The Design and Mapmaking of "Shenzhen and Hong Kong Atlas"

Zongyi He[1], Jing Miao[2], Yajing Yin[2]
[1]School of Resource and Environmental Science, Wuhan University
129 Luoyu Road, Wuhan 430039 P.R.CHINA
[2] Wuhan Geomatic Institute
209 Wansongyuan Road,, Wuhan 430022 P.R.CHINA
E-mail: zongyihe56@yahoo.com

ABSTRACT

In this paper, we discuss the design and mapmaking of "ShenZhen and Hong Kong Atlas" (hereinafter referred to as the Atlas)) under total digital environment.

The Atlas is that makes Shenzhen City and Hong Kong two regions as one cartographic region for the first time. The Atlas involves a wide range of sciences and contains a large quantity of information, and as being a comprehensive information library construction project. The Atlas has authoritative information, innovative designs and the latest data. The compilation and publication of the Atlas may provide map readers with comprehensive, detailed, high quality and convenient information guidance，and contribute to the cultural exchanges, social and economic development of Shenzhen and Hong Kong. This paper researches the design principles and unique feature of the Atlas based on the analysis of the development status and trends of contemporary atlas. Because the basic cartographic information sources between Shenzhen and Hong Kong are different, the basic cartographic information of the Atlas needs to connect and coordinate in the map design and mapmaking to make the two regions as a whole graphics area.

This paper discusses the Atlas for the principles and methods of arrangement and composition of design, format and layout design, framing and scale design, color design, symbol design, annotation design, map index design and so on with atlas design and production theory. Hill-shading method was used to represent the relief trend of Shenzhen and Hong Kong. The Atlas classifies and grades of various kinds of geographic features such as residential areas, roads, water system, titles, village names in the uniform standards，and take social and cultural differences of the two regions into account in symbol design and annotation translation, etc. It makes atlas form an organic-related and mutually complementary map system, so as to show the characteristics of the integration of Shenzhen and Hong Kong.

The paper discusses the digital mapmaking process of the Atlas, and describes the digital cartographic process of the atlas in detail, including computer mapmaking methods of the map data layers design, roads, water system, landscapes, residential areas, boundaries, vegetation and map index with examples. Hill-shading was done based on digital vector contour line. It establishes a new map generalization concept in the production of the regional map. Compared with traditional atlases, it is focused on the expression of the authenticity of the geographical factors and pay attention to the harmonization and coordination in the selection and generalization degree of the content. According to the differences between two data sources, take a different degree in selection and generalization for Shenzhen and Hong Kong. Map content of Shenzhen tends to detailed and authentic direction，while map content of Hong Kong is simplified based on the original，so the balance of the information of the two regions was ensured.

Key Word: Atlas, Map Design, Digital Mapmaking, Shenzhen, Hong Kong

1. Introduction

The exchanges and cooperation between Shenzhen and Hong Kong is ever closer, as the trend of urban integration is becoming significant. In order to build a legible utility and comprehensive information database to serve cooperation between Shenzhen and Hong Kong, we design and make “Shenzhen and Hong Kong Atlas”, which displays the geographic information, social economy and natural environment, both in time and space. It involves a mass of design and mapmaking problems in the process of drawing Shenzhen and Hong Kong as a unified cartographic region. It is the first time on the mainland to use maps from Lands Department of Hong Kong as basic data source. Because of some differences in map compilation of technical specifications between the two regions, it should form an organic, complete map system to supplement each other, rather than a simple splicing of the two regions. It includes some key technologies on design and mapmaking consequently.

2. Design principles and characteristics

Due to the different social systems of Hong Kong and Shenzhen, there are significant differences on their expression of the concept of cartography and map content, it is an important principle to achieve the coordination and harmonization in the content and form, in the process of compiling the two places. Only the Atlas with content and formal unity and coordination can reflect its scientific and practical, and describe the organic link between the various geographic features and geographic phenomena in the entire drawing area and interdependent relationship, so as to facilitate the readers' feelings and the information by Atlas. It needs some innovation and changes in the content and form of expression in the design, in order to realize the harmonization of the Atlas.

(1) Establishing a new cartographic generalization concept and form uniform regulation of the map content balance and cartographic generalization. We Pay attention to the harmonization and coordination of generalization extent, to grasp Classification and Grading of various types of geographic features such as residential areas, roads, water systems and geographic names such as block and village. Based on differences in the two data sources, Shenzhen area generalization extent must be more detailed and more real, but Hong Kong’s needs appropriate shortcutting according to the original basis.

(2) With map content in detail, the expression of the various elements really do provide important guidelines to promote the economic development of the two places, to facilitate the flow of people, logistics, to ensure the accuracy of the content of the map. It should handle the relationship of map elements correctly. The Atlas content should be clear, straightforward, and legible, which can server more comprehensive, more accurate, and more detailed geographic information for the citizens of Hong Kong and Shenzhen, and supply more convenient information services for readers and cooperation of the two regions.

(3) Keeping coordination in the symbol design, annotation design and color design. Similar geographic features use the same representation, for instance, for those place names of different named characteristics while the same the unit nature and level, the symbol, annotation, colors and fonts must be unified. It is easy to compare both natural phenomena

and socio-economic and cultural characteristics. The design of the symbol should be accepted by the two readers at the same time, neither popular nor cumbersome, and present an entirely new appearance.

2. Layout and composition design

The Atlas layout includes introductory maps group, region overview maps group, blocks detailing maps group and place name index. Region overview maps and blocks detailing maps are the Atlas' main parts. The Atlas has 400 pages totally, including 170 maps —309pages, and place name index 91 pages.

2.1 Introductory maps group

Introductory maps group consists of five thematic maps. It mainly demonstrates some general situations of Shenzhen, Hong Kong and the surrounding areas, such as the administrative divisions, topography, geographical location and transport links with Pearl River Delta and Macao, rail traffic, border crossings, tourism resources, etc.

2.2 Regional overview maps group

There are 18 maps in the regional overview map group. This map group takes Shenzhen and Hong Kong as one cartographic region to frame, covering all areas of Shenzhen and Hong Kong, and matched seamlessly. The regional overview map showed water system, residential areas, roads, boundaries, vegetation, topography and other basic geographic information of Shenzhen and Hong Kong.

2.3 The blocks' detailed maps group

There are 147 maps in the blocks' detailed map group, this map group used to show the detailed geographic information, such as companies, schools, hospitals, hotels, restaurants, shopping malls, theaters, post offices, attractions, temples, gas stations, bus stations, parking places, building numbers, house numbers, and so on, which in the downtown area within the city limits.

2.4 Place name Index

Place name Index in the two areas of Shenzhen and Hong Kong were classified and arranged in the gazetteer, which including the names of the government agencies and their offices, the names of regions, districts, buildings, industrial zones, roads, transport facilities, hospitals, schools, public services, cultural facilities, sports venues, attractions, hotels, shopping malls and religious places.

2.5 The bookmarked legend

Legend is readers' tools when using maps; it is an essential reading guide. Usually, the legend of the atlas is arranged behind the catalogs, but before the index, it is very inconvenient when reading maps because readers have to turn to the legend page many times. The legend was arranged in the front of this atlas at the fixed position; besides, the bookmarked legend was also designed, so it is convenient for reading, and very novel and unique. There are two bookmarked legends, one is for the blocks' detailed maps, and the other for the regional overview maps.

3. The Book Size and layout design

The atlas was designed as 16 format, full page printed. The map name was arranged both in the left and right upper corner, in the strip box at the left side of the map are Chinese and

English names of map, and the background color of the strip box were designed according to the different scales and different regions. The regional overview maps, the blocks' detailed maps of Shenzhen, the blocks' detailed maps of Hong Kong, the map index of Shenzhen and the map index of Hong Kong, these five parts were designed as five different colors to distinguish. The purpose of this kind of design is to facilitate readers, so readers can view the corresponding parts of the maps according to the side-color of the atlas, instead of turning to the catalog page. At the same time, the atlas became harmonious and beautiful by this design. The whole map page is divided in to 9 horizontal, 13 vertical rows by the square rid between the inner map margin and the outer map margin, 117 squares in total. Numbers from 1 to 9 denoted the horizontal rows, and the vertical rows were denoted by capital letters from A to N. Thus, the important companies, place names, roads were accurately located by using "place names + pages + Horizontal numbers + vertical numbers" style when making the index of the map, so as to make the readers convenient when finding the position information.

4. The framing and scale design

The atlas was framed by rectangular method, from top to bottom, from left to right.

The regional overview maps took Shenzhen and Hong Kong these two areas as one to frame, all scales were designed as 1:55000, except Dayu Island of Hong Kong as 1:70000. The maps matched seamlessly, and there are 18 maps in total.

The blocks' detailed maps are mainly distributed in the downtown area within the city limits, and divided into three kinds of scales, 1:8500, 1:10000 and 1:12000 by density differences of the map features. The numbers of the three kinds of maps were 32, 53 and 62, 147 in total.

5. The color design of the map

To point symbols and text annotation, generally the higher saturation color was chosen. Single symbol generally used monochrome, for the point symbols and annotation areas were small, if used different colors may not be clear. In this atlas, point symbols and annotation mainly used red and blue, which with higher saturation, green and black also used on a small amount of symbols.

In addition to express the different categories of linear features, such as roads, railways, rivers, realm, coastline and so on, the color of linear symbols also need to reflect the hierarchical relationship, primary and secondary relationship between the similar feature. In the atlas, warm tone of high lightness and saturation were used mainly for the linear features, making its visual level jump above the areal features, and in contrast with the large area of cold tone areal features such as the ocean, hill-shading, easy to be perceived by the readers. Roads are divided into highway, express way, main road, branch line, trail; the level of highway is the highest, using high lightness and saturation yellow solid line to express the middle, with red edges; level of fast road and main road is lower than highway, using higher saturation red solid line to express the middle, with darker brown edges; level of branch line secondary main road, using lower saturation yellow solid line to express the middle, with darker brown edges; level of the trail is lower, represented by very fine brown dotted line.

Color of areal symbols need to consider the size of the symbol, and needs to coordinate with other symbols in hue. Small area of the areal symbols suitable with dark color, houses in this atlas were used brown; larger area of areal features suitable unsaturated light color, otherwise it will appear visually obtrusive. In atlas, the relief shading used as the background of the

whole map is a light green hue, oceans, rivers, lakes and reservoirs is filled with light blue, for relatively larger symbol such as forest, nature reserves, cultivated land and mangrove forest etc. Using deep green hue hollow areal symbols to indicate, avoid covering large area of hill-shading.

6. Map symbol design

A set of succinct and clear symbol system was designed in Atlas, both relatively uniform and different, as far as possible to meet the different reading habits of readers in Hong Kong and mainland, fully considering the convenience of reading. There were the following features on the symbol design in Atlas:

(1) Map symbols were abstractness. The most essential characteristics of geographic feature and internal rules can be expressed by the abstract. When designing the symbol, shape characteristics and basic structure should be kept for concrete objects, such as church, temple, mosque, etc. For no specific image features should be selected the graphic that has close ties with it, such as post offices, view points, airports, etc. In the atlas, the church symbol preserved the most symbolic sign of the cross structure (Figure 1), so that readers can easily produce association when reading.

Figure1. The abstract symbol of map

(2) Reflect the wholeness and difference of the same category geographical features. Such as school, supporting health services, commercial departments, etc. Use similar basic graphics to reflect the common category, use different text symbols and colors to reflect the individual characteristics (figure 2).

Figure2. The wholeness and difference of map symbol.

7. Expression and mapmaking of map features

The map projection data is different in these two regions, which all belong to the inverse cylindrical projection, so the difference is negligible. We can integrate the topographic map data of these two regions through projection transformation.

7.1 Expression and mapmaking of water system

On the regional map, cartographic generalization of water system is mainly reflected in the

selection. Due to the reduction of the map scale, double line rivers with the width less than 0.4mm is represented by single line rivers, rivers and ditches with the length less than 1cm can be eliminated, as shown in figure 3. Three kind of river reaches which are disappeared reaches with the length over 2mm, underground reaches with the length less than 1mm and seasonal rivers with the length over 1.5cm should be expressed on the map. The seasonal rivers, which are the source of rivers with the length less than 5mm, should be expressed as perennial rivers .

(a) Before generalization (b) After generalization

Figure3. Rivers generalization

7.2 Expression and mapmaking of residential areas

A new method to generalize the residential areas was used in this atlas. Focus on the expression of the authenticity of the shape of buildings, residential comprehensive degree is smaller, even on the regional map can basically maintain the true form of the single houses, and indicate the number of the important residential buildings in large scale map. And according to the differences between Shenzhen and Hong Kong data, the map of Shenzhen area should turn into details and reality, the map of Hong Kong area should be simplified on the basis of data, close to the Shenzhen region. It can satisfy both of the readers in Hong Kong and Shenzhen, and can also keep the coordination between distribution and completeness of the information content of a map.

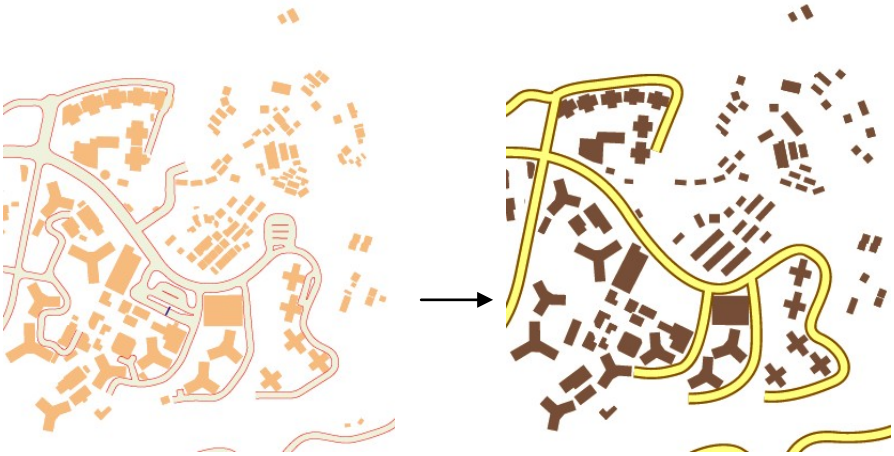
According to the differences between two data, take a different degree in residential areas selection and generalization for Shenzhen and Hong Kong. Map content of Shenzhen tends to detailed and real direction，while map content of Hong Kong is simplified based on data，so the balance of the information of the two regions was ensured.

The residential areas should be maintained at the original and independent shape as much as possible in the integration. As usually, the building that is less important and under the selected indicators will be removed (figure 4).

A stretch of larger buildings in urban should keep original channels after reduction. The buildings can be merged with the original structural features of the neighborhood when they are too intensive (figure 5).

For the irregular buildings such as rural areas express the independence by using the collinear manner though they are quite dense. When the scale is reduced, in order to keep the actual location and reflect the structural characteristics it is good to remain the certain channels of

the buildings but not merge them mechanically or arbitrarily (figure 6).



(a) Before generalization (b) After generalization

Figure 4. Residential areas generalization

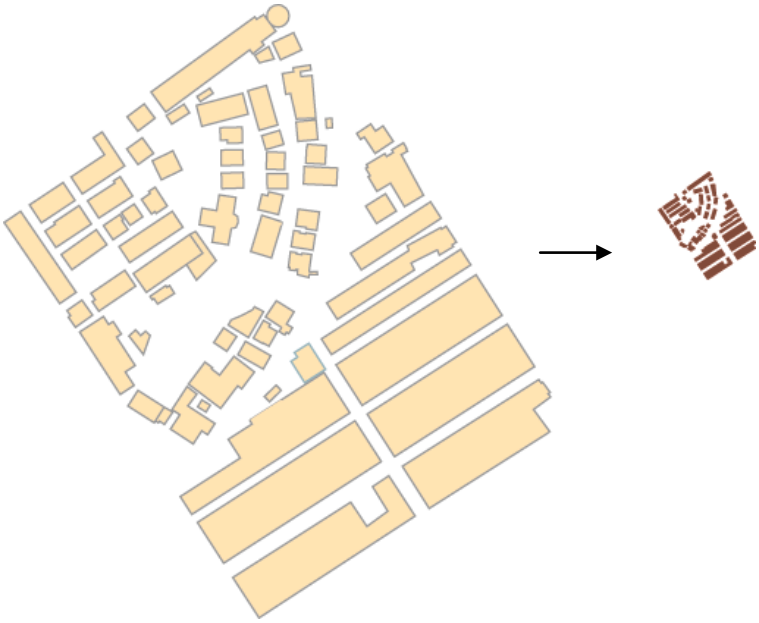


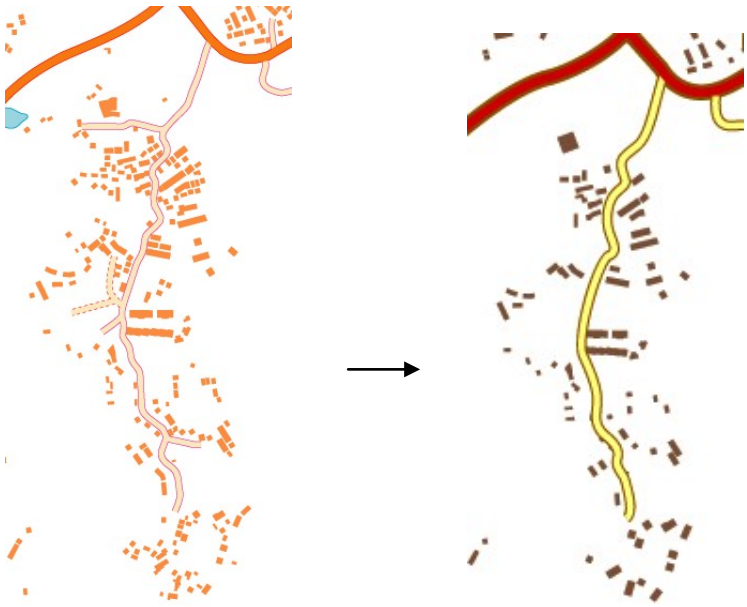
Figure5. Residential areas generalization

7.3 computer mapmaking methods of roads

It is different in the classification of road between Shenzhen and Hong Kong. In order to keep the road system, the road is divided into the following categories such as rail, light rail (Hong Kong only), tramway (Hong Kong only), the Peak Tram, subway, expressway, arterial highway (especially the main road within the city, urban expressway, national highway and provincial highway), ordinary road (minor street within the city), sidewalk and so on.

Road include expressway, arterial highway (including fast artery, national highway and provincial highway), feeder road (including county road and township road). Others are non-motorized vehicles, alley, limited channel and one-way street. The characteristic of mountain road that is winding and zigzagging should be described as detailed as possible. When two roads are too close, they can be expressed collinear. For the road that is connected to the high-grade road and across the entire areas of mountains, farmlands or forests should be

retained. It is the same with the road across the river. Besides, the branch road and short road leading to the construction zone can be removed. Figure7 is road before and after selection and generalization.



(a) Before generalization (b) After generalization

Figure 6. Residential areas of irregular generalization

(a) Before generalization (b) After generalization

Figure 7. Roads generalization

7.4 computer mapmaking methods of landscapes

The landforms of the detailed blocks are represented by the contours and hypsometric tints. Hill-shading method is used to represent the landforms of the regional chorographic map.

Steps of generating hill-shading map:

(1) Preprocessing the contour data. The contour data of the resource is Adobe Illustrator format. Some contours are not complete but segmental which should shift to the MapGIS software to connect them and then set the property values accordingly.

(2) Using the contour data constructing DEM. The following operations are conducted by the ArcGIS. First, using the Create TIN tool to build TIN, processing the original data in the ArcGIS spatial analysis framework and then extracting the orthocenter of each side of the flat

triangle and the midpoint of each side, aligning the points and assign values to them. Then, restructuring the grids to generate DEM data.

(3) Generating shaded relief image by using DEM data. The shading module in the Atlas3D is used to shape the landscape. In the software we need to set the angle and orientation of the light source, the size of the block, the horizontal scale, the vertical scale and so on.

(4) Post-processing the shaded relief image. Photoshop software was used to tone color and detail of the image.

(5) Overlaying the vector data with the shaded relief image. The image was imported into the Adobe Illustrator software. The image should be placed in the bottom of all vector elements and then adjust the position to match with the vector elements.

Figure 8 is a regional overview maps represented with hill-shading method.

Figure 8. A regional overview maps represented with hill-shading method

8. Conclusion

The Atlas is that makes Shenzhen City and Hong Kong two regions as one cartographic region for the first time. The Atlas has authoritative information, innovative designs and the latest data. The compilation and publication of the Atlas may provide map-readers with comprehensive, detailed, high quality and convenient information guidance, and contribute to the cultural exchanges, social and economic development of Shenzhen and Hong Kong.

Reference

[1] Guorui Zhu. Cartography[M].Wuhan: Wuhan University Press, 2004

[2] Zongyi He. Computer Cartography[M]. Beijing:Publishing House of Surveying and Mapping, 2008

[3] Zongyi He.The design and research of Shenzhen Atlas[J].Science of Surveying and Mapping, 2001,26(1):25-29

[4] Xirui Gao, Zongyi He. The design and production of the map of the People's Republic of China based on the data of 1:250 0000[J]. Bulletin of Surveying and Mapping, 2009(8):1-5

[5] Robinson A H, Sale R D, Morrison J L. Elements of Cartography[M]New York: Wiley, 1985

[6] Boon Kee Soh, Tonya L. Smith-Jackson. Influence of Map Design, Individual Differences, and Environmental Cues on Wayfinding Performance[J]. Spatial Cognition & Computation, 2004(4): 137-165