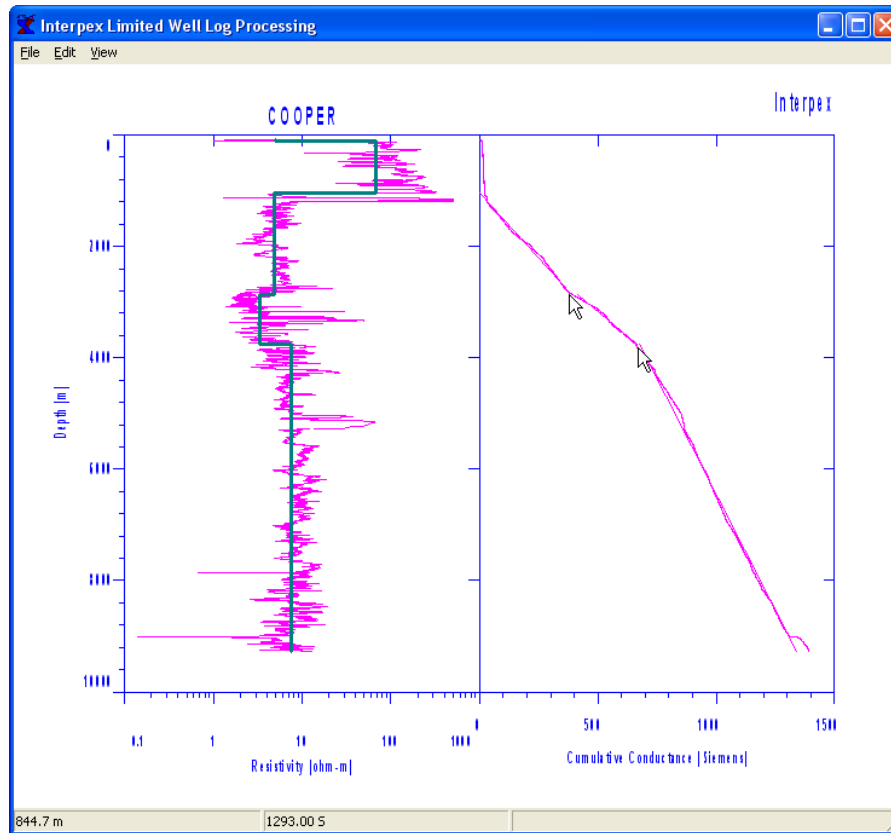
The next two layer boundaries are more easily picked from the cumulative conductance curve, as shown by the two cursors at the pick position. Note the display on the original log shows these make sense.

If you have additional depth information besides the log, boundaries can also be picked at a specific depth by using Edit/Add Segment and entering the depth numerically.
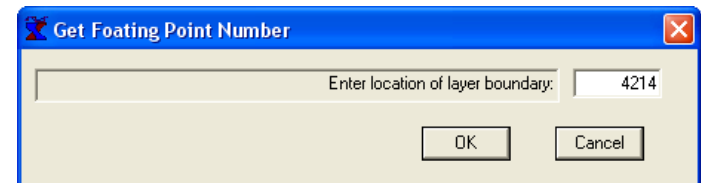
The object is to reduce the many, many layers in the original log to as few as required to adequately represent the geoelectric section.

Select Slope Breaks in the Cumulative Conductance Curve
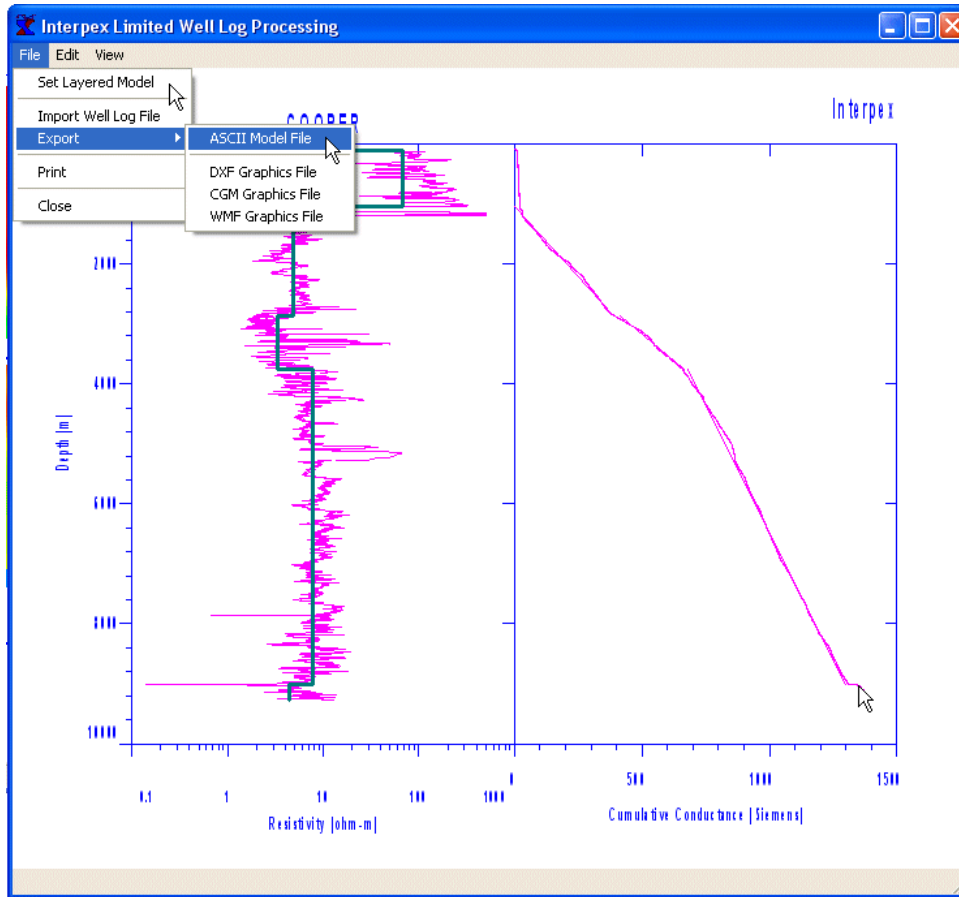
The last boundary is picked near the bottom of the log. We could continue to fine tune the model but this is as adequate a representation as we need, unless there is additional information which indicates more boundaries are needed.

If the log was imported from a sounding window, we can use File/Set Layered Model to put that model in the sounding, or use File/Export ASCII Model File to write the model to a file for later import.

When the analysis is finished, the model can be exported or transferred to a sounding for further work, copy/paste, etc. The log and its decomposition is not saved, but is discarded when the window is closed.