

Producing a Depth-Converted Seismic Horizon in Z-map

Summary

This is a reference guide to creating a depth-converted seismic horizon in LGC's Z-Map Plus™. The procedure followed is:

1. Approximately depth-convert a Seisworks time horizon using TDQ
2. Export an amplitude and depth horizon to Z-map
3. Grid both of these horizons
4. Apply a back interpolation procedure to adjust the depth grid
5. Contour the amplitude (using color filled contours) and the adjusted depth grid
6. Make refinements and add features to the map

Detailed instructions are not given on how to produce the initial amplitude and time horizons in Seisworks, or on how to create Z-map pictures and the features within them, other than the amplitude and depth contours and the well postings created in the work flow. If aid is required in these topics, then the reader should consult the appropriate reference manuals.

1. TDQ

Open TDQ from Open works Applications menu

Model

New

Build

From time-depth tables

Select a good checkshot well or well list that includes one.

Highlight the well in the well list

Select the time-depth table to be used

OK

Horizons

Convert time to depth

Select survey

Select time horizon to be converted

The given default name is fine

OK

An approximate Seisworks depth horizon is now made.

To save the model (so that it can be opened for future depth conversions):

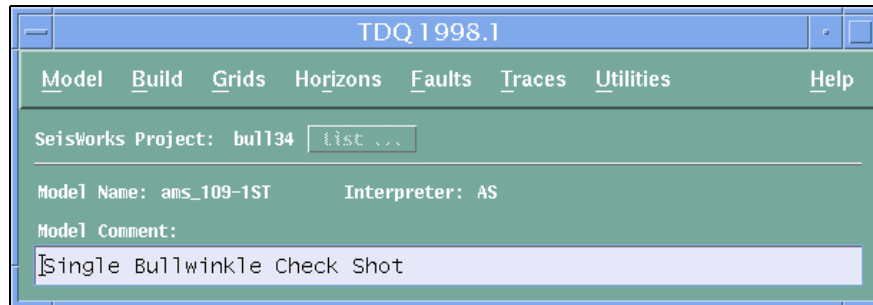
Model

Save As

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Give it a name (identifying it as yours) and a comment if you desire

OK



2. Export to Zmap

Open Seisworks

It is a good idea to check that your new depth horizon has been created and looks approximately correct in Map View before continuing.

From the Seisworks main menu, select

Interpret

Export to Z-MAP Plus

Click the MFD Output – List button:

Create an appropriately named mfd file in your Z-map directory (If you don't have one, then you can add one in /hydro/d0/Zmap).

It is best to create a new Z-map mfd rather than adding the exported horizons to an existing one.

Do not select Flip Values on export

Click the Horizons box.

Select the horizons that you wish to export (amplitude and depth), and deselect any that may be highlighted that you do not want to export.

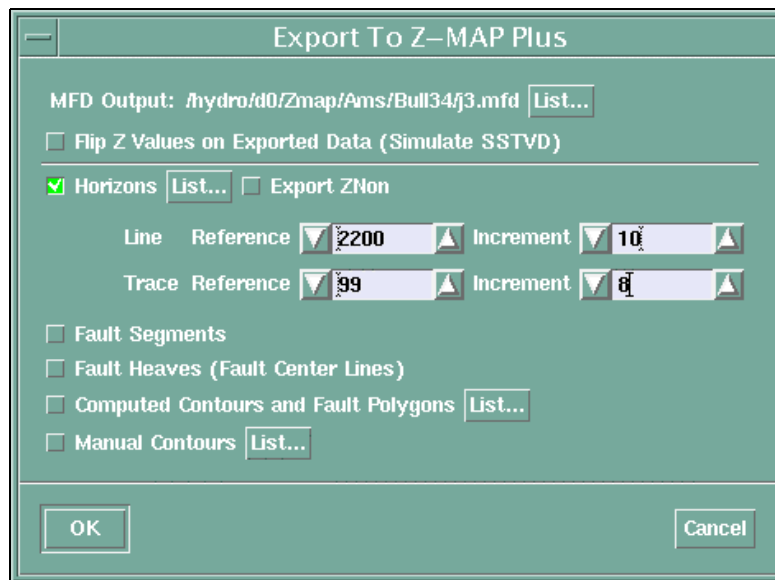
Do not export Znons

You can leave the line and trace values as defaults (the first in the survey), but change the *Increment* to a sensible value, since this determines the density of the exported data. The information at the base of Seisworks Map View will tell you the line and trace increments in the survey. It is best to pick increments that correspond to 100 - 300 feet. Taking every other line and trace will usually accomplish this.

Leave the faults and contours buttons unselected if you do not have any interpreted.

OK

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3. Z-Map

This paper does not give instructions on how to create basemaps and features such as title blocks, map borders etc., but concentrates on how to produce an amplitude map of a seismic horizon with depth converted structure contours.

Open Z-map from the OpenWorks menu

Create or open the picture that will contain the amplitude and structure map of your horizon. Note, there should be sufficient space outside the map border for the amplitude color bar that will be created in this procedure (4 inches is a good value).

Make sure that there is a directory path to the newly created mfd file.

Open the mfd using:

File

MFD Open/Close

3.1 Create a bounding Polygon for the Event

Post either the exported amplitude or depth data from Seisworks using:

View

(X,Y,Z)Point data

Select Data - select your data file

OK (you don't need to alter the other parameters)

The location of all the exported points should be posted on your map. Trace around the edge to make the polygon by:

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Edit

 Edit/Create Data

 Create Data

 Polyline

Give it a filename e.g. *horizon_name polygon*

Save it in the mfd that you created

OK

 OK

Create the line by clicking with the left mouse button and then trace around the outline with the middle mouse button.

Click End And Close to complete the polygon, and then OK.

Delete the posted values using

Edit

 Edit Picture

 Delete Features

 Posted control points and values

 OK

You can check that the polygon was created successfully by

View

 Features

 Lines

 File

 Select Data

Click on your polygon

OK (the other parameters are fine)

You may need to refresh the screen to see it.

3.2 Grid the Amplitude Data

Gridding

 Point Gridding Plus

(It is usually good practice to click Unlock parameters on all of these types of Z-map menus, since unwanted parameters may remain from previous work.)

Changing the gridding parameters greatly affects the gridding procedure and result. The following parameters work well for seismic data, but you may wish to experiment or refer to the Z-map manual for more information.

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Contol points - select your amplitude data

Select a fault set if you have one

Output file names - enter a suitable name e.g. *horizon_name amplitude grid*

Save it in the same mfd

Primary parameters - **Change the search radius to something only slightly larger than the X and Y increments.**

Secondary Parameters - Change weighting to Smooth

Flexing Parameters - Change Smoothness modulus to about 0.8

Number of Refinements : 2

Number of Flex Passes: 7

Other parameters can be left as default

Apply

Gridding should take a couple of minutes.

Click **Save** when it's done.

Make a note of the Z-Value range in the grid, which can be found with

File

Info

Grid Statistics

Click the newly created grid

The information is displayed in the Z-Map system window.

Click **Cancel** when done.

3.3 Color Contour Amplitude Map

The easiest way to make a color contour amplitude map with a scale bar is to use the Color-filled Contour Macro, located in

Macros

Graphics

Color-filled Contours

Click Fill in Macro Parameters Defaults

View Parameter Panels...

Select your amplitude grid

Use a fault file if you have one, otherwise click **None - use no file**

Set Contour Refinement: Fine

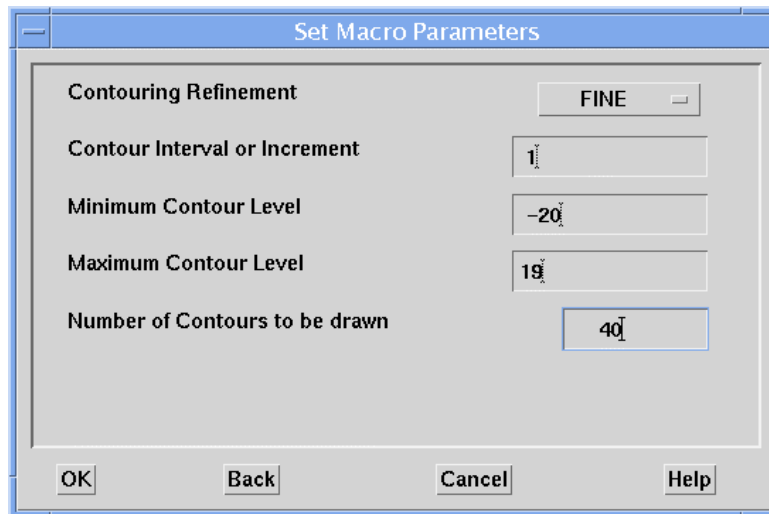
Enter the maximum and minimum contour values that you found from the grid statistics

You want to have about 30 - 50 contours, so set the contours interval accordingly

Number of contours = Max - Min + 1

OK

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The next 2 boxes of parameters are not needed, so click

OK

OK

Change Draw Contour Lines on Picture to OMIT

Colorbar location: Left (or wherever you want it)

OK

Select the polygon that you created

OK for the next box

Apply

The procedure should again take a couple of minutes

Click Save

Redraw your Map in the main window.

You should now have a color contour map with a color scale.

Edit the colors to make a suitable scale using the color table button on the left of the main window



Click on the color squares to edit them. Interpolate is a very useful option. A "spectrum" type color scheme usually works well.

(At this stage, faults can be interpreted in Z-map, using the amplitudes as a guide. This is done using a similar procedure to how the polygon was created previously.)

3.4 Gridding the Depth Data

Grid the depth horizon using exactly the same procedure and changes from the defaults as was done for the amplitude horizon. Name the grid something like *horizon_name TDQ depth grid*. Make sure that you reduce the search radius.

4. Back Interpolation

The next stage is to adjust the crude depth conversion that TDQ produces to fit the well data for the horizon. The back interpolation method finds the depth in the TDQ grid at the position of each well. This is then subtracted from the well depth, then this "error" data is gridded and then added to the original TDQ grid to produce a corrected depth grid.

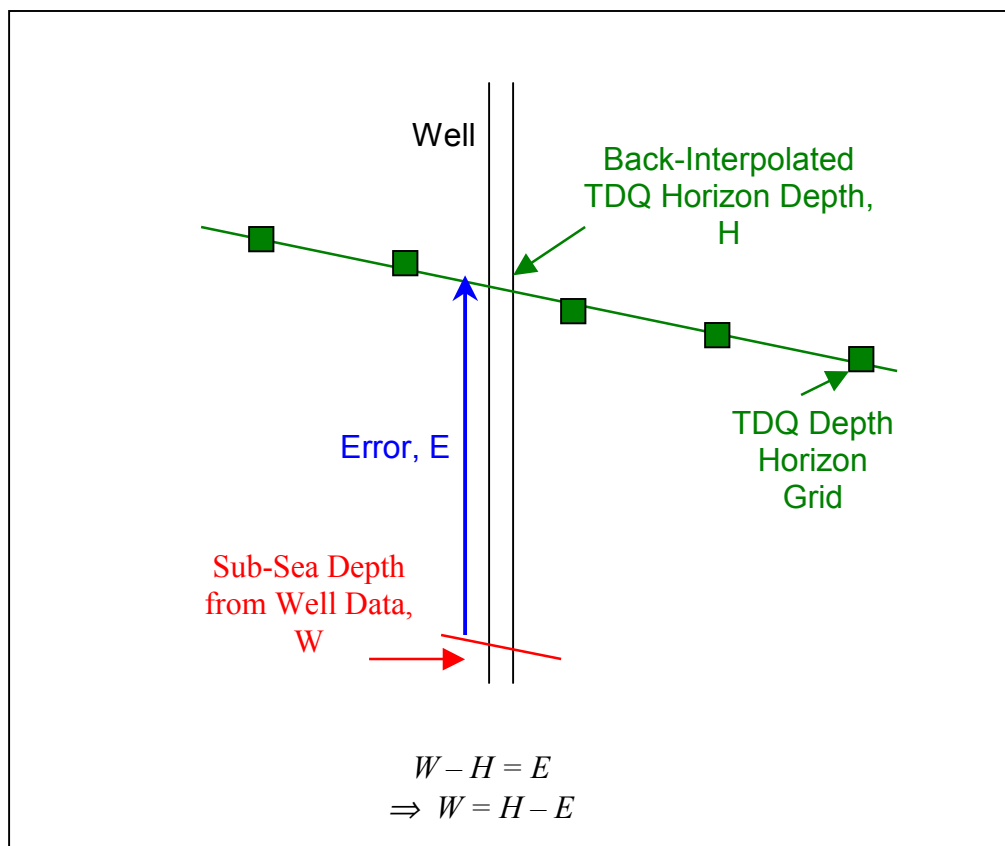


Figure: Diagram illustrating the theory behind the back-interpolation method.

A data file of horizon depth (True vertical, Sub-sea) and well names is needed for this operation. If one does not exist, then you can create a text file in Z-map friendly format and import it (see the reference manual).

4.1 Post the well information on the map

View

(X,Y,Z)Point Data

Select Data: The well data file

Fields to post: The well name and SSTV Depth

Labelling parameters

Field Parameters

Well Name

Choose a color

Font: Duplex

Height: 0.14

SS Depth:

Font: Duplex

Height: 0.12

Location: Below

OK

Save

OK

Operations

Back Interpolation

Select input grid - the TDQ depth grid

Select a fault file if you have one

Select Input Data - the well data file.

Output Z-field:

New Field - Give it a name (e.g. *BI depth data*)

Output Name..

Call it *horizon_name BI depth data*

Apply

Save

4.2 Find the difference between the TDQ depth and the well Depth

Operations

Data Operations

Dual Data Operations

Input data: The data file that you just created

Input A: The back interpolated data

Input B: The well data

Operation: Subtract (This is A-B)

Output Field: New Field e.g. *Depth error*

Field Type: Z-Value

Output Data: Name - e.g. *horizon_name Depth error data*

OK
Apply
Save

The data statistics can be found in the System Window. The values typically range from \pm several hundred feet.

4.3 Grid the Error Data

Gridding

Point Gridding Plus

(Unlock Parameters)

Control points: Your error data set

Z-field: Use the Depth error field that you created

Use a fault file if you have one

Output filename: E.g. *horizon_name depth error grid*

Primary parameters: It is important to alter the X, Y and Z bounding values such that the grid will extend over the whole horizon, and not just where the wells are (the Z maximum and minimum should be increased so that the grid values can increase/decrease beyond the region of the wells - increasing their magnitude by 500 feet should suffice).

Set the X and Y increments to about 400 feet

Leave the Search Radius as the default value

OK

Secondary parameters: Leave as defaults

Flexing parameters: Set Number of Refinements to 2

OK

Apply

Save

4.4 Subtract the error Grid from the TDQ grid

Operations

Grid Operations

Dual Grid Operations

Grid A: The TDQ grid

Grid B: The error depth grid

Operation: Subtract

Output Grid Name: E.g. *Horizon_name Depth Grid*

Source for area of interest: Intersection

OK

Set X and Y increments to 400 ft

OK
Apply
Save

4.5 Contour the New Depth Grid

View

Contouring

Contour

Input file: The new adjusted depth grid

Constraint: Use a fault file if you have one, otherwise the horizon polygon

Contouring Parameters...

Change the minimum to the nearest multiple of 500 below the value given

100 ft is a good contour interval

Curve Sampling Density: Fine

OK

Curve Drawing and Labeling Parameters:

Contour Labels: 5

Reference Contours: 5

Distance to first label: 3

Character Height: 0.15

Change the Starting Color index for Contour Lines to an unused color, e.g. 23

OK

OK

Refresh the Main Window if necessary. Zoom in to verify that the Depth contours honor the well data.

If you did not use a polygon in the contouring (you had a fault file), then the contours will extend beyond the horizon for a short distance. A simple way to deal with this is to make them the same color as the background. Since the map will often be plotted, it is advisable to change to background color from black to white. Then, alter the contour color to white using the color table.

Tip: Z-map often gets confused when using pure black or white because they can alter when the background color is changed. This can be avoided by using a non-pure color i.e. for white, make one of the red, blue or green percentages 99% rather than 100%, and similarly for black.

5. Final Edits

The map can be refined by altering the widths of the lines etc. using

Edit

Edit/Create Data

Contours, Faults, Lines

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Display parameters

By line

- Click on the line you wish to change
- Make whatever changes are necessary
- Click **OK** when you've finished.

You can also make small hand alterations to the contours using:

Edit

Edit/Create Data

Contours, Faults, Lines