Map Printing Color Using Research

Shi Ruizhi, Yang Lin, Wu Changzhi; Zhengzhou Institute of Surveying and Mapping, Zhengzhou,Henan/China

Abstract

Maps are printed mostly with spot colors, which result in plentiful printing plates and high production costs. This paper reviewed the forming historical background and limitation of map spot color printing, analyzed the inevitability and feasibility of printing maps with four colors rather than more than four colors so as to reduce the map printing plates, and designed several printing color-setting projects and approved it with experiment, then concluded the new color using mode of map printing.

0 Introduction

The printed map products have already become human existence and development of importance constitutes part, occupy more and more important position in the people's life, work and study. So the map printing products are also more and more getting to people's concern.

1 Analyzing of currently color to the map printing

1.1 Spot color of maps printing history background and limitation

The color is one of the important formats of map, the map printing request very high quality of the color, the color performances of each cartographic feature contain certain standard, as a result as map publication not only requests to have abundant color, also requests each color accurate, and be up to standard. In the traditional map printing system process, because of the restriction of the technology of map reproduction, during actual process printing, it is easy to be out of register, especially such as particularly some thin lines, literals and so on, always exists errors of overprint. After printed, each color printing plate is out of register. And this will influence printing effect. For getting the perfect color performance effect, people use particularly spot color printing to work out that problem. Spot color also is called special color, is an hybrid color in advance, they appear in single corresponding spot color printing plate and no longer use Yellow, Magenta, Cyan and Black, four printing ink superimposition. Include spot color to establish the map of color, during output, in addition to Yellow, Magenta, Cyan and Black primary color printing plate, will also produce spot color printing plate, defined how many spot color, will produce a same number of the spot color printing plates.

The traditional map printing colors mostly adopt spot color and usually use 6 colors or more, maximum could be attaining more than 20 colors. The standard of some current map cartographies uses spot color. More spot colors divide more printing plates. as a result, the efficiency of the produce is lower, the cost of the printing is higher, these are the essential differences between map printing and other products, also is the inferior position of map printing.

1.2 Putting forward maps' reducing printing plates standpoint

Since digital publication technique appearing, the map printing has already carried out total digital production, especially the usage of four color printing machines, change the map produce of task appearance, especially the accuracy of map overprint has already been resolved , therefore, we use technique to analysis, drew up a color plan of maps to reduce the printing plates, aim at well exerting existing print equipments of the technique potential and be ensure that the map printing has the high quality printing products efficiently.

The design theory of this color plan is ,"using four colors printing substitutes multi-color printing, meanwhile we should pay attention to the particularities of the map colors."This article is based on the map color theory. Thinking about the technology of the map colors, we designed several printing color plans. We have done some experiments to test our schema and got the new color mode of map printing. And we achieved reducing printing plates. It is significative to do this task and there is some technology difficulties to realize it.

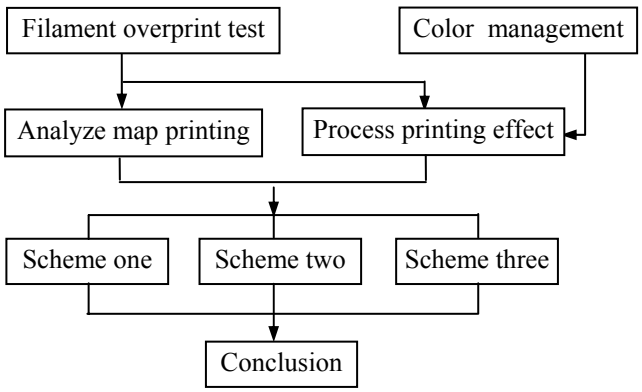

***Fig.1** flow chart of the experiment*

For proving the feasibility of reducing printing plates, we analyzed the particularities of the map colors and the technical function of the printing machines and did the experiments. The Fig. 1 shows the flow of this experiment.

2 Preparation for the experiment of the reducing printing plates technology

2.1 Thin line overprint test

To realize reducing printing plates, we must surmount the limits which we have used for a long time in the field of map printing,"Thin lines can't be printed by process overprint, we can just use the spot color. "Till now, since the limits of the printing

machine's technical function, there is no high request of the map printing accuracy. The Table. 1 shows the overprint accuracy of map printing standard. If we use this accuracy to test thin line overprint, there will be some problem. So first of all, we should do the thin line overprint test by the existing printing machines. We drew the manuscript to control and test the overprint accuracy. See the Fig.2 .In this manuscript, each line is overprinted with four colors, C,M,Y and K. We can use the manuscript to test overprint accuracy of the printing machine directly.

Table.1 the datas of overprint tolerance

Paper size	quarto	folio	octavo	quarto	folio	octavo
Main part	< 0.10	< 0.12	< 0.20	< 0.20	< 0.30	< 0.50
Common part	< 0.15	< 0.20	< 0.30	< 0.30	< 0.40	< 0.60

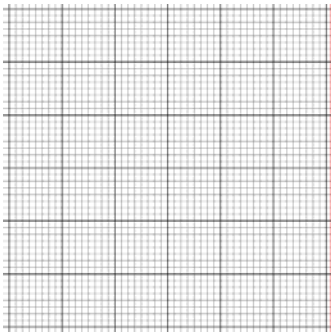

***Fig.2** manuscript for testing overprint accuracy*

We used Herdelbery CD102 to print the manuscript with film burning technology. Analyzing the proof and measurement overprint accuracy, we find that if we observe the proof with our eyes, the overprint with four colors arrives at the effect of printing with just black plate, and if we observe the proof with high power magnifier, the error of overprint is less than 0.02 millimeter.

2.2 The normal map color plan of overprint and analyzing the effect

The kind of map which is printed with Black, Brown, Cyan, Green, Red, Purple is the representative map among the printing maps. Base on this kind of map, we analyzed that which kind of feature need overprinting, the kinds of colors and the percent of the colors which are used to overprint.

According to the basic color theory, the color mixture of printing ink coincides subtractive mixture theory, which is that mixing three primary colors ink: Cyan, Magenta, Yellow(C, M, Y) with different percent, we can get all colors of nature. But the three primary colors ink have color deviation, so we adhibit the forth color, black. The four colors are the printing color primary that we use commonly. So we can make the four colors as one of our color plans (see scheme one). On the other hand, vector map is mostly expressed with line and the color is limited, such as Black, Brown, Cyan, Green, Red, Purple. So shen we choose the printing color primary, we shouldn't just think about the four colors we use commonly and we can make four spot colors as color primary. According to the color mixture theory, the complementary color mix with same percent, we can get the tone color. When the complementary color is add in other colors, it can reduce the brilliance and chroma. We analyzed the result of the color mixture, we got that, Black: we can just use the monochrome black or we can mix Brown and Cyan to get it ; Brown: we can use the spot color or we can mix Magenta ,Yellow and Black(or Cyan) to get it ; purple: we can use the spot color or we can mix Magenta and Black to get it ; Red: we can use the spot color or mix Magenta and Yellow to get it ; Green: we can use spot color or mix Yellow and Cyan to get it. With this color theory, we designed three color plans to test.

The principle of confirming the data of color in this experiment, first is map printing color atlas. we can find the color which we will use in color atlas and read the data of the color. Because there are some differences between the printing condition of color atlas and the actual map printing, the data of the color can just be reference value; second is according to the screen color which is controlled by color management. First of all, we need to match the color of the display and the products printed in actual map printing condition and get installation chromoscope characteristic Profile(ICCProfile). We use this to control the color and make the color of screen be same as the color of printing products. Following, we use the palette of Illustrator to toning and get the datas of color in actual color plan.

2.3 The requests of printing condition and index of quality control

We used Herdelbery CD102 to do the experiment with film burning technology. Tianshi ink and two kinds of printing papers: one is map offset paper, the other is Jingdong 157 copperplate paper. The experiment must arrive at the index of quality control:

Burning: 20% dots aren't clear and 30% dots are clear.

Printing: solid density copperplate paper is Yellow 1.0, Magenta 1.45, Cyan 1.50, Black 1.7 – 1.8; map offset paper is Yellow 0.8, Magenta 1.30, Cyan 1.40, Black 1.5 – 1.6.

The color of printing ink is uniform and saturat , the overprint error is less than 0.02mm.

3 Three design schemes and experiment test

3.1 Routine color plan of four color printing (scheme one)

The idea of this scheme is based on four color printing theory, mixing Yellow (Y), Magenta (M), Cyan (C), Black (B) to overprint with different percent. We can get all colors of the map. The colors:

（1） Brown : C 0 ; M 50 ; K 20 ;
（2）Purple： M 100 ; K 20 ;
（3）① Green symbol（bottle green）： C 100； Y 100 ;
② Green region （reseda）： C 30 ; Y 30 ;
（4）① Cyan line（mazarine）： C 100 ;
② Cyan region（light cyna）： C 30 :
（5） Red：M 100 ; Y 100 ; C 10 ;
（6） Black： K 100 ;

The color in scheme one arrives at routine map color standard. Since the accuracy of overprint is high, the thin lines of the map, for example the contour line, can be overprinted accurately. But in this scheme, the contour line is overprinted by dot. If we observe the lines closely, we can find the lines aren't so clear. The effect

isn't good as spot color printing. To solve this problem, we improved the scheme. We think about that make the contour line be overprinted solidly to reduce the roughness which is coming from the dot overprint. According color mixture theory, if we use the regular four color printing, we can mix 50% Magenta, 60% Yellow and 20% Black to get Brown of the contour line. If we want the dot to be solid, we need to reduce the saturation. The way is adding white ink into Magenta ink and Yellow ink to make the data of the color be almost as the same as 50% Magenta and 60% Yellow. From this, we designed scheme two.

3.2 The color printing using light Magenta, light Yellow, Black and Cyna as color primary (scheme one)

The idea of this scheme is that substitute regular color primary, Yellow and Magenta by spot color, light Yellow and light Magenta. And mix light Magenta, light Yellow, Cyna and Black to overprint with different percent. We can get all other colors of map. m=50%M; y=60%Y.(m means light Magenta, y means light Yellow)

The colors:

（1） Brown : m 100 ; y 100 ; K 20;
（2）Purple： m 100 ; K 20 ;
（3）① Green symbol（bottle green）： C 100； Y 100 ;
② Green region （reseda）： C 15 ; Y 30 ;
（4）① Cyan line（mazarine）： C 100 ;
② Cyan region（light cyna）： C 20 :
（5） Red：m 100 ; y 100 ;
（6） ①Black： K 100 ;
②French grey: K 25;

Scheme two， the contour line in maps is a set color of m 100, y 100 and K20, the contour line in maps is overprinted by light Magenta and light Yellow solidly adding Black to reduce brightness, it solved the phenomenon of contour line being not clear. But after experiment I discovered that I have set light Magenta and light Yellow to be the printing color primary, result in the Purple color become light, especially the Purple line is too light. Bottle green is partial to Cyna, especially the Red is partial to orange red. Its color is similar to contour line in maps Brown. As a result after analysis, this pscheme exists the really big problem. It basically give up this project. But in consideration of want to promise that the contour line in maps brown as far as possible uses an on-the-spot printing, we set up a new three scheme, such as, the contour line in maps uses spot color Brown printing, establishes other colors to be overprinted.

3.3 Use Brown, Cyna, Magenta, and Yellow for the main color.(scheme 3)

The basic design thought of this scheme is: According to the different comparison and get other colors, Use map Brown (BR) as one of four kinds of main colors to print and mix with normal regulations of the Magenta, Yellow and Cyna to overprint. We can get other colors. This scheme use Brown replacing normal Black. In the map, Black is mixed from Brown and Cyna, which is depending on the certain proportion of those colors.

The colors:

（1） Brown : BR 100;
（2）Black： BR 100 ; C 70 ; French grey: BR 25; C 20;
（3）① Green symbol（bottle green）： C 100； Y 100 ;
② Green region （reseda）： C 15 ; Y 15 ;
（4）① Cyan line（mazarine）： C 100 ;
② Cyan region（light cyna）： C 20 :
（5） Red：M 100 ; Y 100 ;
（6） Purple: M 100; BR 20;

From Scheme three, brown is one of the main four colors, the contour line in maps is an solid color printing, it is good to solve the exiting problems in scheme two and scheme one, because the black is overprinted, the color is partial to cyna, is Gray for steel, there is some differences from the color in normal regulations map . But in consideration of steel's gray is also a common color to map printing, it will not bring negative influence of the expressing of cartographic feature and the whole effect of the map. Therefore, this scheme is also a commendable map color plan.

4 Conclusion

After analyzed the maps of the experiment, I think that the scheme one has wide applicability. It is compliant to all map printing colors. Scheme three is compliant to the maps which are printed with six kinds of colors, such as Black, Brown, Cyna, Green, Red and Purple. This experiment further proved that it's possible to use four colors printing substituting multi-color printing and realize reducing printing plates. Through choosing the suitable printing colors, we can achieve that using four colors printing instead of multi-color printing. This research well exerting existing print equipments of the technique potential and be ensure that the map products be printed efficiently. Meanwhile it reduces the costing and improves the quality of printing products.

References

[1]Liu Wuhui, Hu Gengsheng，Wang Qi write. Printing Chromatology. Beijing:chemical industry publishing house, 2004,03.
[2]Xie Zhong,Fan wenyou. Color Processing In Digital Cartography And Map Pubishing System.GIS FORUM , 2005,02,04.

Author Biography

Shi Ruizhi, with a doctor' degree of Engineering, is a professor of Surveying and Mapping Institute in Zhengzhou. She devotes herself to the teaching and research on graphics and image processing as well as printing and Publishing.