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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COLOR PALETTE:
PLOTING GUIDE FOR USE WITH GSMAP AND
GSDRAW DIGITAL CARTOGRAPHIC SOFTWARE

Steve P. Schilling and Ren A. Thompson

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By

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ABSTRACT

Guidelines for plotting a variety of colors and patterns using GMAP and GSDRAW (Selner and Taylor, 1987) digital cartographic programs have been developed. These color and pattern variations can be used to fill polygons (areas) on maps, charts, or diagrams. Batch processing files for plotting a sample color/pattern palette on a Hewlett Packard 7585B 8-pen plotter using GSDRAW software are provided on the disk. The detailed instructions, batch processing files, and variables used to construct the palette will provide the user ready access to 99 fill patterns, and aid in designing other useful combinations.

INTRODUCTION

Applications software developed by the U.S. Geological Survey for digital cartography provide the means to record, store, and plot illustrations that consist of points, lines, and polygons (areas). When plotting these illustrations, polygons may be decorated (filled) with numerous patterns in as many colors as are available on the particular output device. In fact, **GSMAP** or **GSDRAW** (Selner and Taylor, 1987) software provide more than three million ways to fill digitized polygons. Plotting by trial and error to achieve satisfactory fill patterns, that emphasize or enhance important spatial relationships on a geologic map or diagram, is both frustrating and time consuming for the novice and, at times, the experienced user. This manual provides guidance on optimal methods to fill polygons and on how to save time and materials in the process. Batch processing files for plotting a sample color/pattern palette on the Hewlett Packard 7585B 8-pen plotter using **GSDRAW** software are provided on the disk.

The following descriptions and discussions assume the reader is familiar with the digitizing software **GSMAP** and (or) **GSDRAW**, and with their application to a particular configuration of microcomputer and graphic pen plotter. This manual deals solely with plotting techniques that will produce clear, vivid geologic maps and diagrams with these two software packages.

WARNING TO THE USER

The patterns produced from the accompanying disk will run correctly on **GSDRAW** version 3.0. Version 4.0 will NOT plot the dotted-line patterns, the plot will stop and a device time out error will appear on the screen. Version 3.0 of **GSDRAW** must be used for plotting, or a text editor such as SideKick can be used to delete the first, second, and fifth boxes labeled as such in the **PALETTE.BAT** file on the accompanying disk, and then version 4.0 can be used.

Polygons digitized with version 4.0 of **GSMAP** or **GSDRAW** may be plotted with dotted patterns if version 3.0 is used for plotting. No modifications are needed. If dotted fills are not needed, version 4.0 can be used for both digitizing and plotting.

BACKGROUND

Major criticisms of computer-plotted maps and diagrams are that the output appears unfinished, that the product is not publication quality, or that even the 8-pen carousel of the large format plotters do not provide sufficient color diversity for many geologic diagrams. Another common complaint is that pattern variety, density, and color, which are important to communication, are difficult to achieve on the computer. The digital cartographic software **GSDRAW** and **GSMAP** do provide the means to achieve the desired variety and polish. The suggestions in this manual will aid in achieving colorful, quality diagrams.

In this manual, the term polygon means an area surrounded with digitized points and given a 400-line code when plotting with **GSMAP** and **GSDRAW**. Any polygon must be properly closed with a 2-button on the digitizing mouse. If there are internal polygons, the external and internal polygons are closed with a 3-button and the last internal polygon is closed with a 2-button. Any properly closed polygon may then be filled using the pen plotter.

There are three basic ways provided by the **GSMAP** and **GSDRAW** software to apply patterns and color to polygons: (1) fill a polygon with parallel lines (ruled pattern) whose spacing is defined by the user, (2) fill a polygon with cross-hatching where the user enters the angle of rotation for one set of parallel lines and a second set of lines are generated automatically at 90⁰ to the first set, or (3) fill a polygon with solid color. These three general types of fill serve as a basis for creating an essentially unlimited variety of patterns.

The choices available to modify the patterns include varying both the angle of rotation (relative to the illustration border) and the spacing of lines of any set of parallel lines. In addition, the lines drawn by the plotter for any of these types of fill do not have to be solid lines; they may be dotted, dashed, or decorated in any of 20 different line patterns available in **GSMAP** and **GSDRAW** (Selner and Taylor, 1987, p. 32). Furthermore, variety may be added by selecting different pen types, pen tip widths, and plotter media. For example, fiber-tip pens used for paper plots come in about a dozen colors and in two widths.

Before you begin to fill the polygons, you should be aware that it is possible to combine pen colors to give new colors. For example yellow and blue pens may be used to create different shades of green. Also different patterns drawn using the same pen will yield variable intensity (percent of white space versus percent of color space of an area) of the color. These different patterns arise from varying the spacing, line type, etc. discussed previously. In addition, a polygon may be filled more than once. It may be filled as many times as are necessary, varying the plotting instructions with each fill, to achieve the desired effect. This report demonstrates some of the successful combinations from the above choices and provides the instructions to make them.

PRODUCING THE DEMONSTRATION PLOT

The following instructions and descriptions will produce a demonstration plot on a sheet of 33 x 44 inch plotter paper. The following instructions will produce the plot, and the remainder of this report will describe how the polygons were filled. The demonstration plot makes use of a single batch file and will take approximately 150 minutes to plot. Once completed, the demonstration plot contains instructions to use in future diagrams.

EQUIPMENT REQUIREMENTS

- 1) A large format (E-size) plotter meeting the requirements specified by Selner and Taylor (1987, p. 64).
- 2) **GSDRAW** Version 3.0 (Version 4.0 does not allow for dotted fill patterns without stopping the plot on a time out error, see above warning).
- 3) E-size (33 x 44 in.) plotter paper.
- 4) Eight fiber-tip pens (fairly new) of different widths and colors (see suggested colors below).
- 5) About 150 minutes of plotting time.

PROCEDURE

Hard disk users should copy files from the plot disk accompanying this report to their subdirectory that contains **GSDRAW** (this will speed up the plot). The database is called **PALETTE** (.NDX and .LSF files). The batch file is called

PALETTE.BAT. There are several text files that are plotted to show the command parameters for each sample pattern, so copy *.TXT to your hard disk.

If you do not have a hard disk, insert GSDRAW in the B: drive and the plot disk in the A: drive.

Load the following fiber tip pens in the plotter carousel:

<u>carousel position</u>	<u>pen width</u>	<u>pen color</u>
1	p3	green
2	p3	blue
3	p3	black
4	p3	yellow
5	p3	orange
6	p3	purple
7	p7	blue
8	p7	red

- 1) Load the paper into the plotter.
- 2) Establish communications through the com port.
- 3) Start GSDRAW.
- 4) From the menu, choose option 2, "Open an existing data base", for hard disk users enter PALETTE or for floppy disk users enter A:PALETTE.
- 5) Choose option 9, "Plot on the hard copy plotter". When asked if you have a batch file, select Y (yes) and then enter PALETTE.BAT if you have the files on a hard disk or A:PAL.BAT if you are using the floppy disk.

The plotted output is an array of polygon-fill patterns produced with different plotting parameters. There are nine small polygon boxes that make up each large box. Each large box demonstrates a change in some variable for filling polygons. To the right of each large box is a second large box containing instructions on how to plot the patterns (fig. 1). In figure 1, the parts of the large boxes labled 2A and 2B contain four of their nine smaller boxes. The upper left small box of 2B lists the plotting instructions to plot the pattern in the upper left small box of 2A.

PLOTTING INSTRUCTIONS

In the large boxes labled with B's, there are a series of smaller boxes containing plotter entries. In figure 1 for example, box 2B contains the instructions: 409,1,1,0, and beneath that line: 9,20,30. The 409 is the line code identifying the polygon, the first 1 is the carousel position of the pen desired, the second 1 is the line type (in this case a dotted line), and the 0 is for drawing decorated lines (not used in this plot). On the second line the 9 is the fill type (here, a single set of parallel lines with out a border), the 20 is the spacing in thousandths of an inch between the lines, and the 60 is the rotation angle (clockwise from the horizontal) relative to the illustration border. The user may insert these numbers into their plot entry and obtain the same pattern as shown on the demonstration plot with the exception of entering their own 400-line code.

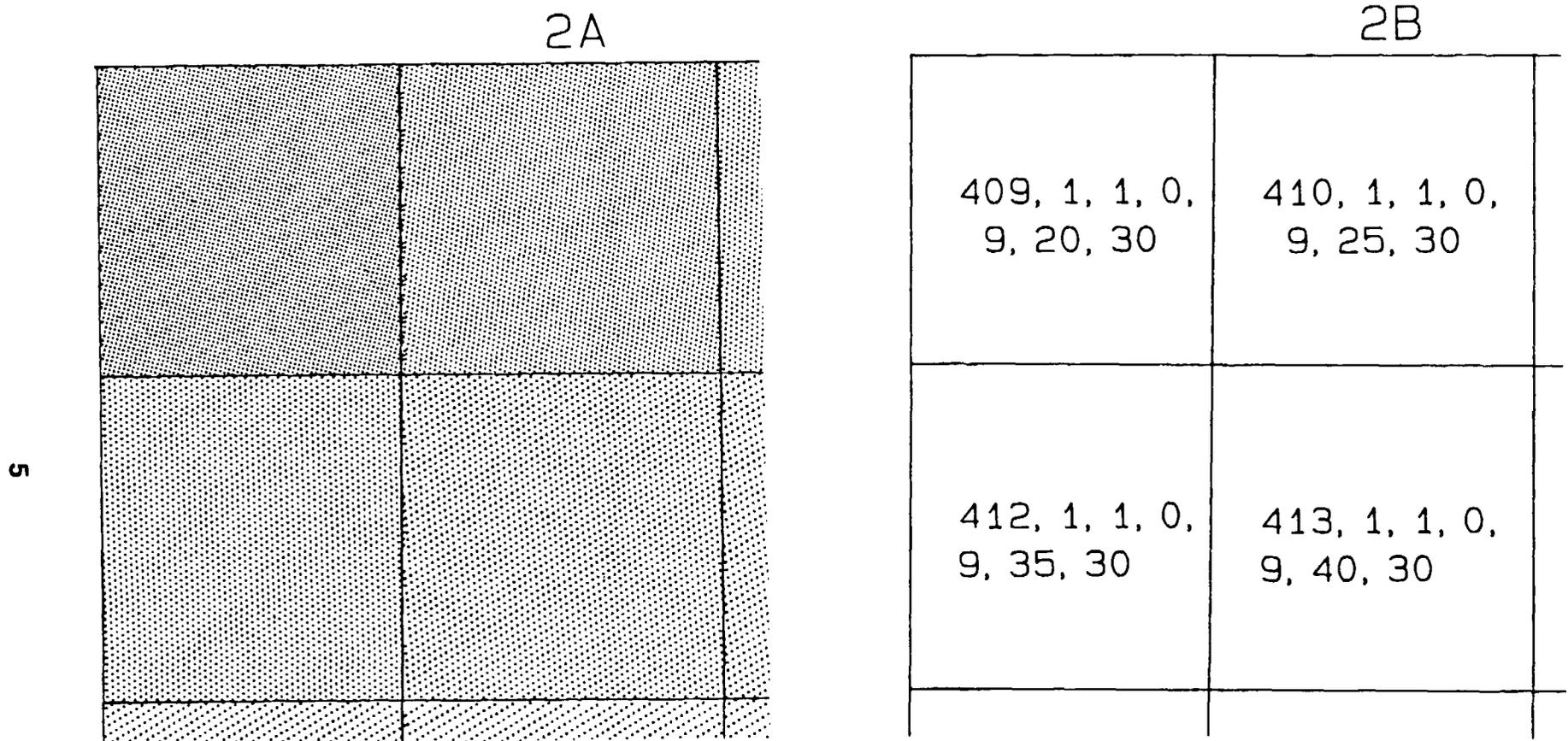


Figure 1.-- Parts of boxes 2A and 2B from demonstration plot. Plotter entries within small boxes of 2B will produce the patterns in the corresponding small boxes of 2A.

PATTERN VARIATIONS

Descriptions of how patterns were changed for each set of nine boxes on the demonstration plot are given in the following sections. Boxes 5A and 6A were plotted with the P7 wide tip pen, and box 8A with a combination of P3 narrow tip and P7. All others were plotted with the P3 narrow tip pen.

Box 1A VARIATION IN LINE SPACING--line code 7

GSDRAW and GSMAP software provide two dotted line patterns where the difference is the spacing between the dots *along* the line. Line type 1 is the narrow pattern and line type 7 is the wider pattern. In this first series of nine patterns, the wider line type 7 is used. All of the parameters for each of the nine patterns are held constant except for the spacing between the lines. That spacing increases in increments of 5 thousandths of an inch from 20 in the upper left small box to 60 in the lower right box.

Box 2A VARIATION IN LINE SPACING--line code 1

For this set of nine boxes the line type is changed to the narrow spacing between dots *along* the line. As in Box 1A above, all of the parameters are held constant except for the spacing between lines that increases from 20 to 60 thousandths of an inch. The upper left small box of 1A may be compared to the upper left small box of 2A. The difference between these two boxes is only the line type, and thus, the spacing of dots *along* the line.

Box 3A VARIATION IN LINE SPACING--solid, parallel

In this set of nine boxes a solid rather than dotted line is used. A single set of parallel lines (ruled pattern) fills the polygon squares. All of the parameters are kept constant except for the spacing between the lines. The spacing is increased by increments of 5 thousandths from 20 to 60 thousandths.

Box 4A VARIATION IN LINE SPACING--solid perpendicular

The GSMAP and GSDRAW software allow for automatically plotting two sets of lines perpendicular to one another (cross-hatch pattern). The user enters the angle of rotation for one set of the parallel lines and the plotter calculates a 90⁰ angle to that set and draws a second set of lines. The spacing entered for the first set is used for the second set. In this set of nine boxes all parameters are kept the same except for the spacing between lines. Again, the spacing is increased in increments of 5 thousandths of an inch from 20 to 60 thousandths.

Box 5A VARIATION IN LINE SPACING--wide tip pen

This set of nine patterns demonstrates the use of a wider tip pen when plotting dotted lines. Line type 7 is used for wider spacing between dots *along* the lines. The spacing between lines increases in increments of 5 thousandths of an inch from 50 to 90 thousandths of an inch. The spacing of the lines in the top row of small boxes may be compared with the bottom row of small boxes in large box

1A. Spacing between lines for these small boxes are identical while pen width, rotation angle, and color are different.

Box 6A VARIATION IN SPACING AND ROTATION--wide tip pen

This set of patterns demonstrates a variation both in spacing between lines and in the rotation angle of those lines. For each of the nine small boxes, the rotation angle equals the spacing between the lines. That angle and spacing distance increases from 50 to 90 thousandths of an inch in increments of 5 thousandths of an inch. The top row of small boxes may be compared to the bottom row of small boxes in box 3A, where the spacing between lines is identical.

Box 7A VARIATION IN LINE TYPE

The line types shown both at the top of the plot and in figure 2 are demonstrated as pattern fills in this set of nine boxes. A constant width of 30 thousandths of an inch between lines is used. Line type 0, 1, 7, and 12 are not used. Box 7A displays some of the various patterns that can be constructed. These patterns work well either by themselves or as overlays on colored patterns.

Box 8A VARIABLE SPACING, COLOR OVERLAY

This series of nine boxes demonstrates the plotting of two different colored sets of lines superimposed on one another. The left column of three small boxes contains single sets of parallel blue lines made with a P7 pen. The spacing between lines increases from 40 to 100 thousandths of an inch from the top box to the bottom box. The right column of three small boxes contains sets of parallel lines made with a narrow tip P3 pen with spacing between the lines decreasing top to bottom from 50 to 30 thousandths of an inch. The middle column of three small boxes contains the combination or overlaying of both sets of lines from the left and right columns, creating different colored patterns. These overlay patterns demonstrate the effects of combining wide and narrow tipped pen parallel line sets that are mutually perpendicular, while varying the spacing between the line sets. These patterns begin to show some of the versatility of combining pen widths and colors.

Box 9A VARIATION OF ANGLE BETWEEN TWO SOLID LINE SETS

The GSMAP and GSDRAW software allows the user to produce automatically a set of perpendicular lines with one set of instructions to the plotter. However, if the user would like to produce two sets of lines that cross at any angle other than 90° , two sets of instructions are necessary. Both sets of plotter entries will be identical except that the angle of rotation will change. Here, each small box in this set of nine, contains two sets of parallel lines. The top left box has a set of lines drawn at $+10^{\circ}$ and a second set of solid lines drawn at -10° . The next small box to the right has lines drawn at $+20^{\circ}$ and -20° , and so forth. This pattern is *NOT* recommended for dotted lines. Any angle may be entered for either of the line sets and that angle does not have to be a positive angle coupled with a negative angle, but any combination of positive, negative, or both. This pattern may also be plotted "on top of" any of the patterns described above and is useful when the user needs to draw attention to a particular area of a diagram.

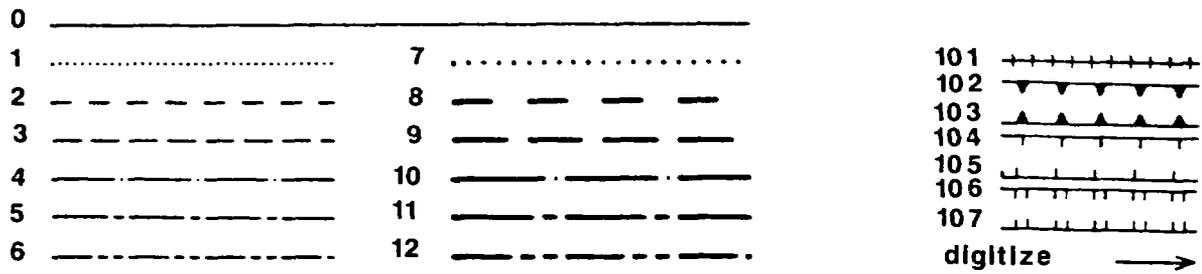


Figure 2.--Line Types available with GSMAP and GSDRAW software (from Selner and Taylor, 1987).

Box 10A OVERLAYING PEN COLORS--solid lines

This series of nine boxes demonstrates the plotting of two different colored sets of lines superimposed on one another. The left column of three small boxes contains, from top to bottom, a single set of parallel orange, blue, and purple lines. The right column of three small boxes contains, top to bottom, yellow, yellow, and blue sets of parallel lines. The middle column of three small boxes contains the combination or overlaying of both sets of lines from the left and right columns, creating different colored patterns. All of the lines are solid lines with constant spacing and, when overlayed, each set of parallel lines is mutually perpendicular.

The plotting sequence of colors does make a difference. For example, yellow lines plotted "on top of" blue lines will result in a slightly lighter shade than blue plotted over yellow, all other factors being constant. Notice that for the yellow/blue combination, the spacing is wider for the blue line set than for the yellow line set. This helps balance the yellow with the blue.

Box 11A OVERLAYING AND VARIATION IN SPACING

This set of nine boxes demonstrates several of the earlier methods. A black dot pattern has been superimposed on a yellow pattern. The top row of three small boxes has identical yellow dotted patterns, the middle row of three boxes has identical yellow solid lines, and the bottom row has three identical patterns of cross-hatched yellow lines. However, each row of yellow patterns differs from the other two rows.

The left column of three small boxes from top to bottom contains identical black dotted line patterns (spacing between lines is 30 thousandths of an inch), the middle column of boxes has identical black dotted overlays (spacing is 60 thousandths of an inch), and the right column of three small boxes has identically plotted sets of dotted line patterns (spacing between lines is 90 thousandths of an inch). In this set of nine boxes, any row (left to right) contains identical yellow patterns with three different black dot overlay patterns, and any column (top to bottom) contains three different yellow patterns with three identical black dot overlay patterns.

SUMMARY

The demonstration plot presents some of the different ways of the millions possible, to fill polygons using **GSMAP** and **GSDRAW** software. These patterns have been tested and may aid the user in designing other useful combinations. Additional points to keep in mind when designing pattern fills are:

- 1) Color perception is based on the ink color, the density of the fill (percent of white space versus percent of color space), and the blending of more than one ink color, thus small changes can produce very different results.
- 2) Dotted lines require more time to plot than solid lines. Solid fills require more time to plot than solid ruled lines. If time is a consideration, use dot patterns and solid fills for smaller areas.
- 3) More than one set of dotted lines plotted at different angles of rotation become quite exotic and will draw the eye to the pattern. Caution is recommended when using this type of pattern.

4) Lighter colors should be used to fill larger areas and darker colors for small or narrow areas.

5) None of the patterns in the demonstration plot have a border. The borders you see around boxes in this plot were digitized separately. The user may enter a fill type of zero for any polygon and produce only a border for that polygon.

6) Additional pattern/color palettes may be created simply by changing the pen combinations in the plotter carousel or editing the batch files.

REFERENCES CITED

- Selner, G.I., Taylor, R.B., and Johnson, B.R., 1986, GSDRAW and GSMAP Version 3.0: Prototype programs for the IBM PC or compatible microcomputers to assist compilation and publication of geologic maps and illustrations: U.S. Geological Survey Open-File Report 86-447A-B, 53 p. and diskettes.
- Selner, G.I., and Taylor, R.B., 1987, GSDRAW and GSMAP Version 4.0: Prototype programs for the IBM PC and compatible microcomputers to assist compilation and publication of geologic maps and illustrations: U.S. Geological Survey Open-File Report 87-496A-E, 90 p. and diskettes.