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Processing Method of Geological Data in Contour Map based on Surfer

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Abstract

With the development of geological science, contour maps play an increasingly important role in mineral exploration and production. At present, there are lots of software for automatically generating contour maps, among which the Surfer software launched by Golden Software of the United States is the most widely used. However, the geological contour map has its own characteristics. If it is directly processed by Surfer software without processing, it is difficult to generate a geological contour map that conforms to the actual situation. Based on the author's many years of using Surfer software, this paper takes the contour map of coal seam thickness as an example. The method of processing geological data in the contour map by using Surfer software is summarized, so that the automatically generated contour map is as close as possible to the geological reality.

Keywords

Contour; Data processing; Complex boundary; Surfer.

1. INTRODUCTION

In geological exploration, production and scientific research, the contour map is a widely used geological map. With the wide application of computer technology, at present, the preparation of contour maps is automatically generated by computer software. Currently there are lots of software that can be used to automatically generate contour maps. Among them, Surfer software from the US Golden Software Company is the most widely used. But Surfer software can't completely handle many complicated geological phenomena. If the data is not processed, the contour map will be generated directly using the Surfer software. The contour map generated may not conform to the actual geological conditions and thus cannot be used well for production and scientific research. The coal seam thickness contour map is taken as an example below. Perform different data processing according to the different geological conditions in the contour map of the coal seam thickness. Explain how to make the automatically generated contour map as close as possible to the geological reality.

2. DATA PROCESSING AND MAPPING METHOD FOR COAL-FREE AREA CAUSED BY SEDIMENTATION

Due to the complexity of geological conditions, usually in a survey area or study area, there is often no coal-free area. A more common situation is that due to changes in the sedimentary environment, coal is not suitable for formation in a certain area during coal formation, resulting in a coal-free zone. The coal seam thickness in the coal-free zone caused by this situation is a gradual relationship, that is, the coal-free borehole represents no coal in a certain area. The coal seam thickness from the coal-free area to the coal-bearing area is gradually changing. In this

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case, to compile the coal seam thickness contour, the zero boundary line must be delineated first (the zero boundary line is the line connecting the points where the coal seam thickness tends to zero on the projection surface, which is the boundary indicating the complete end of the coal seam).Generally, the midpoint method is adopted, that is, the line connecting the midpoint of the coal point and the non-seeing coal point is taken as a zero boundary line. Then use the interpolation method from the zero boundary line to the coal-drilled hole to insert the contour of the coal thickness to be drawn. If you use the Surfer software to draw the contour map directly, the software will not use the correct method described above. Instead, the software interpolates directly from the point where the thickness
is zero, so that the contour map generated is not in line with the geological reality.

As shown in Fig. 1 the three holes of ZH22, ZH23 and ZH24 are coal-free areas caused by sedimentation. If all the data are directly used, the contour map generated by data gridding using Surfer software is as Fig. 2 shows. The coal thickness contour map thus generated is incorrect.

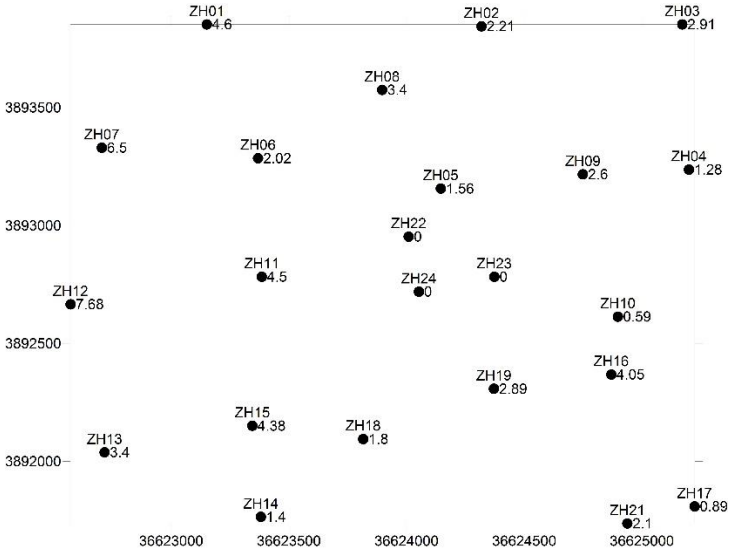

Figure 1. Raw data distribution of coal seam thickness in a research area

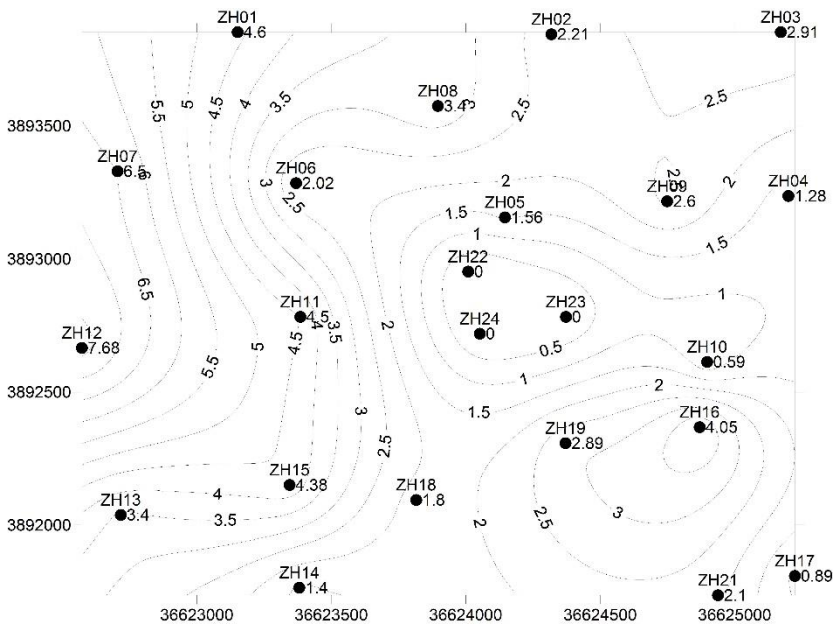

Figure 2. Contour map of coal seam thickness in a study area directly generated by Surfer

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There are some steps:

First, select the “Post Map” under the “Map” menu in Surfer to display the distribution of the original data (see Fig. 1).

In the second step, select the “Digitization” function under the “Map” menu. Then use the mouse to click on the 1/2 of the line connecting the coal point and the non-seeing coal point. Each time you click, the system will record the coordinates of the click (see Fig. 3). After clicking, close the digit. bln window and save document.

The third step is to open the saved digit. bln file, add the coal layer thickness to 0.00 after the coordinates, copy the data, and paste it behind the original coal seam thickness data.

In the fourth step, the processed data is used to generate the coal thickness contour (see Fig. 4).

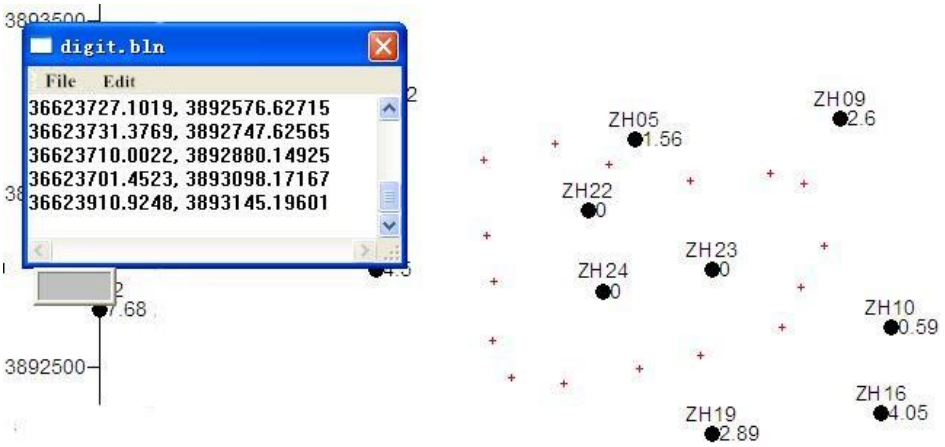

Figure 3. Use the digital function to record the coordinates of 1/2 of the edge of the coal point and the non-seeing coal point.

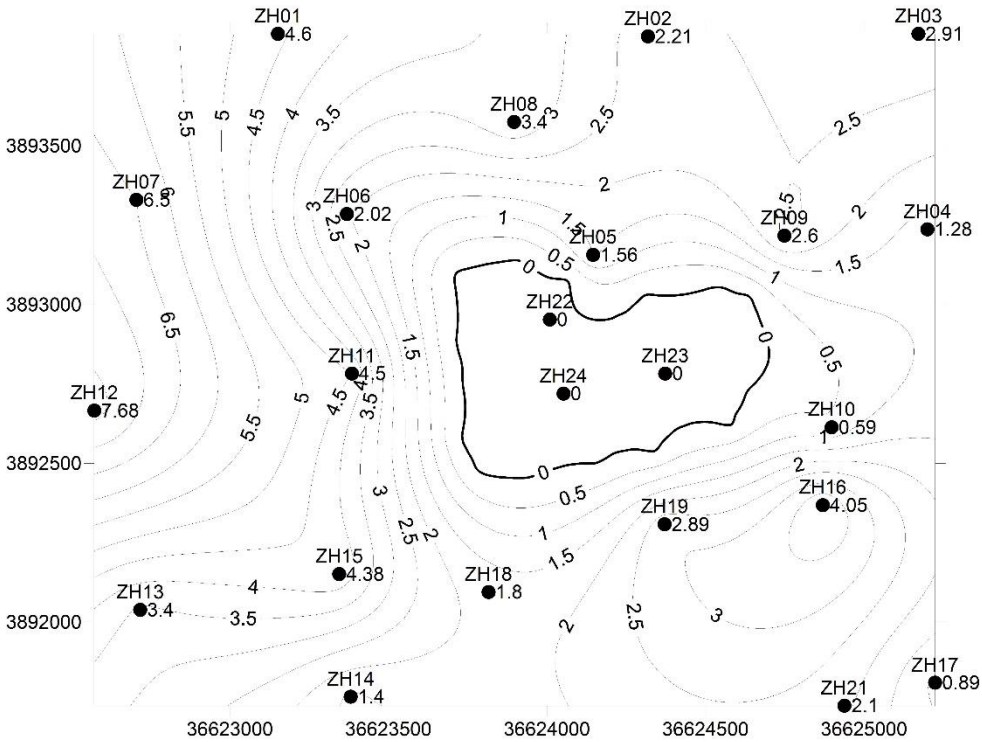

Figure 4. Contour map of coal area in a certain area generated by processed data

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3. DATA PROCESSING AND MAPPING METHOD FOR COAL-FREE ZONE CAUSED BY COLLAPSE COLUMN, IGNEOUS ROCK INTRUSION, COAL SEAM SPONTANEOUS COMBUSTION, RIVER EROSION AND OTHER REASONS

3.1. Data Processing

Usually, the collapse column, igneous rock intrusion, coal seam spontaneous combustion, river erosion and other reasons will cause the coal seam to be missing, thus forming a coal-free zone. During the exploration, the borehole may hit these areas, and the coal seam thickness is zero..How to prepare the contour map of coal seam thickness in this case? If not processed, plot all the raw data directly, and the contours drawn are not in line with the geological reality. However, the above method cannot be used because these conditions are fundamentally different from the coal-free areas caused by sedimentation. Because of the coal-free zone caused by sedimentation, the change in the thickness of the coal seam is gradual. The coal-free zone caused by the collapse column, igneous rock intrusion, coal seam spontaneous combustion, river erosion and other reasons, the change of coal seam thickness is abrupt. For the coal-free zone where the thickness variation of the coal seam is abrupt, the data processing method is the same when using the Surfer software to generate the contour map of the coal seam thickness, that is, the data with zero coal seam thickness is deleted during the drawing, and then used. The whitening method removes the contours of the coal-free zone. The following is an example of a coal-free zone caused by igneous rock intrusion.

If there is a coal-free zone in the western part of the above-mentioned exploration area due to the intrusion of igneous rocks, two of the holes (ZH25 and ZH26) are hit in this area, and the thickness of the coal seam is zero. To deal with this coal-free zone formed by a sudden change in thickness, it is first necessary to create a Surfer boundary file when drawing. Surfer's boundary file is a file for storing closed lines, curves, and ASCII format with dot extension bna. The format is as follows, see Table 1.

Table 1. Surfer's boundary file format table

Primary Name 1	Secondary Name 1	Type/Length Value
X1	Y1	
X2	Y2	
...	...	
Xn	Yn	

Tip:

(1) The primary name is the primary ID name of the boundary object, which is mainly used for external links.

(2) The secondary ID name of the boundary object, which is optional.

(3) Type/length value is an integer that indicates the type (region, line, point) and coordinate point logarithm of the boundary object.

① Type/length value > 2: indicates that the boundary is a closed area and the value is the number of control points on the area;

② Type/length value = 2: indicates that the boundary is an ellipse, the first pair of coordinates thereafter describes the center of the ellipse, and the second pair of data describes the long and short radii of the ellipse, respectively. If the short radius is 0, the boundary object is a circle;

③ Type/length value < -1: indicates that the boundary is a curve and the value is the number of

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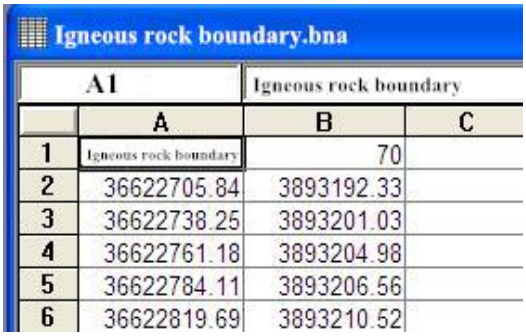
control points on the curve.

④ Type/length value = 1: indicates a point, followed by only 1 pair of coordinates.

Note: When the control point coordinates of the specified area, the end point coordinates must coincide with the starting point coordinates, ie (X1, Y1) = (Xn, Yn).

3.2. Mapping Method

The first step: prepare two data, one is Surfer's boundary file, if the boundary of the igneous rock intrusion area is surrounded by 70 coordinate points (because it is a closed area, the first point coincides with the last point), in Surfer's worksheet Enter the boundary data (can also be used as an excel form or as a TXT text file and then opened in Surfer's worksheet). The first line of input is ”fired rock boundary”, 70. The rest of the behavior is 70 points of X, Y coordinates, and this file is saved as a surfer boundary file (such as "fired rock boundary. bna"), see Fig. 5. The second file is a blank file for whitening. The blank file and the boundary file are different from the first line, and the remaining lines are still X, Y coordinates of 70 points. Simply change the first line to 70,1 (70 means that the coal-free zone is controlled by 70 points, 1 means that 70 points will not be drawn within the closed area enclosed by the control), save as a blank file with the extension bln (such as "fired rock boundary.bln"), see Fig. 6.

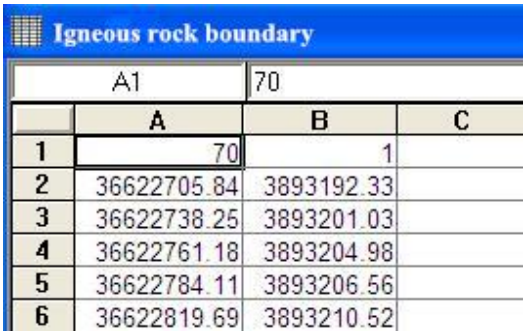


Igneous rock boundary.bna

A1 | Igneous rock boundary

	A	B	C
1	Igneous rock boundary	70	
2	36622705.84	3893192.33	
3	36622738.25	3893201.03	
4	36622761.18	3893204.98	
5	36622784.11	3893206.56	
6	36622819.69	3893210.52	

Figure 5. Igneous rock intrusion area boundary file



Igneous rock boundary

A1 | 70

	A	B	C
1	70	1	
2	36622705.84	3893192.33	
3	36622738.25	3893201.03	
4	36622761.18	3893204.98	
5	36622784.11	3893206.56	
6	36622819.69	3893210.52	

Figure 6. Igneous rock intrusion area bleaching file

The second step: first mesh with raw data (note that the two boreholes in the igneous rock intrusion zone are deleted), and then the generated grid file is whitened with the blank file “fired rock boundary. bna”.

Step 3: Generate a coal thickness contour with a whitened grid file.

Step 4: Use the “post map” function to plot the data on the contour map.

Step 5: Use the “base map” function to plot the igneous rock intrusion zone boundary (the “igneous rock boundary. Bna” file) on the contour map.

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Step 6: Press the F2 function key, select all objects, and then select “Overlay Map” under the “Map” menu to make the coordinate system of each graphic object. The final result is shown in Fig. 7.

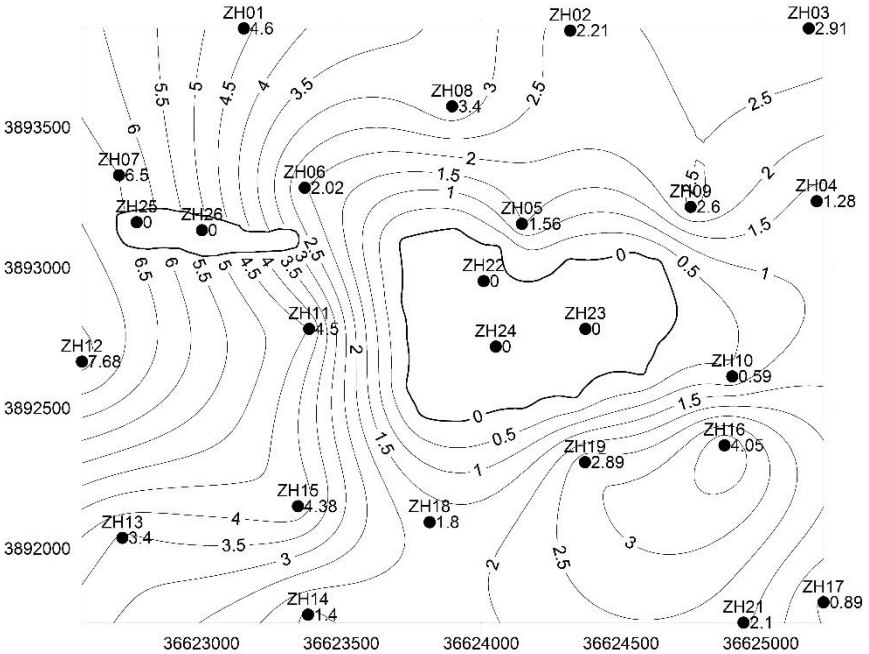

Figure 7. Contour map of coal seam thickness in a survey area

It should be noted that when the actual drawing is performed, only one boundary file can be prepared, and it is not necessary to prepare a whitening file and whiten the grid. The data(Note that the borehole data with zero coal thickness in the igneous rock intrusion zone has been removed.) is meshed directly to generate a contour map. However, when using the base map function to plot the boundary of the igneous rock intrusion zone on the contour map, you should select the filling function of the base map (Fig. 8) to cover the contour of the igneous rock intrusion zone to achieve the same effect. In the object manager of Surfer, the base map should be placed on top of the contour map, otherwise the contour of the igneous rock intrusion area cannot be covered.

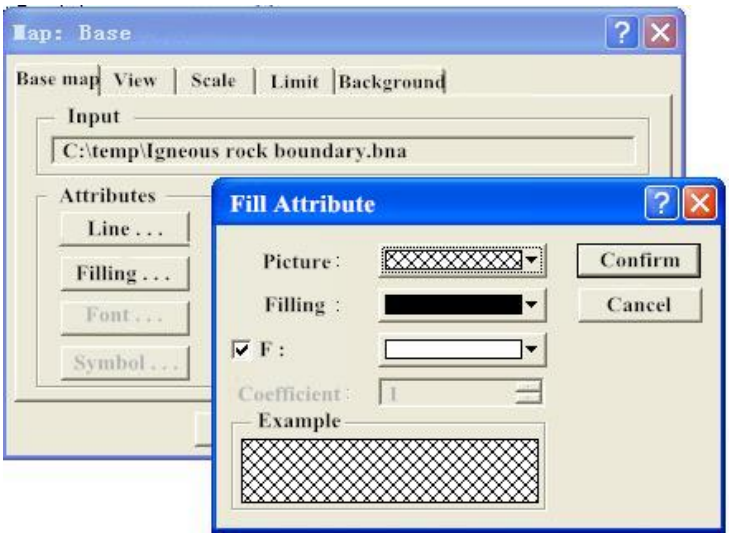

Figure 8. Base map properties dialog

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4. CONCLUSION

At present, there are lots of software that can directly generate contour maps, and no matter how powerful the software is, it cannot completely handle various complicated geological conditions. Therefore, different treatment methods are needed for different geological conditions, so that the generated geological contours can be more in line with the geological reality, so as to better serve production and scientific research. In this paper, only the automatic generation of contour map of coal thickness is taken as an example. It shows that different data processing and drawing methods are adopted for different geological conditions, so that the contour map is more in line with geological reality.

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