UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

GSDRAW AND GSMAP VERSION 5.0: PROTOTYPE PROGRAMS, Level 5, FOR THE IBM PC AND COMPATIBLE MICROCOMPUTERS, TO ASSIST COMPILATION AND PUBLICATION OF GEOLOGIC MAPS AND ILLUSTRATIONS

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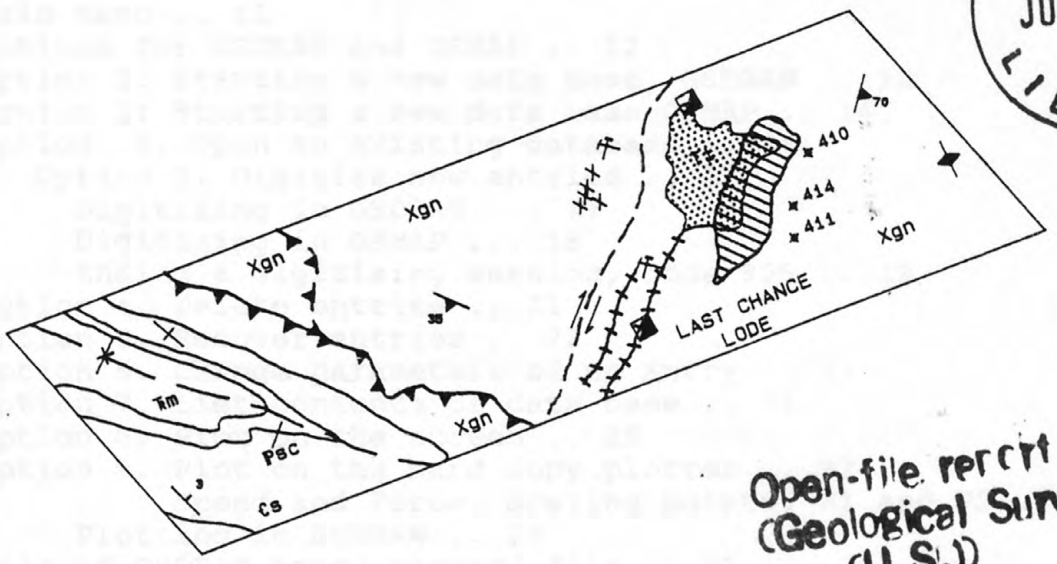

Open-File Report

88-295A Documentation and tutorial(Paper Copy)
88-295B Executable program disks (2)

DISCLAIMER

Although program tests have been made, no guarantee (expressed or implied) is made by the authors or the U.S. Geological Survey regarding program correctness, accuracy, or proper execution on all computer systems.

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INTRODUCTION

GSDRAW and GSMAP are programs for IBM PC (and compatible) microcomputers to assist geologists and illustrators in compilation and publication drafting of geologic maps and illustrations. These programs attempt to do for geologic map compilation and drafting what digital word processing has done to facilitate composition and publication of text. As a set of practical graphics programs, they enable digital compilation of graphical elements, ease the process of modification in response to second thoughts, editorial comments and scale changes, and lead from initial compilation to publication without redigitizing or redrafting. Design goals focused on an "office-scale" system, with an affordable price.

GSDRAW and GSMAP use a high precision digitizer and plotter for entry and plotting of digital data . Program capabilities include modification of databases by deletion of unwanted entries or additions at any time. Part or all of the data in a database can be plotted. Words and alphanumeric characters are entered using a word processing program, and their locations are entered by digitizing. Entries are numbered by the program, and edited or deleted according to this number. Although results can be partly viewed on screen, the primary output is to the plotter. Plots can be made in two modes; the "draft" mode provides entry numbers; the "publication" mode draws plots without entry numbers.

This document describes GSDRAW and GSMAP Versions 5.0. GSDRAW is based on storage of X-Y coordinate data unique to each illustration; GSMAP is based on storage of geodetic coordinates (latitude/longitude). The two programs are otherwise very similar. GSDRAW is used for illustrations, cross sections, and maps where there is either no latitude/longitude grid, or the use of a latitude/longitude system is not necessary; GSMAP enables digitizing a geologic map in pieces, and combination of the pieces in their proper places. GSMAP supports digitizing and plotting in Mercator, Universal Transverse Mercator, Transverse Mercator, Oblique Mercator, Lambert Conformal Conic, Albers Equal Area, Equidistant conic, and Polyconic map projections. A basic set of line and geologic symbol types has been included; additions can be made by users. These programs do not provide the sophistication of commercial CAD systems available for engineers, and are plotter oriented rather than screen oriented. Screen graphics are used to assist digitizing and editing, rather than as primary tools in design or output.

Version 5.0 of GSDRAW and GSMAP is compatible with data bases created by Versions 3 and 4 of these programs. Changes and additions to Version 4.0 are listed in Appendix 3.

Three important changes are:

1. The shift from plotter-firmware to program software for the filling of polygons, increasing the maximum size of the entry that can be digitized and plotted from 500 points to 8,000 points, and adding the capability of filling polygons with symbols on a user specified grid, and allowing the filling of polygons and symbols on plotters that lack firmware to support polygon fill.

2. The addition of a NODE file to assist precision of digitizing where two lines join. This may be important to use of digital data by GIS programs that create and make use of structured data sets.

3. Change of all map projection algorithms to a family of algebraic routines, U.S. Geological Survey 1986, rewritten here from Fortran to QuickBasic for use in GSMAP.

GSDRAW and GSMAP belong to a family of programs being developed to assist workers in the earth sciences. Version 1.0 of GSDRAW and GSMAP was released in February, 1986, Version 3.0 in August 1986, and Version 4.0 in September, 1987. Other programs developed by the authors and released during this time, paralleling the development of this pair. The pace of programming, testing, and documentation has not permitted equal development of all of these programs to bring operations into conformity with practices of GSMAP and GSDRAW Version 5.0. All of these programs are being rewritten so that configuration files for digitizer, plotter and screen, and projection parameter files required for programs using geodetic coordinates will be identical. These will be identified as Level 5 programs when new versions are released. New programs meeting these specifications will be similarly identified.

Utility programs released with GSMAP and GSDRAW Version 4.0, see p. 131 can be used with data bases created by Version 5.0. Additional utility programs are in the works, and will be released when tested and approved. We did not wish to hold up release of GSMAP and GSDRAW Version 5.0 to wait for completion of these other programs. Several of the utility programs will not process individual entries with more than 500 points, a limitation consistent with Version 4.0 of these programs. They will otherwise fulfill their intended functions.

The source code for GSMAP and GSDRAW 5.0 will be included in a future release.

SYSTEM REQUIREMENTS

Hardware for Version 5.0

GSDRAW and GSMAP are designed for use on IBM PC (or compatible) microcomputers, and require digitizers and plotters for operation.

A small complete system would include:

Microcomputer

PC (DOS operating system) with at least 512K RAM, and two floppy disk drives; two serial ports (one for the digitizer, the second for the plotter; one parallel port (for the printer); 8087 co-processor chip (required); graphics card equivalent to the IBM color/graphics adapter (Hercules graphics are **NOT** supported); monitor suitable for use with the graphics card (IBM color/graphics equivalent; CGA and EGA graphics are supported.

Printer with screen dump capability.

Digitizer

Example: GTCO Digi-Pad 5, 11"x17" digitizer (or larger)**/16-button cursor required**

Plotter

Example: Hewlett-Packard HP-7550A 11"x17" plotter

The programs have been successfully operated on Compaq, Columbia, Sperry AT, IBM PC, XT,and AT, GRID, and Leading Edge computers.

GSDRAW and GSMAP Version 5.0 were designed and tested using GTCO digitizers with 16 button cursors. The programs have been sucessfully operated with Calcomp digitizers and other types, and probably can be used with any digitizer with multi-button cursor, that sends ASCII character strings and communicates with the PC through an RS232 serial port. Version 5.0 of GSDRAW and GSMAP support Hewlett-Packard plotters model numbers HP 7470A and above, and other plotters that use the HPGL graphics language. Plotters with configurable memory support special geologic characters; plotters without configurable memory will substitute blanks for these characters. Plotter documentation provides information on availability of configurable memory for special characters.

GSDRAW and GSMAP Version 5.0 can use the EGA color adapter and color Monitor, if available, to display different kinds of lines in different colors. The EGA color graphics adapter card must have 256K memory to plot color on screen in EGA mode.

Software

The minimum software requirements for utilizing the programs are PC/DOS 2.0 or higher, the release diskettes and a word processing program capable of producing ASCII files. A RAM-resident program such as SIDEKICK is very useful during operations.

Installation of software

Installation of the GSDRAW and GSMAP programs requires specification of the designation of the computer's serial port connected to the digitizer, the baud rate setting of the digitizer, the designation of the computer's serial port connected to the plotter, and the baud rate setting of the plotter. Five files on the executable program disk are necessary and sufficient for the operation of GSMAP and GSDRAW.

For old hands

IF the digitizer has the exact settings of the GTCO, and **IF** the plotter has the exact settings of the HP, configured as recommended in the hardware installation section, copy and use the five files on Disk 1. These files are the executable programs GSMAP.EXE and GSDRAW.EXE, and three configuration files. The configuration files used with Version 4.0 of these programs can be used with Version 5.0, but symbol 207 (bar and ball,) will not be supported unless you add it to the older CONFIG.PLT file, or replace this file with the one supplied with this release. We recommend replacing older configuration files with those supplied here.

CONFIG.SCR provides configuration specifications for the screen (CGA, EGA, color or monochrome). Without modification the file supplied can be used with CGA color or monochrome monitors, or for EGA, but with CGA resolution.

CONFIG.DIG provides configuration specifications for the digitizer; without modification, it requires that the **digitizer be connected to COM2, be set to 1200 baud**, and to a resolution of 1/1000 inch.

CONFIG.PLT provides configuration specifications for the plotter; without modification it requires that the **plotter be connected to COM1, and set to 2400 baud.**

The first line of the CONFIG.DIG or CONFIG.PLT files can be changed to reset communication parameters for digitizer or plotter (port designation and/or baud rate). The first lines of these two files correspond to the CONFIG.CAD file of Version 3.0. The GSCAD.SYM file of Version 3.0 is not used with Versions 4 and 5.

Plot and projection files have been changed from those used by Version 4.0 to support new capabilities of Version 5.0 for

both GSDRAW and GSMAP: please review these changes before trying out the new programs.

The configuration files can be configured to meet the requirements of different systems, and to take advantage of EGA adapters and EGA color monitors.

For new users

Please refer to the Installation section of this documentation, APPENDIX 1, for details and worksheet (p. 66).

Manuals supplied with computer, digitizer, and plotter contain details and explanations of parameters needed in the installation of particular hardware.

GSDRAW OR GSMAP ?

These two programs are similar but are not identical.

Use GSMAP for latitude/longitude dependent data, especially where digitizing will be conducted in several pieces and merging of databases will be needed. Lettering will NOT change scale in GSMAP if the plot scale is changed. For accurate digitizing, maps must have been drawn using one of the supported projections. GSMAP databases can be merged; the data can be plotted using any of the eight supported projections. Because data is stored in latitude/longitude coordinates, there is no inherent scale in a GSMAP data base.

Use GSDRAW for diagrams and maps lacking latitude/longitude data. Lettering will change size with change of scale. GSDRAW databases can be merged at positions and scales of choice. GSDRAW should be used for very large scale maps even if latitude/longitude coordinates are available. For example, a sample map at 1"=50' is better done with GSDRAW because the precision of latitude/longitude coordinates may **NOT** be adequate to retain the precision of location required by this scale. Changing of map projections is essentially meaningless to very small areas. Data directly digitized into a GSDRAW data base is stored in digitizer units, inches, if supplied by the digitizer.

A few essential definitions

ENTRY NUMBER

A sequential number, starting with 1 for each illustration is assigned by the program for each entry, whether it is a line, a symbol, text, etc. Additions, deletions, and modifications to the digital file are based on the number of the entry being changed. THE ENTRY NUMBER is supplied on the screen during digitizing, is drawn on "draft mode" plots (the ENTRY NUMBER is plotted to the left of the first point digitized for each entry), and can be obtained from listings on the screen or on the printer. It is displayed on-screen during plotting as each entry is printed.

CODE

A number, 1-699 is entered by the user from the digitizer keypad. Functions are defined by the program for each of seven different groups. Codes are selected by the user within those groups. Details of the functions of different code groups in digitizing and plotting are provided in the reference section of this report.

LINE TYPE

A number, 0-12, is defined in the plotter for different kinds (patterns) of lines - solid, dotted, dashed, etc. The width of a line is determined by the pen used to draw it; the "pattern" by specifying LINE TYPE **when plotting.** <u>All lines are digitized as if solid.</u>

PROJECTION FILES (also called projection parameter files)

Operation of GSMAP requires a file that contains the parameters of the map projection used for digitizing or plotting. These files are described in Appendix 2 of this report. Projection files are prepared using a word processing program before using GSMAP for digitizing or plotting.

NODE-

Version 5.0 brings Nodes and a NODE FILE to GSMAP and GSDRAW. As used in Version 5.0, nodes are automatically established at points that start and finish a line, and can be digitized at intermediate points on a line where the line is intersected by another line.

Snap distance

In Version 5.0 Snap distance is a distance in inches established at the beginning of the digitizing session. If a node is digitized at a distance less than the snap distance from a preexisting node, the coordinates of the point are "snapped" to the precise coordinate values of the first. This means that junctions of lines will match precisely, even if there are small discrepancies in positioning the cursor when digitizing. the snap distance does not change the precision of digitizing or affect the position of points other than the "later" node. The default distance (set by striking the Enter key, without entry of a number) is 0". This is equivalent to the practice of older versions of these programs.

? Make sure that all equipment is operational and turned on. Rebooting the system **after** turning on the digitizer and plotter will help avoid problems in communication between the computer and these devices.

GSDRAW and GSMAP are invoked by entering the name of the program desired. The first screen is a "disclaimer" screen with a "Mini-menu" in the lowermost part providing a choice of three options. All working sessions must start by either starting a new data base or with opening an existing data base. Selection of option 3 from the Mini-menu allows a quick return to the DOS prompt.

MINI-MENU

1. Start a new data base
2. Open an existing data base
3. Exit

If option 1 is selected, procedures for opening a data base will be prompted on the screen; the steps in opening a data base are described below, see description of Option 1 from the Main Menu.

If option 2 is selected, the next screen will prompt for entry of a database; entry of the name of a database (extensions are not entered) will open the database and bring the screen to the Main Menu, GSDRAW, or to a screen displaying the coordinates of the corners of the data base, GSMAP, and thence to the Main Menu after hitting any key.

MAIN MENU

GSDRAW and GSMAP operate most of the time from a Main Menu screen.

CURRENT DATA BASE:
MAP TITLE:

1 - START A NEW DATA BASE
2 - OPEN AN EXISTING DATA BASE
3 - DIGITIZE NEW ENTRIES
4 - DELETE ENTRIES
5 - RECOVER ENTRIES
6 - CHANGE PARAMETERS FOR ENTRY
7 - LIST CONTENTS OF DATA BASE
8 - PLOT ON THE SCREEN
9 - PLOT ON THE HARD COPY PLOTTER
10 - MERGE ANOTHER DATA SET INTO CURRENT DATA SET
11 - COMPUTE POLYGONAL AREA
12 - EXIT

ENTER CHOICE BY NUMBER:

MENU OPTIONS FOR GSDRAW AND GSMAP

Option 1. Starting a new data base, GSDRAW

Entering 1 from either the Mini-Menu or the the Main Menu will start operations to open a new data base.

The first prompt requests:

ENTER MAP DATA BASE NAME:

This requests the name of the file (without extension) that will contain the data base for the map or illustration. After entry the next prompt requests:

ENTER TITLE OF MAP:

This requests the name that will be associated with the map. after entry of the MAP DATA BASE NAME the screen will provide the prompt below:

```
OPTIONAL METHODS FOR SPECIFYING DATA BASE CORNERS
FROM DIGITIZER
     1 ALL FOUR CORNERS
FROM KEYBOARD
     2 - SPECIFY UPPER RIGHT CORNER (X,Y)
     3 - SPECIFY LOWER LEFT (,Y), UPPER RIGHT(X,Y)
     4 - ALL FOUR CORNERS

ENTER OPTION:
```

If Option 1 is selected by entering "1" at the prompt, the screen will clear, and the next prompt (in some cases this prompt may be shown several times) will be:

```
ENTER 0(ZERO)ON CURSOR KEYPAD TO SYNCHRONIZE DIGITIZER INPUT
```

Follow this instruction, lightly tapping the "0" key until the request on the screen asks for entry of a corner of the map on the digitizer. During synchronization, the cursor can be at any location in the active area of the digitizer. The next prompts will be:

```
ENTER UPPER LEFT CORNER ON DIGITIZER:
ENTER LOWER LEFT CORNER ON DIGITIZER:
ENTER LOWER RIGHT CORNER ON DIGITIZER:
ENTER UPPER RIGHT CORNER ON DIGITIZER:
```

Use the "0" key on the digitizer keypad to enter the points requested. The cursor must be precisely located, with cross-hair at the point being entered when the "0" key is pressed. Note that UPPER, LOWER, LEFT, AND RIGHT apply to the map, not to the digitizer. The orientation of the map on the digitizer is not important. The UPPER LEFT CORNER and the LOWER LEFT CORNER define the vertical direction for the database. The horizontal direction is perpendicular to the vertical, and not set by the chosen position for other corners.

Completion of entries of corners from the digitizer will cause return to the MAIN MENU screen.

If option 2, 3, or 4, is selected, prompts will ask for entry of the coordinates desired for the data base corners. These entries are made from the keyboard; no digitizer is required. Option 2 creates a data base with the lower left corner coordinate value set to 0,0, the upper right at the X,Y values specified and upper left and lower right corners to create a rectangle. Options 3 and 4 allow specification of two or all four corners of a data base from the keyboard.

Notes:

-Option 1 starts a data base exactly as done by earlier versions of GSDRAW.

- Options 2, 3, and 4 allow starting a data base from the keyboard (not possible in earlier versions of the program), and permit specification of exact corners useful, perhaps, when digitizing data from an 8" x 10" graph. The coordinates have no units (e.g. inches), when entered; the scaling of the digitizing algorithm allows digitizing from a drawing at smaller or larger scale, or one drawn in different units. Use of these options allows digitizing into an existing orthogonal coordinate system, such as a mine grid in such a way that the X and Y coordinates of the data are recorded in the mine grid system.

- When plotting data, 1:1 scale (entry of 1,1) the size of the plot will be dimensioned such that the values of X and Y will be plotted in <u>inches</u> ! Adjust the plot scales accordingly.

Option 1: Starting a new data base, GSMAP

Entering 1 from either the Mini-Menu or the Main Menu will start operations to open a new data base.

The first prompt requests:
ENTER MAP DATA BASE NAME:
This request is for the name of the file (a filename without extension) that will contain the data for the map. After entry of the name, the next prompt displays: requests:
ENTER TITLE OF MAP:
This asks for the name that will be associated with the map; after entry, the screen will display the following:
TYPES OF MAPS

1 - 7/12 MINUTE
2 - 15 MINUTE
3 - 30 MIN LAT x 2 DEG LONG
4 - 1 DEG LAT x 2 DEG LONG
5 - OTHER

ENTER TYPE:

Enter the type of map to be used. If type 1,2,3 or 4 is selected the following prompt will be seen:
ENTER LAT/LON OF NORTHWEST CORNER See below for format of
DD,SS,C,DDD,MM,SS,C: this entry

Entry of the required coordinates for the northwest corner of the map will return the screen to the Main Menu.

If type 5 is selected the following prompts will be seen, requesting entry of the latitude/longitude coordinates of the four corners of the map:

ENTER LAT/LON OF
NORTHWEST CORNER
DD,MM,SS,C,DDD,MM,SS,C
ENTER LAT/LON OF SOUTHWEST CORNER
DD,MM,SS,C,DDD,MM,SS,C
ENTER LAT/LON OF SOUTHEAST CORNER
DD,MM,SS,C,DDD,MM,SS,C
ENTER LAT/LON OF NORTHEAST CORNER
DD,MM,SS,C,DDD,MM,SS,C

Enter coordinates,
Use the format specified
Degrees, Minutes, Seconds,
"C" represents the Compass
direction required to
complete the entry
W for West Lon, E for E. Lon
N for North Lat, S for S Lat

Completion of entry of the four coordinates in required form (commas separating the numbers for degrees, minutes and seconds will cause return to the Main Menu.

Unlike opening a GSDRAW database from the digitizer, there will be no request for entry of corner points on the digitizer.

Note the format of screen prompts for Latitude,Longitude,C entry; DD,M,C,DDD,MM,SS,C. Seconds can be supplied as a decimal number if this precision is required.

Notes:

- The MAP DATA BASE NAME is the name of the file that contains the data base for the map (or illustration); no more than eight letters (or numbers) can be used. Extensions of files that result are supplied by the program.

- The TITLE OF the MAP is a name that will be associated with the map, and shown on the Main Menu screen and on listings of the contents of the database. No more than eight letters (or numbers) can be used.
- In both GSDRAW and GSMAP, if you attempt to use a MAP DATA BASE NAME that is already in use, the computer will inform you of this with a warning prompt:
A FILE WITH THE NAME OF ____ ALREADY EXISTS
DO YOU WANT TO CONTINUE(Y/N)?
    - If you answer Y, the program will continue and the old file will be overwritten.
    - If you answer N, the program will once again request entry of a new MAP DATA BASE NAME

- The corner points chosen on the hard copy are very important. Proper indexing to the digitizer requires that the points be readily identifiable and precisely located. One kind of mark that is easily identified and very precise is a shallow cross cut with a knife blade in a mylar original; a plus made with a 9H pencil serves well for a paper original.

Option 2: OPEN AN EXISTING DATA BASE

Entering 2 from the Main Menu of either GSDRAW or GSMAP will bring the following prompt:

ENTER MAP DATA BASE NAME:

In GSMAP, entry of the map data base name will cause the latitude/longitude coordinates of the four corners of the database to be displayed on screen, then, hitting any key will cause return to the Main Menu.

In GSDRAW, entry of the database name will cause immediate return to the Main Menu.

If no data base with the name entered exists in the files accessible to the computer, a request for a proper DATA BASE NAME will be made -
AN ERROR HAS OCCURRED OPENING DATABASE _____
CHECK DATABASE NAME. HIT ANY KEY TO RETRY

When the prompt requesting entry of a map data base name is displayed on the screen - Hitting any key will cause the request for a map data base name to return to the screen. Striking Control C (^C) will return the system to the DOS prompt so that directories can be consulted

Notes:

- Each session with GSDRAW or GSMAP must start either by starting a new data base Option 1 or by opening an existing data base Option 2. If another option is selected a message on the screen will request that a data base be opened.

Option 3. DIGITIZE NEW ENTRIES

Digitizing in GSDRAW

Entering 3 from the Main Menu clears the screen, and opens the program for digitizing new entries.

The first prompt will request:

DISPLAY PREVIOUS DATA? (Y/N)

Entry of "N" instructs the program not to display existing entries before starting digitizing; only new entries will be shown. Entry of "Y" will cause all previous entries to be displayed, as well as new entries as they are digitized.

If the digitizer has not been indexed to the hard copy during the current session, the next prompts will request:

ENTER 0(ZERO)ON CURSOR KEYPAD TO SYNCHRONIZE DIGITIZER INPUT

Follow this instruction until the request changes to ask for entry of the four corners of the map from the digitizer keypad (use the "0" key). During synchronization the cursor can be at any point inside the active area of the digitizing tablet.

The prompts for indexing the map to the digitizer tablet are as follows -

ENTER UPPER LEFT CORNER ON DIGITIZER:
ENTER LOWER LEFT CORNER ON DIGITIZER:
ENTER LOWER RIGHT CORNER ON DIGITIZER:
ENTER UPPER RIGHT CORNER ON DIGITIZER:

Move the cursor to each corner in turn, and at each location use the "0" key on the digitizer keypad to index the map to the digitizer tablet. Following the entry of the fourth corner, the screen will clear. If "Y" (display previous data) was selected, the, data will be plotted on the screen; when plotting is complete, a high pitched tone will sound to indicate that the system is ready to receive new entries. If "N" was chosen, the high pitched tone sounds almost immediately after the fourth corner is entered, and data entry can begin. The scale for screen display will be set to maximize use of the screen's area; The X and Y scales are equal.

After the first keypad entry, a line of characters on the bottom line of the screen will show the status of the current entry (the number of the current entry, values entered for PARA1 and PARA2, and the number of points digitized, NO OF PTS.

ENTRY ___ CODE ___ PARA 1 ___ PARA 2 ___ NO. OF PTS ____

Codes, the 7 code groups, and the meanings assigned to Parameter 1 and Parameter 2 for each code group are described in the Reference section of this report.

Three entries are made from the keypad of the digitizer before entering data points:

Code,1-3 digits (if less than 3, the "A" key is used to complete this entry)
Parameter 1 (PARA1), 0-6 digits (if less than 6, the "A" key is used to complete this entry)
Parameter 2 (PARA2), 0-6 digits (if less than 6, the "A" key is used to complete this entry.

After entering CODE, PARA1, and PARA2, the program is ready to accept data points. The 0 key, 1 key, 2 key, and 3 key are used to enter data points. Each key has specific uses. Instructions for digitizing entries in each of the seven code groups are given in the Reference Section.

Digitizing in GSMAP

Entering 3 from the Main Menu clears the screen, and opens the program for digitizing new entries.

The first prompt will request input of the file name (including extension) for the projection parameter file:

ENTER FILENAME OF PROJECTION PARAMETERS:

Following entry, the next prompt asks:

DISPLAY PREVIOUS DATA? (Y/N) **N**

"Y" will cause all previously digitized lines to be shown on the screen. "N" will start the digitizing session without showing previous entries.

If the digitizer has not been indexed to the hard copy during the current session, prompts will request entries to synchronize the digitizer: follow directions. The cursor may be at any position in the active area of the digitizer table during synchronization.

ENTER 0(ZERO) KEY ON CURSOR KEYPAD TO SYNCHRONIZE DIGITIZER INPUT - After synchronization, four prompts will then ask for entry of the four corners of the map from the digitizer keypad (use the "0" key).

ENTER NORTHWEST CORNER ON DIGITIZER:
ENTER SOUTHWEST CORNER ON DIGITIZER:
ENTER SOUTHEAST CORNER ON DIGITIZER:
ENTER NORTHEAST CORNER ON DIGITIZER:

Move the cursor to each corner in turn, and at each location use the "0" key on the digitizer keypad to index the map to the digitizer tablet.

After entry of the fourth corner, the X and Y scales of the map will be shown on the screen.

X SCALE= _____ Y SCALE= _____

The computer will compare the X and Y scale to check for possible problems with the match between the corner points entered and the latitude/longitude coordinates of the data base.

If the X and Y scales differ by more than 2 percent, a message will be shown on screen, and a warning tone sounded:
SCALE DIFFERS BY MORE THAN 2 % IN X AND Y
CONTINUE? (Y/N)
"N" will return you to the menu screen. "Y" will allow you to proceed. This message should prompt careful checking of all parameters entered into GSMAP and the hard copy being digitized.

If no scale problem is identified after digitizing the fourth corner point or a "Y" answer is given to the CONTINUE? question, digitizing can proceed with entry from the keypad of the code desired for the first entry to be digitized.

The scales for screen display will be set to maximize use of the screen's area, and minimize distortion.

After the first keypad entry, a line of characters on the bottom line of the screen will show the status of the current entry; the number of the current entry, values for PARA1 and PARA 2, and the number of points digitized in this entry.

ENTRY___ CODE ___ PARA 1 ___ PARA 2 ___ NO. OF PTS ____

Codes, the 7 code groups, and the meanings assigned to Parameter 1 and Parameter 2 for each code group are described in the Reference Section of this report.

Three entries are made from the keypad digitizer before entering data points:

Code,1-3 digits (if less than 3, the "A" key is used to complete this entry)
Parameter 1 (PARA1), 0-6 digits (if less than 6, the "A" key is used to complete this entry)
Parameter 2 (PARA2), 0-6 digits (if less than 6, the "A" key is used to complete this entry)

After entering CODE, PARA1 and PARA2, the program is ready to accept data points. The 0 key, 1 key and 2 key are used to enter data points;each key has specific uses. Instructions for digitizing entries in each of the six code groups are given in the Reference Section.

Ending a digitizing session, code 999

A code of 999 entered from the keypad will end a digitizing session and return program execution to the MAIN MENU screen.

Notes and suggestions:

- WARNING - Errors will result if the hard copy moves on the digitizer, so fix it so that it won't move. If it should, go back to the menu, and open the database (option 2). Then properly index the copy to the digitizer.
- As long as a session within the same database is continuous, reindexing of hard copy with the digitizer tablet will not be required.
- BE CERTAIN THAT the hard copy is properly indexed to the digitizer whenever data is being digitized. Improperly digitized data can't be "fixed", but must be deleted and the entries re-digitized.
- The hard copy used for digitizing for either GSMAP of GSDRAW can be at any scale, providing that it is properly indexed to the digitizer tablet.
- If a GSDRAW data base is opened by digitizing (method 1), the starting of digitizing using Option 3 will not require re-indexing of the copy to the digitizer table during the same session with GSDRAW. If other methods for opening a data base are used, indexing will be required.

Option 4. DELETE ENTRIES

A 4 entered from the Main Menu of either GSDRAW or GSMAP enables deletion of individual entries.

The first prompt asks if graphical display of data is desired. "Y" will provide a screen display; "N" goes directly to the process of deleting entries.

```
GRAPHICAL DISPLAY ? (Y/N):?
```

Entry of "N" brings the prompt:

```
ENTRY# TO DELETE (0 TO QUIT):?
```

Entering the number of the entry deletes the entry, and causes redisplay of the ENTRY# TO DELETE prompt. Entry of "0" returns program execution to the Main Menu.

```
GRAPHICAL DISPLAY ? (Y/N):?
```

Entry of "Y" will permit the display of data for selected code(s) or all of the entries in the database to be displayed on the screen.

The prompt:

```
CODE TO PLOT(-1=ALL 0=NONE):
```

will be shown until all desired codes are plotted, and a 0 is entered. Entry of Code -1 or codes between 400-499 will bring the prompt:

```
FILL POLYGONS(Y/N): ?
```

At this prompt Entry of Y cause polygons to be filled on the screen, Entry of N will show only the outlines of polygons.

Entry of code 0 will Bring the prompt:

```
ENTRY# TO DELETE (0) TO QUIT):?
```

This prompt requests the number of the entry to be deleted. The on-screen plot of the entry will be deleted from the screen; and another prompt will appear the on screen:

```
DELETE? (Y/N)?
```

This allows second thoughts; and requires confirmation that the entry is indeed to be deleted. A "N" causes the entry to be replotted on the screen, a "Y" will cause a a repeat of the prompt:

```
ENTRY # TO DELETE (0 TO QUIT):?
```

A "0" supplied in answer to the ENTRY# TO DELETE prompt returns program execution to the Main Menu.

Notes:

- The option using screen display is a very useful way to identify the number for a particular entry. "Deleting" the entry, but responding "N" to the prompt permitting second thoughts.
- Generally the filling of polygons serves little purpose, but just delays the main business at hand.

Option 5. RECOVER ENTRIES

Entry of a 5 from the Main Menu of either GSDRAW or GSMAP enables a deleted entry to be recovered.

The first prompt:

ENTRY# TO RECOVER (0 TO QUIT):?

Requests the number of the entry to be restored to the active data base. Entry of a "0" causes return to the Main Menu.

Option 6. CHANGE PARAMETERS OF AN ENTRY

Entry of a 6 from the Main Menu of either GSDRAW or GSMAP enables change of Code, Parameter 1, and Parameter 2, for a single entry or for multiple entries. Such changes might be needed to modify the size of lettering, plotting characteristics, character of lines, or to correct errors made during digitizing. The global option permits changing Code, PARA1, or PARA2 for all entries in the database with a particular code. Entries are prompted from the screen.

The first prompt:
Global Change ?(Y/N/Q)?
A "Y" allows you to make changes to entries with a specified code throughout the database, and change CODE, PARA1, or PARA2. Entry of a "Y" causes the following prompt to appear:

CODE TO BE CHANGED:?

Entry of the code number brings another prompt
CHANGE CODE (CODE), PARA1(P1), PARA2(P2)?

Example:
entry of CODE brings a prompt for entry of the code to be changed. The prompt:

NEW CODE:?
Requests entry of the new code. After entry of the new code, the system returns to the initial prompt:

Global Change ?(Y/N/Q)?

A "N" will cause a series of prompts: enter the information requested.

ENTRY# TO BE CHANGED (0) TO QUIT:
This prompt calls for the number of the entry to be changed. On-screen information will be supplied showing the "old" code and parameters 1 and 2 for the entry, and will request the desired "new" parameters - For example:

OLD PARAMETERS= 1 0 0
ENTER NEW VALUES(CODE,PARA1 PARA2):
Entry of the desired code, the value of parameter 1, and the value of parameter 2 (separated by commas) causes the requested changes in the database, and a return to the prompt:
ENTRY# TO BE CHANGED (0) TO QUIT:

Entry of a "0" causes return to the prompt:
ENTRY# TO BE CHANGED (0) TO QUIT: Entry of a 0 returns the screen to the prompt:

Global Change ?(Y/N/Q)?

Entry of a "Q" returns execution of the program to the Main Menu.

Option 7. LIST CONTENTS OF DATA BASE

Entry of a 7 from the Main Menu of either GSDRAW or GSMAP will provide a listing of information for entries in the data base, either on the screen or the printer, as specified.

A screen prompt begins the listing process -
PRINT ON SCREEN OR PRINTER (S/P):
Entry of "S" (screen) or "P" (printer) as desired is followed by message on the last line of the screen -
FUNCTION KEY 9 TO PAUSE, Q TO QUIT, RETURN TO CONTINUE
Information supplied will be:

MAP NAME
Coordinates of upper left point, coordinates of upper right point, Coordinates of lower left point, Coordinates of lower right point

The next prompt requests the code for data desired:
ENTER LINE CODE(-1 FOR ALL, 0 TO QUIT)
Entry of the desired code will provide the following listing, on the screen or printed, as previously specified. The prompt will be repeated to permit entry of all codes desired.

The GSDRAW Listing provides:

Entry number, Parameter 1, Parameter 2, X and Y coordinates of the first and last points of each entry, and the number of points in the entry. The X and Y coordinates are measured in inches. The lower left corner of illustration is the origin, the line connecting the two left points is the Y axis. The X axis is perpendicular to the Y axis, not defined by other corner points.

The GSMAP Listing provides

Entry number, Parameter 1, Parameter 2, latitude/longitude coordinates of the first and last points of each entry, and the number of points in the entry.

Entry of CODE "0" causes return to the Main Menu.

Notes:
- If the option for screen display is chosen, the display will pause after display of 20 entries. During the pauses, the prompt "HIT ANY KEY TO CONTINUE, Q TO QUIT" Hitting the "Q" key during the pauses will cause return to the Main Menu; during the pauses the F9 key is not required for return to the Main Menu; it is required during the scrolling of the screen display.

Option 8. PLOT ON THE SCREEN

Entry of an 8 from the Main Menu of either GSDRAW or GSMAP will start the screen plot sequence. The entries in the current database can be displayed on the screen. Lines and outlines of polygons will be plotted as lines; polygons may be filled if desired. Numbers, letters, and symbols, will be plotted as points, not as text entries or symbols. During the plotting on the screen, the process can be halted using the F9 key; it will resume after the RETURN key is pressed.

The plot sequence for GSDRAW and GSMAP is fully prompted on the screen.

In GSDRAW prompts relating to map projections will be skipped:
In GSMAP the first prompt will be:

DO YOU WANT A PROJECTED DISPLAY? (Y/N):

If you enter "N", latitude/longitude coordinates will be displayed as if a set of X,Y cartesian coordinates, and the next prompt will be skipped. If you enter "Y", the net prompt will be:

ENTER FILENAME OF PROJECTION PARAMETERS:

Enter the filename, with extension for the map projection you wish to use:

After entry, the next prompt calls for codes and begins the screen plot sequence. This is the first prompt for GSDRAW:

CODE TO PLOT (-1=ALL, 0=NONE): ?

Enter the desired code; entries of this code will be displayed on screen in the order digitized. After all entries with this code have been drawn on the screen, the previous prompt will be displayed again, new codes can be entered, and these entries drawn on the screen.

If a 400-499 code or -1 for "all" is selected, a screen prompt will be displayed.

FILL POLYGONS? (Y/N): ?
IF "N" is entered only the outline of the polygons will be drawn; if "Y" is entered the polygons will be filled.

Entry of a code of 0 (zero), or two strokes of the "Enter" key will bring the screen back to the Main Menu.

Notes:

- The algorithm for polygon fill on the screen is complex. The polygon must be a closed polygon. If a complex polygon is too narrow at the scale plotted on the screen, part of it may not fill. Under certain circumstances the entire screen may be filled ! If this happens, use the F9 key followed by the "Q" key to bring the program back to the Main Menu.

- If the computer is in GRAPHICS mode, and EGA is NOT being used, a screen print can be made by simultaneously striking the Shift and PrtSc keys. Distortion due to the low resolution of the printer is to be expected. Distortion due to screen scaling in early Versions of GSMAP and GSDRAW is not present.

- Latitude and longitude values are plotted on the screen as if X and Y coordinates in unprojected displays in GSMAP. Unprojected displays are used in the screen displays of Options 4 and 10.

- Use of projected displays will increase the time required for screen display.

Option 9. PLOT ON THE HARD COPY PLOTTER

Entry of 9 - from the Main Menu invokes a series of prompts: Before reacting to the prompts MAKE SURE THAT THE PLOTTER IS READY TO FUNCTION AND IS LOADED WITH PENS AND PAPER - if it isn't everything will come to a complete halt after you answer the first question !!! Prompts ask for input of specifications for plots; familiarity with a plot parameters is required.

Batch command files

Batch files are ASCII files that contain answers to the on-screen queries from the computer during interactive plotting, and should be used for complicated plots, plots that take a considerable amount of time, or for replicate plots. It works well to make the first plot of a diagram without using a batch command file, preserve the screen prompts and replies by printing the screen, and write a batch file using this set of answers as its contents. The contents of a batch command file for plotting will be described at the end of this section.

Batch command files (plot files) can be created using any text editor that produces an ASCII file. Wordstar in Non document mode is one example of such an editor.

Offsets

XOFF and YOFF are "offsets", designed to allow moving the entire illustration to a new place on the plotting media. The desired X offset and Y offset are entered in inches (and decimal inches) to position the illustration. X and Y are defined during digitizing, see page 18 of this documentation. The X and Y offsets are measured in inches from the lower left corner, Y vertical, X horizontal, and increasing from this corner. The offsets, XOFF, YOFF, are separated by a comma when entered.

Draft Mode

In Draft Mode, the entry number number will be plotted to the left of the first digitized point for each entry. If Draft Mode is not specified, entry numbers will not be plotted (publication mode).

Rotation

Rotation is a plotter feature enabling rotation of a plot by 90 degrees on the plotter media. Check the plotter manual for rotation instructions. In most cases if the X dimension of the plot exceeds the Y, no "rotation" should be specified.

Speed and Force

Speed and force are plotter characteristics. Pen speed is specified in (cm/sec) and force by integers 1 to 8 that set the force. Optimum speed and force depend on pen type and plot media. Default settings provided by Hewlett-Packard are given here in parentheses. The quality of final plots is generally improved by slowing the pen speed.

PEN TYPE	SPEED cm/sec	FORCE values
Fiber	25 (50)	1 (2)
Roller	30 (60)	3 (6)
Refillable ink pens	12 (30)	2 (2)
Disposable ink pens	15 (15)	1 (1)

Force values = grams
1 = 10 g
2 = 18 g, 3 = 26 g
4 = 34 g, 5 = 42 g
6 = 50 g, 7 = 58 g
8 = 60 g

Width and height for label characters

The width and height of the characters which will be used as the labels of line numbers in draft mode is specified in inches (.1,.15 are good values to use; values of .069,0.1.produce characters of about the smallest legible size. This entry is always required whether draft mode is used or not. The sizes specified for label characters are the sizes used for posting of numbers for 101-199 codes; see Reference Section for uses.

Scaling Points P1 and P2

Specification of scaling Points is required if plots are sent to a file rather than to a plotter. Scaling points P1 and P2 are discussed in the documentation for each plotter. The values of scaling points depend on the kind of plotter and on the size of the plot paper. Values for two plotters are provided below. Paper dimensions are in inches.

For the HP 7550A

	P1x,P1y	P2x,P2y
A size paper 8 1/2 x 11	80,320	10080,7520
B size paper 11 x 17	620,80	15820,10080

For the HP 7585/7586

	P1x,P1y	P2x,P2y
A size paper (8 1/2 x 11	-2790,-4500	2790,4500
B size paper 11 x 17	-7100,-4500	7100,4500
C size paper 17 x 22	-7090,-10075	7090,10075
D size paper 22 x 34	-15710,-15060	15710,15060
E size paper 34 x 44	-20840,-16180	20840,16180

At the very start a warning message furnishes a reminder that the plotter should be ready.

PLOTTER SHOULD BE TURNED ON AND PAPER LOADED !!!!!!

The sequence of prompts is as follows -
"DO YOU WANT TO USE A BATCH COMMAND FILE?(Y/N):

"Y" will bring a prompt requesting entry of the complete file name of the Batch Command File; plot commands will be read from this file. "N" will cause a series of prompts requesting information to appear on the screen; plot commands will be entered from the keyboard; these prompts are as follows:

DO YOU WANT TO USE THE ONLINE PLOTTER(Y/N):

Entry of Y plots data on the plotter, Entry of N sends plot data to a file (commands in HPGL plot language, If "Y" is entered a prompt will ask for the file name to be used. The default (use enter key) is Y. If "Y" is entered the next two prompts will be skipped.

ENTER DISK FILENAME:

Enter the complete file name (Name and extension):

The next prompt asks for entry of the values for the scaling points. See above for a description of scaling points:

P1X,P1Y,P2X,P2Y:

Entry of these values brings the prompt:

DO YOU WANT TO PLOT USING A BATCH COMMAND FILE (Y/N)?

Entry of "Y" will bring a prompt requesting entry of the complete file name of the Batch Command File; plot commands will be read from this file. Entry of "N" will bring the prompt:

USE DATABASE CORNERS FOR PLOT AREA (Y/N):

If you enter "Y" the data base corners will be used as plot corners. If you enter "N", the next four prompts will request entry of the coordinates of the corners of the area to be plotted. Follow the prompts. Enter coordinates using the coordinate system of the map being plotted.

The next prompts set plot specifications:

ENTER SCALE OF MAP TO BE PLOTTED(X,Y):
Scale is entered in relation to the scale inherent in the data base by specifying a multiplying factor. For example 1,1 indicates a same size plot, .5,.5 a half size plot for data digitized in inches (the standard digitizer setting. X and Y may be different (to stretch or expand an illustration). The size of lettering is scaled to the X scale specified and is independent of the Y scale of the plot.

ENTER XOFF,YOFF: See above.
DRAFT MODE(LABEL LINES W/LINE #)(Y/N): See above.
MAP SIZE(X,Y) 7.978001 11.9879 (this message provides the map size in inches; no response is required.

ROTATE (Y/N/Q)? The "Q" entry returns the operation of the program to the start of the sequence of plot specification, in case mistakes have been made, or the size of the plot exceeds plotter media size.

ENTER SPEED, FORCE: See above.
ENTER WIDTH,HEIGHT FOR LABEL CHARACTERS: See above.

Following these entries defining plot characteristics, a series of prompts will request information on entries to be plotted; The code, pen to be used (specified by its numbered position in the carousel), line type and symbol type must be entered; each is specified by a number followed by a comma(,). "Comments" are useful in batch files, but are not usually appropriate when plotting interactively. Plotting of entries is done from the following prompt: after plotting of all entries with a specified code, the same prompt will enable plotting of additional codes.

ENTER CODE,PEN,LINE TYPE,SYM TYPE,COMMENTS:

- The meaning of the LINE TYPE and SYM TYPE entries depends on the line code group; see REFERENCE SECTION for details.

A plotting session is ended by entering **0,0,0,0,** in response to the request for CODE,PEN,LINE TYPE,SYM TYPE,COMMENTS:

0,0,0,0, induces four prompts : Responses to these prompts are not included in Batch command files.

REPLOT SINGLE ENTRY (Y/N):
"Y" allows plotting (or replotting) of a single entry. After providing entry number, and appropriate plot specification (Prompted from the screen). "N" brings the prompt:
DO YOU WANT TO DRAW CORNER BRACES (Y/N):
"Y" causes plotting of corner brackets (the plot corners are the corners of the GSDRAW database, unless windowed.
"N"brings the prompt:
DO YOU WANT TO GENERATE INTERNAL GRID TICK MARKS? (Y/N):
"Y" will bring a prompt asking for the desired spacing (in inches), and cause plotting of "plus" signs to define a grid with origin at the lower left corner of the database. "N" will bring the prompt:

DO YOU WANT TO PLOT THE NODE POINTS(Y/N):
"Y" will cause plotting of small circles at each of the nodes in the NODE file.

An"N" returns operations to the Main Menu. The default answer to the final four prompts is "N" (Strike the Return key at appropriate times)

Example of GSDRAW batch command file

Comments on the right (not enclosed in quotation marks) are not part of the file.

Entry in Batch Command File	Comments
Y	Use data base corners as plot corners
1,1	X,Y scales
1,2	X,Y offsets
N	Draft mode, N
Y	Rotate, Y
25,1	Speed 25, Force 1
0.1,0.15	X,Y size of labels
1,1,0,0, "solid line contacts,use 00 pen"	Lines
4,5,0,0, "solid line faults, use 1 pen"	Lines
400,1,0,0, "igneous rocks, solid fill"	Polygons
3,001,0	Fill type 1,spacing,angle
401,0.02,0,0, "Alteration, use red pen"	Polygons
3,60,45	Fill type 3,spacing,angle
555,1,0,0, "rock unit labels"	Rock units
FILENAME.TXT	File with rock unit labels
1,1,1,0, "dotted line contacts"	Lines
300,2,0,0, "plot with red pen"	Symbols
N	Don't randomize orientation
0,0,0,0,	End of the plot file

There must be a carriage return at the end of the final line of the batch command file.

Answers to the REPLOT SINGLE LINE ?, DRAW CORNER BRACES ?, GENERATE INTERNAL GRID TICK MARKS ? and PLOT NODES ? prompts must be supplied from the keyboard after the plot file instructions have been completed (the default is N).

Plot corners other than the data base corners can be set by entering a "N" as the first line of the plot file, and specifying the X and Y coordinates of the plot window in the next four lines of the plot file. The Format of these lines is X,Y; the values are the X and Y values for the desired plot corners using the coordinate system of the data base.

If a map has been digitized in coordinates other than **inches**, remember to set scales accordingly or plots may not have the sizes expected.

At the very start a warning message furnishes a reminder that the plotter should be ready.

PLOTTER SHOULD BE TURNED ON AND PAPER LOADED !!!!!!

The first prompt requests the name of the projection parameter file. See p. 81-83 for descriptions of these files.

ENTER FILENAME OF PROJECTION PARAMETERS:

After entry of the file name with extension, another prompt will be shown:

DO YOU WANT TO USE THE ONLINE PLOTTER(Y/N):

Entry of Y plots data on the plotter, Entry of N sends plot data to a file. Commands in HPGL plot language. If "N" is entered a prompt will ask for the file name to be used: If "Y" is entered the next two prompts will be skipped.

ENTER DISK FILENAME:

Enter the complete file name (Name and extension):

The next prompt asks for entry of the values for the scaling points. See above for a description of scaling points:

P1X,P1Y,P2X,P2Y:

Entry of these values brings the prompt:

DO YOU WANT TO PLOT USING A BATCH COMMAND FILE?(Y/N)?

Entry of "Y" will bring a prompt requesting entry of the complete file name of the Batch Command File; plot commands will be read from this file. Entry of "N" will bring the prompt:

USE DATA BASE CORNERS FOR PLOT AREA (Y/N):

If you enter "Y" the data base corners will be used as plot corners. If you enter "N", the next prompts will request entry of the latitude/longitude coordinates of the corners of the area to be plotted. Follow the prompts: The default is **Y**

ENTER LAT/LON OF NORTHWEST CORNER OF PLOT AREA
DD,MM,SS,C,DDD,MM,SS,C:
ENTER LAT/LON OF SOUTHWEST CORNER OF PLOT AREA
DD,MM,SS,C,DDD,MM,SS,C:
ENTER LAT/LON OF SOUTHEAST CORNER OF PLOT AREA
DD,MM,SS,C,DDD,MM,SS,C:
ENTER LAT/LON OF NORTHEAST CORNER OF PLOT AREA
DD,C,MM,SS,DDD,MM,SS,C:

Entry of the latitude/longitude coordinates of each of the four corners of the plot area in Degrees, Minutes, Seconds, Ccompass direction is needed, in the format requested -- (numbers and character for compass direction separated by commas). The plot area does not have to be the same as the database area. If the plot area is larger, the data may not be attractively positioned on the sheet. If the plot area is smaller, a window based on latitude and longitude will trim the data plotted to that included in the specified area.

The next prompts set plot specifications:

ENTER SCALE OF MAP TO BE PLOTTED(X,Y):

The map scale in X and the scale in Y must be entered using the denominators of the scale fractions, separated by commas (ie. 24000,24000). Do not use extra commas. Different X and Y scales may be required to precisely fit plots to base maps.

ENTER XOFF,YOFF: See above.

DRAFT MODE (LABEL LINES W/LINE #)(Y/N): See above.

The message, MAP SIZE(X,Y) _._____ _._____ provides the map size in inches. No response is required.

ROTATE (Y/N/Q)? See above.

ENTER SPEED, FORCE: See above.

ENTER WIDTH,HEIGHT FOR LABEL CHARACTERS: See above.

Following these entries defining plot characteristics, a series of prompts will request information on entries to be plotted; The code, pen to be used (specified by its numbered position in the carousel), line type and symbol type must be entered. Each is specified by a number followed by a comma(,). "Comments" are useful in batch files, but are not usually used when plotting interactively.

Plotting of entries is done from the following prompt: After plotting of all entries with a specified code, the same prompt will enable plotting of additional codes.

ENTER CODE,PEN,LINE TYPE,SYM TYPE, COMMENTS=

The meaning of these LINE TYPE and SYM TYPE entries depends on the code group; see REFERENCE SECTION for details.

A plotting session is ended by entering 0,0,0,0, in response to the request for LINE CODE,PEN,LINE TYPE,SYM TYPE,COMMENTS: **0,0,0,0,** induces four prompts : Responses to these prompts are not included in Batch command files.

REPLOT SINGLE ENTRY (Y/N):
A "Y" allows replotting of a single entry. after providing entry number, and appropriate plot specification (Prompted from the screen)

An "N" brings the prompt:
DO YOU WANT TO DRAW CORNER BRACES (Y/N):
"Y" causes plotting of corner braces at the corners specified for the plot:
An "N"brings the prompt:

DO YOU WANT TO GENERATE GEODETIC TICK MARKS? (Y/N):
"Y" will bring a prompt asking for the desired spacing (in degrees as prompted), and cause plotting of "plus" signs to define a grid with origin as close as possible to the lower left corner of the plot specified area (the grid will start at the closest even degree (or degree plus the specified grid interval.
An "N" brings the prompt:

DO YOU WANT TO PLOT THE NODE POINTS(Y/N):
"Y" will cause plotting of small circles at each of the nodes in the NODE file.
An "N" will return operations to the Main Menu.

- The default answer to the final four prompts (strike the return key at appropriate times) is "N"

Example of GSMAP batch command file

Comments to the right not enclosed in quotation marks are annotations that are not a part of the file.

Entry in Batch Command File	Comments
N	Plot corners specified below.
39,0,0,N,106,0,0,W	Lat/Lon NW corner
38,0,0,N,106,0,0,W	Lat/Lon SW corner
38,0,0,N,104,0,0,W	Lat/Lon SE corner
39,0,0,104,0,0,W	Lat/Lon NE corner
500000,500000	X,Y scales
0,0	X offset,Y offset (inches)
N	Draft mode, N
Y	Rotate Y
25,1	Speed 25, Force 1
0.1,0.15	X,Y size of labels (inches)
1,1,0,0, "solid line contacts, use 00 pen"	Lines
4,5,0,0, "solid line faults, use 0 pen"	Lines
400,1,0,0, "igneous rocks, solid fill"	Polygons
1,0.01,0	Fill type 1,space 0.01" (solid fill),angle
400,1,0,0, "edge igneous rocks"	
0,0,0	Fill type 0 to edge polygons
401,2,0,0, "rock alteration, use pen 2"	Polygons
2,0.05,45	Fill type 2,space 0.05",angle
401,3,0,0, "edge alteration, use pen 3"	Polygons
0,0,0	Fill type 0 to edge polygons
555,1,0,0, "rock unit labels"	Text
FILENAME.TXT	File with rock unit labels
1,1,1,0, "dotted line contacts, use 00 pen"	Lines
300,2,0,0, "plot with red pen"	Symbols
N	Don't randomize orientation
0,0,0,0,	End of the plot file

- There must be a carriage return at the end of the final line of the batch command file.

The answers to the REPLOT SINGLE ENTRY?, DRAW CORNER BRACES?, DRAW GEODETIC TICK MARKS? and PLOT THE NODE POINTS PROMPTS must be supplied from the keyboard after the plot file instructions have been completed.

- If you wish to use the corners of the data base as plot corners, put "Y" in the first line of the plot file, and omit the next four lines specifying plot corners.

Option 10. MERGE ANOTHER DATA SET INTO CURRENT DATA SET

Merging of data bases, GSDRAW

Entry of a 10 from the Main Menu will prompt a series of entries enabling adding the data from a specified data base to be to the data base currently being used. Nodes from the node file of the second data base are not added. Screen prompts will be displayed:

ENTER NAME OF DATA BASE TO BE MERGED WITH CURRENT DATA BASE:
ENTER XOFF,YOFF:
ENTER SCALE FACTOR (X,Y):

Answers to these questions will add the data in the named data base to the current database with the specified X and Y offsets, and at the scale requested (offsets are measured in inches), the scale factor entered as a number. For example, a halfsize copy would be specified by 0.5,0.5. Offsets and scale factors can be negative numbers. A database can be added to itself, enabling production of special effects.

Merging of data bases GSMAP

Entry of a 10 from the GSMAP Menu will invoke the following screen prompt:

ENTER NAME OF DATA BASE TO BE MERGED WITH CURRENT DATA BASE:

This asks for the name of the database that is to be added to (or "merged" with) the one currently active. Just the name of the data base is entered, without extension. Entry of this data base name will cause the computer to add the data from the named database to the existing data in the one currently active. In this process, the entry numbers of the "added" base are changed to become sequential with (and follow) those of the active base (to avoid duplication), and "deleted" entries in the added data base are dropped.

If you change your mind and do not want to add a database hit the RETURN key instead of entering a database name, and operations will return to the Main Menu screen.

The process of merging a data base can be watched; a screen prompt will be displayed:

GRAPHICAL DISPLAY? (Y/N):

Entry of a "Y" will invoke the screen plot routine. The entries in the current database will be drawn first, then the additions from the database being merged. Outlines of polygons will be shown; polygons will not be filled. Plotting on the screen may slow the merging process.

When the process is complete, the Main Menu screen will appear.

Option 11. COMPUTE POLYGONAL AREAS

GSMAP. Entry of an 11 from the Main Menu of GSMAP starts a sequence that enables computation of the area in square miles and the length of the perimeter of each previously digitized closed polygonal area (400-499 codes).

The first screen prompt asks for the name of the file containing the projection parameters -
ENTER FILENAME OF PROJECTION PARAMETERS:

- After entering the appropriate filename and extension, another screen prompt will be seen:

PRINT ON SCREEN OR PRINTER S/P:
Entry of an "S" will cause the data to appear on the screen; Entry of "P" will cause the data to be printed on the printer; be sure that the printer is ready !

The next screen prompt will show:
ENTER CODE(400 SERIES ONLY, 0 TO QUIT):

Entry of a code (400-499 group only (used for closed polygons, will cause computation of areas of polygons in square miles for the specified code, and computation of the length of the perimeter of each. The data is provided in the format of the example shown below:

```
CODE 400  (ALL VALUES IN SQ. MILES)

ENTRY NUMBER =    12
AREA OF EXTERIOR POLYGON = 1.21 PERIMETER = 4.42
AREA OF INTERIOR POLYGON = 0.07 PERIMETER = 1.26
AREA (EXT. - INT. POLYGONS FOR ENTRY  12  =    1.13

TOTAL FOR CODE 400 = 3.18
```

- Entry of "0" returns program execution to the Main Menu.

GSDRAW. Entry of an 11 from the Main Menu starts a sequence that enables computation of the area in square units and the length of the perimeter of each previously digitized closed polygonal area (400-499 codes).

The first prompt allows selection of data display on-screen, or as a print out on the printer -

PRINT ON SCREEN OR PRINTER S/P:

Entry of an "S" will cause the data to appear on the screen; Entry of "P" will cause the data to be printed on the printer; be sure that the the printer is ready.

The next prompt asks for entry of the code (400 series) for which area calculations are needed. The results of the calculation are displayed on the screen or printed by the printer, as previously selected. The format is as shown below, in this example, for code 402, A code with a single polygon

```
CODE 402   (ALL VALUES IN SQ. UNITS)

ENTRY NUMBER =    139
AREA OF EXTERIOR POLYGON = 6.25 PERIMETER = 11.86
AREA OF INTERIOR POLYGON = 0.12 PERIMETER = 1.48
AREA OF INTERIOR POLYGON = 0.11 PERIMETER = 1.36
AREA  (EXT. - INT. POLYGONS) FOR ENTRY 139 =  6.02

TOTAL FOR CODE 402 =  6.02
```

- Entry of a "0" code causes return to the Menu.

WARNING IF the "P" option is selected and the printer is not ready, the program will hang up, a TIMEOUT" error message will be displayed on the screen, and the computer system will probably have to be re-booted. !!!

Notes:

- If as is true in most cases, the GSDRAW data base uses inches as coordinates (if the digitizer set up in inches, and the data base records the digitizer coordinates), the area computed will be in square inches and the perimeter in inches. If a different coordinate system is used, for example, a kilometer X,Y system is used, the computation will provide areas and perimeters in the units of the system, eg. sq.km and km.

12. EXIT

Entry of a 12 from the Main Menu will end the session in these programs, and return operation of the system to the DOS prompt.

DIGITIZING - USES OF KEYS ON THE KEYPAD

Non-numeric Keys

The "A" key - is used only to complete entries of CODE, PARA 1, and PARA 2; not during the process of digitizing points. Its function is to end an entry or to enter a 0 and simultaneously complete an entry.

The "B" key - is used to set the area shown on the screen during the process of entering points (to set a new window). Entry of a "B" from the keypad, followed by a "0" at the lower left (southwest) corner of the window desired, followed by a "0" at the upper right (northeast) corner of this window, will reset the area shown on the screen for the current session of the program. All lines in the windowed area will be shown on screen. Resetting the window is most useful when examination of details in a small part of the map is needed.

THE "D" key - "DUPLICATE" digitizer settings is used to set CODE,PARA1 and PARA2 equivalent to those of the previous entry. When the digitizer is ready for input of the code, hitting the "D" key will provide immediate setting of the three entries from the key pad to the settings used for the previous entry. If the "D" key is used just after opening a database, default values of 1,0,0 will be used for CODE, PARAMETER 1, and PARAMETER 2. Use of the "D" key can greatly speed the digitizing process; one key stroke is substituted for a series of entries.

The "E" key - "PUNT", or, "ESCAPE" - is used to recover from mistakes made during keypad entry. At any time <u>during</u> digitizing of an entry, hitting the "E" key (the "ESCAPE" key) will return the system to the starting point for entering the CODE. Information from the partially completed entry will not be added to the database; this avoids the necessity of completing a defective entry during digitizing. This key performs its function from the start of entry of code, until the digitizing of data for an entry has been completed by a stroke of the 1 or 2 key.

The "F" key - is the toggle between the digitizer's point and stream mode on the GTCO digitizer; on other kinds of digitizers it may have no function. The digitizer should be maintained in point mode at all times. If the green light on the keypad of the digitizer is turned on, touch the "F" key to turn it off. Use of the "stream mode" risks data over-run.

Numeric keys

During entry of CODE, PARA1 and PARA2, the numbered keys are used to enter their number value.

- The 0, 1, 2, 3, and 4 keys are used for digitizing data points. Each of these keys has specific and different functions.

- The 0 (zero) key sends the X,Y coordinates of the point at crosshair of the cursor to the computer. The first point of an entry (line), CODES 1-99, 400-499, 601,-699, establishes a NODE and this point is sent to the node file as well as to the database. Points digitized with the 0 key are not sent to the NODE file unless that point is the first point of an entry (line) (Codes listed above).

- The 1 (one) key sends the X,Y coordinates of the point at the crosshair of the cursor to the computer, **AND** closes the entry. This point for lines (CODES listed above) establishes a node, and is sent to the NODE file as well as to the database. If the line ends at the same point (NODE) as it starts, and the last point as digitized is within the "Snap" distance set for the data base, the polygon is closed precisely.

- The 2 (two) key sends the X,Y coordinates of the point at the crosshair of the cursor to the computer, **AND** causes the computer to add another point at the end of the data string with X,Y coordinates identical with the first point of the data string for that entry (thus closing a polygon exactly, **AND** closes the entry. As the first point of the entry (Codes listed above)is a node, the 2 key thus ends a line at a NODE. It closes a polygon precisely even if the last position digitized is farther from the beginning than the "SNAP" distance specified for the data base.

- The 3 (three) key sends the X,Y coordinates of the point at the crosshair of the cursor to the computer, **AND** causes the computer to add another point at the end of the data string with X,Y coordinates identical with the first point of the data string for that entry (thus closing a polygon exactly), but it does not close the entry. It is used during digitizing of polygons to close a polygon, but leave entry of points open so that another polygon (eg. internal polygon), can be digitized into the same entry. The 3 key should only be used with 400-499 codes.

- The 4 (four) key sends the X,Y coordinates of the point at the crosshair of the cursor to the computer **AND** sends the coordinates of that point to the NODE file. This key is used to establish nodes at line junctions while digitizing lines. The **4** key does not terminate the entry.

CODE GROUPS

GSDRAW and GSMAP utilize seven code groups, each with specific and different functions. Use of these code groups is reviewed in the following section. As codes are assigned during digitizing according to plot requirements, digitizing and plotting procedures are discussed together in the following Sections to facilitate comparison.

Code Groups	Function
1-99	Lines and decorated lines.
100-199	Posting of tabular data.
200-299	Individually rotatable symbols.
300-399	User specified codes for other symbols.
400-499	Polygons.
500-599	Alphanumeric characters.
600-699	Splined lines.

LINES AND DECORATED LINES - CODES 1-99

Codes 1-99 are assigned by the user to various kinds of lines. All lines are digitized as if solid. Patterns, line weights, and/or decorations are specified for each code when plotting. Enough different codes should be used to accommodate patterns such as solid, dashed, dotted, and combinations of dashes and dots and different line weights (different pens). Other codes should be assigned to lines decorated by various symbols, such as the filled triangle for thrust faults and the railroad track pattern for dikes.

Digitizing

Three entries from the digitizer keyboard are required:

1. CODE: user defined on the basis of the kind of line desired.
   Criteria to be considered in planning codes include, line type (pattern, solid, dashed, dotted, etc. see Fig. 1), line weight, contacts at .005", faults .015", etc., "decorations", triangles for thrust faults, etc. Following entry of the code, "A" is used to complete the entry.
2. PARA1: "A"
3. PARA2: "A"

During entry from the keyboard, three tones will be sounded, C, F, and finally A (low, medium, high) indicating that the system is ready to receive data points. Digitize the line using a series of "0" key entries until the last point. A "1" will end the line at the point indicated, a "2" will close the line by entering the point digitized and adding the first point digitized, thus closing the line defining the border of a polygon. The function of the "4" key in digitizing lines is described previously. Its use is important primarily for digitizing data to be passed to other programs for processing.

Plotting

Plots of codes 1-99 require a set of four entries separated by commas. Plots of decorated lines also require a second set to specify the spacing desired for decorating symbols. During plotting in the interactive mode, prompts will request all entries. Each set is specified on one line of a batch command file, see examples on p. 23 and p. 26.

The first set, provides response to the prompt:
ENTER CODE,PEN,LINE TYPE,SYM TYPE,COMMENTS:

Entry 1: the code specified (1-99) as defined by the user during digitizing, then a comma (,)
Entry 2: the pen number (1-N depending on plotter), then a comma (,)
Entry 3: the line type; uses line types 0-12 as specified for the plotter (see fig. 1), then a comma (,)
Entry 4: "0" for all lines without decorations; for thrusts and other "decorated" lines the appropriate symbol number

should be used; entry 4 must also be followed by a comma (,). Comments may be added after the final comma, and are useful in plot files; a final carriage return is required.

The second set. If Entry 4 is a number other than 0, the screen will request "ENTER DELTA SPACING:" this is the spacing between symbols that are used to decorate the line, measured in inches.

Notes:

- Use of some regular convention for codes for common kinds of lines will aid digitizing and plotting. One convention easily remembered is to use CODES 1, 2, and 3 for fine solid, dashed, and dotted lines (contacts), 4, 5, and 6 for heavy solid, dashed, and dotted lines (faults); reserve codes 1-15 for geologic lines, and code special lines such as area outlines, using higher numbers.
- A single line (entry)can be digitized with as many as 8000 points.
- If thrust faults are always digitized so that the "teeth" are on one side in the direction of digitizing, a single code is needed, rather than two.
- Experience will assist in answering the question "how many points ?" are needed during digitizing. The factors to consider will include the curvature of the line, the kind of line (dotted lines require fewer points than solid lines), and the scale of the plot anticipated relative to the scale of the digitizing.
- Start and end lines at natural points such as branches or intersections, just as a draftsman would. These minimize defects caused by pen starts and stops, and use nodes to best effect.
- The size of the symbol plotted to decorate a line is set by the program as 100/1000 inch; there is no way to change this size without coding a smaller or larger symbol in the CONFIG.PLT file.
- The symbol on a decorated line will be rotated during plotting to preserve a constant angular relationship between the symbol and the line.
- If **LINE TYPE 99** is specified in the plot file, no line will be drawn! BUT this phantom trace can be decorated. Any symbol can be selected and spaced at specified intervals (DELTA). The symbol will be drawn at a standard size (corresponding to 100/1000 inch size (see description of 300-399 codes).

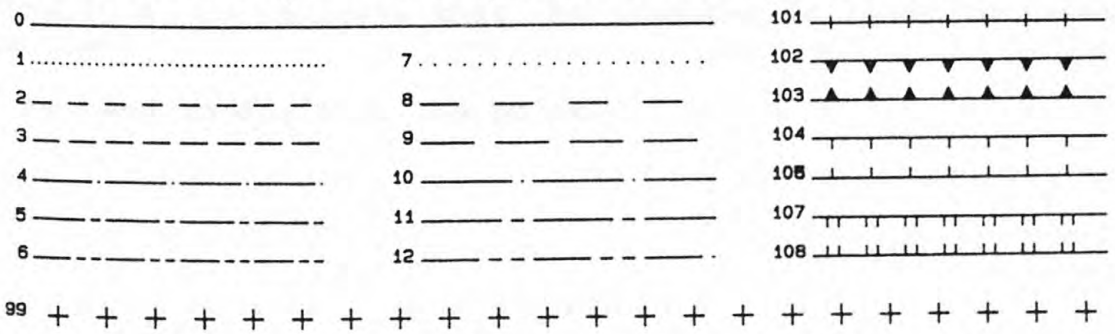


Figure 1._ Line types, **NOT CODES**; numbers to left of lines except decorated lines are line type.

In Fig. 1, numbers to left of decorated lines are the number of the symbol in the CONFIG.PLT file. Lines were digitized from left to right. Direction of digitizing is important to lines decorated on one side. Symbol 9 used to decorate "line" drawn using line type 99.

POSTING OF TABULAR DATA - CODES 100-199

Codes 100-199 are used to plot tabular data and symbols.

Data files must be organized as follows:

Locality number, value 1, value 2, value 3, etc., a table might look like the sample below: TEST.SAM contains a locality number column and four data columns (for four records). This example is from a geochemical study; the data columns represent values in ppm for Cu, Mo, Pb, and Zn. Every column must contain a value for each row. If data is missing for a column, put in a comma, or " " (quote blank quote) so that the computer will find an entry for each column in all rows.

```
410,  50,  10,  100,  200
411,  15,   2,  20,   200
414,  30,  50, 150,   200
416,  70,  10, 300,   500
```

A table like this can be created using a standard ASCII word processing program.

Digitizing

Three entries are required from the digitizer keypad:

1. CODE (100-199 (select according to symbols required
2. PARA 1: Locality number (any number containing up to 6 digits), and an "A" to complete entry if less than 6 digits)
3. PARA 2: Angle of rotation of plotted posting, in degrees, measured counterclockwise from the horizontal, closed by an "A" (the default value of 0 put in using the "A" key without other entry posts values to the right of the point).

Note: **Angles between 91 and 269 degrees cause posting of numbers to the LEFT of the locality point,Angles 270-360,0-90 degrees plot to the right of the point, see Fig. 2.**

During entry from the keypad three tones will sound, C, F, and finally A, to indicate that the computer is ready to receive a data point.

A "1" is used to digitize the point.

Plots of codes 100-199 require three sets of entries: During plotting in the interactive mode, prompts will request all entries. Each set is specified on one line of a batch command file.

The first set, provides response to the prompt:
Enter CODE,PEN,LINE TYPE,SYM TYPE,COMMENTS:

Entry 1: Code (100-199), then a comma (,)
Entry 2: the pen number, then a comma (,)
Entry 3: the number of the symbol desired from file GSCAD.SYM, then a comma (,)
Entry 4: the size of the symbol desired in 1/1000 inches.
Entry 4 must be followed by a comma (,). Comments may be added after the final comma, and are very useful in batch command files.

The second set, provides response to the prompt:
ENTER FILENAME FOR TABLE - this asks for the name of the file containing the data to be plotted.
Entry 1: enter the complete name of the file, including extension.

The third set, provides response to the prompt:
"# COLS, COL # TO PLOT"

Entry 1: the number of columns of data in the table (not including the locality number column)
Entry 2: the number of the data column containing the data that is to be plotted; if 0 is specified, the locality number will be plotted, 1 will cause data from the first column of data to be plotted, 2, the next, and so on.

Notes:
- Posting will be done with a space between the symbol and the adjacent number equal to the half the symbol size specified plus the width specified for the label characters.
- The size of the numbers used for posting will be the size specified in answer to the prompt ENTER WIDTH,HEIGHT FOR LABEL CHARACTERS entered when setting up plot parameters.

Notes:
- If no symbol is wanted, use symbol 30 (has no pen down moves) and nothing will be plotted as a symbol at the point digitized.
- If NO posting is wanted, use a carriage return as the answer to the FILENAME FOR TABLE prompt (or in the batch file at the appropriate place) Specify that the file has one data column, and request plotting from column 1.
- If locality numbers are wanted without the bother of creating a data file, use any non-blank character followed by a carriage return as the answer to the FILENAME FOR TABLE prompt. Specify that the table has 1 data column, and that you wish column 0 plotted. The program will pick up the locality number from the PARA1 in the database, and plot it.

- Locality numbers (first column of the table must be numbers (no alpha characters; other columns in the table may contain numbers and or letters.

The plot below illustrates capabilities of code group 100-199. Locality numbers on the left side were plotted without using an ASCII file, the numbers were plotted from digitizer entry as PARA1. The central group of sample numbers and letters were taken from an ASCII file (previous versions of GSMAP and GSDRAW would not plot letters); numbers near symbols on the right side of the diagram specify the angle specified as PARA2 to illustrate different positions for posting of data. The size of the label characters is set by the entry in the plot file (e.g. 0.1,0.15).

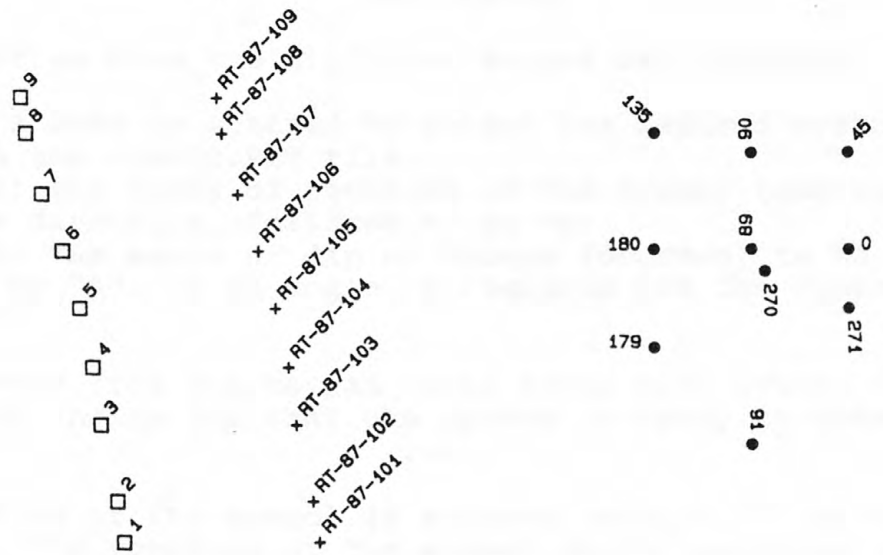


Figure 2._ Plots to illustrate symbols and posting of tabular data using 100-199 codes.

INDIVIDUALLY ROTATABLE SYMBOLS - CODES 201-299

Codes 200-299 are used for individually rotatable symbols. Unlike other code groups, each code has a specific use. Each symbol is specified by CODE NUMBER. Symbols that are included in the standard CONFIG.PLT file are the following:

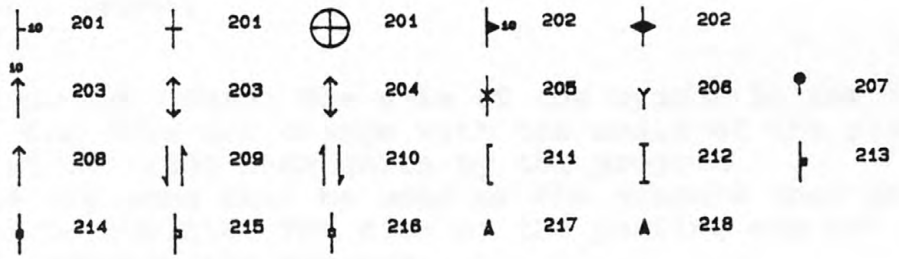


Figure 3._ Standard symbols, codes 201-218. The angle of dip or plunge will be posted for symbols 201, 202, and 203. Posting is not done for other symbols.

Digitizing

Three entries from the digitizer keypad are required:

1. CODE: a code is entered to select the desired symbol from the CONFIG.PLT file.
2. PARA 1: the angle of rotation of the symbol (degrees) in a clockwise direction, followed by an "A:
3. PARA 2: the angle of dip or plunge (degrees) to be posted, followed by "A". If no angle is required for the symbol chosen, enter "A"

During entry from the keypad three tones will sound, C, F, and finally A, indicating that the system is ready to receive data points.

The position of the symbol is entered using a "1" at the location desired. The rotation of the symbol during plotting uses this point as its axis.

Most symbols, including dip and strike, foliation, lineation, anticline arrows and syncline arrows rotate from the center of the symbol, but the bar and ball rotates from the end to be plotted on the fault trace. Each axis has been chosen to assist the drafting process.

Plots of each symbol type, CODES 200-299, require one set of four entries from the keyboard. During plotting in the interactive mode, prompts will request all entries. Each code is specified on one line of a batch command file.

Entry 1: the CODE specifying the particular symbol type to be plotted, followed by a comma (,).
Entry 2: the pen number, followed by a comma.
Entry 3: 0, followed by a comma.
Entry 4: 0, followed by a comma. Comments may be added after the final comma.

Notes:
- GSDRAW AND GSMAP: The size of the symbol is set by the program and does not change with the scale of the plot; the size is set at 100/1000 inch units by the program.
- Fine tip pens must be used or the numbers that are posted will not be legible. The size of the posting can not be modified without changing the program.
- Rotatable symbols that do not require posting of numbers can be added to the CONFIG.PLT file using unassigned numbers up to 299.
- Three different symbols are drawn for symbol type 201, dip and strike, depending on the dip angle specified. These are the standard symbols for dip and strike with posted angle of dip, for vertical dip and for horizontal beds.

- Two different symbols are drawn for symbol type 202, these are the standard foliation symbol with dip angle posted, and the symbol for vertical foliation symbol without posting.

- Two different symbols are drawn for symbol type 203, the standard lineation, depending on the plunge angle specified; these are the standard arrow with posting of the angle of plunge , and the double ended arrow for horizontal lineation.

USER-DEFINED SYMBOLS - CODES 300-399

CODES 300-399 are used for symbols (user-defined codes). The kind and size of the symbols can be individually specified during digitizing. During plotting all symbols of a certain code can be rotated by a specified angle as a group, but not individually within a group. During plotting of a specific code. The orientation of symbols can be "randomized"; each symbol differently rotated using a random number generator. The instructions to the plotter that define symbols are contained in the file named CONFIG.PLT; additions to this file are easily made, see p. 71. The following numbered symbols are in the standard file supplied with GSDRAW AND GSMAP, Version 5.0:

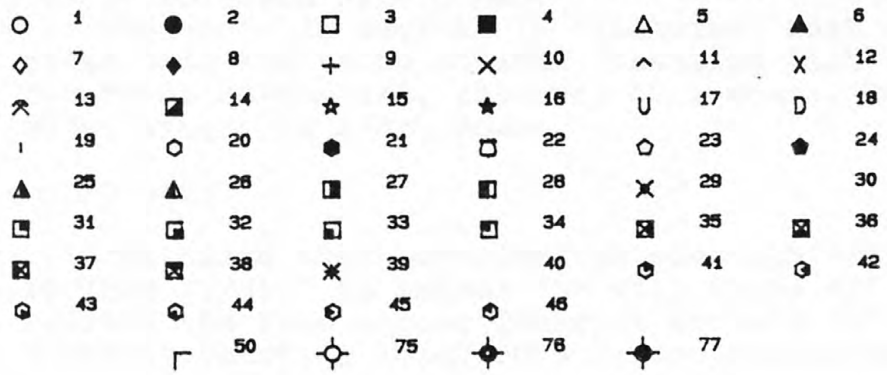


Figure 4._ Standard symbols plotted at a size of 100

Digitizing

Three entries from the digitizer keypad are required:

1. CODE: user defined, on the basis of pen to be used, and rotation desired in plotting.
2. PARA 1: symbol number, (fig. 4)
3. PARA 2: symbol size units, 1,000 inch.

During entry from the keypad, three tones will sound, C,F and finally A, indicating that the system is ready to receive data points.

If a single symbol is desired, a "1" is used. If a number of the same kind of symbol with the same size and rotation are desired, a series of "0"s are used, until the final point, where a "1" should be used to end the entry.

Most symbols are centered at the point digitized. For example, symbol 13 is centered at the crossing point of the pick and hammer. However, the digitized point for symbol 11 is at the top of the symbol.

Plots of symbols and symbol groups, CODES 300-399 require two sets of entries from the computer keyboard. During plotting in the interactive mode, prompts will request all entries. Each set is specified on one line of a batch command file.

The first set, provides response to the prompt, ENTER CODE,PEN,SYM TYPE,COMMENTS:

Entry 1: the CODE specified by the user when digitizing, followed by a comma (,).
Entry 2: pen number, followed by a comma.
Entry 3: 0, followed by a comma.
Entry 4: the angle in degrees (+ clockwise) that all symbols in a given code are to be rotated, assuming that rotations are not to be randomized, followed by a comma. Comments may be added after the final comma.

The second set:

Entry 1: following these entries the question "RANDOMIZE PATTERN (Y/N)?" is asked: "N" will cause all symbols to be rotated the same amount (Entry 4 above); "Y" will cause "random" rotation based on a random number generator.

Notes:

- Although the random number generator is "random" in one sense, it always contains the same series of "random" numbers - like a printed random number table if you always start at the same place. Therefore, sequential plots will have the same symbols rotated to the same degree.
- GSDRAW: Sizes of Symbols are plotted at sizes specified by PARA2 scaled according to the **X** scale of the plot.
- GSMAP: Sizes of Symbols (CODES 300-399 are plotted at sizes specified by PARA 2 and are independent of the scale of the plot.

POLYGONS AND FILLS - CODES 400-499

Codes 400-499 are used for closed polygons so that they can be filled with a pattern during plotting. The area is outlined as a closed area during digitizing. Fill types and the kind of line used are specified in the plotting process. A closed polygon can be identified from the data listing because the coordinates of the first and last point are the identical.

Digitizing

Three entries from the digitizer keypad are required:

1. CODE: user defined, on the basis of fill patterns desired. Any code 400-499 can be used. Polygons to be filled with different patterns should be coded differently.
2. PARA 1: "A"
3. PARA 2: "A"

During entry from the keypad three tones will sound, C, F, and finally A, indicating that the system is ready to receive data points.

The outline of the polygon is digitized using a series of "0" key entries until the last point before closing. This last point is digitized either as a "2", which records the point and closes the polygon, or with a "3", which closes the external polygon but leaves the entry open, for digitizing internal closed polygons which will not be filled. Internal polygons are digitized with a series of "0"s, and closed with a "3", except for the last, which must be closed with a "2"; when plotted, these internal polygons will be left as unfilled "windows" inside the filled polygon. The function of the "4" key in digitizing has been described, see p. 41.

Plots of filled polygons, CODES 400-499, require two or three sets of entries from the computer keyboard.

Fill types in GSMAP and GSDRAW 5 are defined by the program. They are different from the plotter-defined fill types used by earlier versions of these programs.

Fill types, GSMAP and GSDRAW Version 5.

0 -- A line outlines the polygon **does not fill.**
1 -- A set of parallel lines fill the polygon (no outline).
2 -- Two sets of mutually perpendicular parallel lines (grid) Fill the polygon (no outline).
3 - Symbols of type and size specified by the user will be drawn on horizontal lines spaced at user defined intervals (Y delta), at a spacing specified by the user (X delta).

During plotting in the interactive mode, prompts will request all entries. Each set is specified on one line of a batch command file. Examples of batch command files using 400-499 codes are provided on p. 32, 37, and p. 56.

The first set provides response to the prompt:
Enter CODE,PEN,LINE TYPE,SYM TYPE,COMMENTS:
A second prompt then asks for fill type, line spacing, and angle of rotation:

For **all** Fill types, The first set:

Entry 1: the CODE specified (between 400 and 499) as defined by the user when digitizing, followed by a comma (,).
Entry 2: pen number, followed by a comma.
Entry 3: line type, uses line types from 0-12 as specified for the plotter (see fig. 1), followed by a comma.
Entry 4: 0, (decorated lines should not be used) followed by a comma (,). Comments may be added after the final comma.

For Fill types 0,1, and 2
The second and last set:

Entry 1: the fill type, a single digit number from 0 to 3, followed by a comma; the characteristics of the fill are defined by the program.
Entry 2: spacing between fill lines in inches (fill types 1 and 2). For **solid** fills, a spacing of 0.01 inches works with all but the finest pens (use 0 for fill type 0.
Entry 3.: angle, specifies the angle measured from the horizontal (+ counter clockwise) for the direction of the set of lines (first set of fill type 2), use 0 for fill type 0.

For fill type 3, (Symbols plotted at grid points).

The second set:

Entry 1: the fill type (3)
Entry 2: X delta (the spacing in X (horizontal) entered in inches between symbols.
Entry 2: Y delta (the spacing in Y (vertical) entered in inches between lines of symbols.

The third and final set for fill type 3.
Entry 1: the symbol number (from the CONFIG.PLT file)
Entry 2: the symbol size measured in 1/1000 inch.
Entry 3: a Y or N. "Y" specifies for the orientation of the symbols to be randomized, "N" specifies that the orientations are to be the same (0^{o}).

Notes:
- Do not attempt to fill anything except a polygon that has been properly closed on digitizing; if you do, the results are more apt to be amusing than useful.
- The effect of a stipple pattern is obtained by using line type 1, and a spacing of about 0.03", or line type 7 and a spacing of about 0.06.
- No more than 8,000 points can be directly digitized to define both exterior and interior polygons for a single entry.
- Larger polygons can be assembled using GSMPOLY, GSDPOLY or other program external to GSMAP/GSDRAW. Polygons up to 8,000 points can be plotted and filled by GSMAP/GSDRAW Version 5.0. The size of polygons that could be plotted was limited to 500 points in earlier versions of these programs.
- A great variety of fills can be obtained by plotting polygons more than once, e.g changing the angle and spacing of fill type 1, and outlining the polygon using fill type 0.

```
Plot file to plot Fig. 5
Example of polygon fills

Y
1,1
0,0
N
Y
12,2
0.1,.15
100,1,30,0,
EMPTY.SAM
1,0
400,1,0,0, "Polygon 1"
1,.03,90
401,1,0,0, "Polygon 2"
0,0,0
403,1,0,0, "Polygon 3"
3,.10,.10
11,90,Y
404,1,1,0, "Polygon 4"
1,.03,00
405,1,0,0, "Polygon 5"
2,.040,0
410,1,0,0, "Polygon 6"
3,0.07,.06
107,60,Y
406,1,0,0, "Polygon 7"
3,.08,.08
9,35,N
408,1,0,0, "Polygon 8"
2,0.05,45
0,0,0,0,
```

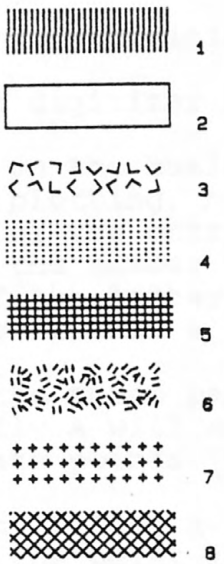


Figure 5._ Examples of polygon fills (patterns). All parameters can be varied by the user, to produce different patterns from the four basic fill types.

ALPHANUMERIC ENTRIES - WORDS, LETTERS, NUMBERS AND A FEW SPECIAL CHARACTERS

CODES 500-599 are used for alphanumeric entries. The letters/numbers to be plotted are entered into an ASCII data file that will be called by its file name during plotting, and their positions digitized.

Choice of CODES is based on, 1) pen needed for plotting, 2) slant angle for letters (block letters or italics), and angle that the character, word, or block of text is to be entered on the page. Separate groups of text entries accordingly into different CODES.

Digitizing

Three entries from the digitizer keypad are required:

1. CODE: user defined on the basis of pen, slant of letters and words desired in plotting, numbered between 500 and 599
2. PARA 1: the number of the entry to be placed on the plot corresponding to the number in the ASCII data file.
3. PARA 2: the size of the lettering, expressed in units 1/1000 inch; this assumes a 1:1 original:final plot scale.

During input of the three parameters from the keypad, three tones, C, F, and finally A will sound, indicating that the system is ready to receive data points.

The initial point, either a "0 or "1" on the keypad places the text block or symbol; the point is digitized at the lower left corner of the first character in the block of text:

- If a "1" is used, the entry is complete
- If a "0" is used, the block of text is placed, and a succeeding "0" and "1" defines a straight-line leader between the positions of the two points, and completes the entry.
- Multiple leaders can be drawn. Use the "0" key for all but the final point. Points 2 and 3, 4 and 5 (etc.) will be connected to draw leaders.

The screen will show the position of the point, and leader(s), but not the words or characters that will be plotted. No attempt has been made to show the characters because of the limited resolution of the screen.

Plots of codes 500-599 require two sets of entries: During plotting in the interactive mode, prompts will request all entries. Each set is specified on one line of a batch command file.

The first set provides response to the prompt:
Enter CODE, PEN, LINE TYPE,SYM TYPE, COMMENTS:

The first set.

Entry 1: the CODE, between (500 and 599), followed by a comma (,).
Entry 2: pen number, followed by a comma (,).
Entry 3: slant angle of letter (an angle measured clockwise from the vertical; 0 degrees for block lettering, about 30 degrees for simulated italics, followed by a comma (,).
Entry 4: angle of rotation of block of text on plot (an angle measured from the horizontal, + counterclockwise, - clockwise), followed by a comma. Comments may be added after the final comma.

The second set: (one entry)

Entry 1: Entry of the name of the file containing the data to be plotted is required in answer to the question:

ENTER FILENAME FOR TEXT:

Entry of the complete filename with its extension is required.

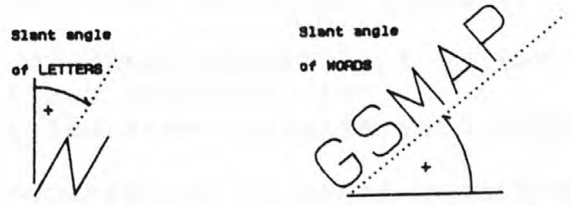


Figure 6._ Examples of slanted letters, and rotated words.

Notes:

- The block of text rotates around the initial digitized point during plotting.
- For GSDRAW the size of the lettering that will be plotted varies with the X scale of the plot, e.g. a half-sized plot (as scaled in the X dimension) will have letters half the size entered during digitizing. The size is independent of the scale in Y.
- For GSMAP the size of the lettering will not be scaled according to plot scale; the size will remain as specified during digitizing (PARA2), or as changed in the data base using option 6.

- If a number is entered for Parameter 2 that does not correspond to an entry in the text file called, no entry will be plotted, but the missing entry will be noted on the screen.

Word and character file

Words and symbols are typed into files in the format specified below for retrieval by GSDRAW and GSMAP programs using codes 500-599. Any name can be specified for this file. The file name will be given as the second entry during plotting of this data. In this file, the number is the label for the succeeding words, characters, or numbers which constitute the entry which will be plotted on the diagram. The number corresponds to Parameter 2 entered from the keyboard during digitizing. The "EOT" is the label marking the end of the entry to be plotted and must be placed on the line below this entry (EOT stands for 'end of text'). Commas are used to separate the three parts of the table entry.

```
Number, "Label",
"EOT"
```

The files (ASCII files) are prepared using a word processing program that does not leave embedded characters (such as nondocument mode Wordstar) and must have a format like the example below (taken from a map explanation) -- there must be no heading for the file.

```
1,"EXPLANATION",
"EOT"
2,"Mississippi Valley-type lead-zinc deposits",
" "
"Outline Iowa part of Upper Mississippi Valley district",
"Outline of mineralized subdistricts",
"Outline of mineralized areas outside main district",
" ",
"Bedded phosphate occurrences in basal Maquoketa Shale",
"EOT"
3,"0",
"EOT"
4,"5 MILES",
"EOT"
5,"1",
"EOT"
```

A carriage return is required at the end of the last line of this file.

Special characters

Five characters have been "redefined" so that they plot differently than they appear on the keyboard and screen; these are of special use to geologists:

Figure 7._ Special characters and keyboard equivalents.

Notes on word and character files:

- A file that looks like this:

```
27,"UNKNOWN",
"RESOURCE",
"POTENTIAL",
"EOT"
```

will plot as :

```
UNKNOWN                  -- because the 27," in front of the U is
RESOURCE                    not plotted, nor are succeeding ",
POTENTIAL                   " and "EOT" characters.
```

- An easy way to set up a file in desired format is to type all of the entities that will be plotted, then add the numbers, quotation marks, commas, and "EOT" in the proper positions.
- The syntax of the file is very important. Characters or punctuation in the wrong place will cause problems during plotting.
- Quotation marks (") cannot be used in a label because they are a delimiter in BASIC. A substitute is provided by redefining the } character, as shown above.
- A maximum of 150 characters (including blanks) can be enclosed between the quotation marks on a single line. This is a limitation imposed by the plotter firmware.
- Other formats for these files can be used. This one is recommended because it is easily checked for syntax.

SPECIAL CHARACTERS ARE NOT SUPPORTED BY PLOTTERS LACKING CONFIGURABLE MEMORY: BLANKS, RATHER THAN THE SPECIAL CHARACTERS CALLED FOR THE \, &, @, {, OR } KEYBOARD SYMBOLS WILL BE "PLOTTED" BY THESE PLOTTERS.

- The keyboard symbols, not the special characters will be entered into the HPGL file if the output is sent to a file.

SPLINED LINES - CODES 600-699

CODES 600-699 have the same function as CODES 1-99, but the lines be SPLINED by generating additional points (curve-fitting to a cubic equation) **during plotting.**

Digitizing and plotting are done in the same ways as for codes 1-99, described earlier in this section.

The effect of splining is to to smooth the "curve" drawn as a series of straight line segments on the plotter, or on the screen; the database is not modified. Splining is done for entries made up of 6 to 4000 digitized points. If there are 5 or fewer data points, or 4001 or more, no splining will be done. The splined line plotted will consist of a series of straight line segments; the line will pass through ALL digitized points. It will appear to be curved, because the splining algorithm creates a series of equally spaced points to fit a series of cubic curves calculated to fit each set of four digitized points in sequence down the line. The plotted line passes through these calculated points as well as through all of the data points. For the details of the procedure, see Covington, 1986.

The maximum effect of splining will be seen with entries that have fewer than 1600 points. If digitized points are not equally spaced, the maximum effect will be seen where points are most widely spaced. In effect, if the digitized points are close together, the line joining them is relatively straight; if points are far apart, more curvature is allowed. A line will be plotted connecting segments of equal length to a set of points N times the number digitized, where N is the largest integer determined by dividing 8,000 by the number of points in the line.

Entries digitized as codes 1-99 can be changed to codes 600-699 for plotting by using Option 6.

WARNING: although the curve-fitting done during plotting of codes 600-699 can improve the appearance of lines, splining can create strange effects at sharp corners; see squares in Fig. 7.

The plotting of splined lines with many points, especially of patterned lines (dotted, dashed) may be very slow.

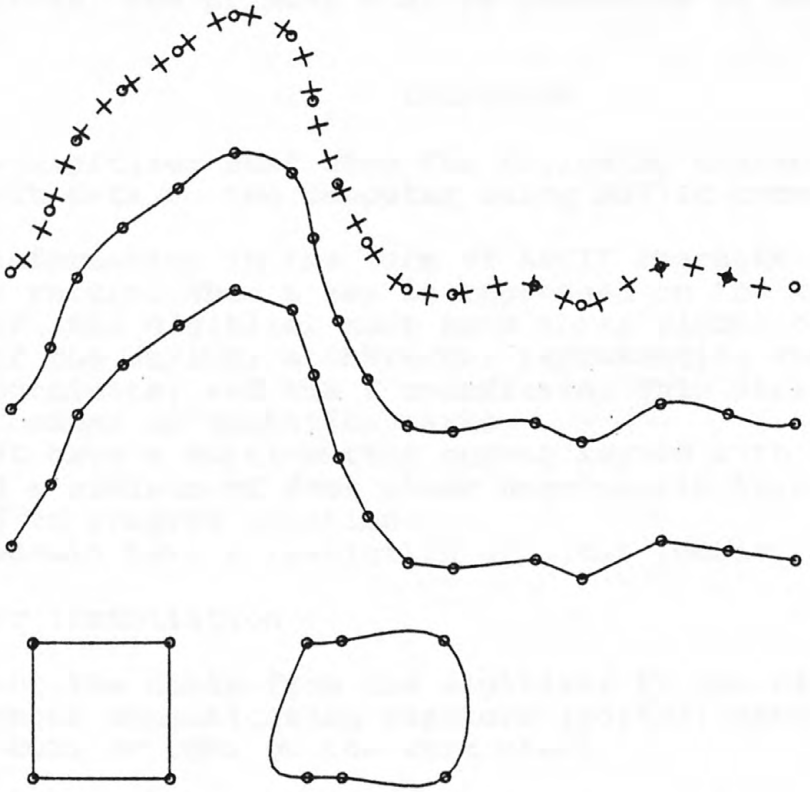


Figure 8._ The upper three curves were digitized using 17 points, each (circles); the uppermost was plotted using CODE 1, line type 99, symbol 9; the center curve was plotted as a CODE 601, and splined to a smooth curve; the lower curve was plotted as code 1, line type 0, and clearly shows breaks where data points are located. The two polygons were plotted using CODE 601, digitized points are shown by circles. The upper left corner of each polygon was digitized twice (to close the polygon. As the square on the left is defined by 5 points, no splining took place. The figure on the right was digitized as a square, (7 points) and splined to its deformed shape.

APPENDIX 1

HARDWARE INSTALLATION AND CONFIGURATION FILES

Appendix 1 deals with the physical installation of the digitizer and plotter, the connection of these devices to the computer, and verification of correct installation. A work sheet is supplied, p.66, to assist recording of settings. The makeup of configuration files and modifications required to tune the files to specific hardware configurations is covered in the final section.

The plotter and the digitizer must be connected to serial ports; there must be a match between the port connections, the communications parameters of these devices, and the settings of the programs. The printer must be connected to parallel port #1 (LPT1:).

DIGITIZER

The digitizer must have the following characteristics:
- Transmit data to the computer using RS232C communications protocol
- Send information in the form of ASCII characters followed by a carriage return. When a key is depressed on the keypad of the digitizer, the digitizer must send three pieces of information as a part of the string; a character representing the key depressed, the X coordinate, and the Y coordinate. This string must not contain commas or quotation marks.
- It must have a multi-button cursor keypad with the 10 numeric keys and a minimum of four other non-numeric keys that can be assigned to program functions.
63- It should have a resolution of 0.001 inches.

Digitizer installation

1. Connect the cable from the digitizer to one of the asynchronous communication adapters (ports); note whether the port is COM1 or COM2 on the work sheet.

2. Set the digitizer switches for the communications speed you want to operate; we have found 1200 baud to be satisfactory; record the baud rate on the work sheet.

3. Set digitizer switches for parity; generally you will have a choice of the following:

S - SPACE: Parity bit always transmitted and received as a space (0 bit)
N -NONE; No transmit parity, No receive parity checking
O - ODD: Odd transmit parity, odd receive parity checking
E -EVEN: Even transmit parity, even receive parity checking
M -Mark: Parity bit always transmitted and received as a mark (1 bit)

We normally use N: record the setting on the work sheet

4. Set the number of databits per character on the digitizer switches. The choice is generally 7 or 8. We generally use 8. Record the value on the work sheet

5. Set the number of stopbits on the digitizer switches. The choice is 1 or 2; we use 1; record the setting on the work sheet.

6. Set the digitizer switches to transmit a carriage return only; set switches to NOT transmit a line feed.

The following BASIC (BASICA) program can be used to check transmission between the digitizer and computer. It may require modification to reflect the values set in previous steps. It is set up using the values we normally use. Modifications normally are on line 10; refer to the BASIC manual supplied with your computer for a description of the OPEN COMn: command.

```
10 OPEN "COM2:1200,N,8,1" FOR INPUT AS #1
20 PRINT "HIT KEYS ON DIGITIZER KEYPAD ONE AT A TIME"
30 LINE INPUT #1, DSTRING$
40 PRINT DSTRING$
50 GOTO 30
60 END
```

If the above program does not run, check switch settings and/or cable connections, and retry the program. If it still does not work, check the digitizer manual, and seek assistance.

For the GTCO Digi-Pad series of digitizers used for development connect a null-modem cable from the computer serial port (COM2:) to port J5 on the digitizer. The cable diagram is shown in the User's Manual, Appendix on RS232 interfacing, Fig. 1, DTE-to-DTE cabling. The following switch settings are used.

	1	2	3	4	5	6	7	8	
S1	1	1	1	0	0	0	0	1	1 = ON
S2	1	1	1	0	1	0	0	0	0 = OFF
S3	0	1	1	0	1	0	0	0	

PLOTTER

Hewlett-Packard plotters were used to develop these programs. They may work with other plotters that use the Hewlett-Packard Graphics Language.

Plotter Installation

1. Connect the cable from the plotter to the remaining asynchronous communications adapter (port); note on the work sheet whether it is connected to COM1 or COM2

2. Set the plotter switches (hardware or software) for the communication speed at which you want to operate; we have found 2400 baud to work well. Record the baud rate on the work sheet.

3. Set the plotter switches for parity. Generally you will have a choice of the following:

S - SPACE: Parity bit always transmitted and received as a space (0 bit)
N -NONE; No transmit parity, No receive parity checking
O -ODD: Odd transmit parity, odd receive parity checking
E -EVEN: Even transmit parity, even receive parity checking
M -Mark: Parity bit always transmitted and received as a mark (1 bit)

We normally use N; record the setting on the work sheet

4. Set the number of stop bits on the plotter switches. You will have a choice of 1 or 2; we use 1. Record the setting on the work sheet.

5. Check other settings on the plotter; we use the following.
Remote
Standalone
Handshake: hardwire Direct
Duplex: Full

The following BASIC program (BASICA) can be used to check transmission between the plotter and computer. It may require modification to reflect values set in previous steps. It is set up for the values we normally use. Modifications normally are one line 10. This program came from the Hewlett-Packard operation and Interconnection Manual for the HP 7550A Graphics Plotter; refer to the BASIC manual supplied with your computer for a description of the OPEN COMn: command.

```
10 OPEN "COM1:2400,N,8,1,RS,CS65535,DS,CD" AS #1
20 PRINT #1 "IN;OI;"
30 INPUT #1,ID$
40 PRINT #1,"LB";ID$;" COMMUNICATION OK";CHR$(3)
60 PRINT #1, "PA 0,0;SP0;"
70 END
```

The program will read the model of the plotter and plot the following message on the plotter using the pen in carousel position one.

```
7550A COMMUNICATIONS OK
(YOUR MODEL #, if not a 7550A)
```

If the above program does not run, check switch settings and/or cable connections, and then retry the program. If it still does not work, check the plotter manual, and seek assistance.

For the HP 7585B plotter the following switch settings apply: the cable must be connected to the COMPUTER/MODEM port.

```
RS232C                NORMAL
                      NORMAL
     STANDALONE
                      NORMAL

Parity                OFF
                      ODD
Duplex                ODD
     HARDWIRE
                      NORMAL
```

For the HP 7475 plotter, the following switch settings apply:

```
     0    S2
     0    S1
     0    Y
       1  US
     0    B/A3-.A/A4
       1  B4
     0    B3
       1  B2
     0    B1
```

SCREEN and GRAPHICS ADAPTER

On the worksheet, make a record of the kind of Graphics adapter (CGA or EGA, and the kind of Monitor (Color or Monochrome).

GSMAP/GSDRAW do **NOT** support Hercules or Hercules compatible graphics adapters.

Version 4.0 provides support for the IBM Enhanced Graphics adapter (EGA), either with monochrome or color monitor. To implement this support, lines in the CONFIG.SCR file are used to specify colors for individual codes. Using CGA with color monitors, only the text screens will appear in color. With EGA, and a color monitor, lines, points, and polygons will also be shown in color.

The colors for individual codes are selected from 16 available colors for each code desired by specifying choices during the software installation procedure, or by adding lines to the CONFIG.SCR file at some later time. Each line has the following format; code, color number. A carriage return is required at the end of each line.

Colors are specified by number (see BASIC Manual)

0	Black	8	Gray
1	Blue	9	Light Blue
2	Green	10	Light Green
3	Cyan	11	Light Cyan
4	Red	12	Light Red
5	Magenta	13	Light Magenta
6	Brown	14	Yellow
7	White	15	High Intensity White

INSTALLATION WORKSHEET

DIGITIZER

Port _____
Speed _____
Parity _____
Bits/Char ____
Stop bits ____

Key Char position _____
X Coordinate Starting _____
Width of X Coordinate _____
Y Coordinate Starting _____
Width of Y Coordinate _____

Non Numeric Keys:

A Labeled _____ Transmits as _____ ASCII code _____
B Labeled _____ Transmits as _____ ASCII code _____
D Labeled _____ Transmits as _____ ASCII code _____
E Labeled _____ Transmits as _____ ASCII code _____

ASCII codes are listed in the back of the BASIC Manual

PLOTTER

Port _____
Speed _____
Parity _____
Bits/Char _____
Stop bits _____

SCREEN

Graphics adapter _____
Monitor _____

Installation of software: Configuration files

If the digitizer is connected to COM2 and set to 1200 baud and is a GTCO Digi-Pad 5, or emulates the GTCO, and, the plotter is connected to COM1, and set to 2400 baud, both set as recommended in the hardware installation The configuration files can be used without modification.

CONFIG.DIG	Digitizer configuration
CONFIG.PLT	Plotter configuration and symbols
CONFIG.SCR	Screen configuration

Programs will operate with the monitor in CGA mode using these files.

The contents of the configuration files, and changes that may be made to accommodate different systems are described on subsequent pages, with printouts of sample files annotated to explain their contents.

Parameters apply to GTCO digitizer. Annotations are not a part of the file

```
"COM2: 1200,N, 8, 1"  |          Port, baud rate, see OPEN COM, instruction
 1,1                  | Position, # characters sent when a key is depressed
2, 5, .001            |           Start position, field length X coordinate
8, 5, .001            |Start position, field length Y coordinate,resolution
15                    |                                Length character string
0,0                   | The final 15 lines contain the character sent by the
1,1                   | digitizer, a comma, and the label on the key of the
2,2                   | digitizer keypad
3,3                   |
4,4                   |
5,5                   |
6,6                   |
7,7                   |
8,8                   |
9,9                   |
:,A                   |
;,B                   |
<,C                   |
=,D                   |
>,E                   |
```

No blank lines are allowed at the beginning or end of the file

Without comments the file is as below.

```
"COM2: 1200,N, 8, 1"
 1,1
2, 5, .001
8, 5, .001
15
0,0
1,1
2,2
3,3
4,4
5,5
6,6
7,7
8,8
9,9
:,A
;,B
<,C
=,D
>,E
```

- No blank lines are allowed at the beginning or end of the file

For CGA adapter with color or CGA monochrome monitor, CONFIG.SCR file contains one line

"CGAC"

For EGA adapter with EGA monochrome monitor, CONFIG.SCR contains one line.

"EGAM"

For EGA adapter with color monitor, CONFIG.SCR is as follows:

"EGAC"
1,8
2,6
4,1
5,14
8,10
9,2
11,12
300,14
400,12
401,11

Each succeeding line contains a code number, a comma, and a color number (see p. 66) 15 colors different from background (#0) are available so that entries of different codes will be drawn in different colors on the screen

No blank lines are allowed at the beginning or end of the file

Notes:
- VGA and PGA graphics adapters are not supported.

The first line of the CONFIG.PLT file sets communication parameters between the computer and the plotter. The rest of the file contains the code for symbols (see p. 55-59. These parameters are described in the BASIC manual, see OPEN COM statement.
the

Part of CONFIG.PLT [code after symbol 2 not printed]

```
"COM1: 2400,N, 8, 1,RS,CS65535,DS,CD"
50,4
"PU",1.0,0.0
"PD",-1.0,0.0
"PD",0.0,-1.0
"PU",0.0,1.0
1,2
"PU",0.0,0.0
"CI",1.0,0.0
2,4
"PM",0,0
"PU",0.0,0.0
"CI",1.0,0.0
"PM",2,0
```

CODING OF NEW SYMBOLS

New symbols can be encoded by the user and included in the CONFIG.PLT file. Coding is easier than might be anticipated. Symbols are drawn with straight lines and/or with circles. Areas and or circles may be filled.

Starting

To be consistent with other symbols, sketch a square with sides of unit length, with a point at the center. Assume that the pen is at the center point of the square. Each line of the code describing the symbol provides one instruction to the computer: the center of the square is the point that is digitized. A symbol is drawn using straight line segments (moves) and circles; moves can be either with pen up (no line drawn) or with pen down (line drawn); moves can be combined to define polygons which will be filled (solid fill); circles may either be filled or not filled.

The first line of the code for a symbol specifies the number assigned to the symbol and the number of lines (records) required to define that symbol. Subsequent lines consist of a series of instructions for the plotter. No more than 25 lines may be used.

Moves

A line starting with a "PU" tells the the pen in the plotter to move to a new position with the PEN UP (no line drawn), a line starting with "PD" specifies that the move is made with PEN DOWN (drawing a line). All moves are relative to the last point. After a "PU" or "PD" at the start of a line a comma must be used; the number after this comma specifies the X distance to the next point, then a comma must be used; the number after the second comma specifies the Y distance to the next point. Each line that begins with a "PU" or "PD" instruction, also specifies coordinates in X and Y for the next point, relative to the current pen position.

Polygons

A line starting with a "PM" is an instruction to the plotter about a polygon.

"PM",0,0 defines the start of a polygon.

"PM" 2,0 ends a polygon and ends polygon mode in the plotter.

The polygon defined between "PM",0,0 and "PM",2,0 instructions will be filled with a solid pattern.

Moves between "PM"0,0 and "PM,2,0 instructions should define a closed polygon); if the polygon is not closed, the "PM"2 instruction forces a closing of the polygon to the point occupied by the pen when the "PM",0 instruction was issued.

Exterior and interior polygons

"PM",1,0 ends a polygon but leaves the computer in polygon mode. This instruction is used, for example, between moves that define an external polygon and moves that define an internal polygon to be left unfilled.

The "PM",1,0 instruction forces a closing of the polygon back to the position of the pen at the time the "PM",0,0 instruction was issued.

Circles

A line of code starting with a "CI" instruction calls for the drawing of a circle; the "CI" must be followed by a comma; the number following the comma specifies the diameter of the circle to be drawn; this number is followed by a comma, then by a 0 (zero). The diameter is specified in units relative to the unit square, see Fig. 8.

The center of the circle is the point occupied by the pen at the time the "CI" instruction is given. A "CI" instruction defines a complete polygon; it is equivalent to a set of moves between "PM"1,0 instructions, but counts as a single line.

Additional information on coding is given in the Interfacing and Programming Manual supplied with HP plotters. Please note that all of the HPGL commands **ARE NOT SUPPORTED** by GSMAP and GSDRAW. Use only the commands provided above.

Examples to illustrate symbol coding

Effect of instructions diagrammed on Fig. 9

```
Symbol 209; Uses PU and PD moves

209,6               - symbol number, number of lines of code
"PU",0.2,-0.5
"PD",0.0,1.0
"PD",0.1,-0.2
"PU",-0.5,0.2
"PD",0.0,-1.0
"PD",-0.1,0.2

Symbol 14; Uses PU and PD moves, and one filled polygon

14,8                -symbol number, number of lines of code
"PU",0.5,0.5        - move to the upper right corner of symbol; PU
"PD",-1.0,0.0       - move to upper left corner; PD
"PD",0.0,-1.0       - move to lower left corner; PD
"PM",0,0            - starts polygon to be filled
"PD",1.0,0.0        - move draws lower line of filled triangle
"PD",0.0,1.0        - move draws right edge of filled triangle
 "PD",-1.0,-1.0      - move draws hypotenuse of filled triangle
"PM",2,0             Ends definition of filled polygon


- Filling of triangular polygon
    Note: the "PM 0,0" instruction starts definition of a polygon to
be filled; the PM,2,0" ends the polygon's definition

77,14; Uses PU and PD moves, two circles, one defined as polygon
"PU",0,1.0
"PD",0,-0.5
"PU",0,-0.5
"PM",0,0            -starts filled polygon=circle
"CI",.5,0           -specifies circle, diameter 0.5
"PM",2,0            -ends filled polygon=circle
"PU",0,-0.5
"PD",0,-0.5
"PU",-1.0,1.0
"PD",0.5,0.0
"PU",1.0,0.0
"PD",0.5,0
"PU",-1.0,0.0
"CI",1,0             open circle; polygon not specified; circle
                     will not be filled


- The "units" for the diameter of the circles are specified in
the same "units" as the "moves" for the pen, based on the unit
square
- Lines for symbol 77 go outside the unit square; this is
permissible.  The only reason for the unit square is to assist in
keeping symbols similar in size.
- Symbol 209 with coding as drawn here was found to be too small;
current CONFIG.PLT files contain a symbol which is twice the size
of this one.
```

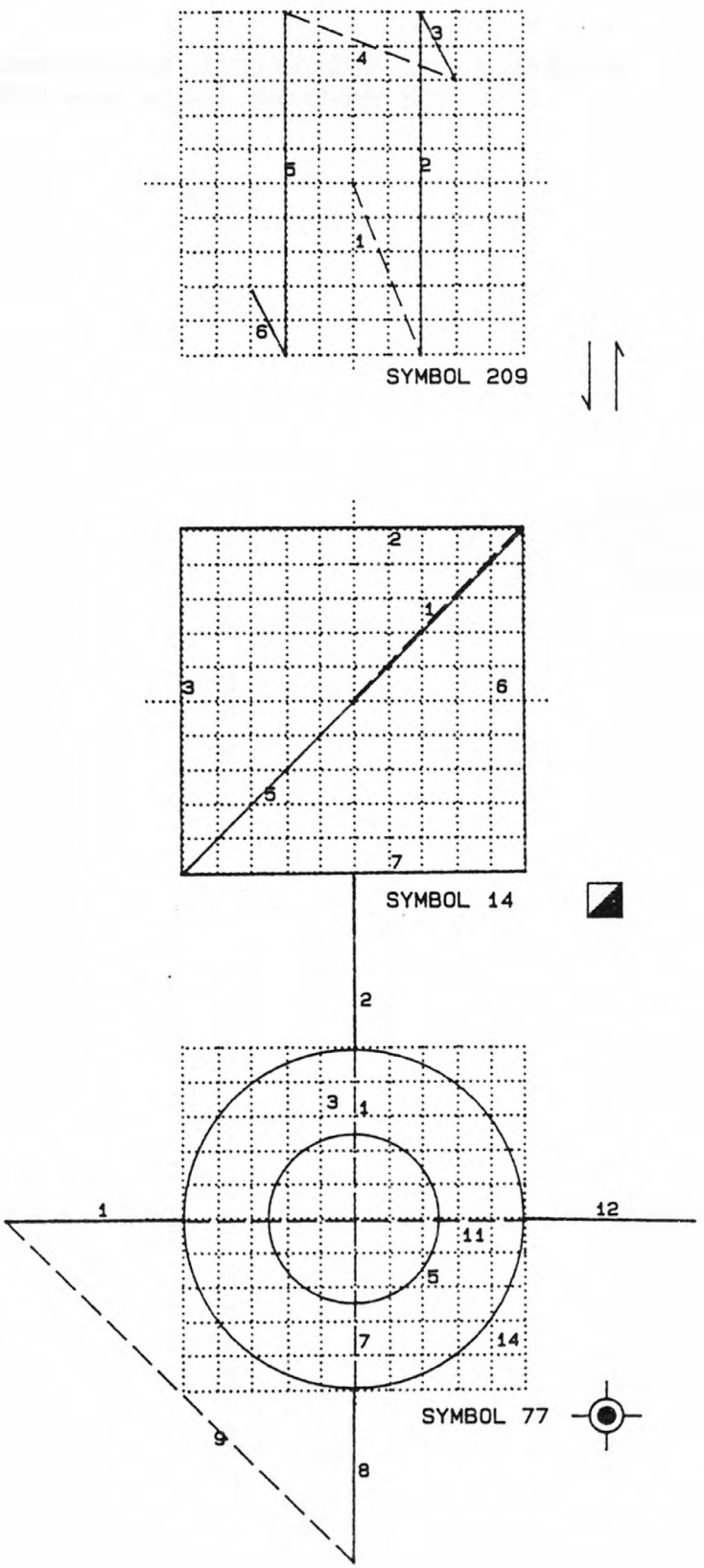


Figure 9._ Examples of coding of symbols. Unit square shown by dotted lines, pen up moves by dashed lines, pen down moves by solid lines.

Figure 10._ Chart summarizing digitizing and plotting requirements for GSDRAW and GSMAP Version 5.0

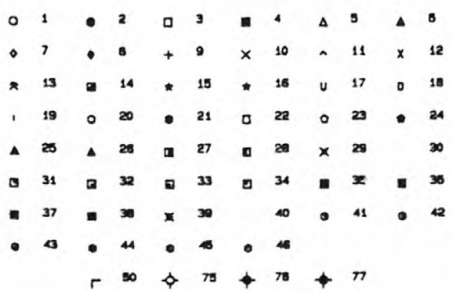
GSMAP AND GSDRAW

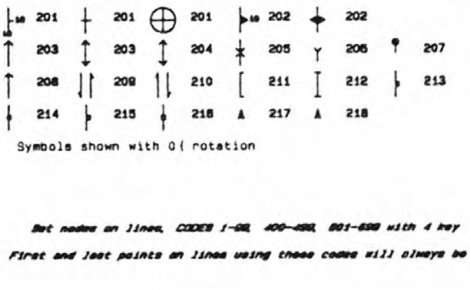
GSMAP VERSION 5.6
GSDRAW VERSION 5.6

CODES	DIGITIZER ENTRIES			DIGITIZING PROCEDURE (KEYPAD)	PLOTTING ENTRIES FROM KEYBOARD			
	CODE	PARAMETER 1	PARAMETER 2		ENTRY 1	ENTRY 2	ENTRY 3	ENTRY 4
LINES *CODES 1-99* Select on basis: 1. line type 2. line weight 3. decorative symbol	Code + A	A	A	Digitize with 0 key, end with 1 key, OR, use 2 key on next-to-last point to automatically make last point the same as the first point. Use 4 key to set nodes along lines	*SET 1* Code (1-99)	Pen number	Line type 0 1 2 3 4 5 6	0 for undecorated lines; use symbol numbers from CONFIG.PLT file for decorated lines 101 102 103 104 105 106 107 Digitize
					SET 2 ENTER DELTA: spacing (inches) between symbols on line	*ONLY FOR DECORATED LINES!*		
TABULAR DATA *CODES 101-199*	Code	Locality number + A	Rotation angle, counterclockwise +, + A, for postings	Use 1 key to digitize location	*SET 1* Code	Pen number	Symbol number, from CONFIG.PLT file; 0 if no symbol desired	Symbol size, raster units: 1.016/in
					SET 2 FILENAME.EXT for file that contains data			
					SET 3 # data columns in data file	# of data column containing data to be plotted; 0, locality #s		
INDIVIDUALLY ROTATABLE SYMBOLS *CODES 201-299*	Symbol number CONFIG.PLT file, 201-299	Rotation angle (clockwise) of symbol + A	Dip or plunge angle to be posted + A	Use 1 key to digitize location	Symbol number CONFIG.PLT file, 201-299	Pen number	0	0
USER-DEFINED SYMBOLS *CODES 300-399* Select on basis: 1. pen 2. rotation of symbol group	Code	Symbol number, CONFIG.PLT file + A	Symbol size, raster units: 1.016/in + A	Digitize with 1 key if one symbol is needed; for multiple symbols of the same kind, digitize using the 0 key until the last, then use the 1 key	*SET 1* Code	Pen number	0	Rotation angle for symbol set
					SET 2 N maintains digitized angle, Y randomizes plot angle			
CLOSED POLYGONS *CODES 400-499* Select on basis: 1. pen 2. fill type 3. angle of lines in fill	Code	A	A	Digitize with 0 key up to next-to-last point, use 2 key to close polygon. UNLESS an internal, unfilled polygon is needed; in this case, complete external polygon with the 3 key. Digitize internal polygon with the 0 key up to next to last point, close internal polygon with 2 key. Use 4 key to set nodes along polygon outlines	*SET 1* Code	Pen number	Line type	0
					SET 2 Fill type 0 no fill #1 Parallel lines #2 Rectangular grid #3 Symbols on parallel lines	Fills # 1, #2 Spacing of lines Fill #3, X Delta	Fills #1, #2 Angle of rotation horizontal=0 (+ counter-clockwise) Fill #3, Y Delta	
					SET 3 Fill #3 only Symbol Number	Symbol size	Randomize, Y/N	
WORDS AND LETTERS *CODES 500-599*	Code	Number from file MAPNAME.RU + A	Letter height, raster units: 1.016/in + A	Digitize position of lower left corner, first line of text, with 1 key, OR, digitize the same position with the 0 key, then use 0 key and 1 key to draw straight line leader between last two points	*SET 1* Code	Pen number	Slant angle of LETTERS	Slant angle of WORDS
					SET 2 FILENAME.EXT for data file			

SPECIALLY DEFINED CHARACTERS FOR 500-599 CODES
keyboard - plot \ - \ & -& @ -@ { -((deg) } -) (sec)

	CODE	PARAMETER 1	PARAMETER 2		ENTRY 1	ENTRY 2	ENTRY 3	ENTRY 4
SPLINED LINES *CODES 601-699* Select on basis: 1. line type 2. line weight 3. decorative symbol	CODE	A	A	Digitize with 0 key, end with 1 key, OR, use 2 key on next-to-last point to automatically make last point the same as the first point. Use 4 key to set nodes along lines	*SET 1* Code (1-99)	Pen number	Line type 0 1 2 3 4 5 6	0 for undecorated lines; use symbol numbers from CONFIG.PLT file for decorated lines 101 102 103 104 105 106 107 Digitize
					SET 2 ENTER DELTA: spacing (inches) between symbols on line	*ONLY FOR DECORATED LINES!*		





Set nodes on lines, CODES 1-99, 400-499, 601-699 with 4 key

First and last points on lines using these codes will always be nodes

APPENDIX 2

MAP PROJECTIONS

Appendix 2 briefly covers map projections used on some USGS maps and the contents of projection parameter files needed to use these projections for digitizing and plotting with Level 5 software.

Map projections

The capabilities of Level 5 programs enable precise matching of many USGS maps. Map projections and USGS practice are described by Snyder 1987.

Information on the map projection is given in marginal notes on USGS maps, but the data on the parallels and meridian used to prepare the map is not provided. This information is needed for digitizing and plotting.

The summary below should help, but please read the original by Snyder, 1982. This bulletin answers questions you should have.

Albers Equal-Area projection

When used for maps of the 48 conterminous states, the standard parallels are 29,30,0,N degrees and and 45,30,0,N .

For maps of Alaska, the standard parallels are 55,0,0,N degrees and 65,0,0,N degrees.

For maps of Hawaii, the standard parallels are 8,0,0,N and 18,0,0,N

Transverse Mercator

AMS 1 degree by 2 degree sheets use the Transverse Mercator projection. Determine and use the meridian central to the map. This is the line of longitude at the center of the sheet.

Beginning in the late 1950's the Transverse Mercator projection was used by the USGS for nearly all new quadrangles covering states using TM Plane coordinates. The central meridian and scale factor for these maps are those of the State Plane Coordinate System (SPCS zone. The scale factor of 0.9996 given in the example corresponds to a reduction of 1:2,500 one part in 2,500 as given in the tables of Bulletin 1532.

Universal Transverse Mercator

The UTM projection is used for all new 30 minute by 60 minute quadrangles. The proper Standard Meridian can be determined either by using tables or by locating the nearest line of longitude of whole number of degrees that is divisible by 3 but not by 2. The UTM projection will be used by the USGS for 1 x 2 degree sheets as it updates the series.

Polyconic

Many 7 1/2 and 15 minute quadrangle maps have been drawn using the Polyconic projection. Determine and use the meridian central to the map. This is the line of longitude at the center of the sheet.

Lambert Conformal Conic

For the 500,000 scale base maps of the 48 contiguous states, the Lambert projection was used with standard parallels of 33,0,0,N and 45,0,0,N.

The Lambert conformal conic was used for most 24,000 scale quadrangles prepared after 1957 which lie in zones for which the Lambert is the base for the State Plane Coordinate System Standard parallels depend on the ZONE. See Snyder, 1982.

The Lambert conformal conic is used by the USGS for a map of the US showing all 50 states in true relative position. This map has been issued at scales of 1:6,000,000 and at 1:10,000,000. For this map the standard parallels are 37,000,000,N and 65,000,000. Determine and use the meridian central to the map. This is the line of longitude at the center of the sheet. The map projection is clearly labeled on most USGS maps. Use the projection designated on the map. For most maps there is little difficulty in determining the parameters needed to construct projection files for digitizing and plotting.

* For recent 7 1/2 minute quadrangles there may be some difficulty in determining the proper parameters to use in projection files to precisely match those used in their construction, because the State Plane Coordinate System - a rectangular grid - not a map projection seems to have been the determining factor in selection of map projection.

* States split into two groups, those that use the Transverse Mercator to define the state plane coordinate system, and those that use the Lambert Conformal Conic. p. 58. Accordingly, Transverse Mercator and Lambert are used for new 7 1/2 minute quadrangles.

* Beginning in the late 1950's the Transverse Mercator projection was used by the USGS for nearly all new quadrangles covering states using TM Plane coordinates. The central meridian and scale factor for these maps are those of the SPCS zone. (The

scale factor of 0.9996 given in the example above corresponds to a reduction of 1:2,500 (one part in 2,500) as given in the tables of Bulletin 1532. To use this projection, one must compute the scale factor using the scale reduction figure in the table, and use the proper central meridian, a longitude value which is different for each zone in a state. Snyder, 1982.

* The Lambert conformal conic was used for most 24,000 scale quadrangles prepared after 1957 which lie in zones for which the Lambert is the base for the State Plane Coordinate System Standard parallels depend on the ZONE. Snyder, 1982

POLYCONIC APPROXIMATION

A useful approximation for digitizing and plotting is to use the Polyconic Projection. The maximum difference in the 700-800 mm diagonals of 7 1/2 or 15 minute between Transverse Mercator, Lambert, and Polyconic projections is about 0.05 mm. This is a much smaller figure than that expected due to size changes due to changes in humidity for a paper copy. It is only twice the precision attributed to a good digitizer.

Before digitizing, we suggest starting a data base with the proper data base corners, then plotting the corners using stable film, and comparing the result with a scale-stable base map. If it fits, you are ready to digitize. If there are problems, try the listed projection, using the parameters given by Snyder, 1987. This procedure not only checks to see if the projection file is the correct one, but also finds possible errors of entry for data base corners. Checking by plotting corners before digitizing can save lots of time.

Examples of Projection Files

1. Universal Transverse Mercator

File	Description of Contents
1	"1" designates Universal Transverse Mercator
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in km, Clarke 1866
105,0,0,W	Longitude, Principal Meridian of UTM Zone
0.9996	Scale factor

2. Albers Equal Area

File	Description of contents
2	"2" designates Albers Equal Area
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in km, Clarke 1866
45,30,0,N	Latitude, first standard parallel
29,30,0,N	Latitude, second standard parallel
100,0,0,W	Longitude, meridian central to map

3. Lambert Conformal Conic

File	Description of contents
3	"3" designates Lambert Conformal Conic
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in km, Clarke 1866
33,0,0,N	Latitude, first standard parallel *see below for 7 1/2' Quads
45,0,0,N	Latitude, second standard parallel *see below for 7 1/2' Quads
105,0,0,W	Longitude, meridian central to map *see below for 7 1/2' Quads

4. Mercator

File	Description of contents
4	"4" designates Mercator
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in km, Clarke 1866
105,0,0,W	Longitude, Meridian Central to map

5. Polyconic

File	Description of contents
5	"5" designates Polyconic
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in km, Clarke 1866
105,0,0,W	Longitude, meridian central to map

6. Transverse Mercator

File	Description of contents
6	"6" designates Transverse Mercator
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in km, Clarke 1866
105,0,0,W	Longitude, meridian central to map *see below for 7 1/2' Quads
0.9996	Scale factor

6. Transverse Mercator, "parameters for special DNAG map, for spherical Earth"

File	Description of contents
6	"6" designates Transverse Mercator
6371.204	Radius of Earth in km
671.204	Radius of Earth in km
100,0,0,W	Longitude, meridian central to this map
0.926	Scale factor unique to this map

7. Oblique Mercator Projection

The sample oblique mercator projection file provides parameters used in generating a map of the Appalachians.

File	Contents
7	"7" designates Oblique Mercator
6378.2064	Equatorial radius, in km, Clarke 1866
6356.5838	Polar radius in KM, Clarke 1866
1.0	Scale factor along central axis
42,0,0,N	Latitude, center point of projection
73,0,0,W	Longitude, center point of projection
51,30,0,N	Latitude, S end of line defining axis
56,0,0,W	Longitude, S end of line defining axis
33,30,0,N	Latitude, N end of line defining axis
84,30,0,W	Longitude, N end of line defining axis

8. Equidistant Conic

File	Description of contents
8	"8" designates Equidistant Conic
6378.38584	Equatorial radius, in km
6356.910	Polar radius in km
9,0,0,N	Latitude, first standard parallel
4,0,0,N	Latitude, second standard parallel
66,0,0,W	Longitude, meridian central to map

Values in the example above are for the Equidistant Conic projection called PROYECCION CONICO SECANTE COPENSADA in use in Venezuela with the values for the radii and parallels as shown above. The Equidistant conic is also used for certain maps of Alaska where it has been called the "Modified Mercator", even though it is a conic projection and not a cylindrical projection like the other Mercator projections.

Note:
- Latitude,Longitude values are entered in Degrees,Minutes,Seconds and followed by the Appropriate letter: for example, W longitude, N latitude in the conterminous U.S.

- A spherical form of the Transverse Mercator projection was chosen for the 1979 1:5,000 scale map of North America. This map was adopted by The Geological Society of America as the base for publications in the DNAG (Decade of North American Geology) series.

DIFFERENCES BETWEEN VERSION 5.0 AND Versions 3 AND 4 OF GSMAP AND GSDRAW

- Map projection algorithms have been changed to match those of the USGS National Mapping Division (Reference). These routines have been translated from Fortran to Microsoft Quick Basic for use in GSMAP. Changed from Version 4. Different plot and projection files are required.

- Map projections supported by GSMAP for digitizing and plotting now include Mercator, Universal Transverse Mercator, Transverse Mercator, Oblique Mercator, Polyconic, Lambert Conformal Conic (one or two parallels), Albers Equal Area, and Equidistant Conic. Problems with the Transverse Mercator projection in earlier versions of GSMAP at very high or very low longitudes have been eliminated. digitizing and plotting can be done for maps crossing the "quadrant" boundaries used in versions of GSMAP through Version 4.0

- Nodes and a node file have been added. These facilitate accurate digitizing so that line junctions will meet with mathematical accuracy. This facilitates export of digital files to structuring programs and creation of "polygon" coverage (changed from Version 4).

- Entries of up to 8,000 points can now be digitized and plotted, (filled if required). Filling of polygons is now done by Program software (changed from plotter firmware), to permit filling on additional kinds of plotters).

- GSMAP has been rewritten to more fully utilize the structured concepts of Microsoft QuickBasic. The programs cannot be tested or executed under BASICA; they have been compiled using Microsoft QuickBasic, Version 2; and support the 8087 chip using 87BASIC from MicroWay which modifies the standard libraries to call the 8087 co-processor; the 8087 chip is required.

- Option 1 (START A NEW DATA BASE): Data bases can be started from the keyboard for both GSDRAW and GSMAP. Short cuts speed start of data bases for standard quadrangle series (changed from Version 4).

- Option 2 (OPEN AN EXISTING DATA BASE): After opening a data base (GSMAP), the latitude and longitude of the data base corners are displayed on the screen (changed from Version 3).

- Option 3 (DIGITIZE NEW ENTRIES): The border of the area is not displayed on the screen so that all lines you see are in the data base (changed from Version 3).

- Option 4 (DELETE ENTRIES): You can selectively display entries for one or more codes in the GRAPHICAL DISPLAY mode. Polygons can be filled on the screen to assist this process (changed from Version 4).

- Option 6 (CHANGE PARAMETERS FOR ENTRIES): global changes can be made to a specified code, and/or to PARA1 and PARA2 for the specified code (changed from Version 3)

- Option 7 (LIST CONTENTS OF DATA BASE): if the screen option is chosen, there will be a pause after each set of 20 lines is displayed (changed from Version 3).

- Option 8 (PLOT ON THE SCREEN): codes can be separately or sequentially plotted, and polygons can be outlined or filled. EGA adapters are supported (changed from Version 3), map projections can be specified in GSMAP, (changed from Version 4).

- Option 9 (PLOT ON THE HARD COPY PLOTTER): at the end of the plot sequence, grid points can be generated at user specified intervals (GSMAP,geodetic grid, GSDRAW, inches). Corners of GSMAP,GSDRAW are changed in shape (using symbol 50) to distinguish from grid marks. Corners can be plotted on draft mode or publication mode plots. A new line type **99** allows plotting of "decorations" without a connecting line. The posting of numerical data, codes 100-199 is no longer restricted to the right side of the digitized point,, PARA2 is now used to specify a rotation angle for posting enabling choice of the position of posting for each point (changed from Version 3), Plot corners can be specified in plot files in GSDRAW so that a plot "window" can be specified without use of the digitizer, data base corners in GSMAP can be used as default plot corners, output can be directed to a file, or to the plotter(changed from Version 4).

- Option 10 (MERGE ANOTHER DATA SET INTO CURRENT DATA SET: the process of merging data bases can be displayed on-screen (changed from Version 3.).

- Option 11 (COMPUTE POLYGONAL AREA): The areas and perimeters of polygons defined by 400 series codes can be computed: GSMAP (areas, x.xx square miles, perimeters, x.xx miles); GSDRAW (areas x.xx square units, perimeters x.xx units; the units are those of the data base). The values can either printed on the printer, or **displayed on screen** (changed from Version 4.).

- Symbols, The "CI" circle immediate" instruction can now be used, so that circles can be drawn at any position in a symbol without coding a lengthy series of moves; "PM" instructions are now used to define polygons to be filled. Changed from Version 3.

- ASCII tables utilized by Code Group 100-199 can contain alphanumeric data in all columns except the first, locality identifier (changed from Version 3).

- Code group 600-699 is used for lines, like Code group 1-99, but lines are splined by curve fitting to a cubic equation during plotting added to Version 3.0, changed from Version 4 to spline lines with many more points.

Description of contents of disks 1 and 2 of this Open-File Report.

88-295B Executable program disks

GSDRAW.EXE	GSDRAW program
GSMAP.EXE	GSMAP program
DRAW.NDX	Example of GSDRAW database (index file)
DRAW.LSF	Example of GSDRAW database (data file)
DRAW.NOD	Example of GSDRAW database (node file)
DRAW.RU	Example of ASCII word and character file
DRAW.PLT	Example of GSDRAW plot file
MAP.NDX	Example of GSMAP database (index file)
MAP.LSF	Example of GSMAP database (data file)
MAP.PLT	Sample plot file for GSMAP
CONFIG.PLT	CONFIG.PLT Configuration file for plotter
CONFIG.DIG	CONFIG.DIG Configuration file for GTCO Digi-Pad 5 digitizer
CONFIG.EGA	Configuration file (CONFIG.SCR) for EGA with color monitor
CONFIG.SCR	Configuration file for CGA monitor
MAP.PRJ	Sample projection file UTM, Principal Meridian 105°
ALB100.PRJ	Projection file Albers Equal Area, 100° meridian
LCC105.PRJ	Projection file Lambert Con. Conic, 105° meridian
POL105.PRJ	Projection file Polyconic, 105° meridian
TM105.PRJ	Projection file Transverse Mercator, 105° meridian
OM.PRJ	Projection file Oblique Mercator, Appalachian map
VENEZ.PRJ	Projection file Equidistant Conic Venezuela
MERC.PRJ	Projection file Mercator
DNAG.PRJ	Projection file "DNAG" with spherical earth

The database DRAW contains the illustration shown on the front cover of this documentation; plot on 8 1/2 X 11 inch paper; pen 1, fine black, pen 2, fine red, pen 3, fine blue, pen 5, heavy black. The data base Map is empty, but can be used for digitizing using the MAP.PRJ projection file, the plus signs as corners for the MAP database.

Acknowledgments

Significant contributions to the development of the GSDRAW and GSMAP programs have come from many people. Mark E. Gettings provided original ideas to the structure of the projection routines; Bruce R. Johnson developed the hardware configuration; Frederic H. Wilson offered numerous suggestions for improvements and is responsible for the EGA support introduced in Version 4.0. Grateful thanks are extended to Warren J. Nockleberg, David P. Buscher, Anna B. Wilson, and Edward du Bray; These and other early users suffered through numerous changes, modifications, and bug fixes.

REFERENCES

Covington, M. A., 1986, Smooth curves: PC Tech Journal, August, p. 110-120.

Newman, W.M., and Sproull, R.F., 1979, Principles of interactive computer graphics, second edition: McGraw-Hill, 541 p.

U.S. Geological Survey, 1986, Software documentation, General cartographic transformation package: U.S. Geological Survey, National mapping program, Technical Instructions, unpublished report, 68 p.

Snyder, J. P., 1982, Map Projections used by the U.S. Geological Survey: U.S. Geological Survey Bulletin 1532 313 p.

Snyder, J. P., 1987, Map projections, a working manual: U.S. Geological Survey Professional Paper 1395, 393 p.

Snyder, J. P., 1988, Oral communication: Parameters for maps of Venezuela bearing the designation Proyeccion Conico Secante Compensada.

ABOUT GSDRAW AND GSMAP Version 5.0
Introduction

The documentation for GSMAP and GSDRAW attempts a systematic description of these programs. This text is a supplement providing ideas developed during use of the programs and answering some of the common questions asked by new users at training sessions. It also deals with some of the changes introduced into Version 5.0 of these programs.

This text is written for new users who have scanned the documentation, but have not yet studied it. We hope it will also assist users of previous versions of these programs to come up to speed in Version 5.0. Data bases generated by Versions 2, 3, 4, and 5 of GSDRAW and GSMAP are completely compatible. Modification of older projection files and plot files will be required. That's the price of avoiding *obs (see glossary for terms marked with an asterisk). If you don't need this tutorial, start a bonfire with the paper you're now reading. Outside, please. At any rate, welcome to GSMAP and GSDRAW Version 5.0. Please accept this document as revealed truth.

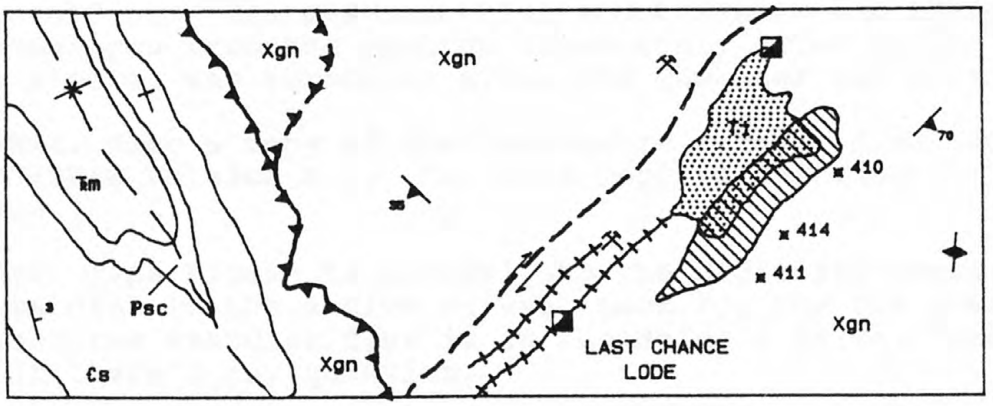


Figure 11._ Drawing for GSDRAW and GSMAP exercises.

*JUMPSTART I, GSDRAW

The following section would be called a Tutorial except that under that name you would expect a scholarly exposition and read only the first half page; it provides a guide through one small project, one that provides familiarity with many GSDRAW procedures. The exercise assumes availability of necessary hardware and software.

We suggest that you retrieve your copy of the *documentation for GSDRAW and GSMAP Version 5.0 (the first part of this Ms.) from its present position supporting the short leg of the drafting table, so that it is available for reference. Terms in this Ms marked with an asterisk are defined in the GLOSSARY. In case of emergency look them up.

First. Find a *guru and ask *him to make sure that the computer, digitizer, printer, and plotter are working, properly configured, and cabled, that the hardware is ready. If no *guru can be found, read the *documentation. Don't try to fight hardware and software problems at the same time.

Second. Turn on the plotter, the digitizer, the printer, and the computer. See manufacturer's instructions.

Third. Boot up the computer. Do this <u>after</u> the plotter has been turned on. There's something about GSDRAW and GSMAP that may expel you from the program immediately after making a plot if the plotter was turned on after the computer was booted up.

Next. Make a copy of the Executable release disk; Disk 1, GSMAP/GSDRAW Version 5.0. Use this copy as the disk for this exercise.

Now. Tape Figure 11 securely to the digitizer board. Put the exercise disk in the active drive. Look for the DOS prompt; make sure that the exercise disk is in the default drive. Consult a *guru if there's any question.

GSDRAW is a board game. Some gambits can be played without a digitizer, but that's best done after you reach the status of a *guru. The procedures described in this section let you create a digital version of Figure 11. This exercise reviews most of the rules for the board. After completing this GSDRAW exercise you will be ready for some additional rules required in using GSMAP.

Some input for GSDRAW comes from the computer keyboard, some from the keypad of the digitizer. During digitizing sessions, the keypad is used to send instructions to the computer so you don't have to run back and forth between digitizer and computer. First, the digitizer sends instructions to the computer to prepare it to accept data. Then the digitizer is used to generate X,Y coordinates (for a point) that tell the computer where the cursor is on the board with a resolution of 1/1000 inch, and send these coordinate pairs to the computer for storage.

To create a line, a string of X,Y coordinates (pairs) is sent to the computer for storage.

During plotting, the computer will tell the plotter what to do, how to connect the points that have been digitized, and how to draw an illustration according to the rules of GSDRAW.

NOW it's your turn to use GSDRAW.

*Enter GSDRAW from the keyboard (see glossary for definition of "enter" if there's any question. The computer screen will soon exhibit the *disclaimer message. Under the disclaimer four lines of text will be displayed.

```
1 - Start a new data base
2 - Open an existing data base
3 - Exit
Enter choice:
```

Each GSDRAW and GSMAP session must begin by either starting a new data base, or by opening an existing data base. Now, let's start a new data base.

Start a data base by *entering **1** from the keyboard.

The screen will clear, and then will prompt you to select a name for the new data base. Follow the prompts throughout this exercise. The next three entries are made using the keyboard of the computer.

ENTER MAP DATA BASE NAME: For this exercise:

Enter **SPECIAL** You can use any name with 8 characters or less; please follow these directions so we don't get confused. This name will become the name for the data base files, so observe the rules of DOS. Don't enter a name with an extension. GSDRAW will supply extensions. The screen will prompt:

ENTER TITLE OF MAP:

For this exercise Enter **EXERCISE** You can use any name with 8 characters or less. After this entry the screen will clear, and new prompts will be displayed:

```
OPTIONAL METHODS FOR SPECIFYING DATA BASE CORNERS
FROM DIGITIZER
     1 - ALL FOUR CORNERS FROM DIGITIZER
FROM KEYBOARD
     2 - SPECIFY UPPER RIGHT CORNER (X,Y)
     3 - SPECIFY LOWER LEFT(X,Y), UPPER RIGHT(X,Y)
     4 - ALL FOUR CORNERS

ENTER OPTION:
```

Choose Option 1: Enter **1** from the keyboard.

The screen will clear, then display new prompts. Follow directions provided by these prompts.

The next entries in response to screen prompts are made using the keys on the cursor of the digitizer. For the first *entry of **0** to synchronize digitizer input, the cursor can be at any position within the active area of the the digitizer board (the little red light on the cursor must be on). When "entering" the corners carefully position the cross hair of the cursor over the corner, (use the + symbols on figure 1 as corners), press the **0** key on the keypad to *enter the corner, move the cursor to the next corner as specified by the screen prompt,and similarly *enter the other corners in turn, as specified by the prompts shown below.

ENTER **0**(ZERO)ON CURSOR KEYPAD TO SYNCHRONIZE DIGITIZER INPUT
ENTER UPPER LEFT CORNER ON DIGITIZER (use the **0** key)
ENTER LOWER LEFT CORNER ON DIGITIZER (use the **0** key)
ENTER LOWER RIGHT CORNER OF DIGITIZER (use the **0** key)
ENTER UPPER RIGHT CORNER ON DIGITIZER (use the **0** key)

These four entries from the keypad define the data base corners and index the drawing to the digitizer board. After entry of the fourth corner the screen will change to the Main Menu.

The Main Menu offers choices (by number) and shows the name of the current data base, if one is open. By starting data base SPECIAL, you opened this data base. This data base will remain open until you open another one (Option 2), start another (Option 1), or exit from the program. The name of the data base that is open and its title are displayed near the upper right corner.

G S D R A W

CURRENT DATA BASE: SPECIAL
MAP TITLE: EXERCISE

1 - START A NEW DATA BASE
2 - OPEN AN EXISTING DATA BASE
3 - DIGITIZE NEW LINE SEGMENTS
4 - DELETE LINE SEGMENT
5 - RECOVER LINE SEGMENT
6 - CHANGE PARAMETERS FOR LINE SEGMENT
7 - LIST CONTENTS OF DATA BASE
8 - PLOT ON THE SCREEN
9 - PLOT ON THE HARD COPY PLOTTER
10 - MERGE ANOTHER DATA SET INTO CURRENT DATA SET
11 - COMPUTE POLYGONAL AREA
12 - EXIT

ENTER CHOICE BY NUMBER:

Now let's start a digitizing session by entering **3**
The screen will clear, and display the following prompt:
DISPLAY PREVIOUS DATA? (Y/N)
Enter **N** from the keyboard (there's no "previous" data in this database to display). If there was data, and you wanted to see it on the screen, entering **Y** would be appropriate.

After entry of **N** another prompt will be added to the screen display.

ENTER Snap Distance:

Enter **.03** *Snap distance is defined in the glossary and in the *documentation. For now, don't worry about this entry; we will discuss it later.

After entry of **.05** The screen will clear and a high pitched tone will sound. The screen will be totally blank, waiting for you. When you started data base SPECIAL you also indexed the hard copy (Fig. 1) to the digitizer board. Make sure that it doesn't move during digitizing. If it does, <u>immediately</u> stop digitizing, open the data base, (Option 2) and index the drawing to the digitizer board.

Until you leave the digitizing session, <u>all</u> entries will be made from the keypad. The high pitched tone will sound each time during a digitizing session when the computer is ready to start receiving information about a line or some other kind of graphical entity.

You are now ready to digitize. But first read ahead a bit; then it will be time to digitize some lines, and other kinds of graphical entities.

A number of kinds of graphical elements are needed to draw Figure 11.

Take a careful look at Figure 11 to identify the kinds of graphical elements.

#1. Lines: seven different kinds.
#2: symbols that have an orientation that means something: four different kinds; (dip and strike, foliation, adit. syncline axis.
#3. Symbols that are always oriented the same way, but that you might like to draw in different sizes: three different kinds; pick and hammer, mine shaft, prospect.
#4. Areas that are filled with a pattern: two different kinds; a stippled area, a line patterned area.
#5. Lettering: two sorts; rock unit labels, and the name of a mine.

Special use is made of capabilities of GSDRAW to plot two elements of this illustration:
#101. Symbols with numbers: representing geochemical values in this example.
#605. A smoothed line: used here for the synclinal axis.

Numbers 1-5 for graphical elements in the list above correspond to the code group numbers that GSDRAW and GSMAP use for these kinds of elements.

GSDRAW and GSMAP use code groups as follows:

1-99. Lines.
200-299. Symbols that must be individually rotated into proper position.
300-399. Symbols where whole groups have the same orientation.
400-499. Areas that need filling with a pattern.
500-599. Alphanumeric entries.

100-199 Numbers/letters read from a row/column table.
600-699 Lines smoothed by the computer.

All lines are digitized as if they were solid lines. Dotted lines, dashed lines, heavy lines, fine lines, decorated lines (thrust faults are shown by lines decorated at intervals with triangles) are drawn by choosing these patterns and decorations at the time of plotting and by selecting a pen with a fine point or one with a broad point. Don't digitize each dash separately. Pretend that the dashes are connected. The plotter will dash the line for you.

When planning digitizing for Figure 11, there seemed to be seven different kinds of lines: the differences being ones of pattern(solid, dashed), "decoration" (the railroad track pattern of the dikes, the teeth on the thrusts), and widths (thin for contacts, the fold axis, and the box around the diagram), and heavy (for faults).

These kinds of lines require seven different codes. We used the following: code 1 for contacts, code 10 for the box around the diagram, code 4 for the dashed strike slip fault; code 5 for the synclinal axis; code 8 for the solid line thrust; code 9 for the dashed line thrust; code 11 for the dikes.

The lines around the stippled area and around the area filled with parallel lines will be digitized using one of the 400-499 "filled area" polygon codes; code 400 for the stippled area, code 401 for the area filled with the pattern of parallel lines. The short leader to the Psc label near the lower left corner of the diagram will be drawn as a leader when digitizing the Psc label.

The computer asks for three pieces of information about each graphical entity that will be digitized. The first is for a code, the second is for PARA1 (parameter 1), the third is for PARA2 (parameter 2). There is a systematic description of these three in the *documentation. The use of code, PARA1, and PARA2 is different for different kinds of graphical entities. Specifying a code requires entry of a string of three numbers; if there are less than three numbers in the code, the code string is ended using the **A** key; Parameter 1 requires 6 numbers or a shorter string ended by the **A** key, or the **A** key alone (enters 0); Parameter 2 likewise requires 6 numbers, a shorter string ended by **A**, or the **A** key alone (enters 0).

For lines, the code can be any number 1-99. PARA1 and PARA2 are 0; these two parameters are included for lines only because it's easier to use three parameters for all codes than to remember different numbers of parameters for different codes.

When entering the code, PARA1 or PARA2, for lines from the keypad, use the numbered keys, then use the **A** key to end a string to complete entry of each of the three. Numbers are entered in sequence from left to right, followed by the **A**.

Now go back to the keypad and enter **10A**. A tone will sound (Concert C) indicating completion of the entry of CODE(1); next enter **A**; a (one will sound (concert F) indicating completion of entry of PARA1; then enter **A**; Concert A will sound, indicating that digitizing of points can begin. These three tones rising in pitch provide auditory proof that the computer is ready for the next entry. The lowest line on the screen will show the values that have been entered, and as digitizing proceeds will show the number of the line entered, the code, the value of PARA1, PARA2, and the number of points entered.

The **E** key

If you make a misteake at any time between starting entry of the code and closing the string of points defining the line, press the **E** key and you will ESCAPE back to the point of starting entry of the code. The entries made between these points will not be recorded in the database.

Digitizing lines (codes 1-99)

The **0** (zero) key, **1** (one) key, and **4** (four) key.

You have entered the code, PARA1 and PARA2, keystrokes **10A**, **A**, and **A**. It's time to put points on the board.

When digitizing data points, the keys on the keypad of the cursor have specific functions. Striking the **0**(zero) key sends a pair of coordinates (X,Y) from the digitizer to the computer. This key is generally used for points on a line from the first to the next-to-last. The last point is digitized with the **1** (one) key. Points where lines join are best digitized with the **4** (four) key to get precise matching of points on both lines. Let's call these points of junction **nodes**. The program creates a file to keep track of the points you digitize as nodes. The file created by this exercise is named SPECIAL.NOD. The first time (but not subsequent times) that the **0** key is used for each line, that point goes into the node file as well as into the data base. When the **1** (one key) is used to end a line, that point goes into the node file. Each time that the **4** (four key) is used it sends that point to the data base and also to the node file.

The bottom line of the screen should now show code 10, PARA1 0, PARA2 0. Let's digitize the top line of the rectangular box first. Take a careful look at it before starting. There are seven places where lines intersect the top side; there are none on the right, six intersections on the bottom, and three on the left.

The computer is ready for input of data points. Move the cursor to the upper left corner, position the crosshair precisely at this point, press the **0** key (a tone will sound; then move the cursor along the line (move to the right) to the first intersection with a line (the fold axis) press the **4** key (a tone will sound), move to the next 6 intersections along the ine. At each press the **4** key (listen for the tones). At the corner (upper right) press the **1** key. A high pitched tone will sound. This tone indicates that the system is ready for you to enter the code for another line.

Look at the bottom line on the screen. It will show code, PARA1, PARA2 and the total number of points for the line that that you digitized. The line is now drawn on the screen. Success!

The **D** key

The computer is ready for entry of code, PARA1, and PARA2 for the next line.

At this point, if you choose, you can use the **D** ("duplicate" key to set the code, PARA1 and PARA2 to the values of the preceding entry with a single keystroke. Try the **D** key. A rapid sequence of three tones will sound. The final tone (Concert A) indicates that the computer is ready to record data points.

Digitize the line forming the right side of the box. At the upper right corner press the **0** key, move to the lower right corner, press the **1** key. The high pitched tone will indicate that you've finished digitizing this line. The newly digitized line will be drawn on the screen.

Use the **D** key to enter code, PARA1 and PARA2 (10,0,0), and digitize the lower line of the box. Start at the lower right corner using the **0** key, move left along the lower line to each of the intersections and press the **4** key at each. Move to the lower left corner, position the cursor and press the **1** key. Use the **D** key to enter code, PARA1 and PARA2. Start digitizing data points at the lower left corner of the box with the **0** key, move up the left side of the box to each of the intersections and press the **4** key at each. Move then to the upper left corner and press the **1** key. This last line completes the box.

The stroke of the **1** key that ends a line tells the computer to record all of the data points in the data base, to add the nodes to the node file, to draw the line on the screen, and to sound the high pitched tone to tell you that the computer is ready for entry of code, PARA1, and PARA2 for another line. A mighty stroke. Four at one blow. Now you can see the box on the screen. If the lines look broken, remember that the resolution of the screen isn't very high. When the line moves from one set of pixels to another it seems to jump abruptly. It won't jump like this when plotted.

Through-going lines with nodes should be digitized first, then the lines connecting to them.

Let's digitize the solid line thrust next. As it is a different kind of line, we need to use a different code. Let's enter code 8 (enter by pressing **8A** on the keypad), PARA1 of 0 (press **A** on the keypad), PARA 2 of 0 (press the **A** key) and listen as the three tones rising in pitch are sounded by the computer. The last, (concert A) indicates that data points can be entered.

Start with the **0** (zero) key at the point where the thrust line ends on the north side of the rectangular box, then precisely follow the line with the cross hair of the cursor , and press the **0** key at frequent intervals. Pretend that this is the kids game of "connect-the-dots" and put in enough points that straight line segments connecting the points will produce a close approximation of the curved line. Watch for the intersection of the solid line thrust with the dashed line thrust and use the **4** key at this intersection. Continue down along the solid line thrust and put points in with the **0** (zero) key until you have put in the next to last point. When you reach the end of the line, press the **1** (one) key. The high pitched tone will sound. The line just digitized will be drawn on the screen and added to the data base.

Let's talk a little about what the computer did when you digitized the node points on the thrust. Yes, points, plural, not

singular, three to be precise: the first point digitized with the **0** key, the node point digitized with the **4** key, and the last point, digitized with the **1** key. At each of these points digitized as nodes the computer read through the node file to see if a node had already been digitized closer than the snap distance that you set 0.03 at the beginning of the digitizing session. A node point closer to a node than the snap distance, in this case 0.03 inches) will be moved to the exact coordinates of the node. That's really what you wanted wasn't it ? You wanted the points to match mathematically, but somehow the node on the thrust might have been off by a thousandth of an inch. You've been working too hard. The computer will only "move" node points, and then only if a node has been previously digitized at a distance less than the snap distance set at the beginning of the digitizing session. The data points digitized with the **0** key won't move. If you set the snap distance to 0 by hitting the return key instead of entering a number , node points won't be moved. Although you entered three node points when digitizing the thrust, only one new one was added to the node file SPECIAL.NOD. The coordinates of the nodes" on the ends of the lines matched the coordinates entered when you digitized the border of the map, because the computer matched them for you, so new nodes were added; the node digitized using the **4** key was added.

Now the system should be ready for you to digitize another line. Digitize one of the contacts in the upper left part of the map. Use code 1, PARA1 0, PARA2 0: You remember the key strokes, don't you ? **1,A** then **A**, then **A**, with the three ascending tones telling you the computer was listening to your instructions. Start digitizing data points on the line with the **0** key, digitize points with the **0** key, watch for intersections (set nodes at points of intersection along the line using the **4** key), and end the line with the **1** key. The high pitched tone will sound.

Follow the digitizing procedure you used for the previous lines, and digitize another of the contact lines. Remember to start at one end using the **0** key, follow the line entering points with the **0** key, put in intersections (nodes) with the **4** key and finish the line using the **1** key. Again, the closing of the string of points will be signaled by a high pitched tone.

Use of the **D** key will save keystrokes and time.

Finish digitizing the rest of the contacts; **D** key to set code=1, PARA1=0 and PARA 2=0. Use, the **0** key, **4** key, and **1** key to digitize data points as described above. You're already an expert ! *Guru status comes later.

Next enter code=4, PARA1=0, PARA2=0, keystrokes **4A**,**A**, **A**, and digitize the strike slip fault; you know which keys to use.

Next, enter code=11, PARA1=0, PARA2=0, keystrokes **11A**, **A**, **A**, and digitize a dike, following the solid line with a series of **0**'s and ending each line with the 1 key. The pattern of the line (solid) and the "decoration" (cross lines) will be specified during plotting. Digitize the dike just as if it as a thin solid

line, and forget about the decorations. Digitize the second dike, the **D** key will set code, PARA1 and PARA 2.

Now it's time to digitize the dashed line thrust fault. The thrust you've already digitized (code 8) was mapped with a solid line; a different code must be used so that the plotter will draw a dashed line. With a decoration (the triangular teeth) that plots only on one side of the line, the direction of digitizing is important. Please digitize the dashed thrust, keeping the teeth on the right side of the line (with respect to the direction of digitizing). Start at the top. Once again ignore the dashes and the teeth, digitize as you did the other lines, but use code 9. Enter code, PARA1, and PARA2 using keystrokes **9A**, **A**, **A**, and digitize with the **0**, and **1** keys (there are no intermediate nodes that require use of the **4** key.

Remember that dashes and teeth are plot characteristics. After digitizing,the screen will show lines, but not patterns or decorations.

Let's review the digitizing of a line.

The **0** zero key is used from the start until the next-to-last point, each time it is pressed, an X,Y coordinate pair is sent to the computer. Striking the **1** one key sends a pair of coordinates from the digitizer to the computer, and also tells the computer that a string of points has been completed, and re-sets the program to the point of entry of the code. The **4** four key is used to digitize a point on a line between the first and last points that you wish to be a node. The first and last points will always be entered as nodes.

Codes 600-699 are splined lines.

The function of this code group is like that of group 1-99 except that the computer will smooth the line plotted by computing up to as many as 5 times the number of points digitized using a cubic equation, spacing these points equally along the line, then connecting all of these points with straight line segments, Rather than playing connect-the-points-digitized like codes 1-99. A splined line will pass through all digitized points; the algorithm is house-broken.

Let's digitize the synclinal axis. Enter code=605, PARA1=0, PARA2=0 keystrokes (**5A**), **A**, **A**, and digitize the line. The pattern along this line will be set by the plotter later, so digitize it with a series of **0**'s, a **4** for the node, and a **11** to end the line. Remember to digitize it as if it were a solid line (not one dash at a time).

Don't digitize the leader in the southwest part of the map as a line. This will be digitized as a part of the label -- a bit later.

The 2 (two) key

The **2** key. A stroke of the **2** key records two points. Use it to complete outlines of closed polygons like the line that encloses the stippled area. One recorded point will be the point where the Cursor is positioned; the second will be the **first** point of the line. Pressing the **2** key will also close the string of points defining the line (listen for the high pitched tone). The five points generated by three **0**'s and one **2** outline a polygon with 4 sides. The last point will have X,Y coordinates identical to the first (the program copies the coordinates of the first point). The outline generated will close to mathematical precision.

Now let's digitize the outlines of the two areas filled with patterns. First specify code 400, keystrokes **400**; as there are three numbers, an **A** must not entered to complete entry of the code, then press **A**, then **A**, to enter PARA1=0 and PARA2=0. Then choose an identifiable point on the outline of the stippled area, press the 0 key, and follow the outline with a series of **0**'s, ignore the mine shaft symbol, digitize intersections with other lines **4** key, and at the next-to-last point on the line, a point near the initial point, press the **2** key. As you now know, this key will record a point and close the line by repeating the first point; it will also return the computer to the stage where the code for another line can be entered.

Enter **401**, **A**, **A**, to specify code=401, PARA1= 0, PARA2= 0, and digitize the outline of the area filled with the parallel line pattern. Use key strokes like you did for the preceeding polygon.

Individually rotatable symbols, specific codes 200-299 group

Now take a close look at the symbols that are used on the map. Certain symbols (e.g. dip & strike) must not only be plotted in the right place, but also must be drawn at a specific angle. Each of the individually rotatable symbols has it's own code, PARA1 is used to specify the angle of rotation (clockwise) from the **0°** position for that symbol; PARA2 is used for the angle that is to be posted for the three symbols that the program can post angles of dip or plunge: dip & strike, foliation, and lineation.

The strike and dip symbol near the lower left corner of the map is entered as Code=201, PARA1 = 345, PARA2 = 3. Dip & strike symbols are always code 201. The zero ° rotation for this symbol is for a N strike and an E dip. If the dip angle is 90°, the proper symbol will be drawn, and no angle will be posted. If the dip is 0°, the proper symbol will be drawn and no angle will be posted. Foliation symbols are specified by code 202. PARA1 specifies the rotation of the symbol, Rotation of 0 ° gives a north strike, an east dip; PARA2 is used for the dip angle to be posted. If a 90° angle is specified for the dip angle, the correct symbol will be drawn and no dip will be posted. The adit symbol is specified by code 206. PARA1 rotates it from its 0° position, an adit headed south. Enter **0** ("A") key for PARA2 for all individually rotatable symbols except for the three listed above for which angles can be posted.

Let's run through the entries required for three of the individually rotatable symbols on the map. First, let's digitize the strike & dip symbol near the left corner of the map. The key strokes needed to enter code, PARA1, and PARA2, are the following: **201**, **345A**, **3A**; during entry the now-familiar CFA tones will be heard. Then move the cursor to the precise position of the center of the symbol, and use the **1** (one) key to digitize the point. The high-pitched tone sounded will indicate that the computer is ready for entry of the code for the next entity.

Select the foliation symbol at the right edge of the map, enter code 202, PARA1 of 5, and PARA2 of 90 (keystrokes **201**, **5A**, **90A**). Move the cursor to the center of the symbol on the map and digitize the point with a the **1** key. Next digitize the left adit (code=206, PARA1= 10, PARA2=0; (keystrokes **206**, **10A**, **A**), then, with the cursor in proper position, use the **1** key to digitize the point. Finish digitizing the other symbols of these types. The paired arrows indicating the direction of offset on the strike slip fault require code =210; you figure the required rotation (PARA1; use the A key to enter **0** for PARA2. The symbol specifying the synclinal axis requires code=205, a value for PARA 1 to rotate the symbol from a N-S direction, you figure the required rotation, PARA2=0. Digitize with the **1** key.

More symbols, codes 300-399

The 300-399 code group is used for symbols that are not individually rotatable, but which must be drawn to a specified size. These symbols can be rotated in groups defined by code number. The code is entered as any other code would be, PARA1 is used for the symbol number, PARA2 is used to specify size (in units of 1/1000 inch). The prospect symbol is symbol number 12, the mine symbol, number 13, the mine shaft symbol, number 14. 300-99 code group symbols can either be digitized individually (using the **1** key, or in groups using the **0** key, if a number of symbols with the same code, symbol number, and symbol size are needed; the final symbol in the group is digitized with the **1** key. Let us suggest the key strokes that might be used to digitize the symbols on Figure 1; let's use code 300 for all of them. Enter **300, 14A 100A**; move the cursor to bring the cross hair to precisely the center of the lower mine shaft symbol, press the **1** key. The high-pitched tone will sound, and a point will appear on the screen indicating the position digitized. Next, press the **D** key, the three tones (CFA) will sound and the screen will show code=300, PARA1=14, PARA2=100. Move the cursor to the other mine shaft symbol, press the **1** key. The high pitched tone will sound, the screen will show the point, and the computer will be ready for entry of a code.

Digitize the prospect symbols next. Use the key strokes **300, 12A, 80** to enter code=300, PARA1=, PARA2=80 (a size of 80 (80/1000 inch, then move the cursor to the center of one of the prospect symbols, press the **0** key; move to the other prospect symbols in turn, digitize all but the last by pressing the **0** key. Digitize the last using the **1** key (to end the entry).

Next digitize the mine symbols, using code=300, PARA1=13 and PARA2=0. Digitize individually using the **1** key, then the **D** key to set code, PARA1, and PARA2, or as a group using the **0** key except for the last symbol; use the **1** key.

The principal difference in digitizing symbols as a group or individually, is in editing. Symbols digitized individually can be deleted individually. Symbols digitized as a group can only be deleted as a group.

```
(DRAW.RU)

1,"@m",
"EOT"
2,"&sc",
"EOT"
3,"\s",
"EOT"
4,"Xgn",
"EOT"
5,"Ti",
"EOT"
6,"LAST CHANCE",
"   LODE",
"EOT"
```

The information in the listing to the left under the name of the file (DRAW.RU) is from the ASCII file needed when Figure 1 is plotted. It contains information you will need to complete the digitizing of this figure. This file is included on the release disk you copied to make the exercise disk.

Codes 500-599 draw information from an ASCII file using an index number as PARA1. Check the listing carefully, and some resemblance will be seen to the lettering on Figure 1.

Let's look at the line starting with 4, and the line immediately below this line, to see what this strange list means.

The number 4 will be used as PARA1 for an entry code=500 (could be any code 500-599); the letters that will be plotted are the ones between the quotation marks Xgn; these letters make up one of the rock unit labels on the figure. The "EOT" (always upper case letters, please, stands for END OF TEXT and is used to end the lines that will be plotted for an entry (code 500-599 when PARA=4.

Let's look at the line starting with 6, and at the two lines below it. If PARA1=6 is entered, these two lines will be plotted (see figure 1 for how it looks. The "following "EOT" line ends this two line text entry. They will be digitized and plotted together!

Let's digitize the alphanumeric data, and then discuss the punctuation of the ASCII file, and some of the characters that plot differently than they appear in the file.

Please use code 500 for all of the rock unit labels. PARA1 will be entered to match the number of the entry in the file DRAW.RU needed on the figure. PARA2 specifies the height of the letters needed in units of 1/1000 inch).

Digitizing for symbols without leaders is done by moving the cursor to the precise position where the lower left corner of the block of text should be plotted; in the case of the Xgn, the lower left corner of the X; let's run through the key strokes needed to place one of these Xgn labels; code=500, PARA1=4, PARA2=80; in sequence keystrokes **500 4A 80A**; then digitize the entry by moving the cursor to the lower left corner of the X and

pressing the **1** key. Use code=501 code for the entry of the LAST CHANCE LODE block of text. The key strokes would be **501**, **6A**, **80A**, then the position of the text is digitized by pressing the **1** key after the cursor had been precisely positioned at the lower left corner of the L in LEFT; both lines of text will be positioned from this single point. Separate entry of the word "LODE" would require a different ASCII file entry.

Specification of certain infrequently used characters in the ASCII file causes plotting of some of the geologic characters not found on any keyboard. Some of these are used on Figure 1.

ASCII FILE	Symbol plotted
\	Cambrian C
&	Pennsylvanian P
@	Triassic TR
{	o superscript degree symbol
}	" superscript second symbol

You can't use the quotation mark to specify seconds in the ASCII file because it is a delimiter in BASIC, the language used in writing this program.

Now you can read DRAW.RU and decipher its arcane symbols.

Please resume digitizing, use code=500, PARA1 to match the number in the DRAW.RU file for the entry you want to digitize, and PARA2=80 (letters 80/1000" high), and digitize the remaining rock unit labels except the Psc label that has a leader). Use the **1** key.

Digitizing a label with a leader is done slightly differently.

As usual, speecify code, PARA1, PARA2 (for this label keystrokes **500**, **2**, **80** to set code=500, PARA1=2, PARA2=80.

The label Psc is digitized by moving the cursor to the lower left corner of the P, and then pressing the **0**; then the leader is digitized by moving the cursor to one end of the leader, pressing the **0** key, moving the cursor to the other end of the leader and pressing the **1** key to end both the leader and the entry. A line will be drawn between the last two points. The leader is a part of the digitized label, as it should be. Multiple leaders can be digitized (see *documentation.

If a label with a leader is deleted, the leader is also deleted.

Proper entries using codes 500-599 always have odd numbers of points. If entries using these codes have even numbers of points expect big trouble. Lines will be plot that you didn't digitize and don't expect.

The 100-199 code group is used for symbols that are to be posted with values drawn from a table. Examples would include sample localities for which chemical values might be of interest.

An ASCII table in proper format would look like this one, named DRAW.SAM, and used for this exercise.

```
410, 50, 10, 100, 200  | Each row has sample number, Cu, Mo, Pb, Zn values
411, 15,  2,  20, 200  |
414, 30, 50, 150, 200  |
416, 70, 10, 300, 500  |

#    CU  MO   PB   ZN   | Notes can be added to the end of the file so that
GEOCHEMISTRY FOR DRAW   | you can remember what it represents
EXERCISE
```

Symbols with posting of 410, 411, and 414 to the right of the symbol should be digitized in this exercise using code 101. The locality identification number is entered as PARA1. Enter PARA1=0 for each of these points. The function of PARA2 is discussed in the documentation. It can be used as an "angle" to place the posting into different positions.

The keystrokes for code, PARA1 and PARA2 for the uppermost sample locality are **101, 410A, A** to enter code=101, PARA1=410, PARA2=0. Then digitize the center point of the symbol using the **1** key. The other points (posted 411, and 414) should be digitized similarly.

The digitizing of Figure 1. is now complete!

ENDING A DIGITIZING SESSION

Enter a CODE of **999** to return to the Main Menu

Let's chat about some of the details of the procedures that you so obediently followed. Although lines can be digitized in any sequence, using any code 1-99, the best use of the node file suggests that through-going lines with many nodes be digitized first. We did the box first because we didn't want these nodes to move from the position we digitized them; moving points would be easily noticed in these straight lines. We did the solid line thrust next for the same reason. A minute shift in position of the end of the dashed line thrust will escape detection. Nodes are set only by entries with codes in groups 1-99, 400-499, and 600-699.

Codes in the 600-699 group are well used for lines like the fold axis on this drawing. After all, it's hard to find the precise trace of an axial surface in the field.

It's good practice to use different codes for entries with different functions. One code could have been used for the box and for contacts, one for rock unit labels and for the name of the mine. Using separate codes increases flexibility in plotting. This way its easy to plot the mine name in red, or to plot just the rock unit labels, or just the mine name, or to plot a heavy line for the box.

Careful placement of nodes pays off in a finished appearance for digitized maps, and is essential if the digitized data is to be transmitted to other systems for structuring (building of areas (polygons) by combining lines. It requires no additional time, just alertness.

Now let's plot the results.

Load a piece of paper in the plotter. Put a fine black pen in position 1, a fine red pen in position 2, a fine blue pen in position 3, and a coarse black pen in position 5 (these positions correspond to choices made when creating the plot file (DRAW.PLT) which we will use.

Enter 9 (from the keyboard of the computer to choose Option 9 from the Main Menu.

G S D R A W

CURRENT DATA BASE: SPECIAL
MAP TITLE: EXERCISE

1 - START A NEW DATA BASE
2 - OPEN AN EXISTING DATA BASE
3 - DIGITIZE NEW LINE SEGMENTS
4 - DELETE LINE SEGMENT
5 - RECOVER LINE SEGMENT
6 - CHANGE PARAMETERS FOR LINE SEGMENT
7 - LIST CONTENTS OF DATA BASE
8 - PLOT ON THE SCREEN
9 - PLOT ON THE HARD COPY PLOTTER
10 - MERGE ANOTHER DATA SET INTO CURRENT DATA SET
11 - COMPUTE POLYGONAL AREA
12 - EXIT

ENTER CHOICE BY NUMBER: 9

After entering **9** the screen will clear, and you will be reminded that the plotter must be ready. You did turn the plotter on, didn't you ? and load it with paper !

This warning message will be displayed on the screen.

PLOTTER SHOULD BE TURNED ON AND PAPER LOADED!!!!!!

You don't need to respond to this warning (just check to see that the plotter is ready. If it isn't and you go too far into the plot sequence, you may have to re-boot the system, or use ^C to go back to the DOS prompt.

Respond to the next prompt:

DO YOU WANT TO USE THE ONLINE PLOTTER (Y/N):

Enter **Y**. A "N" will send the plotter instructions to a file, but that's for special purposes, not for now. After you enter **Y** the next prompt will be displayed:

DO YOU WANT TO USE A BATCH COMMAND FILE (Y/N)

Enter **Y** for this first plot. A **N** requires answering a lot of questions; do that later. Take advantage of the batch command (plot) file on the disk.

The next prompt will ask for the name of the plot file:

ENTER BATCH COMMAND FILENAME:

Enter **DRAW.PLT** Now the plotter will go to work. Watch the screen, watch the plotter, or drink a cup of coffee. But don't go too far. In a few minutes, prompts will appear that require entries from you.

To finish off a plotting sequence, four prompts will require entries from the keyboard. The first prompt provides the opportunity to replot a single entry. This lets you draw a map, one line at a time. This is useful in editing a complex map, but not needed now.

REPLOT SINGLE ENTRY (Y/N): Enter **N**

The second prompt provides opportunity to plot corner braces to show where the corners of the data base (or plot file) are located.

DO YOU WANT TO DRAW CORNER BRACES? (Y/N) Enter **N**

The third prompt provides opportunity to draw tick marks on a regular grid (with spacing that you specify in inches) inside the drawing, a capability that may be useful in plots used for editing or merging of data bases.

The fourth prompt lets you plot the node points, a capability that may be useful in editing. Answer **N**

The default answer (provided by hitting the ENTER KEY) to these four prompts is **N**.

Entry of an answer to the fourth of these prompts (plot nodes) returns operation to the main Menu.

Try out some of the options on the Main Menu to see how they work. (see description in *Documentation), or just follow the prompts on screen. DO NOT ask for printouts (on the printer) unless the Printer is **On**. You are free to do as you like, far be it from us to dictate, but do so knowing that requests for printouts without a printer ready to go may cause the system to take time out, and may require re-booting the computer. YOU WERE WARNED !

If you want to learn more about plotting enter 9 and make another plot, but this time do it interactively. The print below is similar to the DRAW.PLT file,with annotations. Its contents provide the replies for the screen prompts in interactive plotting.

To specify an interactive plot, enter **N** to the prompt asking if you wish to use a BATCH COMMAND FILE.

```
PLOT FILE                          |  Comments added here
                                   |
Y                                  | yes, use the data base corners as plot corners
1,1                                | Xscale,Yscale
0.3,2.2                            | Xoffset,Yoffset
N                                  | draft mode No
Y                                  | rotate Yes
12,2                               | speed,force
0.1,0.15                           | X,Y size of posting in inches
10,1,0,0,  "box outline"           | code 10, Pen 1, line type 0 Solid), 0 no symbol,
1,1,0,0,  "contacts"               | code 1, Pen 1, line type 0 (solid), 0 no symbol,
4,5,3,0,  "heavy black lines"      | code 4, Pen 5, line type 3 (dashed, 0 no symbol,
605,1,9,0,  "long dashed lines"    | code 605, Pen 1, line type 9 (long dashes),0  no symbol,
8,1,99,102,"triangles on thrusts"  | code 8, pen 1, line type 99 symbols only, symbol 102,
0.2                                | spacing of .2"
9,1,99,102, "triangles on thrusts" | code 9, pen 1, line type 99 symbols only, symbol 102,
0.18                               | spacing of .2"
8,5,0,0,  "heavy lines on thrusts" | code 8, pen 5, line type 0 (solid), 0 no symbol,
9,5,3,0, "strike slip fault"       | code 9, pen 5, line type 3 (dashed) no symbol,
11,2,0,101,  "dikes"               | code 11, pen 2, line type 0 (solid), symbol 101,
0.1                                | spacing of 0.1 inch
201,1,0,0,                         | code 201 dip and strike, pen 1, line type 0, 0,
202,1,0,0,                         | code 202 foliation, pen 1, line type 0, 0,
205,1,0,0,                         | code 205 syncline, pen 1, line type 0, 0,
206,1,0,0,                         | code 206, adit, pen 1, line type 0, 0
210,1,0,0,                         | code 210, right lateral symbol, pen 1, line type 0, 0,
500,1,0,0,  "text"                 | code 500 (text), pen 1, vertical letters, horizontal words,
DRAW.RU                            | name of text file (DRAW.RU)
501,1,0,0, "text"                  | code 501 (text), pen 1, vertical letters, horizontal words,
DRAW.RU                            | name of text file (DRAW.RU)
300,1,0,0,  "symbols"              | code 300 (symbols), pen 1, line type 0, rotate 0°,
N                                  | don't randomize orientations of symbols
400,2,1,0, "stipple"               | code 400, pen 2 , line type 1 (dotted), 0 no symbol,
1,.03,0                            | fill type 1, line spacing .03", 0 horizontal
400,1,0,0, "outline of red stipple"|code 400, pen 1, line type 0 (solid), 0 no symbol,
0,0,0                              | fill type 0 (outline only, 0
401,3,0,0, "blue lined area"       | code 401, pen 3, line type 0, 0 no symbol,
1,0.05,-45                         | fill type 1, spacing .05", slant at -45°
301,1,0,0, "corner pts             | code 301, pen 1, line type 0, 0 no symbol
N                                  | don't randomize orientation
101,1,39,40, "locality pts"        | code 101, pen 1, symbol #39, size 40/1,000",
DRAW.SAM                           | name of data file for 101 code
0,0,0,0, "END OF FILE"             | END OF PLOT FILE
```

Consult the *documentation for the details about what these answers mean.

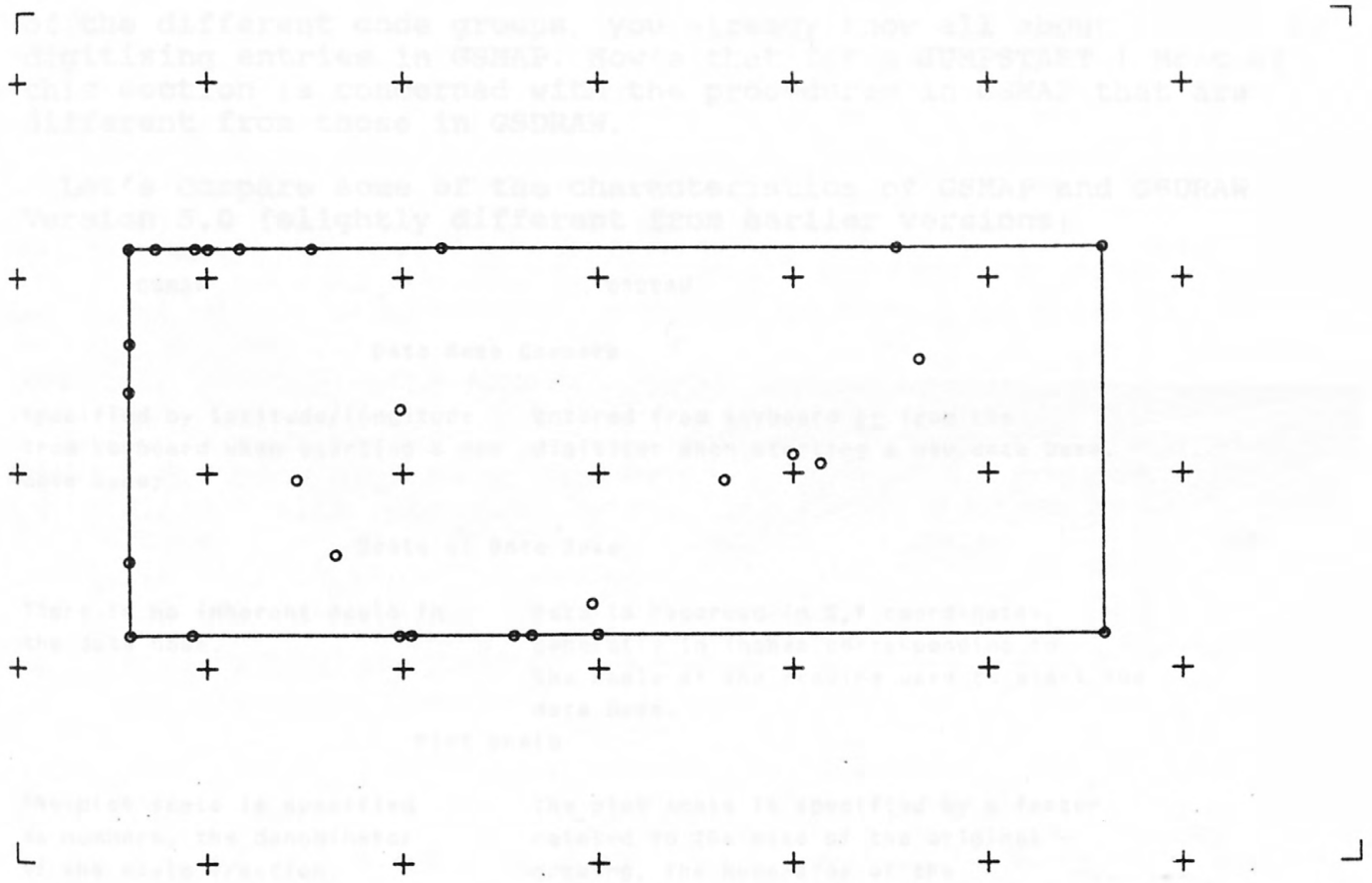


Figure 12._ Corners, nodes and 1" grid ticks produced by answering Yes to the four prompts following plotting using the plot file, compare, Fig. 11.

Digitizing in GSMAP is the same as Digitizing in GSDRAW. If you digitized Figure 1 and understand its constructs and the uses of the different code groups, you already know all about digitizing entries in GSMAP. How's that for a JUMPSTART ! Most of this section is concerned with the procedures in GSMAP that are different from those in GSDRAW.

Let's compare some of the characteristics of GSMAP and GSDRAW Version 5.0 (slightly different from earlier versions)

GSMAP	GSDRAW
Data Base Corners	
Specified by latitude/longitude from keyboard when starting a new data base;	Entered from keyboard or from the digitizer when starting a new data base.
Scale of Data Base	
There is no inherent scale in the data base.	Data is recorded in X,Y coordinates, generally in inches corresponding to the scale of the drawing used to start the data base.
Plot scale	
The plot scale is specified as numbers, the denominator of the scale fraction. eg. 1:24000 scale is specified as 24000	The plot scale is specified by a factor related to the size of the original drawing, the numerator of the scale fraction. eg. a 1:2 plot (half size) is specified as a scale of 0.5
Plot areas	
Corners are specified by latitude/longitude coordinates, or data base corners may be used.	Corners of plot area are those of the data base, or may be set from the digitizer using when using " on - screen windows, see *documentation, or may may be specified by coordinates specified in the X,Y system of the drawing.
Plotted size of symbols and text (300-399 & 500-599) codes	
Independent of plot scale.	Size automatically changed as a function of the scale in X, independent of SCALE in Y.

GSDRAW records data in X,Y coordinates, scaling the X,Y values in inches sent to the computer by the digitizer to the coordinates of the data base corners. Digitizing into a single data base can be done from drawings at different scales so long as the geometry of the data base corners is identical.

GSMAP records data in Latitude/Longitude coordinates. Use of map projection routines computed to "double precision" means that digitizing can be done from maps using most of the common map projections, data from different maps using different projections and at different scales can be directly combined , and maps can be drawn on any of the supported projections (see *documentation for list), at any scale within the limitations of legibility and plotter size.

Like GSDRAW, GSMAP requires that CONFIG.DIG, CONFIG.SCR, and CONFIG.PLT be available on the default drive. The program file GSMAP.EXE is also required. In addition GSMAP requires a PROJECTION file (also called a projection parameter file). This is an ASCII file that tells the computer which projection to use and provides data to the computer needed for calculations.

MAP PROJECTIONS

GSMAP has forced many users to reacquaint themselves with map projections, a topic covered to some degree in dimly remembered classes. From a practical standpoint, digitizing from a base map and plotting to make precise overlays for base maps usually aren't very complicated. One reference is very important. USGS Professional Paper 1395, by J. P. Snyder, 1987 contains answers to the questions you should have. Information on the map projection is almost always printed near the lower left corner of the map. On 1^{o} x 2^{o} degree maps, The projection is given under the bar scale. Look for magic words, Lambert Conformal Conic, Polyconic, Transverse Mercator, Albers Equal Area, (and such) on map borders.

For work with 7 1/2 and 15 minute quadrangles, a quote from Snyder, 1982 p. 127 may provide needed perspective ".... the discrepancy between measurements of diagonals on two maps of the same quadrangle, one using the Transverse Mercator or Lambert Conformal Conic projection and the other using the Polyconic, can reach about 0.05 mm." This distance, .0196" is about a half-line width for contact-weight lines (.003 to .005 inch. Read all of p. 127, as .05 mm constitutes a worst case. 7 1/2' and 15' quadrangles thus can be digitized using the correct UTM, LCC, or Polyconic projection files. The Polyconic projection of GSMAP 5.0 is generally recommended for 7 1/2 and 15 minute quadrangles.

We'll assume that you are game for a small exercise using GSMAP. In it we will use the UTM projection. The required projection file is named MAP.PRJ and is included on the GSMAP disk.

If you didn't have it, you could quickly write it using an ASCII word processing program or EDLIN, a program you never use that probably came along with your computer.

The projection file required by GSMAP Version 5.0 for this exercise is printed below with comments to show what each line means.

MAP.PRJ	Comments
1	1 designates Universal Transverse Mercator.
6378.2064	Equatorial radius in km, Clarke 1866.
6356.5838	Polar radius in km. Clarke 1866.
105,0,0,W	Longitude, Principal Meridian of UTM Zone for the map in this exercise.
0.9996	Scale factor used for the UTM projection.

Figure 11 has been set up so that the + symbols outside the corners of the rectangle can be used as the corners for a GSMAP exercise.

The coordinates below will enable opening of a data base and digitizing into that data base using the MAP.PRJ projection file. These coordinates are in the proper format for data entry: first Latitude, then Longitude, in Degrees, Minutes, Seconds, each followed by a single character providing the compass direction. In the conterminous 48 states, latitudes are always North=**N**, longitudes are always West=**W**.

Northwest corner 38,15,0,0,N,106,0,0,W
Southwest corner 38,0,0,N,106,0,0,W
Southeast corner 38,0,0,N,105,30,0,W
Northeast corner 38,15,0,N,105,30,0,W

Now Enter **GSMAP**

A *disclaimer screen will appear. Under the disclaimer text, four now familiar lines of text will be displayed.

1 - Start a new data base
2 - Open an existing data base
3 - Exit
Enter choice:

You must first activate a data base, Option 1 or 2, either by starting a new data base, or by opening an existing data base. In this case let's create a new data base with the coordinates supplied above.

Enter **1**

The screen will clear and a series of prompts will appear. The first two (request entry of a map data base name and a title for the map. These entries are exactly the same as in GSDRAW. Follow directions (The names used in this exercise are shown in BOLD print below.

ENTER MAP DATA BASE NAME: **MAP**
ENTER TITLE OF MAP: **EXERCISE**

After these two entries have been made, an on-screen message, with prompt below will be displayed: See *documentation for details.

Choose map type 5 by entering **5**

The next four prompts ask for entry of the Latitude,Longitude coordinates of the four corners of the map.
Follow the prompts. Their meaning should be clear. The

Latitude/Longitude, and Compass direction for each corner is entered in turn in response to the screen prompts; for each corner, latitude first, longitude second; both in degrees, minutes, and seconds (and decimal seconds), then the Compass direction, separated by commas, as shown. The coordinates shown are those for the GSMAP exercise, using Figure 1.

```
ENTER LAT/LON OF NORTHWEST CORNER
DD,MM,SS,C,DDD,MM,SS,C:          38,15,0,N,106,0,0,W
ENTER LAT/LON OF SOUTHWEST CORNER
DD,MM,SS,C,DDD,MM,SS,C:          38,0,0,106,0,0
ENTER LAT/LON OF SOUTHEAST CORNER
DD,MM,SS,C,DDD,MM,SS,C:          38,0,0,105,30,0
ENTER LAT/LON OF NORTHEAST CORNER
DD,MM,SS,C,DDD,MM,SS,C:          38,15,0,105, 30,0
```

After the coordinates of the NORTHEAST corner are entered, the screen will return to the Main Menu. The name and title of the data base will be displayed.

The concept of compass direction is old hat, Just remember that latitudes north of the equator are north=**N** latitudes, longitudes for 180 degrees west of GRENWICH are west=**W** longitudes. Go east or too far west, latitudes are east=**E** latitudes. A long time ago a great Wizard thought that this was a better idea than falling off the edge of a flat earth.

```
   G  S  M  A  P

                                        CURRENT DATA BASE: MAP
                                               MAP TITLE: EXERCISE

  1  -  START A NEW DATA BASE
  2  -  OPEN AN EXISTING DATA BASE
  3  -  DIGITIZE NEW LINE SEGMENTS
  4  -  DELETE LINE SEGMENT
  5  -  RECOVER LINE SEGMENT
  6  -  CHANGE PARAMETERS FOR LINE SEGMENT
  7  -  LIST CONTENTS OF DATA BASE
  8  -  PLOT ON THE SCREEN
  9  -  PLOT ON THE HARD COPY PLOTTER
 10  -  MERGE ANOTHER DATA BASE
 11  -  COMPUTE POLYGONAL AREA
 12  -  EXIT
                                    ENTER CHOICE BY NUMBER:
```

Enter **3** to select option 3. Let's examine the differences in starting a digitizing session in GSMAP from starting digitizing in GSDRAW.

After entry of **3**, the screen will clear and a different prompt will appear:

ENTER FILENAME OF PROJECTION PARAMETERS:

ENTER **MAP.PRJ** This entry of the complete name of the projection file is the reason it must be ready ahead of starting any real work with GSMAP. In real life, be very careful to match the projection specified by the projection file with the projection of the hard copy being digitized.

The next set of prompts will be almost the same as those for GSDRAW ! The differences are only in the naming of the corners.

ENTER SNAP DISTANCE:

Enter **.03**

You know now all about *snap distance. .03 inches is a good value to use most of the time; it does the job, and creates few problems for most maps. After entry the prompt will ask if you want previous data to be displayed:

DISPLAY PREVIOUS DATA? (Y/N):

After this entry (enter **N** from the keyboard, the next entries are made from the keypad of the digitizer cursor. Use the 0 key, as specified in the prompts.

ENTER 0(ZERO) KEY ON CURSOR KEYPAD TO SYNCHRONIZE DIGITIZER INPUT
ENTER NORTHWEST CORNER ON DIGITIZER
ENTER SOUTHWEST CORNER ON DIGITIZER
ENTER SOUTHEAST CORNER OF DIGITIZER
ENTER NORTHEAST CORNER ON DIGITIZER

Make these entries in the same way you did in opening the GSDRAW digitizing session (see directions provided earlier, if there are any uncertainties). Remember that the cursor can be located anywhere within the active area of the digitizer board for synchronization, but must be **precisely** located when entering the corners.

Digitizing in GSMAP is the same as in GSDRAW. The same code groups are used, their functions are identical,PARA1, and PARA2, have the same meanings, the keys on the digitizer have the same uses, and entry of a code of 999 ends a digitizing session.

If you are so inclined, you could digitize Figure 1 again,but isn't once more than enough ?

With your experience with GSDRAW and GSMAP, you're an expert. Our bet is that you can comprehend the *documentation, and follow on-screen prompts. Let's not waste time with more step-by-step-by-step stuff. The GSMAP exercise is over. We'd like to add comments based on experience.

Real maps

Green line mylar maps are always right. ?? **RIGHT** !! Note that many of the green line map bases that we use have been made by splicing a number of quadrangle maps together. The match with a GSMAP plot, or the validity of digitizing will depend on the precision of the splicing. Each piece can be digitized, but the composite may not all fit. Check **before** digitizing.

Check the fit of overlays starting with the corner points. Do this first, before digitizing, and before plotting an entire map. You can be sure that if the corners don't match, the rest of the map won't either.

An easy way to check is to make up the proper projection file, and a plot file with corners specifying the corners of the base that will be used in digitizing and which must be matched (later) in plotting. Remember that the corners plotted in GSMAP are those specified in the plot file, not those of the data base, unless you want them to be. Any data base can be used for a test plot. All you need is a plot file with the proper corners and at the proper scale. No CODES need be plotted; a 0,0,0,0, to end the file will suffice, the corners can be plotted (Yes, plot the corner braces), and geodetic tick marks at an appropriate spacing. These index marks can be compared with those on the base map. If there is a problem don't go farther, until the source of the problem can be identified. Some problems might be, use of an inappropriate projection file, the wrong corners on the plot file, mis-identification of latitude/longitude marks on the base, mismatch of scale of map and plot. Later, the data base used for digitizing should be checked by digitizing some of the points on the map with known latitude and longitude. A printout of the coordinates of some of these points will either inspire confidence or mandate a new start.

Mark the corners to be used in digitizing, make them easy to find and easy to reoccupy with the cursor on the digitizer. A shallow cross cut into a mylar sheet with a knife blade leaves no room for doubt as to the location of the data base corner.

Two sets of latitude/longitude corners on the same map ? There are notes on many recent 7 1/2 minute quadrangle maps that should be read. For example "Polyconic projection 1927 North American datum" "To place on the predicted North American Datum 1983 move the projection lines 7 meters north and 51 meters east as shown by dashed corner ticks". Which to use ? The corners of the map that's contoured have latitude/longitudes using the 1927 datum. Stick with the 1927 datum, at least for the present.

Steps in planning a GSMAP project.

Start by visualizing the final product. What must be shown, how many overlays must be generated to accommodate publication needs for the separate printing negatives needed for screening, color, lines, symbols, lettering, and so on. Digitizing from copy at final map scale will simplify decisions on letter and symbol size, and assist in making a final product that is aesthetically pleasing as well as accurate. 1:1 digitizing and plotting usually requires use of a magnifier during digitizing. To us this is a small price to pay to simplify thinking and checking of plots against original materials.

1. Identify the base map projection and scale, and find and mark the latitude/longitude corners that will be used in digitizing. Look carefully for joins between pieces of the base; check to see if these will be a problem, perhaps even a problem requiring digitizing and plotting in pieces.

2. Work from stable base copy if at all possible. If not, find an environment that won't change during digitizing. Changes in humidity are worse than changes in temperature in causing changes in the scale of paper copy. GSMAP accommodates changes in scale but requires indexing of the data base corners to the digitizer board. GSMAP does not accommodate changes in scale, or movement of the hard copy on the digitizer board during a digitizing session. If there has been a change of humidity, close the data base and open it again. Then index the copy on the digitizer board. If precious lines are only on rain-spotted field sheets, and the scale is in doubt, index digitizing to a greenline overlay, and adjust small areas of the paper copy to fit - just as you would do if you were making a copy in ink - and move the paper, not the mylar, as needed. Make each area fit, one at a time. There is no "fix" for digitizing done using an improperly indexed hard copy.

3. Make up the projection file needed for digitizing and plotting.

4. Now, start to plan the codes that will be used for digitizing the map. This is a good time to start making an annotated plot file. Print a copy for use during digitizing. You will need a record of the codes you used and the purpose for each. Why not kill two birds with the same file ? A printed copy of this file will be useful during digitizing to help keep codes consistent.

5. Make up and print the file containing text entries for the 500-599 code entries that will be used --- the labels for rock units, and other text belonging to the map. The printed copy will provide a ready reference during digitizing.

6. Start a GSMAP data base with corners that match the corners to be used in digitizing; then digitize a few points on the map; start with points that have known latitude and longitude. Use a code unlikely to be used later, like 399, then print out the latitude and longitude and compare these with the coordinates on the map.

7. Plot the corners and digitized internal reference points using stable film, add geodetic tick marks at suitable intervals, and compare with the base.

Planning codes for digitizing.

How much standardization of codes is necessary ? The ability to edit and change means that you aren't stuck with an early unwise decision. We suggest that what happens between a consenting adult and *his Personal Computer is between them and their software.

Suggestions offered here may be useful to start, but should not be misconstrued as legislating requirements. It seems to us that the consistency of use of codes during digitizing for each project is of primary importance. Enough code groups must be used to provide easy separation of elements during plotting. The suggestions of particular numbers for particular kinds of elements given below are intended more to indicate the kind of elements that require separate codes than to specify a code for each. We can't remember these either !

Make fully annotated plot files so that the codes used for all digital data can be understood by another user, and so that you can remember what you did, after the lapse of a few hours has obliterated short term recollection of details (most of us have memories with a short half-life).

If a number of different maps are to be digitized, sticking with one set of codes throughout will simplify digitizing and plotting - for example, a slight modification of a copy of a plot file takes less time than starting from scratch.

The seven code groups of GSMAP and GSDRAW have functionalities that dictate many uses. Suggestions here are divided according to these code groups.

Planning codes for lines (1-99, and 601-699) should begin with decorated lines that are to be plotted using decorations that are on one side of the line (like thrust faults) because the direction of digitizing is important. Be aware of both the advantages and disadvantages of splining. Check the documentation describing the 600-699 codes.

Code Group 1-99 Lines and decorated lines
Reserve codes 1-15 for geologic lines

Code	Line type	Decoration	Specification
1	0	0	Fine solid lines, 00/000 pen Example: contacts
2	3	0	Fine dashed lines, 00/000 pen Example: inferred
3	1	0	Fine dotted lines, 00/000 pen Example: concealed contacts
4	0	0	Heavy solid lines, 0/1 pen Example: faults
5	9	0	Heavy dashed lines, 0/1 pen Example: concealed faults
6	7	0	Heavy dotted lines, 0/1 pen
7	0	102/103	Heavy solid lines with triangular teeth on one side Example: thrust faults 0/1 pen
8	9	102/103	Heavy dashed lines with triangular teeth on one side Example: inferred thrust faults
9	7	102/103	Heavy dotted lines 0/1 pen Example: concealed thrust faults

Code group 100-199 symbols, with posting from an ASCII table.
Reserve codes 100-115 for geologic entries, and be sure that the name of the ASCII data file for related data is included in the plot file created for the map

Code group 200-299 Individually rotatable symbols. These symbols have standard geologic meanings. Uses and "standardization" of codes are defined by the CONFIG.PLT file

Code group 300-399 symbols. Some of the symbols in the CONFIG.PLT file have standard meanings; others don't. Any code can be used for any symbol.
Reserve codes 300-315 for the geologic entries, and use higher numbers for cultural features, geography, etc.

Code group 400-499 polygons.
Reserve 400-415 for geologic features, and use higher numbers for cultural features, geography, etc.

Code group 500-599 alphanumeric entries drawing from an ASCII file. Separate different kinds of uses. We suggest that 500-515 be reserved for geologic entries, and that 555 be used for labels for geologic units. These labels may be an important part of the data base if the digital data is exported to a GIS system. We strongly suggest that these labels be clearly separated from other types of text. If there are labels for features such as areas of rock alteration, these labels should be entered using a separate and different code. This will simplify later use of the digital files.

Multiple ASCII files can be used for the 500-599 code group, but only one for a particular code. Consistency is needed. We suggest that the name of the file used for labels for rock units should be DATABASE.RU; If another file is needed, use a different extension.

Code Group 601-699 Splined lines and decorated lines
Reserve codes 601-615 for geologic lines

Code	Line type	Decoration	Specification
601	0	0	Fine solid lines, 00/000 pen Example: contacts
602	3	0	Fine dashed lines, 00/000 pen Example: inferred
603	1	0	Fine dotted lines, 00/000 pen Example: concealed contacts
604	0	0	Heavy solid lines, 0/1 pen Example: faults
605	9	0	Heavy dashed lines, 0/1 pen Example: concealed faults
606	7	0	Heavy dotted lines, 0/1 pen
607	0	102/103	Heavy solid lines with triangular teeth on one side Example: thrust faults 0/1 pen
608	9	102/103	Heavy dashed lines with triangular teeth on one side Example: inferred thrust faults
609	7	102/103	Heavy dotted lines 0/1 pen Example: concealed thrust faults

Archiving GSMAP databases

Nothing is deader than last week's set of files. GSMAP database files and the associated plot files and projection files may constitute something of more than immediate value. If so, copies should be "archived". Remember to include a copy of the CONFIG.PLT file used for plotting. Remember that this can be modified by the user, and hence can be changed. Your fully annotated plot file will be invaluable to a subsequent user. You might even write a README file to jog your own memory - for example, what color pens go into which positions in the carousel.

DEBUGGING ILLUSTRATIONS

There is no ready method for moving points or lines. GSMAP and GSDRAW allow you to delete entries and to add others from the digitizer. At cleanup time for an illustration it may become necessary to change codes, PARA1 or PARA2 for particular entries, or for groups of entries to modify the illustration.

Editing starts with identification of the entry number for a particular graphical element. At the start of digitizing data in a new database the computer assigns the number 1 to the first entry digitized, 2 to the second, and so on, for each entry, whether point, line, or, polygon. These sequential numbers are not changed by editing of parameters, deleting or undeleting of entities. Numbers may be changed by merging of data bases, or by use of utility programs such as GSMSUB, GSMPOLY, and GSMASC. Numbers therefore must be determined for the particular data base being modified (not for a previous version).

Suggestions below provide several ways of identifying entry numbers.

- The number of the entry is plotted on the map when a draft mode plot is made; the number is drawn just to the left of a one-point entry, or just to the left of the first digitized point if there is more than one point.

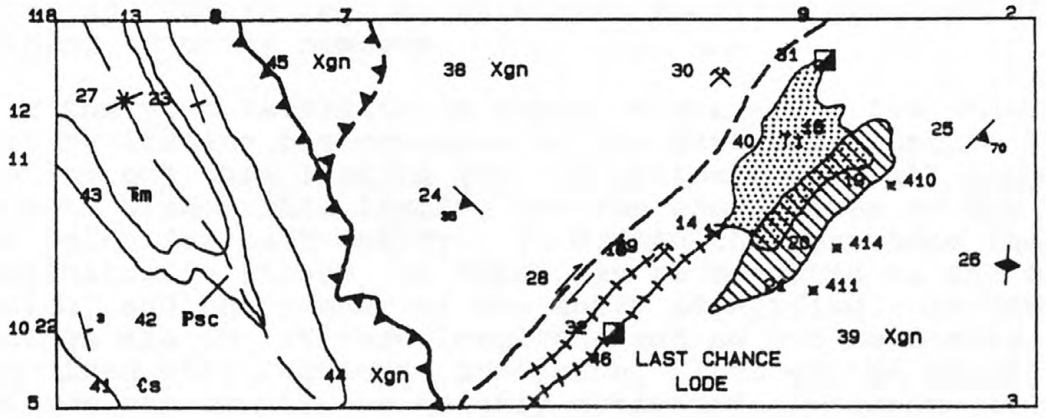


Figure 13._ Draft mode plot of Figure 11.

- In many cases, a draft mode plot will unequivocally identify the number of the entry in question.

- If you exercise Option 8 and plot the data on the screen, the entry numbers are displayed for the entry being plotted. With a finger on the F9 button and an eye on the screen, it may be possible to identify the number, or at least get a close approximation of the number.

-If you exercise option 4 (DELETE LINE SEGMENT) using the mode in which data is plotted on the screen (perhaps with windowing set from the digitizer to get the area of interest plotted at a large size), guesses (informed ?), entry by entry, can be quickly confirmed. Remember that a line identified for deletion will disappear from the screen, and that the screen prompt asking for confirmation that you indeed do want to delete the line lets you identify an entity for deletion, have second thoughts, not delete it, and thus not introduce a mistake. If you set a window using the digitizer that is exactly the same size as the window on the screen (make a template for your particular monitor), the 1:1 screen plot lets you make quick comparison of data on a hard copy with the data on the screen, and the "delete" technique using option 4 will almost always identify a particular entry.

- On a complex map, there may be ambiguities due to over-posting of entry numbers and/or data on draft-mode plots. These ambiguities can be reduced by plotting a small piece of an illustration at a large size, by specifying a large size for the label (ENTER WIDTH,HEIGHT FOR LABEL CHARACTERS); .1,.15 might generally be appropriate, but .1,.5 might produce more legible numbers in a specific case (tall skinny numbers). Plots can be interrupted (F9) key, the paper in the plotter changed, and restarted (Return key) to eliminate specific problems with over-plotting of entry numbers.

- For the most recalcitrant cases, there are a few other tricks. Start by listing the contents of the data base (Option 7) and by printing out this listing (the -1 option to get all line codes in the data base. This listing has the coordinates of the first and last point for each entity. In GSDRAW this provides these coordinates in inches, so these can be measured on the original drawing, and the number of the entry identified. In GSMAP these listings are in latitude-longitude and so not so easily determined with requisite precision, although the general position can usually be quickly estimated. Reference to the printed list will tell you if a certain number is possible for a particular graphical element (use the plot files to verify the kind of entries that you digitized with each particular code, for 500 codes check the number (PARA2) of the associated words and numbers).

- A technique of last resort utilizes the REPLOT SINGLE LINE option displayed as an on-screen prompt at the conclusion of making all plots. Print the Plot File, and all other ASCII files (those supporting 500, 100 codes. Copy the plot file, change it to make a draft mode plot, but put in a 0,0,0,0, line immediately after the specification of the width and height of the label characters (before any codes have been specified). Make a plot using this plot file. You can then plot a "single entry" following prompts on the screen.

REPLOT SINGLE LINE Y/N: Answer **Y**, specify the number of a suspect entity. Use the list of contents of the data base so that you can match the line number with the proper code, and use the printout of the plot file so that you know the parameters for plotting. Let the plotter do its work, check to see if you have identified the offending line number; after plotting the single line, the screen will return to the REPLOT SINGLE LINE prompt; remember to answer **Y** (the default is **N**). This procedure can be repeated for single entries until the one requiring change can be identified.

*Horseshoe nails, commas, blanks, quotation marks, and other causes of error messages

Some error prompts are readily understood, others are misleading. In the latter category: the plotter is humming and drawing, and starting to plot one of the 500 codes - and its silent screen prompts:

Input past end in line 6750 of module GSDRAW at address 1D95:5F)2

What's wrong ? Probably there is a problem with punctuation in the ASCII text file. Examine the grammar. Check to see that that all required commas and quotation marks are in their proper places and that none are missing. Any time there is a problem in plotting 500-599 codes look carefully at the ASCII text file and make sure that all commas and quotation marks are properly placed.

Or midway in plotting the 300 code the screen prompts:

Overflow in line 6300 of module GSDRAW at address 1D95:5911
Hit any key to return to system

What's wrong ? In this case the plot file must be OK - it started the 300 code, the ASCII text file isn't being used, so look at the contents of the data base. The error in this case probably is with PARA1 or PARA2 of a particular data point. In a specific case, PARA1 was put in as 11116 (the digitizer can stutter if the cursor is moved during data entry).

This time you know that the data base is OK; but you changed the plot file, and now north is east and the plot, though recognizable, is all screwed up. See figure, next page. Further, the plotter shows the following error message

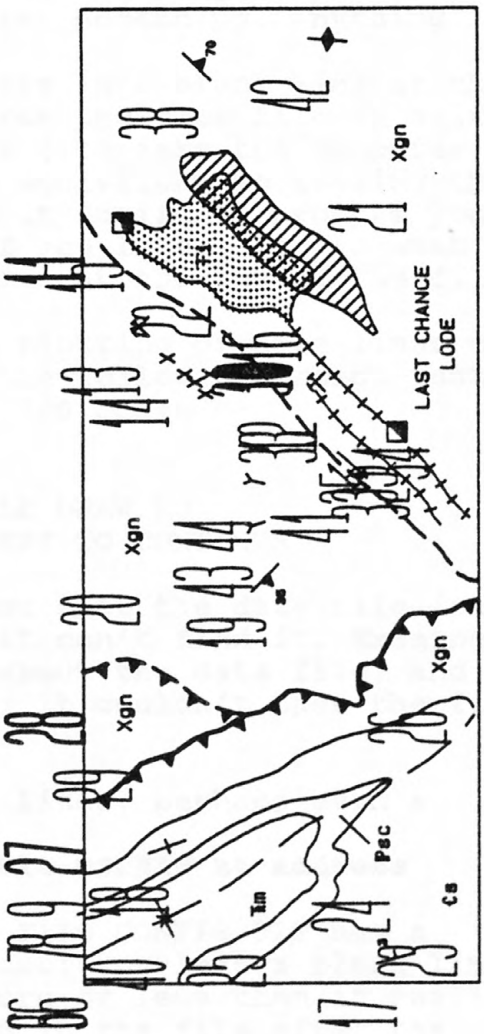
BAD PARAMETER

The problem is almost certainly in the plot file. Figure 4 was plotted from a database that would draw Figure 1 with a valid plot file. One comma was deleted from the plot file to draw this figure. It changed the plot to draft mode, rotated it in the plotter, deleted many lines, and deliberately made a quite unreasonable mess.

If you use GSMAP and activate a GSDRAW data base or GSDRAW to open a GSMAP database, it will seem that you are able to do so, but it won't work out. Try it ! Use GSMAP to open data base "DRAW" on the disk, and look at the strange coordinates of the data base and the, new name for the MAP Title on the Main Menu screen. On one computer with EGA capability, GSMAP drew a psychedelic interpretation of of the DRAW database on the screen, (Option 8, flipped out, and had to be *rebooted.

In case of troubles, make sure that the data base matches the program.

Figure 14._ But for a missing comma, this would be figure 11.



Or, the plot file looks perfect, all commas in place; The plot's perfect **BUT** after finishing the plot, the screen prompts:

PREMATURE EOF IN BATCH CONTROL FILE HIT ANY KEY TO CONTINUE

A *HORSESHOE NAIL is missing from the plot file ! There is no carriage return after the final line 0,0,0,0, and even though you may not be able to see it, the computer demands it to finish off the plot sequence, so it returned the system to DOS.

If the printer is not ready, but you ask for something to be printed, the error message below will be displayed:

Device fault in line "3960" (the number will depend on which printout has been specified; but the prompt:
Hit any key to return to system:
Should get your attention. If you have insulted the computer recently it may send you a time out message, and have to be *rebooted. Be kind.

Or, the plot file looks perfect, all commas in place; but it doesn't plot anything ! After a bunch of text passes over the scream, it quickly reaches the prompt asking if you want to replot a single line ? You only want it to plot something, anything!

Check the plot file to see if there is a blank line at the head of the file. If there is, the input from the plot file is shifted down one record, and quickly, the plot file asks the computer to plot a code 0 (zero) entries. This is equivalent to telling the program that the plot is finished, so it dutifully prompts you to to direct it to draw a single entry if you like. It did what you told it to do. Delete the blank line at the top of the file.

Or, after a promising start, and plotting of some lines or symbols, the silent screen furnishes the following prompt just after starting to consider one of the 500 codes --

FILENAME FOR TEXT = DRAW.RU
AN ERROR HAS OCCURRED OPENING DATA FILE DRAW.RU
CANNOT PLOT 500 SERIES DATA. HIT ANY KEY TO CONTINUE

The computer is trying to tell you that the data file isn't where it is supposed to be, and that it can't find it. Examine the plot file to see what you put in about the data file, and look to see where the file is located; it couldn't open the file because it couldn't find it.

After a promising start plotting lines, perhaps even a symbol or two, the screen prompts:
String Space Corrupt in line 0 of Module GSDRAW at address BF00:0000
A likely explanation is that the File CONFIG.PLT has a problem. Perhaps when you added a symbol you left a blank line, or claimed that a symbol had a move more or less than it really did. Attempts to plot symbols located in the file after the

error will draw the prompt warning of corrupted string space; plots of symbols in the file before the mistake will be successful; this is an attempt by the computer to lull you into thinking that all is well, even when it isn't.

Another error message is peculiar to Versions 4 and 5 of GSDRAW and GSMAP. If you attempt to use an EGA adapter that has less than 256 K RAM (such as the older IBM adapters, you will see a message something like this.

Illegal function call in line 3851 of module GSDRAW at address 065:3985
Hit any key to return to system

There's no illegal function call. The computer is lying to make up for lack of enough RAM in the EGA adapter card. It just doesn't want to admit even one shortcoming.
+

EGA adapters with less than 256 K RAM can be used in CGA mode. Change the first line of the CONFIG.SCR file, see *Documentation, Appendix 1; of course you can't see different codes in different colors, or the higher resolution that you paid for. You may get the same error message on some systems if you specify EGA in the CONFIG.SCR file, but leave the graphics card in CGA mode, even though the hardware's OK. Try it and see. The price is no more than rebooting the system. The computer will quickly let you know who's boss (and it ain't you).

Certain computers and certain accelerator boards are not compatible with adapters and monitors in the EGA mode. The error message is about the same as above. Check the *documentation for your hardware.

ARCHMAGE
A wizard important enough that he doesn't write or publish documentation for *his programs.

ADVERTISEMENT
A list of references, featuring papers by the authors.

BOOT
Used here to describe the process of loading the operating stem into the computer. The word is supposed to come from "bootstrap", as in lifting yourself by your own. The complete derivation would be worthy of this glossary.

CODE
In GSMAP and GSDRAW, code is a number specified in digitizing or plotting. Different code groups have different functions, some are specific to a particular symbol, others can be used for lines, others for polygons, others for alphanumeric entries. Planning proper use of codes is essential to creating good maps. That's why codes are dictated in the GSDRAW exercise for each graphical element. Yes, we will trust you later. Codes can be easily changed, either as a group, or for individual entries. Planning codes may be called scheming, but should not be called plotting; that's something else.

DISCLAIMER
The statement on the first page of an Open-File Report, or on the first screen seen when running a program that puts all responsibility back on you. Just like a wizard to do that.

DOCUMENTATION
The systematic description of a program and how it works. The word is always preceded by a pejorative adjective or followed by a negative clause, like "it won't win a Pulitzer Prize". Never read documentation, or at least never admit to having read the documentation. Use it for reference only if a Guru or Wizard is unavailable, or angry.

ENTER
If you are asked to enter something from the Keyboard, type the letters and numbers and immediately after strike the Enter key; if you are asked to enter something from the keypad press the appropriate buttons on the keypad of the digitizer cursor while it is within the active area of the digitizer board (the little red light on the cursor will be on if it's in the active area). This definition only applies if the computer and digitizer have first been turned on.

ENTRY NUMBER

A sequential number assigned by the computer, starting with 1 for each illustration. Its displayed at the bottom of the screen while digitizing, and is used for changing parameters for entries for deleting entries, or for undeleting entries.

GURU

A person believed by someone else to know more about a program than he does

HE, HIM

Sorry about the sexist terms, but please take no offense; the awkwardnesses of inclusive language are avoided in this Ms by assuming that the reader will supply the missing genders, if he, she, it desires.

HPGL

Short hand for Hewlett Packard Graphics Language. This language is used by GSMAP and GSDRAW to speak to the plotter.

HORSESHOE NAIL

Carriage return. The lack thereof can create problems at the end of a plot file, or one too many (a blank line at the head of a plot file) can create different problems; either is hard to spot on the screen.

INFINITE LOOP

See, loop, infinite.

JUMPSTART

The educational equivalent of a cup of strong coffee, two sugars, and no cream.

LEVEL

Webster variously .., conforming to the liquid parts of the earth's surface, honest ... has to be something else. Used with GSMAP and related programs to specify the stage of development relative to the stages of development of GSMAP.

LINE TYPE

A number that is used to specify the pattern used to draw a line. Line types 0-12 draw lines, type 99 is a phantom line known only by its decorations.

LOOP, INFINITE

See, Infinite loop. It's easily entered if ASCII files used in GSDRAW/GSMAP procedures have incorrect punctuation.

NAD

Stands for North American Datum. Most USGS maps use the 1927 set; quadrangle corners are provided on many new maps for NAD '83. Stick with NAD '27 until further notice. We'll call you; don't call us.

NODE

Webster's first definition .. "an entangling complication" digitized point where lines should meet. Once digitized, you can't digitize another node closer to it than the *snap distance set at the beginning of the current digitizing session. Proper use of nodes greatly facilitates closing of polygons.

OBS

Stands for obsolescence. The inevitable fate of static programs. To avoid obs successive versions of GSMAP and GSDRAW have been published at "appropriate" intervals. Data files of versions 2,3,4,and 5 are compatible. The price of avoiding obs and moving to Version 5.0 is the revision of some projection and plot files. Sorry about that. But keep on using Version 1.0 if you like. Our royalty is the same. You can run GSMAP and GSDRAW Version 1.0 using BASICA. It takes geologic time. That's one of many reasons that you may prefer Version 5.0.

PROJECTION FILES

Also called projection parameter files. They are typed before need (or copied from the release disk if you are lazy or smart). In GSMAP they provide information to the computer needed to specify the map projection and to specify the size and shape of the Earth. Clarke's 1866 polar and equatorial radii are used for almost all USGS maps. Take that, all you satellite types.

SNAP DISTANCE

A distance in inches set at the beginning of a digitizing session. See *node. The term has nothing to do with how close you can get to a Wizard with a corrupted version of *his source code before ... 0.03 (inches) is a good number to use.

SOURCE CODE

The source code for GSMAP, GSDRAW, and the utility programs Version 4.0 has been published. Version 5.0 will follow. **Warning.** If the source code is altered, even by one character, the Wizard is no longer responsible in any way. Do not risk the wrath of a Wizard by asking for debugging of altered SOURCE CODE.

SPLINE

As in splined lines, CODES 600-699. A sort of curve fitting done by the computer to draw smoother curves. It adds points to the ones you digitize to make people think you did more work than you really did. If you aren't careful the computer will throw you a curve that's different than the one you expect, just to get its hard earned pound of flesh.

Wizard

The person who knows the most about a particular program, including detailed knowledge of the SOURCE CODE.

XI

The eleventh commandment.

THOU Shalt make backups!