

# THE DESIGN OF IMAGE TOPOGRAPHIC MAPS AND HILL-SHADING TOPOGRAPHIC MAPS IN THE WESTERN MAPPING PROJECT

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## ABSTRACT:

In order to provide users with more diverse varieties of new GIS products that contain richer content, it is proposed that Image topographic maps and hill-shading topographic maps should be produced as the DLG topographic maps offered in the 1:50 000 topographic mapping of blank areas in the western region, China. This paper first describes the contents contained in the Image topographic map and hill-shading topographic map, and principles about how to represent them. Then, the technological process of produce Image topographic map and hill-shading topographic map are given. Now, two technical specification documents that specify how to produce Image topographic maps and how to produce Hill-shading topographic maps have been put forward based on some experiments, and the study results have been applied to the 1:50 000 topographic mapping of blank areas in the western region project. It demonstrates that the Image topographic maps are good supplementary products for topographic maps, which can provide more texture information for users, and the Hill-shading topographic maps are good substitute products for topographic maps in some areas, which can represent characteristics of terrain and surface features better.

## 1. INTRODUCTION

### 1.1 General Instructions

Topographic map is the general map that represents relief and features on Earth's surface, and shows altitude by means of contour lines. [1] It plays an important role in the national economical and social development.

In order to provide users with more diverse varieties of new GIS products that contain richer content, it is proposed that Image topographic maps and hill-shading topographic maps should be produced as the DLG topographic maps offered in the 1:50 000 topographic mapping of blank areas in the western region, China. Image topographic maps are good supplementary products for topographic maps, which can provide more texture information for users, and the Hill-shading topographic maps are good substitute products for topographic maps in some areas, which can represent characteristics of terrain and surface features better.

## 2. CONTENT AND REPRESENTATION OF IMAGE TOPOGRAPHIC MAP AND HILL-SHADING TOPOGRAPHIC MAP

### 2.1 Content and representation of Image topographic map

**2.1.1 Content** The 1:50000 Image topographic map of National western mapping project is the composite product created by overlay of data selected from DLG product on DOM, processing of spatial relations and symbolization of vector data. It is composed of two parts. One part is vector geography elements selected from DLG, including residence, transportation, water system, boundary, contour, annotation and so on. The other part is the color digital orthographic map created by image rectification, synthesis and fusion from

original image and it provides terrain background texture information.

In order to provide users with reference information that can be used to identify features in the DOM, image blocks are supposed to be extracted from DOM as a part of legend. Principles for image blocks extraction are specified as follows:

- a) Polygon features are the main elements to be extracted.
- b) The features selected are supposed to reflect the regional characteristics.
- c) The colors and textures of the blocks extracted should be distinctive.
- d) The theme features should be prominent in the blocks.

To make sure that Image topographic map contains as much information as possible, and more information can be got from DOM texture information, principles for selection vector data from DLG are specified as follows:

- a) Do not select the natural features that can be identified clearly from DOM, such as polygon water feature.
- b) Select as much artificial features as possible when they do not affect to identify feature based on texture information of DOM.
- c) Select as much annotations as possible

**Representation** Vector features are overlaid on color DOM. To make sure that symbols and annotations are easy to read, the symbols should inherit the standard topographic map symbols which are specified in GB/T 20257.3-2006 as much as possible.

Furthermore, to make symbols and annotations clear in the Image topographic map, symbols are used the form of chromatic, contrast and magnification. Based on these principles, symbols of vector features and annotations are

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designed for the 1:50000 Image topographic map of National western mapping project. Some symbols are specified as follows.

Symbol name	Style(mm)	Height (mm)	width (mm)	Line width (mm)	Color	Outline (mm)	Data type
Wild animal channels		2.0	3.7	0.2	C100Y100		Point
Tunnel		2.4	3.4	0.2	K100	0.2 white	Point
Railway				0.5	K100	0.15 White	Central line
Freeway				0.9	Y100	0.15 M100Y100K10	Central line

Figure 1. Some symbols of vector features

For DOM representation, the color should be approximate to the natural color. When there is a conflict between the richness of image color levels and the consistency of each mapsheet, ensure the richness of image color levels first. Though the consistency of hue is not overemphasized, there should not be apparent difference between image mosaic belts.

## 2.2 Content and representation of Hill-shading topographic map

**2.2.1 Content** The 1:50000 Hill-shading topographic map of National western mapping project is the product composited by Hill-shading map that is created from digital elevation model data and cartographic data of 1:50000 topographic map. It is composed of two parts. One part is basic geography elements such as residence, road, river, boundary, vegetation and so on, and they are theme elements in Hill-shading topographic map. The other part is the Hill-shading map created by digital elevation model data and it provides terrain background image.

**2.2.2 Representation** The 1:50000 Hill-shading topographic map retains all features contained in the cartographic data of 1:50000 topographic map, including residence, road, water system, boundary, land use, vegetation and so on. It remains the same representation and uses the same symbols that are specified in GB/T 20257.3-2006 as the traditional topographic map, which not only incarnates the normativeness, inheritance of topographic map but also makes mapping quick as soon as possible.

The Hill-shading map is the background image for Hill-shading topographic map. To ensure that it can provide terrain information well, principles for Hill-shading map representation are as follows.

a) The Hill-shading map is specified to be monochrome gray color.

The fundamental feature representation colors in the standard topographic map are specified as follows: water system should be blue, residence should be black, transportation should be black, yellow and green, boundary should be black and fuchsin, topography should be brown, vegetation should be green, soil should be brown, annotation should be red, black, blue and yellow. After many experiments, it demonstrates that monochrome gray color for Hill-shading can provide better terrain background image and does not affect the representation of fundamental vector features.

b)The color contrast should be moderate, and the hue should not affect reading of theme features.

c)While representing the stereoscope shape of terrain, Hill-shading map should maintain detail characteristics of physiognomy.

The intensity of stereoscope impression of Hill-shading map depends on the contrast of light and shade in sunny slope and shady slope of hill. The more contrast, the more stereoscope impression. However, since too strong contrast will make the detail characteristics fuzzy, the contrast intensity should be proper.

When overlaying of Hill-shading with vector features, the polygon feature will cover the Hill-shading and make shade invisible within the polygon area. For example, if the scope of vegetation is so wide that it covers the whole hillside, the hill-shading with terrain background will be covered by the vegetation feature. To solve the problem, the polygon features are specified to be transparent to a certain extent. Since low transparency of polygon makes the stereoscope shape faint, and high transparency makes the polygon feature faint, the transparency should be proper to make sure that both vector features and Hill-shading are distinct. After trial and error, transparency with 30% or so of polygon is appropriate to display.

## 3. TECHNOLOGICAL PROCESS

### 3.1 Technological process for Image topographic map production

First, vector features are selected from 1:50 000 DLG according to the specification requirements. After overlay of DOM that is already adjusted with vector features selected, the spatial relations between features should be processed and map decoration should be made. Then the Image topographic map is completed after checking and accepting. The product format should be EPS.

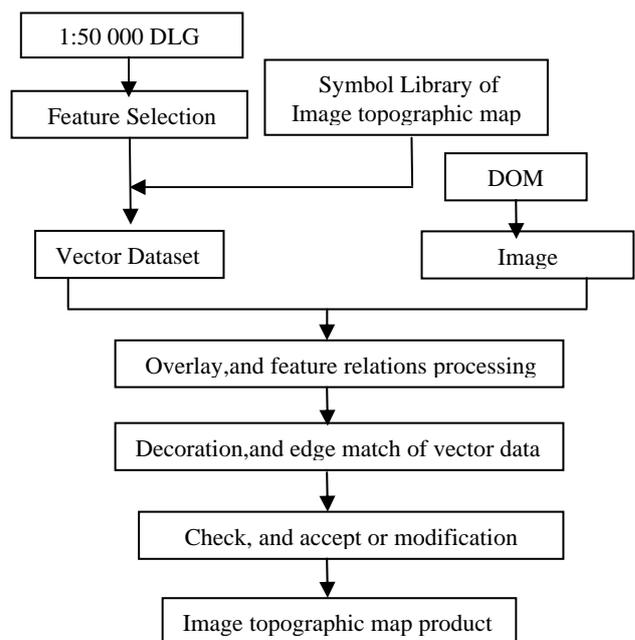


Figure 2. Process for Image topographic map production

### 3.2 Technological process for Hill-shading topographic map production

First, gray Hill-shading map is created from DEM with the help of GIS software by setting suitable parameters(illumination angle, altitude angle, pixel size, etc.) while taking account of the regional geomorphologic characteristics.After the hill-shading map is adjusted with the support of the image processing software, it overlays with cartographic data of 1:50000 topographic map. Then, through the pocess of feature relations processing,maps decoration, and check,accept or modification, the Hill-shading topographic map product is completed.

### REFERENCES

[1]2002.5.*Chinese Terms in Surveying and Mapping (Second Edition)*2002. Science Press

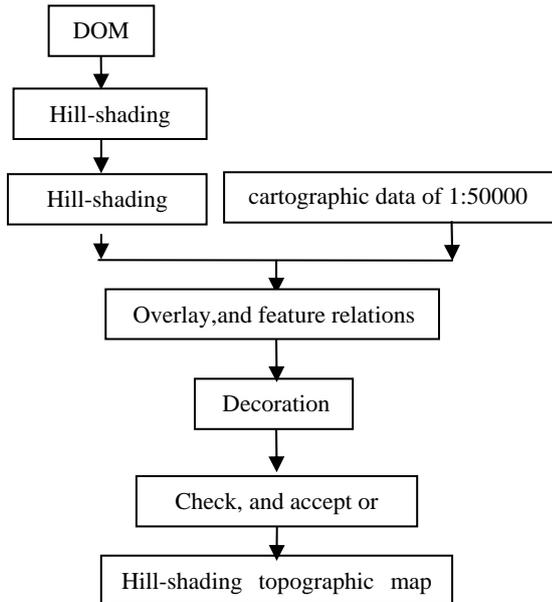


Figure 2. Process for Hill-shading topographic map production

### 4. CONCLUSION

Lately, two technical specification documents that specify how to produce Image topographic maps and how to produce Hill-shading topographic maps have been put forward based on some experiments, and the study results have been applied to the 1:50 000 topographic mapping of blank areas in the western region project. It demonstrates that the Image topographic maps are good supplementary products for topographic maps, which can provide more texture information for users, and the Hill-shading topographic maps are good substitute products for topographic maps in some areas, which can represent characteristics of terrain and surface features better.

Thus, it is suggested in this paper that Image topographic maps should be produced in the overall national extent as supplementary products for topographic maps based on further experiments, and Hill-shading topographic maps should be produced as substitute products for topographic maps in the areas where height difference is larger than 50 meters within one map sheet. Based on further experiments, Hill-shading topographic maps are suggested to be extended to 1:250 000 topographic maps production and 1:1000 000 topographic maps production.