

SOFTWARE VALIDATION TEST PLAN AND REPORT

Surfer[®], Version 8.0

Prepared for

**U.S. Nuclear Regulatory Commission
Contract NRC-02-02-012**

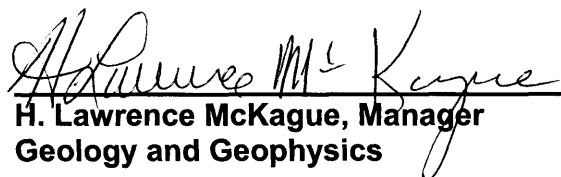
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12/16/04
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CONTENTS

Section	Page
FIGURES	ii
1 SCOPE OF VALIDATION.....	1
2 REFERENCES	1
3 ENVIRONMENT	1
3.1 Software	1
3.2 Hardware	1
4 PREREQUISITES	1
5 ASSUMPTIONS AND CONSTRAINTS	2
6 TEST CASES	2
6.1 Display Geospatial Data.....	2
6.1.1 Objective.....	2
6.1.2 Test Input.....	2
6.1.3 Test Procedure	2
6.1.4 Test Results.....	4
6.2 Display and Customize Various Maps.....	5
6.2.1 Objective.....	5
6.2.2 Test Input.....	5
6.2.3 Test Procedure	5
6.2.4 Test Results.....	7

FIGURES

Figure	Page
Figure 1. Open-File Report 00–188 Flight Path (Blakely, et al., 2000)	9
Figure 2. Open-File Report 00–188 Contour Map (Blakely, et al., 2000).....	10
Figure 3. Surfer® Flight Path Post Map	11
Figure 4. Surfer® Contour Map.....	12
Figure 5. Surfer® Surface Map	13
Figure 6. Surfer® Wire Frame Map.....	14
Figure 7. Surfer® Image Map	15
Figure 8. Surfer® Shaded Relief Map.....	16
Figure 9. Surfer® Vector Map	17

1 SCOPE OF VALIDATION

Surfer® developed by Golden Software, is a contouring, gridding, and surface mapping package for scientists and engineers. It converts data into contour, surface, wireframe, vector, image, shaded relief, and post maps. Virtually all aspects of maps can be customized to produce exactly the desired presentation. The features that will be validated in this Test Plan and Report are:

- Gridding
- Contour Maps
- Digitize Boundaries
- Worksheet
- Post Maps
- 3D Surface Maps
- 3D Wireframe Maps
- Shaded Relief Maps
- Vector Maps
- Image Maps

Software validation of Surfer® should confirm that the software can correctly perform the above listed functions with original data, maintaining geospatial relationships and coordinates. This list of functions is a subset of the entire list of functions available. It was chosen as a representative sample of commonly used functions necessary for processing raw data from start to finished product.

2 REFERENCES

Blakely, R.J., V.E. Langenheim, D.A. Ponce, and G.L. Dixon. "USGS Aeromagnetic Survey of the Amargosa Desert, Nevada and California: A Tool for Understanding Near-Surface Geology and Hydrology." Open-File Report 0-188. U.S. Department of the Interior. U.S. Geological Survey. 2000. <<http://geopubs.wr.usgs.gov/open-file/of00-188/>>

Golden Software product web site for Surfer®.
<<http://www.goldensoftware.com/products/surfer/surfer.shtml>>

3 ENVIRONMENT

3.1 Software

- System: Microsoft® Windows 2000

3.2 Hardware

- Computer: Intel® Pentium
- CPU 2.8 GHz
- Memory: 510 MB RAM

4 PREREQUISITES

Not applicable.

5 ASSUMPTIONS AND CONSTRAINTS

None.

6 TEST CASES

6.1 Display Geospatial Data

6.1.1 Objective

Demonstrate that Surfer® can correctly grid and display original geospatial data in correct geographic coordinates by contouring a map with an irregularly spaced grid. This will demonstrate the ability to grid and contour while limiting extrapolation extents using Contour Maps, Post Maps, worksheets, and digitizing boundaries.

6.1.2 Test Input

Benchmark data were provided from the U.S. Geological Survey Open-File Report *Aeromagnetic Survey of the Amargosa Desert, Nevada and California: A Tool for Understanding Near-Surface Geology and Hydrology* (Blakely, et al., 2000). A digital image of the flight path for the aeromagnetic survey is included as Figure 1 and a contour map as Figure 2. The raw data is located in an ASCII data file *amargosa.xyz*. The color file *ChromaDepth.clr* can be found in the program sample files directory: C:\Program Files\Golden Software\Surfer 8\Samples.

6.1.3 Test Procedure

1. Start Surfer® and create a new Plot Document in the test directory by clicking on the new icon (looks like a sheet of paper with the top right corner folded down). Save it with the name *amargosa_1.srf*.
2. Grid the data by selecting Data under the Grid menu. A dialog box will appear prompting you to select the file to grid. Select *amargosa.xyz* from the test directory. You will have to select Files of type "All Files (*.*)" to see the file name in the text field. Click on OK. A series of dialog boxes will appear prompting you for information. In the first window, ensure to check the Space and Tab delimiters, Skip leading spaces, and Treat consecutive delimiters as one and then click OK. In the second window, set the X, Y, and Z parameters:
 - X is Column B (longitude)
 - Y is Column C (latitude)
 - Z is Column H (leveled magnetic field intensity)

Set the Gridding Method to Minimum Curvature. Keep the default Output Grid File name of *amargosa.grd*. The default is to keep the same name as the input file but change the extension to ".grd" and save the file in the current working directory (the test directory). Click OK. A window will appear to signal the completion of the gridding process. Click OK.

3. Create a contour map of the grid file just created. Go to the Map menu and select Contour Map → New Contour Map. Select the grid file *amargosa.grd* that was just created. A contour map should appear. This is not the final map. Because the data are irregular and

we have not told Surfer® the extent of the data, the contour map will fill the entire grid plane with interpolated results. The next step will limit the interpolation to the extent of the available data.

4. Limit the extent of the contour map by creating a polygon file with the data extents.
 - Create a new worksheet with the file *amargosa.xyz*. Highlight the longitude and latitude data in columns B and C, copy them, and paste them into a new worksheet. Save the new worksheet as *xy_coords.txt* in the test directory.
 - Create a new Post Map with the *xy_coords.txt* file. Under the Map menu, select Post Map -> New Post Map and Open the file *xy_coords.txt*. The Post Map should show the flight path for the data collection (Figure 3). The coordinates will not match Figure 1, as they are in different units. This will be described in more detail in step 6 but does not affect results described in the current step. The X and Y axis are set to proportional scaling by default. Since this is not how the Open-File Report 00-188 contour maps (Figures 1 and 2) represent the X and Y axis, this feature will be disabled. To turn this off, double click on the Post Map and under the Scale tab on the Properties dialog window, uncheck the Proportional XY Scaling box. Because we still want a square map, set X Scale and Y Scale lengths both to 5.0. This will automatically adjust the Map units.
 - If the test is successful, the flight path created by Surfer® in Figure 3 should be similar to the flight path in Figure 1. There will be slight differences between the two figures. The flight path in Figure 1 has been altered to remove tie-lines that can be seen in Figure 3 created here with all of the raw data intact. The tie-lines appear as three diagonal lines from the top to the bottom of the flight path. Figure 1 has additional dashed boundary lines that this test does not recreate. Note that the scale bar in Figure 3 is a symbol added for reference only and is not an accurate representation of scale (see step 7 for more detail).
 - Create a polygon defining the edge of the data by right clicking on the post map of the data points and choose the Digitize option. Click the mouse to save XY point coordinates to the *digit.blm* window. Grid the vertex points of the areas you want to blank (i.e., select vertex points to create polygons for the areas on the flight path that do NOT have data), then choose the Grid | Blank menu commands, specify the input GRD and BLN files, and name the new output GRD file *amargosa_final.grd*.
5. Create a new contour map from the file *amargosa_final.grd* in the same manner as the first contour map was created in step 3. Edit the contour map to create the desired presentation.
 - Double click on the map and a Contours Properties dialog window will appear. Under the General tab check the Fill Contours and Color Scale boxes. Under the Levels tab, click on the Level heading and set the minimum and maximum levels to -200 and 80 with an interval of 20. Click on the Fill heading and a dialog window will appear that will allow you to change the Foreground Color (i.e., the contour fill colors). Click on the Foreground Color box and Load a color file from the sample directory C:\Program Files\Golden Software\Surfer 8\Samples named *ChromaDepth.clr*. Under the Scale tab, uncheck the Proportional XY Scaling box and set both X Scale and Y Scale lengths to 5.0. Apply all of the changes with the "Apply" button on the Contours Properties dialog and click OK.

- Once the contour dialog box has closed, double click on the Color Scale to open the Color Scale Properties dialog box. Change the Label Frequency to 2, apply the change and click OK.
6. Modify the grid lines by double clicking on the proper axis and setting the desired options in the dialog window that appears. Figure 2 from the Open-File Report has the format dd°mm' (degrees, minutes) for the longitude and latitude, a conversion made by the software program that generated the figure. Since the input file *amargosa.xyz* is in decimal degrees, Surfer® will use decimal degrees for the X and Y axis values. By dividing the minutes by 60 and adding this to the degrees, the output format becomes decimal degrees. For example, the first x-coordinate is 116°45'. This translates to $116 + 45/60 = 116.75$ decimal degrees. The values in the Surfer® map will be negative for the x-axis because the data are negative in the input file (all longitude values west of the prime meridian are negative).
 - Right Axis – under the General tab, uncheck the Show box and under the Ticks tab, select None for Major and Minor Ticks
 - Left Axis – under the Scaling tab, set the First Major Tick to 36 and the Last Major Tick to 36.75 with a Major Interval of 0.25
 - Top Axis – under the Scaling tab, set the First Major Tick to –116.75 and the Last Major Tick to –115.75 with a Major Interval of 0.25.
 - Bottom Axis – under the General tab, uncheck the Show box and under the Ticks tab, select None for Major and Minor Ticks
 7. Create a scale bar by clicking on the map to select it and selecting Scale Bar under the Map menu. Set the Number of Cycles to 5, the Cycle Spacing to 0.1, the Label Increment to 10 and X axis for the Scale tracks. Click OK. Notice that this scale bar only represents what the user tells it to represent. It does not automatically interpret distances from the map. It is only a symbol added for clarity and is useful only if the user already knows what the scale should be set to and ensures that the symbol is the correct length against the map.
 8. Create a text caption for the scale bar symbol by clicking on the text icon on the toolbar. It looks like a capital T. Click on the Plot area where you want the text added, type the content, and modify the font as desired. Use the same method to add the label “nT” to the color scale bar, the unit “KM” to the distance scale bar, and the scale “1:250,000” below the scale bar symbol.
 9. All objects in the Plot area can be dragged and dropped to create more aesthetically pleasing arrangements.
 10. Compare final map (Figure 4) with Figure 2 from Open-File Report 00–188. Verify the coordinates are correct and that anomalies appear in the same locations and are of the same magnitudes (based on their respective color tables). Verify the map and color scales are the same and the area of data plotted on the Surfer® map corresponds to the area of data within the flight path (Figure 1).

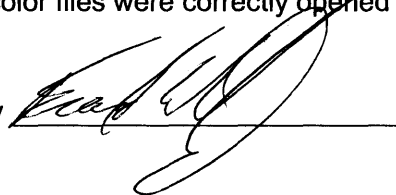
6.1.4 Test Results

PASS/FAIL: The test is successful if all required results are obtained in Section 6.1.3.

This test **PASSED**. The following comments substantiate the PASSING test results.

- Surfer® correctly gridded and displayed original geospatial data in correct geographic coordinates.
 - Surfer® correctly generated the flight path using data manipulated within the worksheet. This output shown in Figure 3 has the correct path for the aeromagnetic survey flight path and matched with Figure 1.
 - The final map shown in Figure 4 has the correct coordinates, the same shape (i.e., the areas where data exists correspond with the flight path shown in Figure 1 and the red dashed line in Figure 2), and the same magnetic intensities as the original map (Figure 2).
- Digitizing the boundaries of the Post Map that contained the flight path was performed correctly. The proof of this is the shape of all maps that had NULL data blanked with this file (Figures 4, 5, 6, 7, 8, and 9). They all have the same shape as the flight path in Figures 3 and 1.
- All manipulations of grid lines, color scales, text, scale bars, other utilities caused the desired effects.
- Data files and color files were correctly opened and used.

Tester: Brandi L. Winfrey



Test Date:

10/20/04

6.2 Display and Customize Various Maps

6.2.1 Objective

- Demonstrate that Surfer® can correctly display original geospatial data as 3D Surface, 3D Wireframe, Image, Shaded Relief, and Vector Maps.

6.2.2 Test Input

Data file *amargosa_final.grd* created in Step 6.1 of this procedure. The color files *Angled Black.clr* and *Grayscale.clr* can be found in the program samples files directory: C:\Program Files\Golden Software\Surfer 8\Samples.

6.2.3 Test Procedure

1. Create a new Plot Document in the test directory by clicking on the new icon. Save it with the name *amargosa_2.srf*.
2. Create a 3D Surface Map by clicking on Surface under the Map menu. Select the file *amargosa_final.grd* in the test directory.
 - Customize the Surface Map in the same manner as steps 5, 6, and 7 in Test Procedure 6.1.3 with the following exceptions.

- Substitute the color file *Grayscale.clr* for the *ChromaDepth.clr* file used in the first test. Change the black color to an olive-green color.
 - On the Surface Properties dialog window, under the Scale tab, scale the Z-axis to 3.00
 - Under the General tab, where it says Blanked Nodes, check the circle “Remap to:” and set the value to -205 so that the grid lines at -200 will be visible above the null floor.
 - On the X and Y axis dialog windows, under the Scaling tab, set both X and Y axis to cross the Z axis at -200.
 - Rotate the figure using the 3D trackball to obtain a useful view.
 - Verify that the Surface Map (Figure 5) agrees with the data presented in Figures 2 and 4.
3. Create a 3D Wireframe Map by clicking on Wireframe under the Map menu. Select the file *amargosa_final.grd* in the test directory.
- Customize the Wireframe Map in the same manner as steps 5, 6, and 7 in Test Procedure 6.1.3 with the following exceptions.
 - Under the General tab on the Wireframe Properties dialog window, set the Base Elevation to -200 and check “Show Base”. Check only the X and Y Plot lines.
 - On the Wireframe Properties dialog window, under the Color Zones tab check zones X and Y and Color Scale. Click on the level header and set the contour to min and max to -200 and 80, respectively, with an interval of 20. Click on the Line header and select colors for the min and max values. Surfer® will scale all intermediate contours accordingly.
 - On the Wireframe Properties dialog window, under the Scale tab, scale the Z-axis to 2.00
 - On the X and Y axis dialog windows, under the Scaling tab, set both X and Y axis to cross the Z axis at -200. Set the Z axis to cross the X axis at -116.75.
 - Rotate the figure using the 3D trackball to obtain a useful view.
 - Verify that the Wireframe Map (Figure 6) agrees with the data presented in Figures 2 and 4.
4. Create an Image Map by clicking on Image Map under the Map menu. Select the file *amargosa_final.grd* in the test directory.
- Customize the Image Map in the same manner as steps 5, 6, and 7 in Test Procedure 6.1.3 with the following exceptions.
 - Substitute the color file *AngledBlack.clr* for the *ChromaDepth.clr* file used in the first test. Check the “Interpolate Pixels” box on the General tab of the Shaded Relief Properties dialog window.
 - Verify that the Image Map (Figure 7) agrees with the data presented in Figures 2 and 4.

5. Create a Shaded Relief Map by clicking on Shaded Relief Map under the Map menu. Select the file *amargosa_final.grd* in the test directory.
 - Customize the Shaded Relief Map in the same manner as steps 5, 6, and 7 in Test Procedure 6.1.3.
 - Verify that the Shaded Relief Map (Figure 8) agrees with the data presented in Figures 2 and 4.
6. Create a Vector Map by clicking on Vector Map → New 1-Grid Vector Map under the Map menu. Select the file *amargosa_final.grd* in the test directory.
 - Customize the Vector Map in the same manner as steps 5, 6, and 7 in Test Procedure 6.1.3 with the following exceptions.
 - The Vector Map displays vectors generated by Surfer® by numerically computing the gradient of the represented surface. The gradient values are always positive and therefore the color scale will not match the scale in all other figures. This is correct.
 - Under the Symbol tab on the Vector Properties dialog window, substitute the color file *Grayscale.clr* for the *ChromaDepth.clr* file used in the first test. Change the black color blue and the white to red. Set the minimum and maximum Data to Color Mapping limits to 10 and 3000, respectively. Check “Show Color Scale”.
 - Under the Scaling tab of the Vector Properties dialog window, set the minimum and maximum magnitude to 10 and 3000, respectively.
 - Keep the Proportional XY Scaling box checked under the Scale tab.
 - Verify that the Vector Map (Figure 9) agrees with the data presented in Figures 2 and 4.

6.2.4 Test Results

PASS/FAIL: The test is successful if all required results are obtained in Section 6.2.3.

This test **PASSED**. The following comments substantiate the PASSING test results.

- Three-dimensional surface, three-dimensional wire frame, images, and shaded relief maps had the same defining features (i.e., magnetic intensities are high or low in the same respective places). The Vector Map, though it represented different units, showed a strong correlation to the data modeled in Figure 1, with areas of the largest gradients corresponding to areas with sharp changes in magnetic intensity.
- Surfer mapped the input data coordinate system correctly for all maps (Figures 5–9). When compared to Figures 2 and 4, everything lines up.

- All manipulations of grid lines, Z-values, color scales, text, and 3D rotations caused the desired effects.
- Data files and color files were correctly opened and used.

Tester: Brandi L. Winfrey

A handwritten signature in black ink, appearing to read 'Brandi L. Winfrey', written over a horizontal line.

Test Date:

10/2004

9

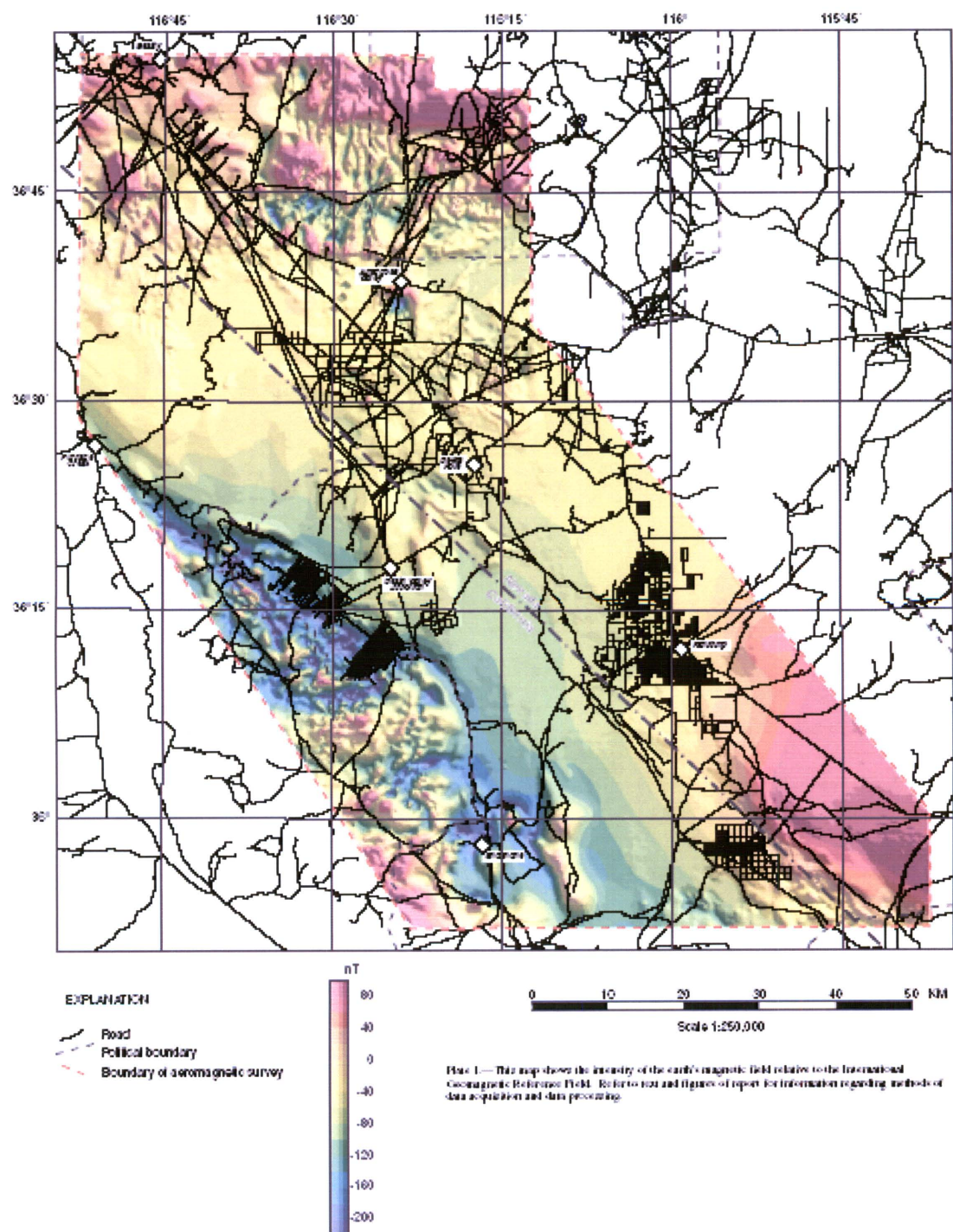


Figure 2. Open-File Report 00-188 Contour Map (Blakely, et al., 2000)

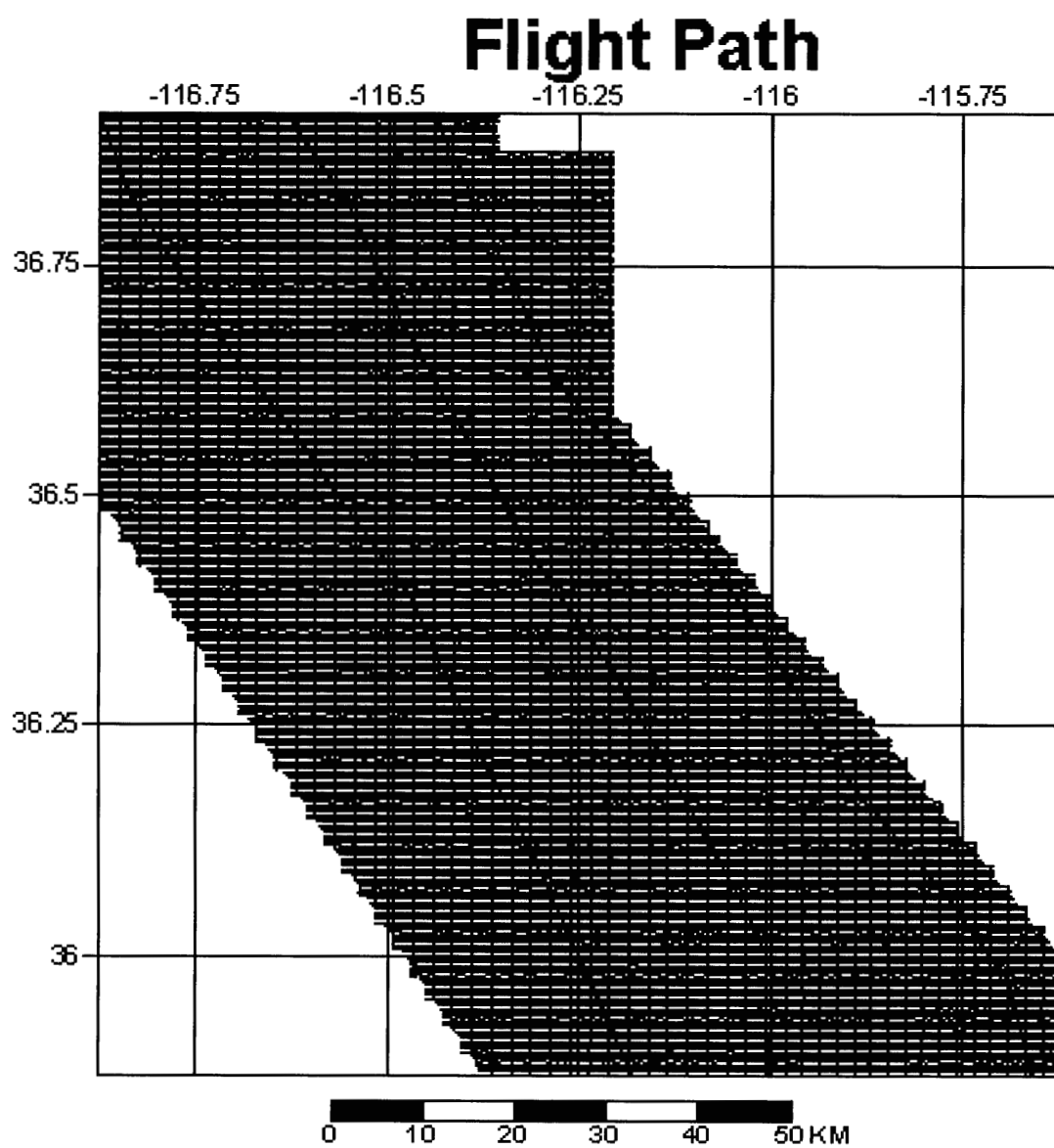


Figure 3. Surfer® Flight Path Post Map

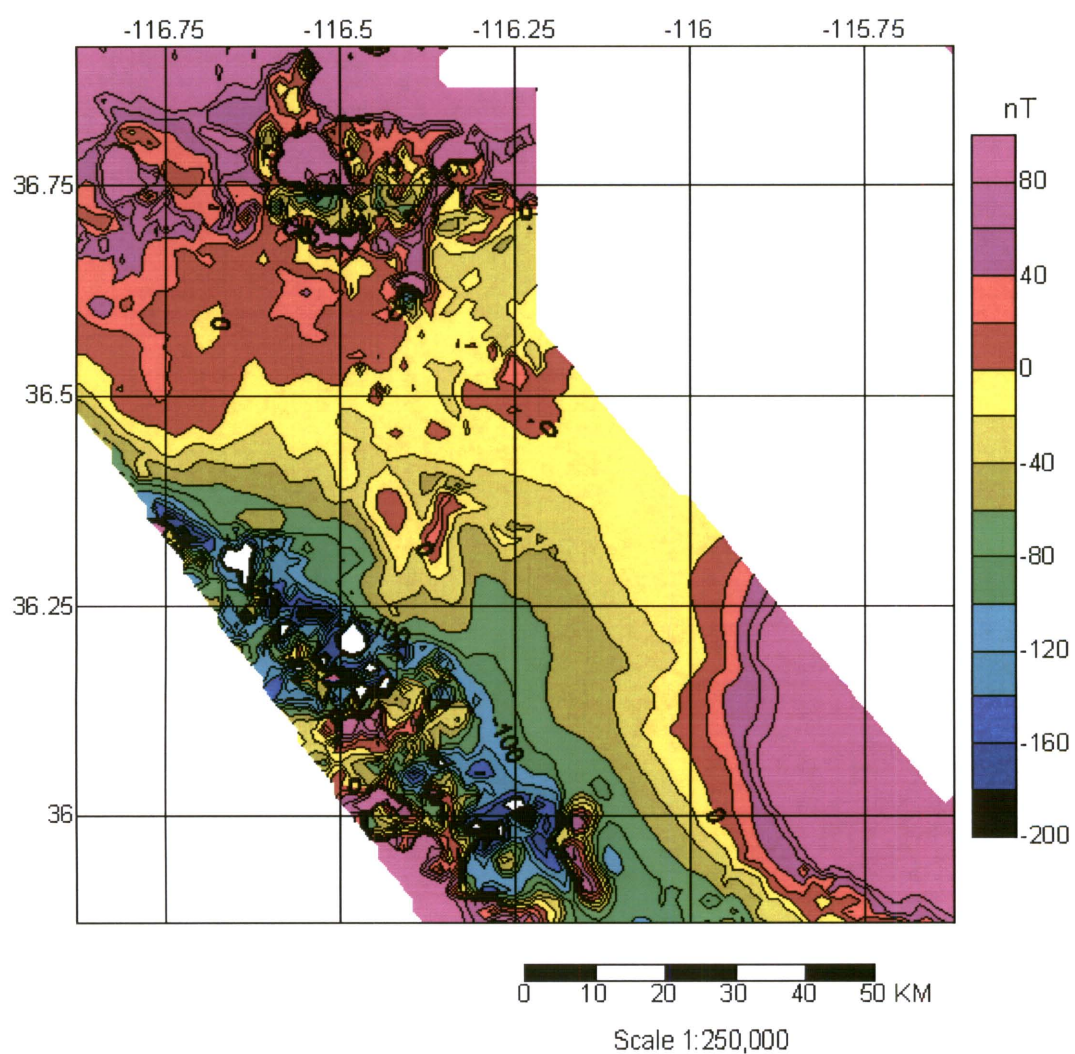


Plate 1. --- This map shows the intensity of the earth's magnetic field relative to the International Geomagnetic Reference Field. Refer to text and figures of report for information regarding methods of data acquisition and data processing.

Figure 4. Surfer® Contour Map

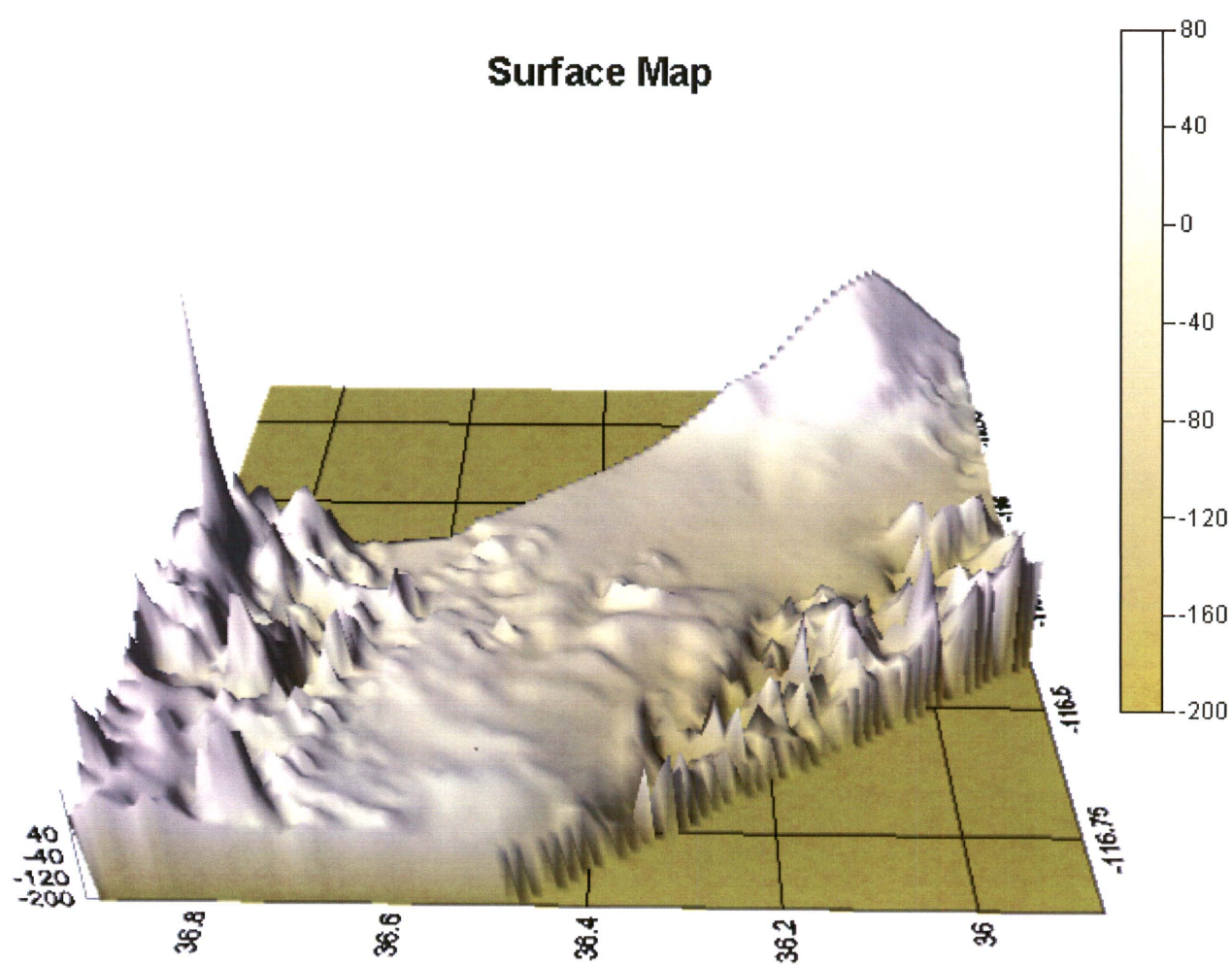


Figure 5. Surfer® Surface Map

Wire Frame Map

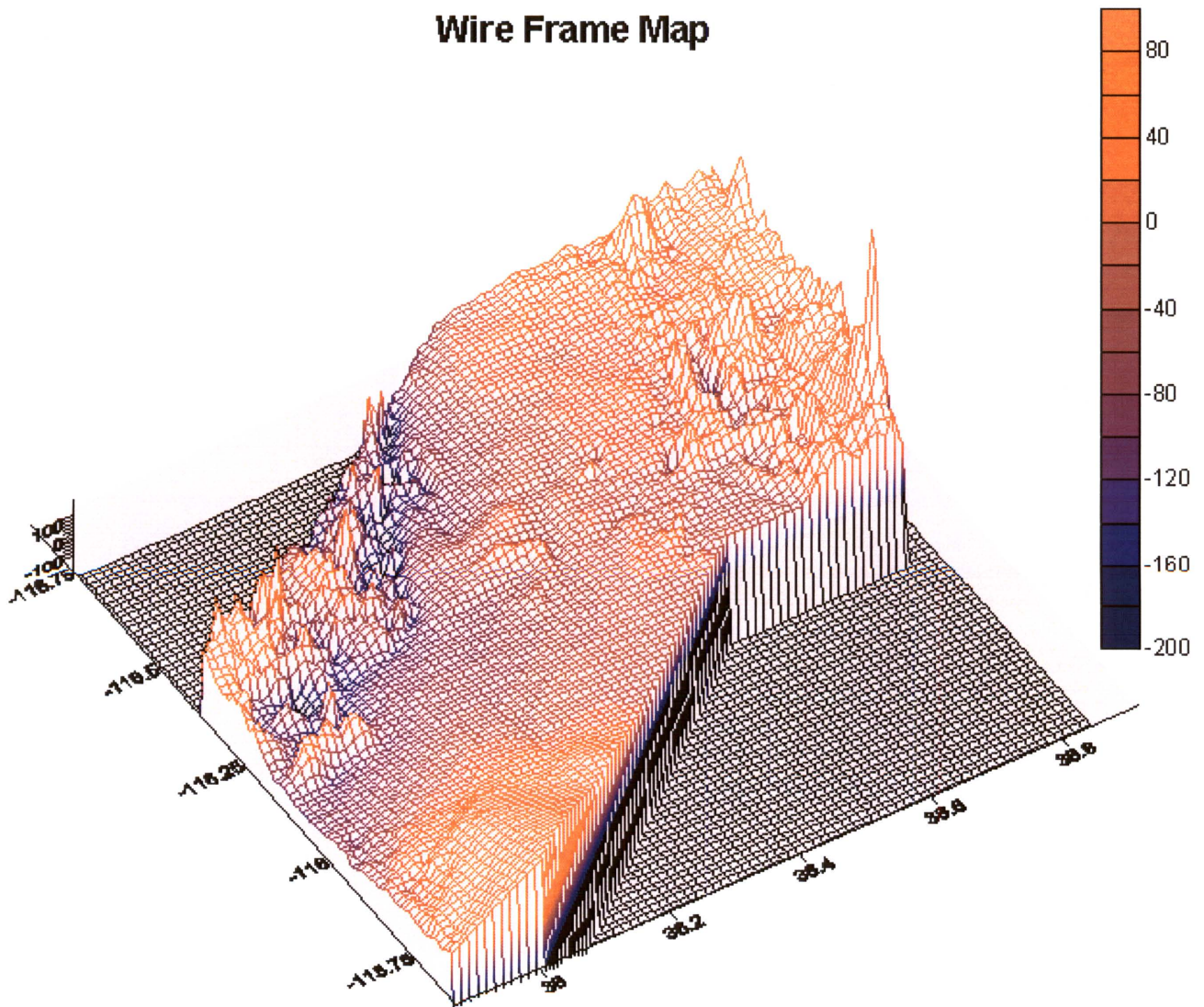


Figure 6. Surfer® Wire Frame Map

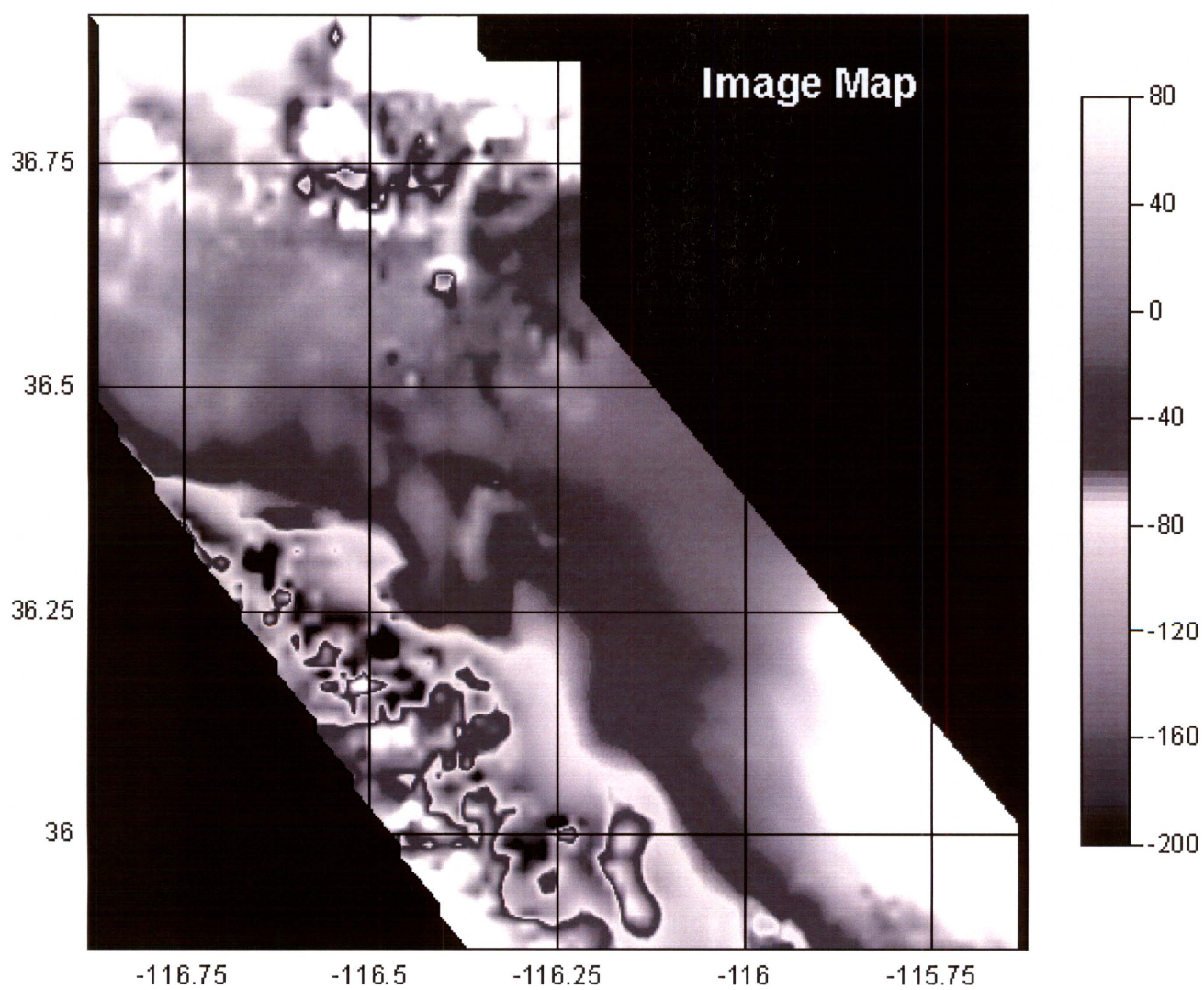


Figure 7. Surfer® Image Map

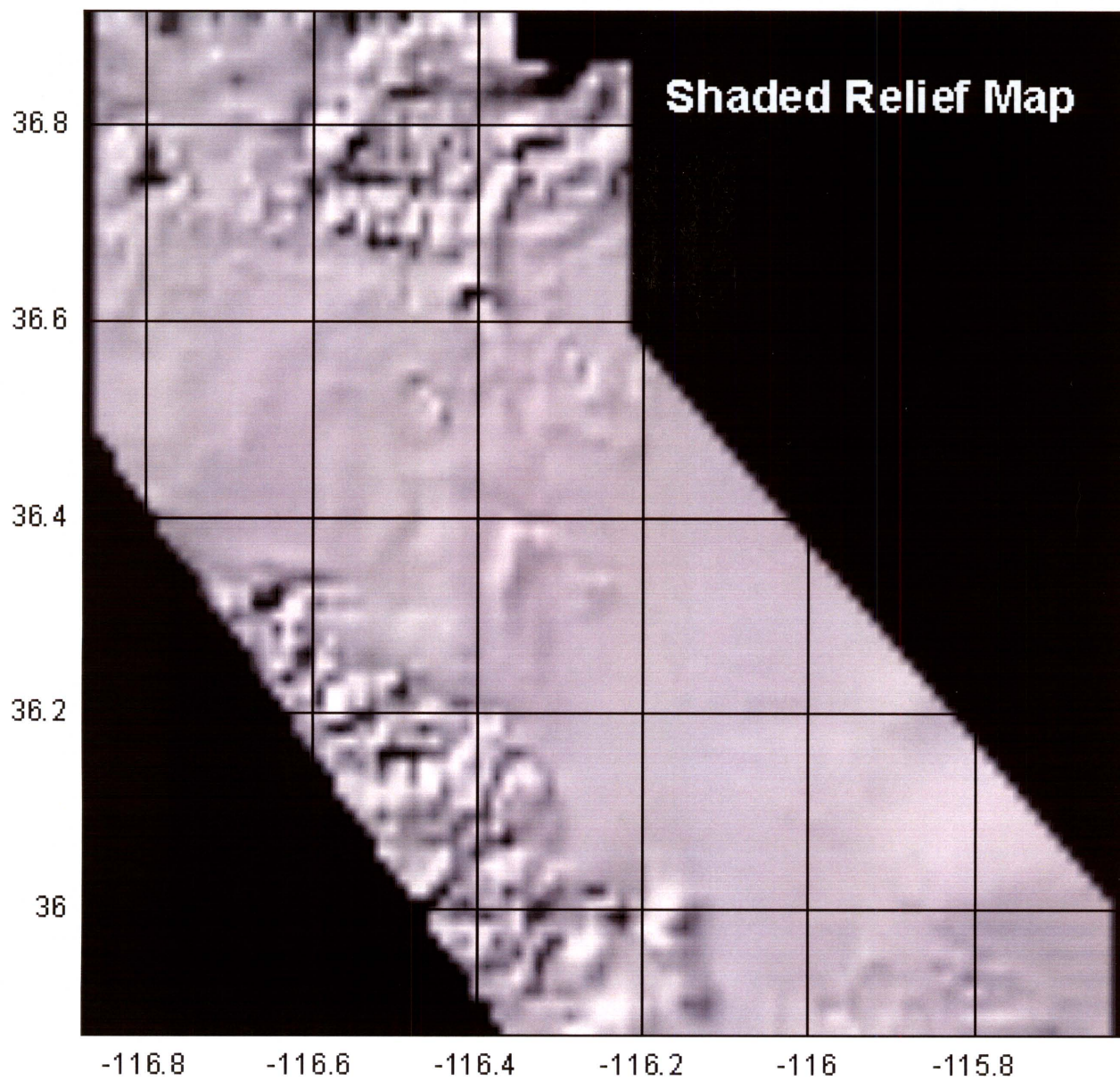


Figure 8. Surfer® Shaded Relief Map

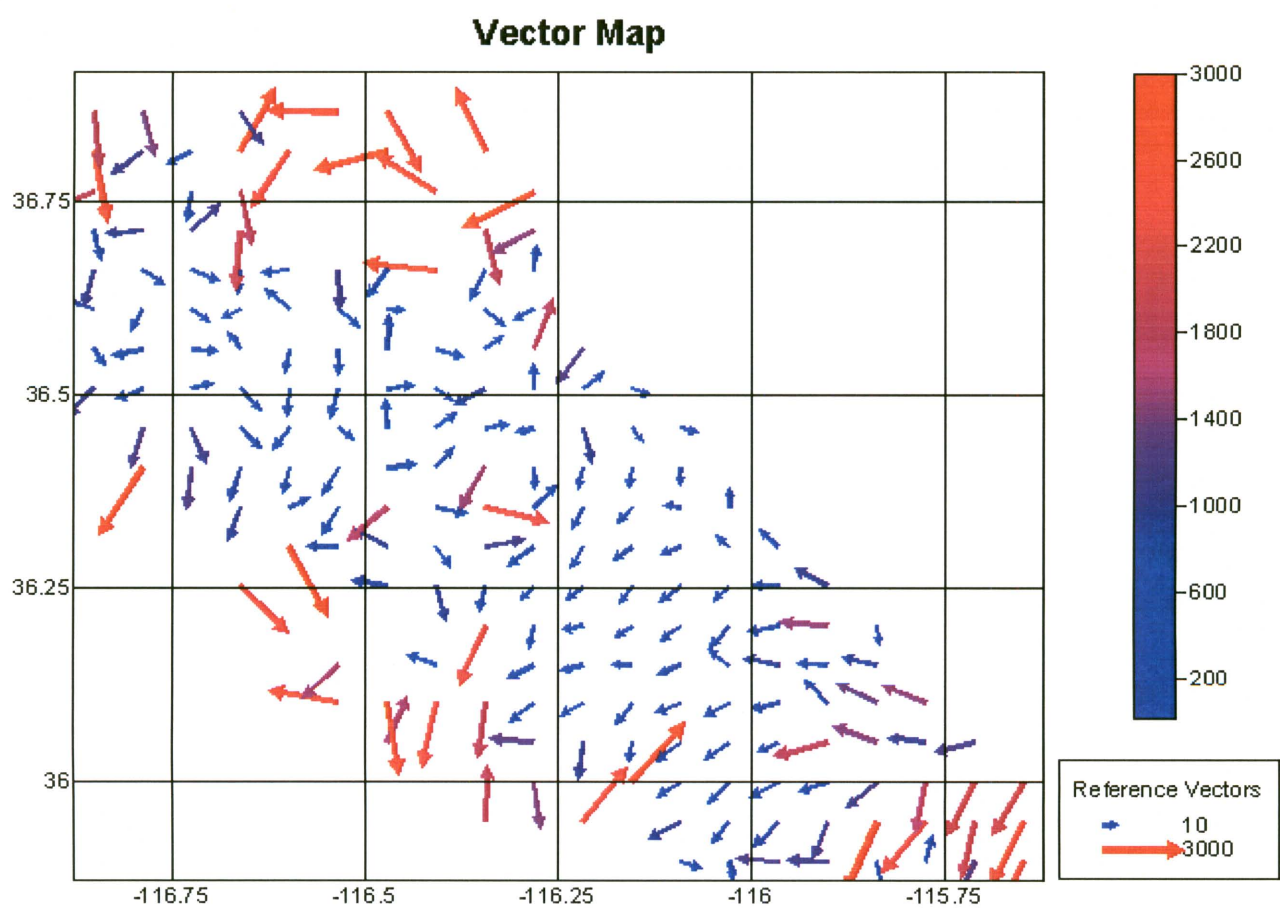


Figure 9. Surfer® Vector Map