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An Introduction to MAPGEN

by

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INTRODUCTION

MAPGEN is a map-plotting system developed by Gerald Evenden (1986) that provides the capability of composing and drafting a map using a computer. It allows the user to draw lines, characters, and symbols and to compose text that is of camera-ready quality. Normally the text, labels, thematic data, and each component of the basemap information (coastline, bathymetry, topography), are dealt with as separate overlay files in MAPGEN, so the user has some flexibility in editing the data used to create each discrete component of the map.

This report is meant to introduce MAPGEN to the neophyte or to serve as a refresher for the occasional user of MAPGEN. Its purpose is not to act as a reference for the MAPGEN system but rather to present the MAPGEN concepts.

It is arranged so that the user can proceed through the map-composing process from start to finish. It is hoped that by creating a map, and thereby, going through the process one time, the user will begin to understand the MAPGEN system as a whole.

MAPGEN contains many options not discussed here. Once a basic familiarity is attained the user may want to refer to the MAPGEN User's Manual (Evenden and Botbol, 1985) to learn the many operations the system can perform. In addition to this report and the manual, there are reports by Robb (1989) and Hampson and Wright (1988) which give additional insight into MAPGEN and the map-making process and present many samples of control files and scripts which can be used in map generation.

MAPGEN makes use of the UNIX operating system. Syntax and run-line structure should be familiar to anyone with some knowledge of UNIX. This report attempts to present commands in such a way that someone with little or no UNIX experience should be able to use MAPGEN.

There are four appendices to this report. Appendix A describes methods and programs used to convert output from a TEKTRONIX scanner's TEKNICAD editor to MAPGEN format. Appendix B gives detailed directions on how to create a dashed line pattern and how to blank out a portion of a line in MAPGEN. Appendix C is the MAPGEN font table. Appendix D contains instructions on the use of ZOOM and SZOOM, earlier versions of the MAPGEN graphics display software.

MAPGEN occasionally undergoes modifications. The descriptions in this report apply to the version available on November 15, 1991. Subsequent changes should affect only procedure; the concepts behind and the structure of the MAPGEN system should remain unchanged.

EXPLANATION

MAPGEN is a powerful digital drafting tool. It is used to compose a map and generate all of the accompanying text, i.e., titles, labels, symbols, explanations, and scales. A composite map with text that meets U. S. Geological Survey publication standards can be generated on a computer. The entire map can be assembled digitally with MAPGEN; there is no need for several different devices and procedures to piece together the various parts of the map.

In order to describe MAPGEN's procedures some cartographic terminology must be used. The following definitions and figure 1 are intended to explain those cartographic terms.

There are two parts of a map, the INTERNAL and EXTERNAL. INTERNAL is the part of the map which contains the information being conveyed in pictorial form, that is, the representation of some part of the earth's surface. The internal part of the map is enclosed by the GRATICULE or NEATLINE.

EXTERNAL (or COLLAR) is all of the information outside the graticule, for example, text, title, map symbols, etc.

OVERLAYS are the various components of the map, which "overlay" one another to produce the complete map. A geographic grid would be one overlay, while topographic contours would constitute another, and text would be a third.

The steps required to use MAPGEN to make a map are summarized below and in the flow chart in figure 2.

1. Assemble all data to be presented on the map into data files formatted in MAPGEN format (latitude<tab>longitude<tab>attribute)
2. Determine what the scale and projection of the map will be and the size of the external part of the map. Create a file using these parameters and use it as input to the MAPDEF routine. The output will be the DEFINITION file which is used to scale and position all overlays to the correct locations on the map.
3. Decide how the geographic grid will be presented: tick marks?, full lines?, how often annotated? Put this information into a control file and run the GRID routine to produce the geographic grid overlay file.
4. Create the map overlay files using the LINES routine for line and polygon data and the POINT routine for point data.
5. To view the map overlays on a graphics terminal and interactively label or edit the overlays use the ZOOM, SZOOM, or XZOOM routine, depending on which version of MAPGEN is being used.
6. Create the text for the external part of the map. Text overlays are generated using LEGEND. LEGEND processes cartesian (x,y) coordinate data while LINES and POINTS process geographic (latitude, longitude) coordinate data.
7. The PLOTTER command is used to generate a plot-file which can be exported to a plotter for the final step of getting a hard-copy plot of the map.

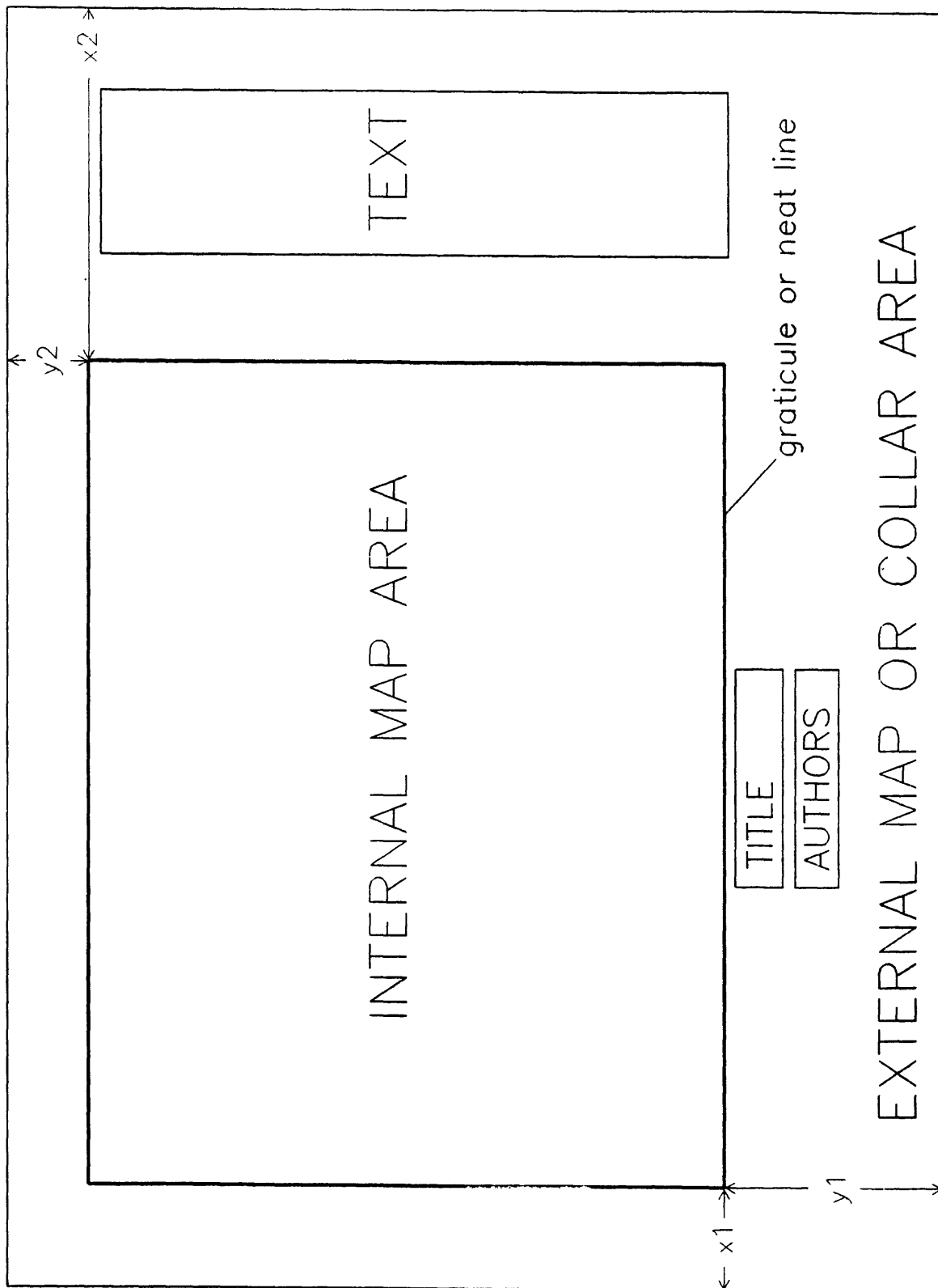


Figure 1. The internal map is outlined by the graticule or neat line. The remainder of the map is referred to as the external map. Distances between the lower left and upper right corners of the external map and the internal map are indicated by $x1$, $y1$, and $x2$, $y2$, respectively.

STEPS TO CREATE A MAP

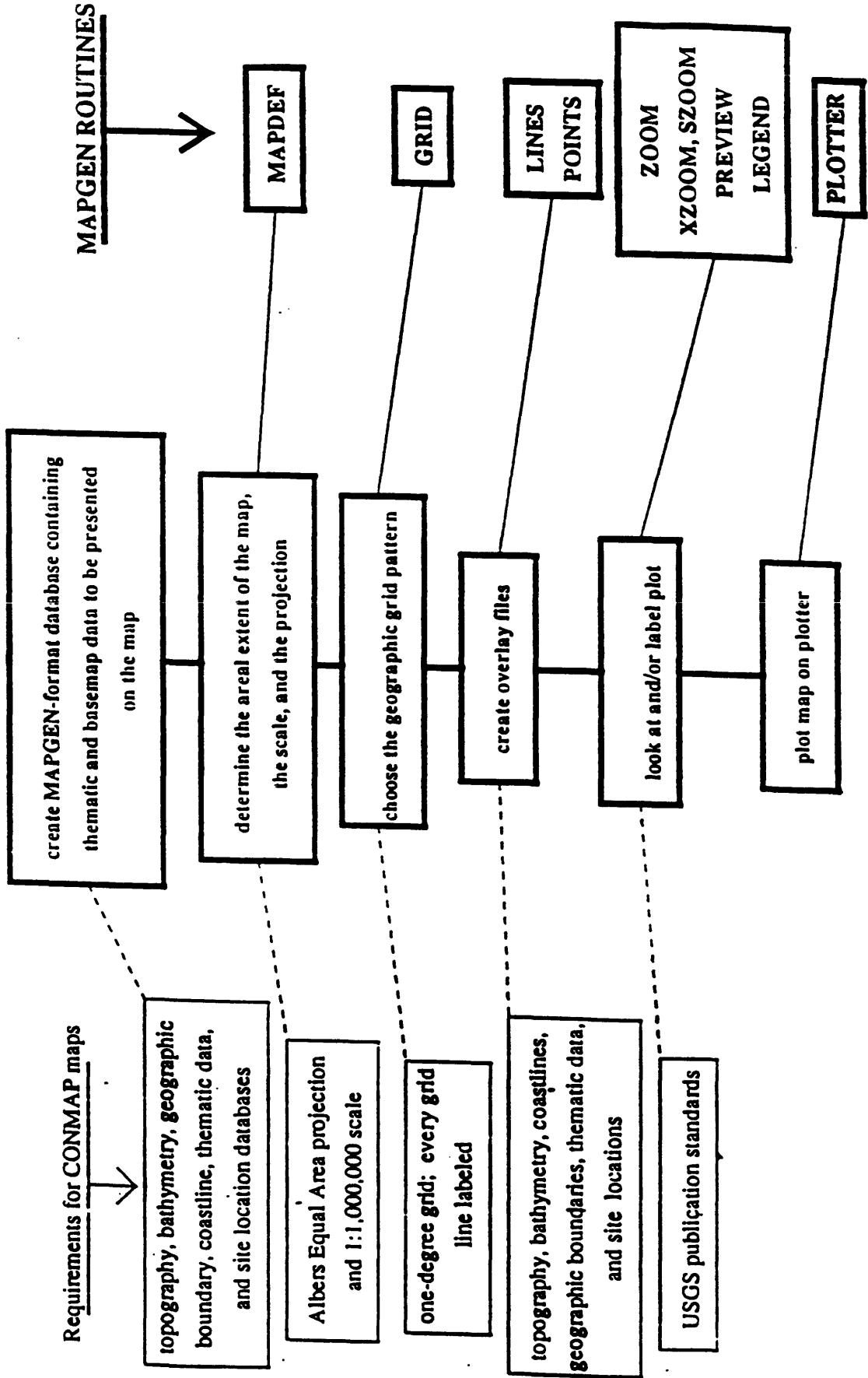


Figure 2. Diagram outlining the steps followed to create a map, the MAPGEN routines used to accomplish each step, and the standards for CONMAP maps.

The center column of the flow chart in figure 2 gives a brief description of the process by which the map is generated, and the column on the right indicates the MAPGEN routines which accomplish the specific tasks referred to in the center column. For this report the standards and conventions adopted for the Continental Margin Mapping Program (CONMAP) series of maps are used in the examples. These standards are listed in the left-hand column in figure 2.

Each section of this report corresponds to one of the steps in the map making process. At the beginning of a section the CONMAP standards and the MAPGEN routines related to that step are stated. A brief description of the procedure is followed by the basic command statements and samples of input/output files needed to create a map.

The descriptions of the commands in each section are preceded by the words "STEP n" and an arrow, for example:

STEP 1 ==>

If the user is somewhat familiar with MAPGEN the command samples may be all he or she requires, and the introductory text can be skipped.

Many of the commands and control files presented here can be rewritten in more efficient forms. The reader is referred to the MAPGEN User's Manual (Evenden and Botbol, 1985) and the reports of Robb (1989) and Hampson and Wright (1988) for other, often more streamlined, examples. The samples presented here are given in the most basic form for clarity. Each user should tailor commands to his or her own needs.

I. CREATE A DATABASE

CONMAP REQUIREMENTS

digital "vector" databases:
topography, bathymetry, geographic
boundaries, thematic data, site
locations, coastlines

MAPGEN format basically consists of two columns of data, latitude and longitude, separated by a tab. If needed there may be additional columns of attribute data, also separated by tabs. Header and comment records can be inserted in a MAPGEN format file if they are preceded by ## to indicate to the MAPGEN system that subsequent information in that record is to be treated as a comment field and not as data. The delimiter, # -b, is used to indicate the start of a new data segment. The standard convention of representing southern latitude and western longitude by negative numbers, is used. Latitude and longitude usually are expressed as decimal degrees although degrees, minutes, and seconds can be used. When degrees, minutes, and seconds are used, they can be expressed in any of the following forms: -130d52'30", 130d52'30"w, -130d52'30, or 130d52'30w

STEP 1 ==>

Create a data file in MAPGEN format or convert an existing data file to MAPGEN format.

The data file, bty2000.dat, below, is in MAPGEN format. Header records are preceded by ##; # -b indicates the start of a segment of data; the latitude-longitude data are in two columns separated by a tab.

SAMPLE of a MAPGEN-format file: bty2000.dat

```
##Southern California Bathy 2000m
# -b
31.984527      -119.657230
31.977650      -119.652241
31.964300      -119.637357
31.951686      -119.618799
31.944891      -119.606446
31.943558      -119.601928
.
.
.
31.857007      -119.404532
31.851156      -119.400374
31.845315      -119.394989
31.827738      -119.383739
# -b
30.517131      -117.574557
30.514073      -117.565109
30.513529      -117.551193
```


30.514073	-117.565109
30.513529	-117.551193
30.511162	-117.542982
30.512319	-117.534403
30.513350	-117.506182
.	.
.	.
.	.
30.605526	-117.479412
30.611473	-117.482342
30.618145	-117.483238
30.625507	-117.485364
# -b	
30.319258	-116.651698
30.316049	-116.654524
30.314962	-116.656967
30.312101	-116.660209
30.309617	-116.661409
30.306084	-116.661776
.	.
.	.
.	.
.	.
.	.

Many of the databases used in making the CONMAP series maps were created using a TEKTRONIX scanner. Appendix A describes the procedure for converting output from the scanner's TEKNICAD editor to a MAPGEN format file.

II. SET SIZE AND SCALE OF MAP

CONMAP REQUIREMENTS:
 Albers Equal Area projection
 1:1,000,000 scale

MAPGEN ROUTINE(S):
 MAPDEF

The MAPDEF routine will scale the map and calculate the dimensions of the map plot. MAPDEF output is a "map definition" file which will be needed to generate subsequent map overlay files. It contains a computation of the dimensions of the final map plot. The latter will be helpful when the user is deciding on the locations of titles and text associated with the legend of the map.

STEP 2 ==>

Determine the latitude-longitude bounds, scale, and projection of the map, and the location of the internal map. Then create a control file. In the sample below the first column is the control file; the second column is used to explain the items in the first column. The second column is not part of the control file.

sample control file: spac.indef

```

126dw 117dw 30dn 35dn           =boundaries* of internal map
+proj=aea                       =projection (Albers Equal Area in this case)
1000000                          =scale (denominator in fractional expression)
                                =rotation (in this case blank because it = 0)
3 12   =x1,y1   (x,y) cm from external map origin to lower left
15 3   =x2,y2   corner of internal map (x1,y1) and from upper right
                                corner of internal map to upper right corner of ex-
                                ternal map (x2,y2) (see Figure 1).
```

*Map boundaries are indicated by left longitude, right longitude, south latitude, north latitude, in that order. Degrees are indicated by the letter, d, minutes by the symbol, ', and quadrant by the letter w, n, e, or s.

The COMMAND:

```
mapdef spac.def < spac.indef
```

where:

```
spac.indef = input file
spac.def   = output file
```

will generate the definition file (def file), spac.def.

A sample def file follows:

```

#MAPGEN:4
#proj_Chebyshev
#   run-line non +:
# proj -m 0.02 -T -126,-117,30,35,-1
#   final cartographic parameters:
# +proj=aea +lon_0=-121.5 +a=6378206.4 +b=6356583.8
F,-121.5,-126,-117,30,35
  u: 4
  1 3 16817.19 -263.89 -0.27
  3 1 -1.57
  v: 3
  0 4 272935.40 11142.63 11.46 -0.71
  2 2 199.10 -3.12
# u,v sums: 0.0416891 -0.0207552, |u,v sums|: 0.0416937 0.0214494
#end_proj_Chebyshev
#ll-rng
-2.19911485751 -2.04203522483, 0.523598775598, 0.610865238198
#cm scale cts_cm
-2.12057504117 1000000 200
#board: 119.72 71.71 cm.
23944 14342
#data: 3.00 89.72 12.00 68.71 cm.
600 17944 2400 13742
#translation
1 0 9272 8068
##END MAPDEF

```

where #board: gives the dimensions of the external map and #data: gives the distance from the external map origin to (1) the left border of the internal map, (2) the right border of the internal map, (3) the bottom of the internal map, and (4) the top of the internal map.

III. CHOOSE THE GEOGRAPHIC GRID PATTERN

CONMAP REQUIREMENTS:
 one degree spacing
 every grid line labeled
 no tick marks

MAPGEN ROUTINE(S):
 GRID

The geographic grid can be drawn with full lines or tick marks. The user defines the line spacing and also the placement of grid or tick labels. The CONMAP series has full lines drawn and labeled at a one-degree spacing.

STEP 3 ==>

to construct a geographic grid with one-degree spacing and each line labeled create the following control file. The control file is in the first column. Comments are optional.

SAMPLE control file: spac.ingrid

```
-pi 1 -mi 1  ##interval for lats and lons (parallels & meridians)
-s .2        ##character size .2cm
-d .25       ##annotation offset .25cm from line
-a tlr      ##annotate Top, Left, Right, Bottom
              borders of the grid with lat,lon values
```

The COMMAND:

```
grid -mo spac.def spac.grid spac.ingrid
```

using the def file created in Step II, will generate a plot file, spac.grid. An example of the plotted grid is shown in figure 3.

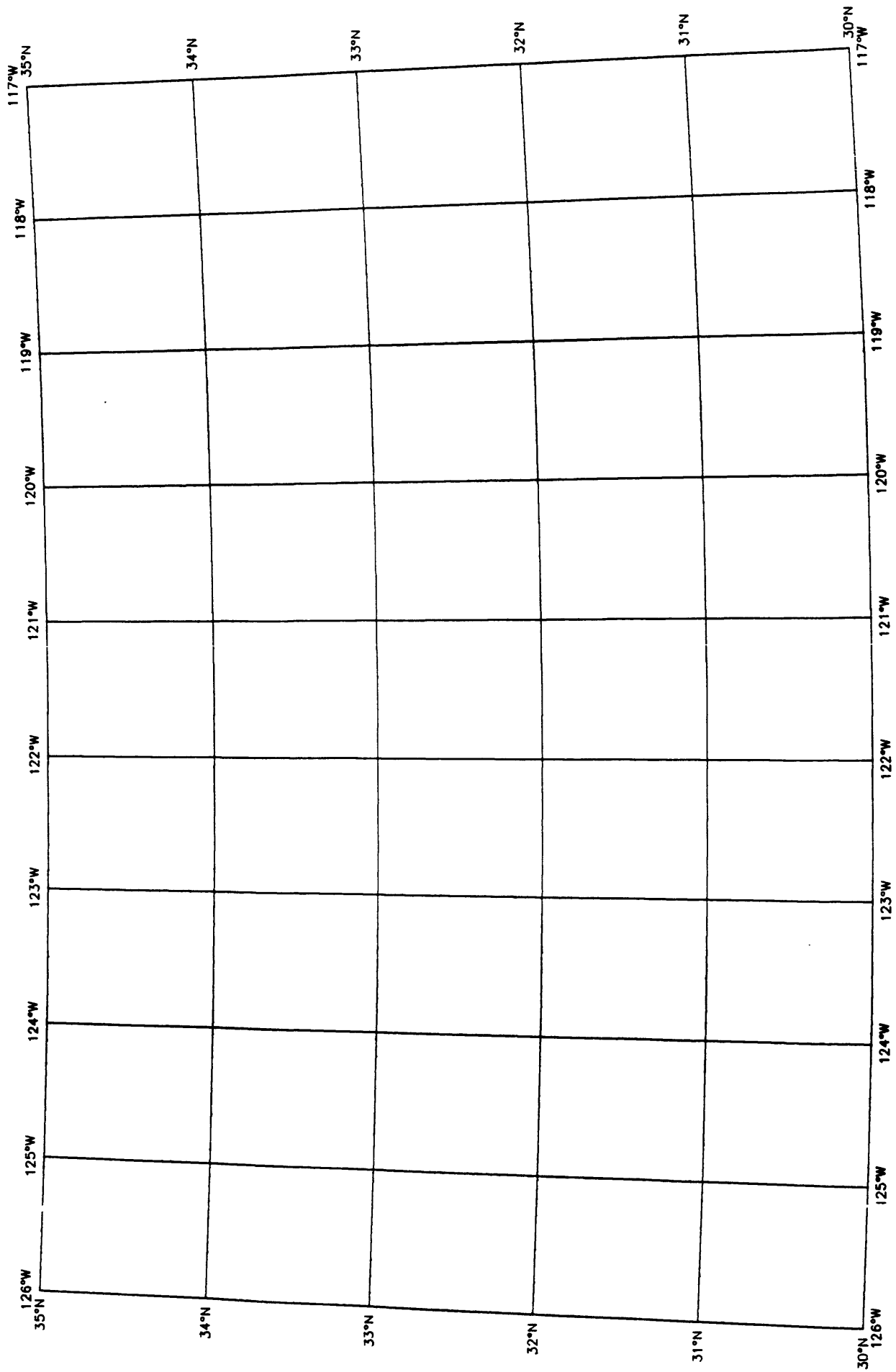


Figure 3. Geographic grid created using the MAPGEN GRID routine.

IV. CREATE AN OVERLAY FILE

CONMAP REQUIREMENTS

thematic data, topography
 bathymetry, coastlines,
 state boundaries, sites

MAPGEN ROUTINE(S)

LINES
 POINTS

The term "overlay file", as used in the MAPGEN system, refers to a plottable data file (metagraphic file). It is a binary file containing coordinates and plotter commands which cause the plotter to draw lines and symbols on an output device. We use the extension .ov to indicate an overlay file.

Source data for some often-used CONMAP overlay files may be obtained from the U.S. Geological Survey-National Oceanic and Atmospheric Administration Joint Office for Mapping and Research (JOMAR) library (MS 915, U. S. Geological Survey, Reston, VA 22092). These include topographic and bathymetric contour, coastline, state boundary, and geographic label files.

Two aspects of line drawing which are often required are dashed-lines and blanking out of certain segments of a line. Because these two options are not described in detail in the user's manual (Evenden and Botbol, 1985) instructions for their use are included in Appendix B of this report.

STEP 4 ==>

An overlay file is created from the ASCII latitude-longitude data file by using the LINES program or the POINTS program.

LINES:

This program should be used to create an overlay file for thematic data composed of lines (for example: faults or track lines) or polygons (for example: closed contours or basin outlines).

The COMMAND used to create an overlay file from the bathymetry data file, bty2000.dat, is:

```
lines -mo spac.def bty2000.ov bty2000.dat
```

LINES produced the overlay file, bty2000.ov, from which the map in figure 4 was generated.

POINTS:

Individual points (for example, site locations) should be plotted using the POINTS routine.

The symbol to be plotted at the data point is chosen from the font tables (see Appendix C). The code for that symbol is entered in a control file.



Figure 4. Plot of the 2000-meter contour overlay.

Labeling of points:

If posted points along a line (for example, a track line) are desired on an overlay plot, the characters to be posted are entered into the third column in the MAPGEN format data file (see example below). Final camera-ready maps usually will not be labeled in this manner because cartographic standards require more precise placement of labels. The LEGEND and ZOOM, SZOOM, or XZOOM routines are used when creating labels according to USGS standards.

The following file, input.dat, can be used to create a posted graphics output file. The input.dat control parameters and the lines command will create a line composed of several segments with circles around the line-segment end points and labels at each of the end points.

SAMPLE input file: input.dat

```

#-c          #begin character plotting with data set that follows
#-l          #begin line plotting with data set that follows
#-s          #begin symbol plotting with data set that follows
#-p 1        #pen number 1
#-f 3        #post characters contained in field 3
#-cf -       #character font is default
#-cr o       #annotation is orthogonal to the line
#-cs 0.4     #character size is 0.4 cm
#-cx 0.7     #offset distance of characters from line = 0.7 cm
#-sf -syml   #for symbols use font table "-syml"
#-sc 56      #identifies specific symbol to be used (circle)
#-ss 0.7     #size of symbol in cm
#-sr 0       #symbol rotation is 0 degrees
32.05733     -120.99550      point 1
32.33975     -120.94390      point 2
#-cr 320     #rotate next label 320 degrees
32.69959     -120.87240      point 3
#-cr o       #annotation is orthogonal to the line
33.01273     -118.83800      point 4
33.98392     -118.78320      point 5

```

The LINES COMMAND:

```
lines -mo spac.def input.ov input.dat
```

will produce the overlay plot in figure 5(a)

To plot only the points contained in the input file, the control parameters should be modified to remove the #-l line plotting parameter, and the points command should be used to process the input data.

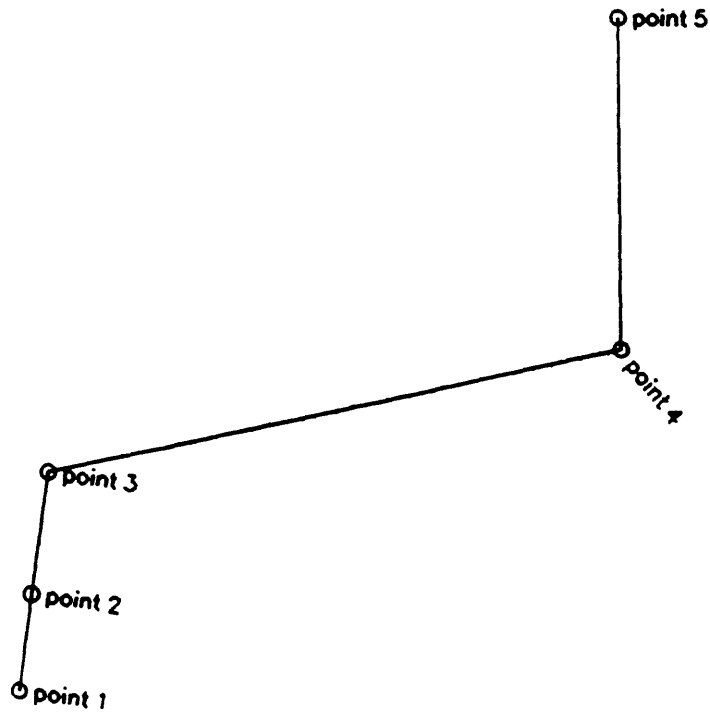


Figure 5(a). Plot of a line connecting five points. Each point is labeled and indicated by a circle symbol.

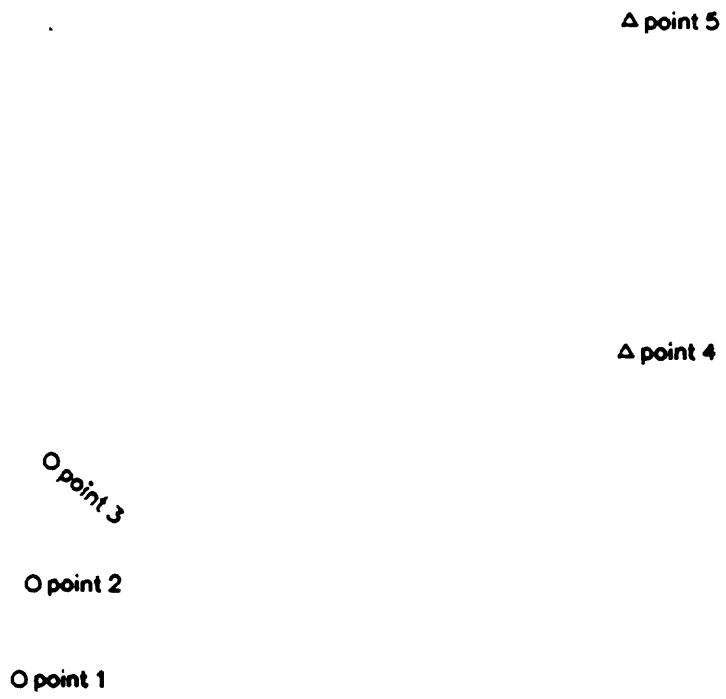


Figure 5(b). The five points plotted in figure 5(a). The line has been omitted and two of the points are indicated by a triangle symbol.

input.dat (modified):

```

#-c          #begin character plotting with data set that follows
#-s          #begin symbol plotting with data set that follows
#-p 1        #pen number 1
#-f 3        #post characters contained in field 3
#-cf -       #character font is default
#-cr o       #annotation is orthogonal to the line
#-cs 0.4     #character size is 0.4 cm
#-cx 0.7     #offset distance of characters from line = 0.7 cm
#-sf -sym1   #use font table "-sym1"
#-sc 56      #identifies specific symbol to be used
#-ss 0.7     #size of symbol in cm
#-sr 0       #symbol rotation is 0 degrees
32.05733    -120.99550      point 1
32.33975    -120.94390      point 2
#-cr 320    #rotate next label 320 degrees
32.69959    -120.87240      point 3
#-cr o       #annotation is orthogonal to the line
#-sc 25     #change symbol to triangle
33.01273    -118.83800      point 4
33.98392    -118.78320      point 5

```

The points COMMAND:

```
points -mo spac.def input.ov input.dat
```

will produce the plot shown in figure 5(b). The symbol was changed for the last two points by the insertion of an additional #-sc parameter line preceding those points.

V. LOOK AT OVERLAYS

CONMAP REQUIREMENTS

MAPGEN overlay files

MAPGEN ROUTINE(S) :

```

PREVIEW
SZOOM
XZOOM
ZOOM

```

PREVIEW displays the overlay files on the host graphics terminal. There are four display programs available: PREVIEW, ZOOM, SZOOM, and XZOOM. ZOOM, SZOOM, or XZOOM normally are used because they allow enlargement of sections of the plot on the screen. ZOOM, the original MAPGEN display software, was developed for Tektronix 4010 terminals and is used on VT-100s. SZOOM is an early menu driven version of ZOOM used in SUNVIEW mode on SUN workstations. XZOOM is the current version and operates in X-Windows. Editing, for example, drawing lines, marking points, and labeling, can be performed in XZOOM, SZOOM, or ZOOM. Instructions for using XZOOM editing features are in Section VI of this report. ZOOM and SZOOM are no longer maintained. Appendix D contains their user instructions for old versions of MAPGEN.

STEP 5 ==>

XZOOM: The input files are the overlay files that are to be viewed and the definition file.

Create a file called plot and in it put the names of the overlay files to be viewed. To produce the image in figure 6 the file, plot, would be:

```

spac.grid bty2000.ov

```

Then type the COMMAND:

```

xzoom

```

A window with a menu across the top (figure 7) and an arrow-shaped, cross-shaped, or thin vertical-column cursor will appear on the screen. The cursor shape depends on where in the window the cursor is located. The cursor shapes may vary depending on which system is running the MAPGEN software. Using the mouse move the cursor to the menu function "def" and press the left mouse button. A white text window will pop up and the word, "def", will appear in it. Below the text space the choices, ENTER, OVERWRITE, APPEND, and ABORT will appear. Move the cursor to the text space. The thin vertical-column and a caret cursor will indicate character entry can begin. To edit the word, def, type in the correct word or words. The delete key can be used to delete letters. The caret cursor can be moved using the keypad on the right side of the keyboard. For the example shown in figure 6, def was edited to spac.def. Move the arrow cursor to ENTER and press the left mouse button. Then move the arrow cursor to "(re)plot" (at the top of the XZOOM window) and press the left mouse button. The message, "plotting overlays wait", will appear in the black message area and the overlays, listed in the file, plot, will be plotted in the display or plot area. In section VI the remaining menu functions are explained.

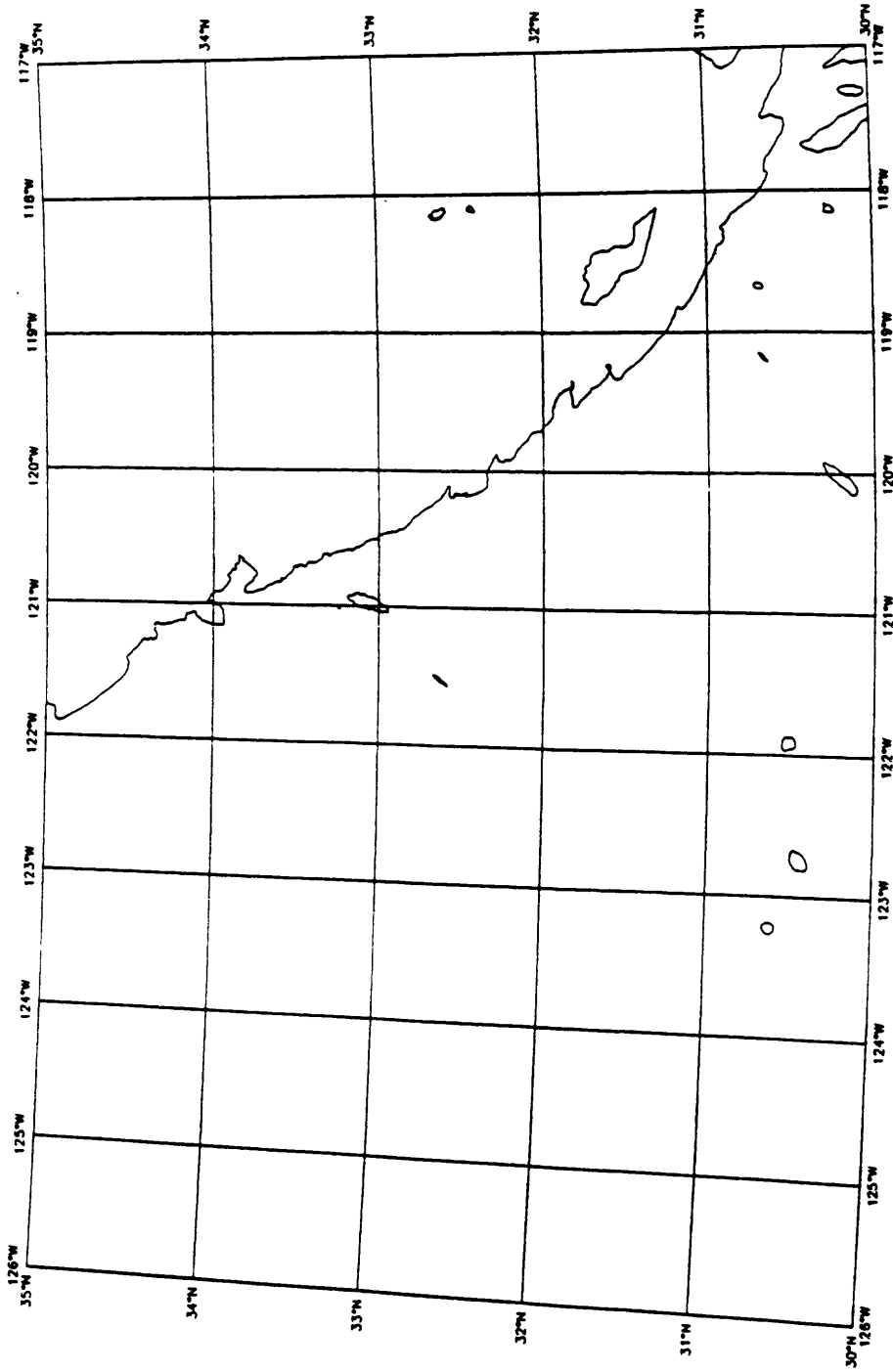


Figure 6. Graphics display of grid and 2000-meter contour overlays.

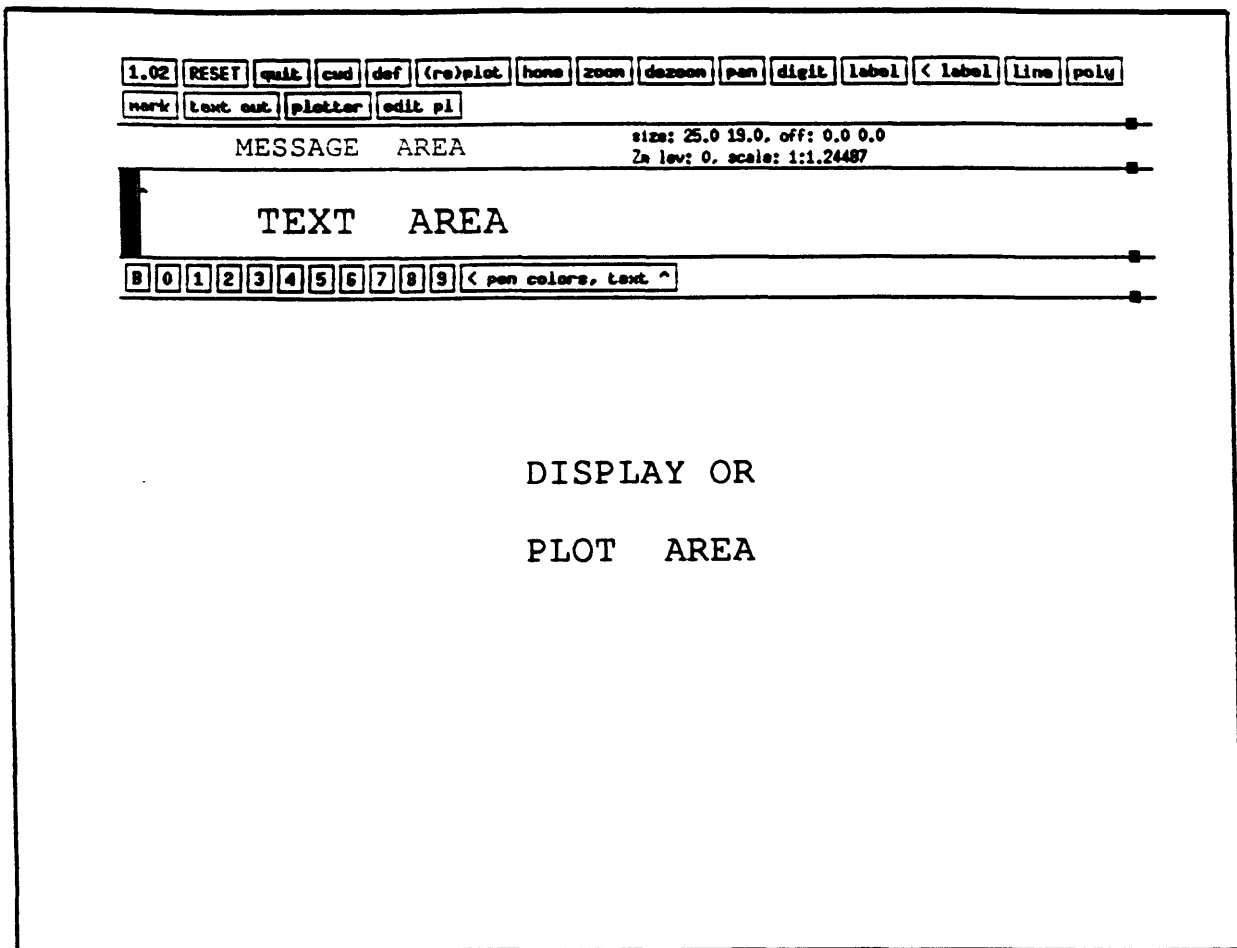


Figure 7. Display window in XZOOM mode.

VI. LABEL PLOT AND/OR ADD LINES OR SYMBOLS

CONMAP REQUIREMENTS
 USGS cartographic
 standards

MAPGEN ROUTINES (S)
 LEGEND
 ZOOM
 SZOOM
 XZOOM

After a map has been plotted, labels may be added interactively while the map is displayed on the terminal screen. The following directions will allow users to label working copies or final copies of maps. Final copies of the map must be labeled according to USGS standards.

In MAPGEN a symbol is centered at its x,y coordinate location. The rotation is around the center of the symbol not a corner of the symbol.

The locations of labels are determined using a graphics display of the map. MAPGEN puts the labels into a separate MAPGEN format ASCII file with the default name, digit. The user can insert header information in this file and then convert it to an overlay file for plotting. The LEGEND routine is used to create the overlay file.

STEP 6 ==>

The output file, digit, that is created interactively in XZOOM mode, is processed with the legend COMMAND:

```
legend -mo spac.def label2000.ov digit
```

A labeled 2000 meter bathymetry map is shown in figure 8. The portions of contour lines overwritten by the labels can be removed by "blanking", a process described in Appendix B.

To create the file, digit, first display the map on the screen by entering the COMMAND:

```
xzoom
```

XZOOM displays a menu at the top of the screen (figure 7). Below it is a black band that is a message area for MAPGEN information, status, and error messages. Below that is a mustard colored area where the user enters text. The largest part of the window is the area used for the graphics display. The cursor shape changes depending on the portion of the window in which it is located. In XZOOM mode a menu function is chosen by placing the cursor on the function and pressing the left mouse button.

The first nine functions at the top of the XZOOM window control the display:

"RESET" is chosen when a graphics display error has occurred.

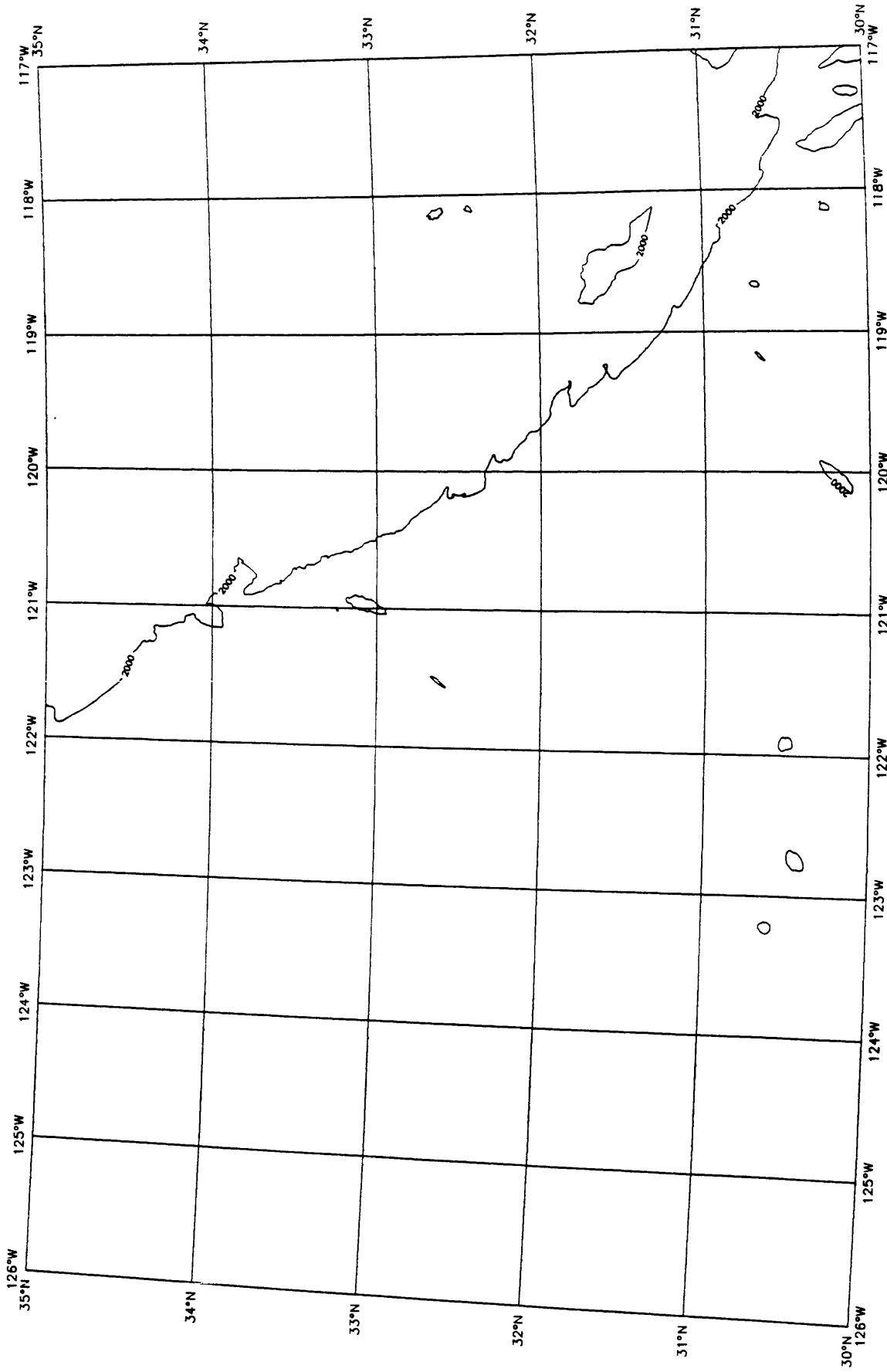


Figure 8. Map with 2000-meter contour line labeled.

"quit" is used to exit from XZOOM.

"cwd" can be used to change directories without exiting from XZOOM.

"def" is the first option chosen in XZOOM. A window is opened allowing the user to enter the name of the appropriate def file.

"(re)plot" will refresh the screen with lines or text that are in the plot file or the "digit" (see below) file.

"home" brings up the original display on the screen. While it is plotting, MAPGEN will display the message, "plotting overlays wait".

"zoom" will magnify a portion of the screen. Choose the "zoom" option, then, move the cursor to a corner of the area to be enlarged, depress the lefthand button on the mouse, hold it down and move the mouse, creating on the screen, a rectangle that defines the area to be enlarged. Releasing, and then depressing the left mouse button again will bring up the magnified image on the screen. Instructions are given in the output message area.

"dezoom" reverses the ZOOM procedure by returning to the previous display.

"pan" controls the panning option. After choosing "pan", place the cursor at a point and depress the lefthand mouse button. Move the cursor to the new position where that point will be located and depress the lefthand mouse button again. Directions appear in the output message area.

Editing and labeling can be done after the "digit" option is chosen.

"digit", when chosen, will display a window for output-file name entry. The name of the output file to which the digitization will be written is entered in the text-entry area and the ENTER option is chosen. OVERWRITE is chosen if the user intends to overwrite a previous output file of the same name. APPEND is used to add to an existing output file and ABORT is chosen to terminate the process. Editing or text writing can be done once the output file has been specified.

In XZOOM mode text to be entered with the "label", "<label", or "text out" options first is typed in the mustard colored text-entry area.













The function "text out" should normally be chosen immediately after "digit". It allows the user to create the output file header and choose whatever options (font, size, etc.) are needed. For the text to appear in the graphics display during the current session the output file first must have font and size parameters. The following parameters or whatever parameters are appropriate should be entered in the mustard-colored message area:

-f - -s .20

then "text out" is selected to enter the parameters in the output file. After the parameters have been set the "label" or "<label" options can be used. "(re)plot" will bring the labels up on the screen.

Table C-2. THE MAPGEN FONT TABLE

Digraph Listing of Font -cartr

1/001		22/026	+/43/053	+	@/64/100	U/85/125	U	j/106/152	J
2/002		23/027	./44/054	,	A/65/101	V/86/126	V	k/107/153	K
3/003		24/030	-/45/055	-	B/66/102	W/87/127	W	l/108/154	L
4/004		25/031	./46/056	.	C/67/103	X/88/130	X	m/109/155	M
5/005		26/032	//47/057	/	D/68/104	Y/89/131	Y	n/110/156	N
6/006		27/033	0/48/060	0	E/69/105	Z/90/132	Z	o/111/157	O
7/007		28/034	1/49/061	1	F/70/106	[/91/133	[	p/112/160	P
8/010		29/035	2/50/062	2	G/71/107	\92/134	\	q/113/161	Q
9/011		30/036	3/51/063	3	H/72/110	]93/135	]	r/114/162	R
10/012		31/037	4/52/064	4	I/73/111	~/94/136	~	s/115/163	S
11/013		/32/040	5/53/065	5	J/74/112	_95/137	_	t/116/164	T
12/014		!33/041	6/54/066	6	K/75/113	`96/140	`	u/117/165	U
13/015	"34/042	"/34/042	7/55/067	7	L/76/114	a97/141	a	v/118/166	V
14/016	#35/043	#/35/043	8/56/070	8	M/77/115	b98/142	b	w/119/167	W
15/017	\$36/044	\$/36/044	9/57/071	9	N/78/116	c99/143	c	x/120/170	X
16/020	%37/045	%/37/045	:58/072	:	O/79/117	d100/144	d	y/121/171	Y
17/021	&38/046	&/38/046	:59/073	:	P/80/120	e101/145	e	z/122/172	Z
18/022	'39/047	'/39/047	<60/074	<	Q/81/121	f102/146	f	{/123/173	{
19/023	(40/050	(/40/050	=61/075	=	R/82/122	g103/147	g	|/124/174	|
20/024	)41/051	)/41/051	>62/076	>	S/83/123	h104/150	h	}/125/175	}
21/025	*42/052	*/42/052	?63/077	?	T/84/124	'i/105/151	'	~/126/176	~

Digraph Listing of Font

—CC

1/001	22/026	+ /43/053	⊙/64/100	U/85/125	Ф	j/106/152	Й
2/002	23/027	, /44/054	А/65/101	V/86/126	Х	k/107/153	К
3/003	24/030	- /45/055	В/66/102	W/87/127	Ц	l/108/154	Л
4/004	25/031	. /46/056	С/67/103	X/88/130	Ч	m/109/155	М
5/005	26/032	//47/057	Д/68/104	Y/89/131	Ш	n/110/156	И
6/006	27/033	0/48/060	Е/69/105	Z/90/132	Щ	o/111/157	О
7/007	28/034	1/49/061	Ғ/70/106	І/91/133	Ъ	p/112/160	И
8/010	29/035	2/50/062	Ж/71/107	√92/134	Ы	q/113/161	Р
9/011	30/036	3/51/063	З/72/110	І/93/135	Ь	r/114/162	С
10/012	31/037	4/52/064	Й/73/111	~/94/136	Э	s/115/163	Т
11/013	/32/040	5/53/065	Ў/74/112	_/95/137	Ю	t/116/164	У
12/014	!/33/041	6/54/066	К/75/113	~/96/140	Я	u/117/165	Ф
13/015	"/34/042	7/55/067	Л/76/114	o/97/141	а	v/118/166	Х
14/016	#/35/043	8/56/070	М/77/115	b/98/142	б	w/119/167	Ц
15/017	\$/36/044	9/57/071	Н/78/116	c/99/143	В	x/120/170	Ч
16/020	%/37/045	:/58/072	О/79/117	d/100/144	Г	y/121/171	Ш
17/021	&/38/046	:/59/073	Р/80/120	e/101/145	Д	z/122/172	Щ
18/022	'/39/047	</60/074	Q/81/121	f/102/146	е	{/123/173	Ъ
19/023	(/40/050	=/61/075	R/82/122	g/103/147	Ж	|/124/174	Ы
20/024	)/41/051	>/62/076	S/83/123	h/104/150	З	/125/175	Ь
21/025	*/42/052	?/63/077	T/84/124	.i/105/151	И	~/126/176	Э

Digraph Listing of Font —cgi

1/001	22/026	+ /43/053	@ /64/100	U /85/125	Ψ	j /106/152	κ
2/002	23/027	, /44/054	A /65/101	V /86/126	λ	k /107/153	λ
3/003	24/030	- /45/055	B /66/102	W /87/127	μ	l /108/154	μ
4/004	25/031	. /46/056	C /67/103	X /88/130	ν	m /109/155	ν
5/005	26/032	//47/057	D /68/104	Y /89/131	ξ	n /110/156	ξ
6/006	27/033	0 /48/060	E /69/105	Z /90/132	ο	o /111/157	ο
7/007	28/034	1 /49/061	F /70/106	[/91/133	π	p /112/160	π
8/010	29/035	2 /50/062	G /71/107	\ /92/134	ρ	q /113/161	ρ
9/011	30/036	3 /51/063	H /72/110	] /93/135	σ	r /114/162	σ
10/012	31/037	4 /52/064	I /73/111	~ /94/136	φ	s /115/163	φ
11/013	/32/040	5 /53/065	J /74/112	_ /95/137	χ	t /116/164	χ
12/014	! /33/041	6 /54/066	K /75/113	` /96/140	ψ	u /117/165	ψ
13/015	" /34/042	7 /55/067	L /76/114	a /97/141	α	v /118/166	
14/016	# /35/043	8 /56/070	M /77/115	b /98/142	β	w /119/167	
15/017	\$ /36/044	9 /57/071	N /78/116	c /99/143	γ	x /120/170	
16/020	% /37/045	: /58/072	O /79/117	d /100/144	δ	y /121/171	
17/021	& /38/046	; /59/073	P /80/120	e /101/145	ε	z /122/172	
18/022	' /39/047	< /60/074	Q /81/121	f /102/146	ζ	{ /123/173	
19/023	(/40/050	= /61/075	R /82/122	g /103/147	η	| /124/174	
20/024	) /41/051	> /62/076	S /83/123	h /104/150	ϑ	} /125/175	
21/025	* /42/052	? /63/077	T /84/124	i /105/151	ι	~ /126/176	

Digraph Listing of Font -cip

1/001	22/026	+ /43/053	@/64/100	U/85/125	<i>U</i>	j/106/152	<i>j</i>
2/002	23/027	./44/054	A/65/101	V/86/126	<i>V</i>	k/107/153	<i>k</i>
3/003	24/030	- /45/055	B/66/102	W/87/127	<i>W</i>	l/108/154	<i>l</i>
4/004	25/031	./46/056	C/67/103	X/88/130	<i>X</i>	m/109/155	<i>m</i>
5/005	26/032	//47/057	D/68/104	Y/89/131	<i>Y</i>	n/110/156	<i>n</i>
6/006	27/033	0/48/060	E/69/105	Z/90/132	<i>Z</i>	o/111/157	<i>o</i>
7/007	28/034	1/49/061	F/70/106	[/91/133	<i>[</i>	p/112/160	<i>p</i>
8/010	29/035	2/50/062	G/71/107	\/92/134	<i>\</i>	q/113/161	<i>q</i>
9/011	30/036	3/51/063	H/72/110	I/93/135	<i>I</i>	r/114/162	<i>r</i>
10/012	31/037	4/52/064	I/73/111	~/94/136	<i>~</i>	s/115/163	<i>s</i>
11/013	/32/040	5/53/065	J/74/112	_/95/137	<i>_</i>	t/116/164	<i>t</i>
12/014	!/33/041	6/54/066	K/75/113	`/96/140	<i>`</i>	u/117/165	<i>u</i>
13/015	"/34/042	7/55/067	L/76/114	a/97/141	<i>a</i>	v/118/166	<i>v</i>
14/016	#/35/043	8/56/070	M/77/115	b/98/142	<i>b</i>	w/119/167	<i>w</i>
15/017	\$/36/044	9/57/071	N/78/116	c/99/143	<i>c</i>	x/120/170	<i>x</i>
16/020	%/37/045	:/58/072	O/79/117	d/100/144	<i>d</i>	y/121/171	<i>y</i>
17/021	&/38/046	:/59/073	P/80/120	e/101/145	<i>e</i>	z/122/172	<i>z</i>
18/022	'/39/047	</60/074	Q/81/121	f/102/146	<i>f</i>	{/123/173	
19/023	(/40/050	=/61/075	R/82/122	g/103/147	<i>g</i>	|/124/174	
20/024	)/41/051	>/62/076	S/83/123	h/104/150	<i>h</i>	}/125/175	
21/025	*/42/052	?/63/077	T/84/124	i/105/151	<i>i</i>	~/126/176	

Digraph Listing of Font -crl

1/001	22/026	+ /43/053	+	@ /64/100	@	U /85/125	U	j /106/152	j
2/002	23/027	. /44/054	,	A /65/101	A	V /86/126	V	k /107/153	k
3/003	24/030	- /45/055	-	B /66/102	B	W /87/127	W	l /108/154	l
4/004	25/031	. /46/056	.	C /67/103	C	X /88/130	X	m /109/155	m
5/005	26/032	//47/057	/	D /68/104	D	Y /89/131	Y	n /110/156	n
6/006	27/033	0 /48/060	0	E /69/105	E	Z /90/132	Z	o /111/157	o
7/007	28/034	1 /49/061	1	F /70/106	F	[/91/133	[	p /112/160	p
8/010	29/035	2 /50/062	2	G /71/107	G	\ /92/134	\	q /113/161	q
9/011	30/036	3 /51/063	3	H /72/110	H	I /93/135	I	r /114/162	r
10/012	31/037	4 /52/064	4	I /73/111	I	~ /94/136	~	s /115/163	s
11/013	/32/040	5 /53/065	5	J /74/112	J	_ /95/137	_	t /116/164	t
12/014	! /33/041	6 /54/066	6	K /75/113	K	` /96/140	`	u /117/165	u
13/015	" /34/042	7 /55/067	7	L /76/114	L	a /97/141	a	v /118/166	v
14/016	# /35/043	8 /56/070	8	M /77/115	M	b /98/142	b	w /119/167	w
15/017	\$ /36/044	9 /57/071	9	N /78/116	N	c /99/143	c	x /120/170	x
16/020	% /37/045	: /58/072	:	O /79/117	O	d /100/144	d	y /121/171	y
17/021	& /38/046	: /59/073	;	P /80/120	P	e /101/145	e	z /122/172	z
18/022	' /39/047	< /60/074	<	Q /81/121	Q	f /102/146	f	{ /123/173	{
19/023	(/40/050	= /61/075	=	R /82/122	R	g /103/147	g	| /124/174	|
20/024	) /41/051	> /62/076	>	S /83/123	S	h /104/150	h	} /125/175	}
21/025	* /42/052	? /63/077	?	T /84/124	T	.i /105/151	.i	~ /126/176	~

Digraph Listing of Font —crp

1/001	22/026	+ /43/053	+	@/64/100	@	U/85/125	U	j/106/152	j
2/002	23/027	, /44/054	,	A/65/101	A	V/86/126	V	k/107/153	k
3/003	24/030	- /45/055	—	B/66/102	B	W/87/127	W	l/108/154	l
4/004	25/031	. /46/056	.	C/67/103	C	X/88/130	X	m/109/155	m
5/005	26/032	//47/057	/	D/68/104	D	Y/89/131	Y	n/110/156	n
6/006	27/033	0/48/060	0	E/69/105	E	Z/90/132	Z	o/111/157	o
7/007	28/034	1/49/061	1	F/70/106	F	[/91/133	[	p/112/160	p
8/010	29/035	2/50/062	2	G/71/107	G	\ /92/134	\	q/113/161	q
9/011	30/036	3/51/063	3	H/72/110	H	] /93/135	]	r/114/162	r
10/012	31/037	4/52/064	4	I/73/111	I	~/94/136	~	s/115/163	s
11/013	/32/040	5/53/065	5	J/74/112	J	_ /95/137	_	t/116/164	t
12/014	! /33/041	6/54/066	6	K/75/113	K	` /96/140	`	u/117/165	u
13/015	" /34/042	7/55/067	7	L/76/114	L	o /97/141	o	v/118/166	v
14/016	# /35/043	8/56/070	8	M/77/115	M	b /98/142	b	w/119/167	w
15/017	\$ /36/044	9/57/071	9	N/78/116	N	c /99/143	c	x/120/170	x
16/020	% /37/045	: /58/072	:	O/79/117	O	d /100/144	d	y/121/171	y
17/021	& /38/046	: /59/073	:	P/80/120	P	e /101/145	e	z/122/172	z
18/022	' /39/047	< /60/074	<	Q/81/121	Q	f /102/146	f	{ /123/173	{
19/023	(/40/050	= /61/075	=	R/82/122	R	g /103/147	g	| /124/174	|
20/024	) /41/051	> /62/076	>	S/83/123	S	h /104/150	h	} /125/175	}
21/025	* /42/052	? /63/077	?	T/84/124	T	i /105/151	i	~ /126/176	~

Digraph Listing of Font -cscp

1/001	22/026	+ /43/053	+	@ /64/100	U /85/125	U	j /106/152
2/002	23/027	. /44/054	,	A /65/101	V /86/126	V	k /107/153
3/003	24/030	- /45/055	-	B /66/102	W /87/127	W	l /108/154
4/004	25/031	. /46/056	.	C /67/103	X /88/130	X	m /109/155
5/005	26/032	//47/057	/	D /68/104	Y /89/131	Y	n /110/156
6/006	27/033	0 /48/060	0	E /69/105	Z /90/132	Z	o /111/157
7/007	28/034	1 /49/061	1	F /70/106	[/91/133	[	p /112/160
8/010	29/035	2 /50/062	2	G /71/107	\ /92/134	\	q /113/161
9/011	30/036	3 /51/063	3	H /72/110	] /93/135	]	r /114/162
10/012	31/037	4 /52/064	4	I /73/111	~ /94/136	~	s /115/163
11/013	/32/040	5 /53/065	5	J /74/112	_ /95/137	_	t /116/164
12/014	! /33/041	6 /54/066	6	K /75/113	` /96/140	`	u /117/165
13/015	" /34/042	7 /55/067	7	L /76/114	o /97/141	o	v /118/166
14/016	# /35/043	8 /56/070	8	M /77/115	b /98/142	b	w /119/167
15/017	\$ /36/044	9 /57/071	9	N /78/116	c /99/143	c	x /120/170
16/020	% /37/045	: /58/072	:	O /79/117	d /100/144	d	y /121/171
17/021	& /38/046	: /59/073	:	P /80/120	e /101/145	e	z /122/172
18/022	' /39/047	< /60/074	<	Q /81/121	f /102/146	f	{ /123/173
19/023	(/40/050	= /61/075	=	R /82/122	g /103/147	g	| /124/174
20/024	) /41/051	> /62/076	>	S /83/123	h /104/150	h	} /125/175
21/025	* /42/052	? /63/077	?	T /84/124	i /105/151	i	~ /126/176

Digraph Listing of Font -dr

1/001	·	22/026	×	+ /43/053	+	@ /64/100	@	U /85/125	U	j /106/152	j
2/002	°	23/027	←	./44/054	,	A /65/101	A	V /86/126	V	k /107/153	k
3/003	◦	24/030	∇	- /45/055	-	B /66/102	B	W /87/127	W	l /108/154	l
4/004	◯	25/031	‡	./46/056	.	C /67/103	C	X /88/130	X	m /109/155	m
5/005	⊙	26/032	§	//47/057	/	D /68/104	D	Y /89/131	Y	n /110/156	n
6/006	◻	27/033	†	0/48/060	0	E /69/105	E	Z /90/132	Z	o /111/157	o
7/007	△	28/034	±	1/49/061	1	F /70/106	F	[/91/133	[	p /112/160	p
8/010	◇	29/035	∞	2/50/062	2	G /71/107	G	\ /92/134	\	q /113/161	q
9/011	☆	30/036	π	3/51/063	3	H /72/110	H	] /93/135	]	r /114/162	r
10/012	+	31/037	°	4/52/064	4	I /73/111	I	~ /94/136	~	s /115/163	s
11/013	×	/32/040		5/53/065	5	J /74/112	J	_ /95/137	_	t /116/164	t
12/014	*	!/33/041	!	6/54/066	6	K /75/113	K	` /96/140	`	u /117/165	u
13/015	●	" /34/042	"	7/55/067	7	L /76/114	L	o /97/141	o	v /118/166	v
14/016	■	# /35/043	#	8/56/070	8	M /77/115	M	b /98/142	b	w /119/167	w
15/017	▲	\$ /36/044	\$	9/57/071	9	N /78/116	N	c /99/143	c	x /120/170	x
16/020	★	% /37/045	%	: /58/072	:	O /79/117	O	d /100/144	d	y /121/171	y
17/021	↑	& /38/046	&	: /59/073	:	P /80/120	P	e /101/145	e	z /122/172	z
18/022	↗	' /39/047	'	< /60/074	<	Q /81/121	Q	f /102/146	f	{ /123/173	{
19/023	⊕	(/40/050	(	= /61/075	=	R /82/122	R	g /103/147	g	| /124/174	|
20/024	*	) /41/051	)	> /62/076	>	S /83/123	S	h /104/150	h	} /125/175	}
21/025	◻	* /42/052	*	? /63/077	?	T /84/124	T	i /105/151	i	~ /126/176	~

Digraph Listing of Font -engl

1/001	22/026	+ /43/053	+	@/64/100	U/85/125	Ū	j/106/152	j
2/002	23/027	, /44/054	,	A/65/101	V/86/126	Ų	k/107/153	k
3/003	24/030	- /45/055	—	B/66/102	W/87/127	Ŵ	l/108/154	l
4/004	25/031	. /46/056	.	C/67/103	X/88/130	Ŷ	m/109/155	m
5/005	26/032	//47/057	/	D/68/104	Y/89/131	Ÿ	n/110/156	n
6/006	27/033	0/48/060	0	E/69/105	Z/90/132	Ʒ	o/111/157	o
7/007	28/034	1/49/061	1	F/70/106	[/91/133	Ɔ	p/112/160	p
8/010	29/035	2/50/062	2	G/71/107	\/92/134	Ǝ	q/113/161	q
9/011	30/036	3/51/063	3	H/72/110	] /93/135	Ǝ	r/114/162	r
10/012	31/037	4/52/064	4	I/73/111	~ /94/136	Ǝ	s/115/163	s
11/013	/32/040	5/53/065	5	J/74/112	_ /95/137	Ǝ	t/116/164	t
12/014	! /33/041	6/54/066	6	K/75/113	` /96/140	Ǝ	u/117/165	u
13/015	" /34/042	7/55/067	7	L/76/114	a /97/141	Ǝ	v/118/166	v
14/016	# /35/043	8/56/070	8	M/77/115	b /98/142	Ǝ	w/119/167	w
15/017	\$ /36/044	9/57/071	9	N/78/116	c /99/143	Ǝ	x/120/170	x
16/020	% /37/045	: /58/072	:	O/79/117	d /100/144	Ǝ	y/121/171	y
17/021	& /38/046	; /59/073	;	P/80/120	e /101/145	Ǝ	z/122/172	z
18/022	' /39/047	< /60/074	<	Q/81/121	f /102/146	Ǝ	{ /123/173	{
19/023	(/40/050	= /61/075	=	R/82/122	g /103/147	Ǝ	| /124/174	|
20/024	) /41/051	> /62/076	>	S/83/123	h /104/150	Ǝ	} /125/175	}
21/025	* /42/052	? /63/077	?	T/84/124	.i /105/151	Ǝ	~ /126/176	~

Digraph Listing of Font -germ

1/001	22/026	+ /43/053	@/64/100	U/85/125	u	j/106/152	j
2/002	23/027	, /44/054	A/65/101	V/86/126	Ů	k/107/153	ř
3/003	24/030	- /45/055	B/66/102	W/87/127	Ů	l/108/154	l
4/004	25/031	. /46/056	C/67/103	X/88/130	Ǽ	m/109/155	m
5/005	26/032	//47/057	D/68/104	Y/89/131	ŷ	n/110/156	n
6/006	27/033	0 /48/060	E/69/105	Z/90/132	Ȝ	o/111/157	o
7/007	28/034	1 /49/061	F/70/106	[/91/133	p	p/112/160	p
8/010	29/035	2 /50/062	G/71/107	\ /92/134	q	q/113/161	q
9/011	30/036	3 /51/063	H/72/110	] /93/135	r	r/114/162	r
10/012	31/037	4 /52/064	I/73/111	~ /94/136	ř	s/115/163	ř
11/013	/32/040	5 /53/065	J/74/112	_ /95/137	t	t/116/164	t
12/014	! /33/041	6 /54/066	K/75/113	` /96/140	u	u/117/165	u
13/015	" /34/042	7 /55/067	L/76/114	a /97/141	a	v/118/166	b
14/016	# /35/043	8 /56/070	M/77/115	b /98/142	b	w/119/167	bw
15/017	\$ /36/044	9 /57/071	N/78/116	c /99/143	c	x/120/170	ř
16/020	% /37/045	: /58/072	O/79/117	d /100/144	d	y/121/171	y
17/021	& /38/046	: /59/073	P/80/120	e /101/145	e	z/122/172	ž
18/022	' /39/047	< /60/074	Q/81/121	f /102/146	f	{ /123/173	s
19/023	(/40/050	= /61/075	R/82/122	g /103/147	g	| /124/174	ß
20/024	) /41/051	> /62/076	S/83/123	h /104/150	h	{ /125/175	ß
21/025	* /42/052	? /63/077	T/84/124	i /105/151	i	~ /126/176	~

Digraph Listing of Font -ital

1/001	22/026	+ /43/053	@/64/100	U/85/125	U	j/106/152	j
2/002	23/027	, /44/054	A/65/101	V/86/126	V	k/107/153	k
3/003	24/030	- /45/055	B/66/102	W/87/127	W	l/108/154	l
4/004	25/031	. /46/056	C/67/103	X/88/130	X	m/109/155	m
5/005	26/032	//47/057	D/68/104	Y/89/131	Y	n/110/156	n
6/006	27/033	0/48/060	E/69/105	Z/90/132	Z	o/111/157	o
7/007	28/034	1/49/061	F/70/106	[/91/133	[	p/112/160	p
8/010	29/035	2/50/062	G/71/107	\92/134	\	q/113/161	q
9/011	30/036	3/51/063	H/72/110	]93/135	]	r/114/162	r
10/012	31/037	4/52/064	I/73/111	~/94/136	~	s/115/163	s
11/013	/32/040	5/53/065	J/74/112	_95/137	_	t/116/164	t
12/014	!/33/041	6/54/066	K/75/113	`96/140	`	u/117/165	u
13/015	"/34/042	7/55/067	L/76/114	a/97/141	a	v/118/166	v
14/016	#/35/043	8/56/070	M/77/115	b/98/142	b	w/119/167	w
15/017	\$/36/044	9/57/071	N/78/116	c/99/143	c	x/120/170	x
16/020	%/37/045	:/58/072	O/79/117	d/100/144	d	y/121/171	y
17/021	&/38/046	:/59/073	P/80/120	e/101/145	e	z/122/172	z
18/022	'/39/047	</60/074	Q/81/121	f/102/146	f	{/123/173	{
19/023	(/40/050	=/61/075	R/82/122	g/103/147	g	|/124/174	|
20/024	)/41/051	>/62/076	S/83/123	h/104/150	h	/125/175	/
21/025	*/42/052	?/63/077	T/84/124	i/105/151	i	~/126/176	~

Digraph Listing of Font -ksym2

1/001	+	22/026		+ /43/053		@/64/100		U/85/125		j/106/152
2/002	X	23/027		,/44/054		A/65/101		V/86/126		k/107/153
3/003	O	24/030	...	- /45/055		B/66/102		W/87/127	,	l/108/154
4/004	⊕	25/031	••	. /46/056		C/67/103	▪▪	X/88/130	↘	m/109/155
5/005	△	26/032	•	//47/057		D/68/104	△△	Y/89/131	≡	n/110/156
6/006	□	27/033		0/48/060		E/69/105		Z/90/132		o/111/157
7/007	●	28/034	+	1/49/061	☆	F/70/106		[/91/133		p/112/160
8/010	—	29/035	☹	2/50/062	□	G/71/107		\ /92/134		q/113/161
9/011	|	30/036	/	3/51/063	□	H/72/110		] /93/135		r/114/162
10/012	·	31/037	//	4/52/064	◦	I/73/111	□	~ /94/136	-	s/115/163
11/013	∕	/32/040	//	5/53/065	□	J/74/112	/	_ /95/137	△	t/116/164
12/014	∖	!/33/041		6/54/066	◦	K/75/113		` /96/140	↷	u/117/165
13/015	∕	"/34/042		7/55/067	□	L/76/114	//	a /97/141	△	v/118/166
14/016	∖	#/35/043		8/56/070	|	M/77/115	□	b /98/142	□	w/119/167
15/017	//	\$/36/044		9/57/071		N/78/116		c /99/143		x/120/170
16/020	≡	%/37/045		: /58/072	//	O/79/117		d /100/144		y/121/171
17/021	≡	&/38/046		: /59/073		P/80/120	∕	e /101/145		z/122/172
18/022	≡	'/39/047		< /60/074		Q/81/121	≡	f /102/146		{ /123/173
19/023	☹	(/40/050		= /61/075		R/82/122	≡	g /103/147		| /124/174
20/024	☹	)/41/051		> /62/076		S/83/123	≡	h /104/150		} /125/175
21/025	☹	* /42/052		? /63/077		T/84/124	≡	i /105/151		~ /126/176

Digraph Listing of Font -OSW

1/001	Ũ	22/026	+	+ /43/053	⊕	⊗	⊙	⊙/64/100	U	U/85/125	U	j	j/106/152
2/002	ö	23/027	,	, /44/054	,	A	A	A/65/101	V	V/86/126	V	k	k/107/153
3/003	ö	24/030	=	= /45/055	=	B	B	B/66/102	W	W/87/127	W	l	l/108/154
4/004	ü	25/031	.	. /46/056	.	C	C	C/67/103	X	X/88/130	X	m	m/109/155
5/005	ß	26/032	/	/ /47/057	/	D	D	D/68/104	Y	Y/89/131	Y	n	n/110/156
6/006	≥	27/033	0	0 /48/060	0	E	E	E/69/105	Z	Z/90/132	Z	o	o/111/157
7/007	≤	28/034	1	1 /49/061	1	F	F	F/70/106	[	[/91/133	[	p	p/112/160
8/010		29/035	2	2 /50/062	2	G	G	G/71/107	\	\/92/134	\	q	q/113/161
9/011		30/036	3	3 /51/063	3	H	H	H/72/110	l	l/93/135	l	r	r/114/162
10/012	⇒	31/037	4	4 /52/064	4	I	I	I/73/111	^	^/94/136	^	s	s/115/163
11/013	✕	/32/040	5	5 /53/065	5	J	J	J/74/112	_	_/95/137	_	t	t/116/164
12/014	!	! /33/041	6	6 /54/066	6	K	K	K/75/113	˘	˘/96/140	˘	u	u/117/165
13/015	"	" /34/042	7	7 /55/067	7	L	L	L/76/114	@	@/97/141	@	v	v/118/166
14/016	•	# /35/043	8	8 /56/070	8	M	M	M/77/115	b	b/98/142	b	w	w/119/167
15/017	◊	\$ /36/044	9	9 /57/071	9	N	N	N/78/116	c	c/99/143	c	x	x/120/170
16/020	%	% /37/045	:	: /58/072	:	O	O	O/79/117	d	d/100/144	d	y	y/121/171
17/021	&	& /38/046	;	; /59/073	;	P	P	P/80/120	e	e/101/145	e	z	z/122/172
18/022	˘	' /39/047	<	< /60/074	<	Q	Q	Q/81/121	f	f/102/146	f	{	{/123/173
19/023	(	( /40/050	=	= /61/075	=	R	R	R/82/122	g	g/103/147	g	|	|/124/174
20/024	Ä	) /41/051	>	> /62/076	>	S	S	S/83/123	h	h/104/150	h	}	}/125/175
21/025	Ö	* /42/052	?	? /63/077	?	T	T	T/84/124	i	i/105/151	i	~	~/126/176

Digraph Listing of Font -30SW

1/001	22/026	Ü	+ /43/053	‡	@/64/100	U/85/125	U	j/106/152	j
2/002	23/027	ö	./44/054	,	A/65/101	V/86/126	V	k/107/153	k
3/003	24/030	ö	- /45/055	=	B/66/102	W/87/127	W	l/108/154	l
4/004	25/031	ü	./46/056	°	C/67/103	X/88/130	X	m/109/155	m
5/005	26/032	ß	//47/057	/	D/68/104	Y/89/131	Y	n/110/156	n
6/006	27/033	z	0/48/060	0	E/69/105	Z/90/132	Z	o/111/157	o
7/007	28/034	z	1/49/061	1	F/70/106	[/91/133	[	p/112/160	p
8/010	29/035	z	2/50/062	2	G/71/107	\ /92/134	\	q/113/161	q
9/011	30/036	z	3/51/063	3	H/72/110	] /93/135	]	r/114/162	r
10/012	31/037	→	4/52/064	4	I/73/111	~ /94/136	~	s/115/163	s
11/013	32/040	z	5/53/065	5	J/74/112	_ /95/137	_	t/116/164	t
12/014	33/041	!	6/54/066	6	K/75/113	` /96/140	`	u/117/165	u
13/015	34/042	"	7/55/067	7	L/76/114	ª /97/141	ª	v/118/166	v
14/016	35/043	#	8/56/070	8	M/77/115	b /98/142	b	w/119/167	w
15/017	36/044	\$	9/57/071	9	N/78/116	c /99/143	c	x/120/170	x
16/020	37/045	%	: /58/072	:	O/79/117	d /100/144	d	y/121/171	y
17/021	38/046	&	: /59/073	:	P/80/120	e /101/145	e	z/122/172	z
18/022	39/047	'	< /60/074	<	Q/81/121	f /102/146	f	{ /123/173	{
19/023	40/050	()	= /61/075	=	R/82/122	g /103/147	g	| /124/174	|
20/024	41/051	)	> /62/076	>	S/83/123	h /104/150	h	} /125/175	}
21/025	42/052	*	? /63/077	?	T/84/124	i /105/151	i	~ /126/176	~

Digraph Listing of Font

-sg

1/001	22/026	+ /43/053	@/64/100	U/85/125	ψ	j/106/152	κ
2/002	23/027	./44/054	A/65/101	V/86/126	Α	k/107/153	λ
3/003	24/030	- /45/055	B/66/102	W/87/127	Β	l/108/154	μ
4/004	25/031	./46/056	C/67/103	X/88/130	Γ	m/109/155	ν
5/005	26/032	//47/057	D/68/104	Y/88/131	Δ	n/110/156	ξ
6/006	27/033	0/48/060	E/69/105	Z/90/132	Ε	o/111/157	ο
7/007	28/034	1/49/061	F/70/106	[/91/133	Z	p/112/160	π
8/010	29/035	2/50/062	G/71/107	\92/134	H	q/113/161	ρ
9/011	30/036	3/51/063	H/72/110	]93/135	Θ	r/114/162	σ
10/012	31/037	4/52/064	I/73/111	~/94/136	I	s/115/163	φ
11/013	/32/040	5/53/065	J/74/112	_95/137	K	t/116/164	χ
12/014	!/33/041	6/54/066	K/75/113	`96/140	Λ	u/117/165	ψ
13/015	"/34/042	7/55/067	L/76/114	α/97/141	M	v/118/166	
14/016	#/35/043	8/56/070	M/77/115	b/98/142	N	w/119/167	
15/017	\$/36/044	9/57/071	N/78/116	c/99/143	Ξ	x/120/170	
16/020	%/37/045	:/58/072	O/79/117	d/100/144	Ο	y/121/171	
17/021	&/38/046	:/59/073	P/80/120	e/101/145	Π	z/122/172	
18/022	'/39/047	</60/074	Q/81/121	f/102/146	Ρ	{/123/173	
19/023	(/40/050	=/61/075	R/82/122	g/103/147	Σ	|/124/174	
20/024	)/41/051	>/62/076	S/83/123	h/104/150	Φ	}/125/175	
21/025	*/42/052	?/63/077	T/84/124	i/105/151	Χ	~/126/176	

Digraph Listing of Font -Sf

1/001	·	22/026	X	+ /43/053	+	@/64/100	@	U/85/125	U	j/106/152	j
2/002	°	23/027	←	, /44/054	,	A/65/101	A	V/86/126	V	k/107/153	k
3/003	◦	24/030	∇	- /45/055	-	B/66/102	B	W/87/127	W	l/108/154	l
4/004	○	25/031	‡	. /46/056	.	C/67/103	C	X/88/130	X	m/109/155	m
5/005	⊙	26/032	§	/ /47/057	/	D/68/104	D	Y/89/131	Y	n/110/156	n
6/006	□	27/033	†	0 /48/060	0	E/69/105	E	Z/90/132	Z	o/111/157	o
7/007	△	28/034	±	1 /49/061	1	F/70/106	F	[/91/133	[	p/112/160	p
8/010	◇	29/035	∞	2 /50/062	2	G/71/107	G	\ /92/134	\	q/113/161	q
9/011	☆	30/036	π	3 /51/063	3	H/72/110	H	] /93/135	]	r/114/162	r
10/012	+	31/037	°	4 /52/064	4	I/73/111	I	~ /94/136	~	s/115/163	s
11/013	x	/32/040		5 /53/065	5	J/74/112	J	_ /95/137	_	t/116/164	t
12/014	*	! /33/041	!	6 /54/066	6	K/75/113	K	` /96/140	`	u/117/165	u
13/015	●	" /34/042	"	7 /55/067	7	L/76/114	L	ª /97/141	ª	v/118/166	v
14/016	■	# /35/043	#	8 /56/070	8	M/77/115	M	º /98/142	º	w/119/167	w
15/017	▲	\$ /36/044	\$	9 /57/071	9	N/78/116	N	¸ /99/143	¸	x/120/170	x
16/020	★	% /37/045	%	: /58/072	:	O/79/117	O	 /100/144		y/121/171	y
17/021	†	& /38/046	&	; /59/073	;	P/80/120	P	 /101/145		z/122/172	z
18/022	✕	' /39/047	'	< /60/074	<	Q/81/121	Q	 /102/146		{ /123/173	{
19/023	⊕	(/40/050	(	= /61/075	=	R/82/122	R	 /103/147		| /124/174	|
20/024	*	) /41/051	)	> /62/076	>	S/83/123	S	 /104/150		} /125/175	}
21/025	◻	* /42/052	*	? /63/077	?	T/84/124	T	· /105/151	·	~ /126/176	~

Digraph Listing of Font -sscp

1/001	22/026	+ /43/053	@/64/100	U/85/125	U	j/106/152	j
2/002	23/027	. /44/054	A/65/101	V/86/126	V	k/107/153	k
3/003	24/030	- /45/055	B/66/102	W/87/127	W	l/108/154	l
4/004	25/031	. /46/056	C/67/103	X/88/130	X	m/109/155	m
5/005	26/032	//47/057	D/68/104	Y/89/131	Y	n/110/156	n
6/006	27/033	0/48/060	E/69/105	Z/90/132	Z	o/111/157	o
7/007	28/034	1/49/061	F/70/106	[/91/133	[	p/112/160	p
8/010	29/035	2/50/062	G/71/107	\/92/134	\	q/113/161	q
9/011	30/036	3/51/063	H/72/110	]93/135	]	r/114/162	r
10/012	31/037	4/52/064	I/73/111	~/94/136	~	s/115/163	s
11/013	/32/040	5/53/065	J/74/112	_ /95/137	_	t/116/164	t
12/014	! /33/041	6/54/066	K/75/113	` /96/140	`	u/117/165	u
13/015	" /34/042	7/55/067	L/76/114	a/97/141	a	v/118/166	v
14/016	# /35/043	8/56/070	M/77/115	b/98/142	b	w/119/167	w
15/017	\$ /36/044	9/57/071	N/78/116	c/99/143	c	x/120/170	x
16/020	% /37/045	: /58/072	O/79/117	d/100/144	d	y/121/171	y
17/021	& /38/046	: /59/073	P/80/120	e/101/145	e	z/122/172	z
18/022	' /39/047	< /60/074	Q/81/121	f/102/146	f	{ /123/173	{
19/023	(/40/050	= /61/075	R/82/122	g/103/147	g	| /124/174	|
20/024	) /41/051	> /62/076	S/83/123	h/104/150	h	} /125/175	}
21/025	* /42/052	? /63/077	T/84/124	i/105/151	i	~ /126/176	~

Digraph Listing of Font -sym1

1/001	=	22/026	∧	+ /43/053	⌘	@ /64/100	‡	U /85/125	||	j /106/152
2/002	♀	23/027	▽	. /44/054	♁	A /65/101	Ξ	V /86/126	||	k /107/153
3/003	♥	24/030	□	- /45/055	☉	B /66/102	⊙	W /87/127		l /108/154
4/004	◇	25/031	△	. /46/056	♁	C /67/103	♀	X /88/130		m /109/155
5/005	♣	26/032	◇	//47/057	🔔	D /68/104	♀	Y /88/131		n /110/156
6/006	♠	27/033	☆	0 /48/060	✦	E /69/105	⊕	Z /90/132		o /111/157
7/007	♠	28/034	+	1 /49/061	☪	F /70/106	♂	[/91/133		p /112/160
8/010	▲	29/035	×	2 /50/062	☪	G /71/107	♁	\ /92/134		q /113/161
9/011	●	30/036	*	3 /51/063	♁	H /72/110	♁	] /93/135		r /114/162
10/012	▲	31/037	●	4 /52/064	•	I /73/111	♁	~ /94/136		s /115/163
11/013	∧	/32/040	■	5 /53/065	•	J /74/112	♁	_ /95/137		t /116/164
12/014	∩	! /33/041	▲	6 /54/066	o	K /75/113	♁	` /96/140		u /117/165
13/015	∪	" /34/042	◀	7 /55/067	o	L /76/114	♁	a /97/141		v /118/166
14/016	∩	# /35/043	▼	8 /56/070	o	M /77/115	♁	b /98/142		w /119/167
15/017	∩	\$ /36/044	▶	9 /57/071	o	N /78/116	*	c /99/143		x /120/170
16/020	ℜ	% /37/045	★	: /58/072	o	O /79/117	Ω	d /100/144		y /121/171
17/021	ℑ	& /38/046	↓	: /59/073	o	P /80/120	Ω	e /101/145		z /122/172
18/022	l	' /39/047	†	< /60/074	o	Q /81/121	l	f /102/146		{ /123/173
19/023	∩	(/40/050	⊗	= /61/075	o	R /82/122	l	g /103/147		| /124/174
20/024	∩	) /41/051	⊗	> /62/076	o	S /83/123	|	h /104/150		} /125/175
21/025	∩	* /42/052	⊗	? /63/077	o	T /84/124	||	. i /105/151		~ /126/176

Digraph Listing of Font -tr

1/001	22/026	+ /43/053	+	@/64/100	U/85/125	U	j/106/152	j
2/002	23/027	, /44/054	,	A/65/101	V/86/126	V	k/107/153	k
3/003	24/030	- /45/055	-	B/66/102	W/87/127	W	l/108/154	l
4/004	25/031	. /46/056	.	C/67/103	X/88/130	X	m/109/155	m
5/005	26/032	/ /47/057	/	D/68/104	Y/89/131	Y	n/110/156	n
6/006	27/033	0 /48/060	0	E/69/105	Z/90/132	Z	o/111/157	o
7/007	28/034	1 /49/061	1	F/70/106	[/91/133	[	p/112/160	p
8/010	29/035	2 /50/062	2	G/71/107	\ /92/134	\	q/113/161	q
9/011	30/036	3 /51/063	3	H/72/110	l /93/135	l	r/114/162	r
10/012	31/037	4 /52/064	4	I/73/111	~ /94/136	~	s/115/163	s
11/013	32/040	5 /53/065	5	J/74/112	_ /95/137	_	t/116/164	t
12/014	33/041	6 /54/066	6	K/75/113	` /96/140	`	u/117/165	u
13/015	34/042	7 /55/067	7	L/76/114	a /97/141	a	v/118/166	v
14/016	35/043	8 /56/070	8	M/77/115	b /98/142	b	w/119/167	w
15/017	36/044	9 /57/071	9	N/78/116	c /99/143	c	x/120/170	x
16/020	37/045	: /58/072	:	O/79/117	d /100/144	d	y/121/171	y
17/021	38/046	; /59/073	;	P/80/120	e /101/145	e	z/122/172	z
18/022	39/047	< /60/074	<	Q/81/121	f /102/146	f	{ /123/173	{
19/023	40/050	= /61/075	=	R/82/122	g /103/147	g	| /124/174	|
20/024	41/051	> /62/076	>	S/83/123	h /104/150	h	} /125/175	}
21/025	42/052	? /63/077	?	T/84/124	i /105/151	i	~ /126/176	~

Digraph Listing of Font -tri

1/001	22/026	+ /43/053	@ /64/100	U /85/125	j /106/152
2/002	23/027	. /44/054	A /65/101	V /86/126	k /107/153
3/003	24/030	- /45/055	B /66/102	W /87/127	l /108/154
4/004	25/031	. /46/056	C /67/103	X /88/130	m /109/155
5/005	26/032	/ /47/057	D /68/104	Y /89/131	n /110/156
6/006	27/033	0 /48/060	E /69/105	Z /90/132	o /111/157
7/007	28/034	1 /49/061	F /70/106	[/91/133	p /112/160
8/010	29/035	2 /50/062	G /71/107	\ /92/134	q /113/161
9/011	30/036	3 /51/063	H /72/110	] /93/135	r /114/162
10/012	31/037	4 /52/064	I /73/111	~ /94/136	s /115/163
11/013	/32/040	5 /53/065	J /74/112	_ /95/137	t /116/164
12/014	! /33/041	6 /54/066	K /75/113	` /96/140	u /117/165
13/015	" /34/042	7 /55/067	L /76/114	ª /97/141	v /118/166
14/016	# /35/043	8 /56/070	M /77/115	b /98/142	w /119/167
15/017	\$ /36/044	9 /57/071	N /78/116	c /99/143	x /120/170
16/020	% /37/045	: /58/072	O /79/117	d /100/144	y /121/171
17/021	& /38/046	; /59/073	P /80/120	e /101/145	z /122/172
18/022	' /39/047	< /60/074	Q /81/121	f /102/146	{ /123/173
19/023	(/40/050	= /61/075	R /82/122	g /103/147	| /124/174
20/024	) /41/051	> /62/076	S /83/123	h /104/150	} /125/175
21/025	* /42/052	? /63/077	T /84/124	i /105/151	~ /126/176

APPENDIX D: Instructions for ZOOM and SZOOM:

Presented here are directions for using ZOOM and SZOOM, older versions of XZOOM, intended for use on VT-100 terminals and emulators, and, SUN workstations with SUNVIEW, respectively.

ZOOM

The input files are all of the metagraphic overlay files that are to be plotted on the same map and the definition file.

The COMMAND:

```
zoom -m spac.def spac.grid bty2000.ov
```

will produce a plot of the grid and the overlay file on the CRT and allow the user to begin operating in interactive mode.

Parts of the plot can be enlarged by using the cursor to outline the section to be enlarged. Locate a corner of the area with the cursor, press the space bar, locate the diagonally opposite corner of the area, and press the space bar again. The enlarged area will appear on the screen. The zoom process may be continued on a still smaller section by repeating these steps.

To exit from ZOOM enter q
 To redraw the previous plot enter p
 To redraw the original plot enter h

Once the plot is on the screen, to position a label locate the start point with the cursor and enter the letter a (+ will appear at that location on the screen). Move the cursor to a second location, which together with the first location defines the direction along which the label will be written. Depress the space bar. (Only direction is indicated by the second point; it is not used to define the length of the label.)

NAME OF DIGITIZING OUTPUT FILE: will appear on the screen. Enter the name of the file to which you want the text information written and press <return>. Coordinates and angle at which the label is written will appear on the screen, for example:

```
-xy 33.88 32.02      (cm from map origin)
-r -28.8            (angle of rotation - measured
                   counterclockwise from positive
                   x-axis)
```

ENTER TEXT (NULL LINE TERMINATES) will appear next on the screen

The user then enters text. To exit text-entry mode depress the return key twice. This will end text entry and bring the map back on the screen.

To close the label output file and exit from ZOOM type q
 Edit the label output file as described below before using LEGEND.

Two other labeling options are available, "d" and "l" (i.e., the letter L). If the text is to be parallel with the bottom border of the map (which is sometimes a mapping requirement) d is used instead of a. d requires only one point because the horizontal direction, 0 degree angle, is assumed. l allows the user to draw a line from one location to another rather than enter text. It creates a file with two or more pairs of x,y coordinates, indicating the end points of the vectors making up the line.

The output label file must be edited to set character size, font type, pen number, etc.

output from ZOOM:

```

-xy 33.88 32.02      ##x, y coordinates
-r -28.8            ##angle, from horizontal
-t                 ##text follows
2000                ##text
.                  ##end segment
-xy 47.82 36.31     ##x,y coordinates of next text
-r 12.78            ##rotate text 12.7 degrees counterclockwise
-t                 ##following text is to be posted
2000                ##text
.                  ##end of text

```

Edited sample label control file: label2000.dat

```

-s 1                ##character size in cm
-f -                ##use system font
-p 1                ##pen number = 1
-xy 33.88 32.02     ##x,y coordinates of start of text
-r -28.8            ##rotate text 28.8 degrees clockwise
-t                 ##following text is to be posted
2000                ##text
.                  ##end of text
-xy 47.82 36.31     ##x,y coordinates of next text
-r 12.78            ##rotate text 12.7 degrees counterclockwise
-t                 ##following text is to be posted
2000                ##text
.                  ##end of text

```

If the character size, font, and pen number are to remain constant, the first three lines need to be written only once at the beginning of a legend file.

If the character size, font, or pen size change then the -s, -f, and/or -p lines must be inserted each time a change occurs.

The edited file, label2000.dat, is processed with the legend COMMAND:

```
legend -mo spac.def label2000.ov label2000.dat
```

The segment of line overwritten by the label can be removed by "blanking", a process described in Appendix B.

SZOOM

The COMMAND:

```
zoom spac.def spac.grid bty2000.ov
```

will produce a graphics display of the grid and file bty2000.ov on a SUN workstation CRT. The menu appears on the screen to the left of the image. The menu is used by placing the cursor on top of the chosen function and depressing the left button on the mouse. Pressing the left button will also start any of the operations, for example, panning, or drawing a line. Pressing it again, will end most operations. The POLY and LINE operations are terminated by pressing the right button.

The TEXT option will allow the user to enter text that will be parallel to the lower edge of the plotting surface. Moving the cursor to the position where text will start and depressing the left button on the mouse will produce a prompt at the bottom of the screen instructing the user to enter text. When the text is completed depressing RETURN and a period and RETURN again will enter the text in a log file.

<TEXT allows the user to write text at any angle by following the procedure for TEXT except that after the start point is entered the cursor is moved to a point which indicates the direction in which the text will be written and then the left-hand mouse button is depressed again.

The default header, "-f- -s .3 -l .5 # zoom default header line", is written to the output file.

The function CTL TEXT can be chosen before TEXT. It allows the user to create the header and choose whatever options (font, size, etc.) are needed.

The menu option MARK allows the user to get the x,y coordinates of a point by moving the cursor to the point and depressing the lefthand cursor button.

The LINE option is used to draw a line. Each depression of the left-hand mouse button enters another point on the line into the log file. The righthand button is used to terminate the line.

The POLY option is used to draw polygons and is especially useful in delineating the portions of line graphics which are to be blanked. The cursor is placed at the first point of the polygon and the left-hand button of the mouse is depressed. Subsequent points are picked, moving in a COUNTERCLOCK-WISE direction. After the last point is picked depression of the righthand mouse button will close the polygon to the original starting point.

PAN controls the panning option. This allows the user to move around the graphic and bring up various portions on the screen. Place the cursor at a point and depress the lefthand mouse button. Move the cursor to the new position for that point and depress the lefthand mouse button again.

ZOOM will magnify a portion of the screen. Move the cursor to a corner of the area to be enlarged, hold down the lefthand button on the mouse, while moving the mouse. This creates on the screen, a rectangle that defines the area to be enlarged. Depressing the left mouse button again will bring up the magnified image on the screen.

deZOOM reverses the ZOOM procedure by returning to the previous window.

HOME brings up the original display on the screen

RePLT will refresh the screen with text or lines that have just been entered.

EXIT, in addition to breaking out of SZOOM, produces the prompt that requests the user enter an output file name if any new data were generated during the SZOOM process.

The COMMAND:

```
legend -mo spac.def label2000.ov label2000.dat
```

will create an overlay file from the SZOOM output file, label2000.dat

The "label" option will allow the user to place the text, written in the text-entry area, on the map display. It will be parallel to the lower edge of the display. Moving the cursor to the map location where the text will be written and pressing the left button on the mouse will produce a small circle on the display. This is the location of the center of the first character of the text. Pressing the right button on the mouse will enter the coordinates of this point into the digit file and stop the process.

"<label" allows the user to write text at any angle by following the procedure for "label" except that after the start point is entered the cursor is moved to another point which indicates the direction in which the text will be written and then the left-hand mouse button is depressed again. This line indicates direction only; it is not related to length of text. After the direction has been entered press the right-hand mouse button to complete the process.

The "line" option is used to draw a line. After "line" is selected each depression of the lefthand mouse button enters a point on the line into the log file. The righthand button is used to terminate the process.

The "poly" option is used to draw polygons. The lefthand button of the mouse is depressed indicating the first point of the polygon. Subsequent points are picked and entered using the left button. If the polygon is being drawn as part of the blanking procedure the polygon points must be picked moving in a COUNTERCLOCK-WISE direction. After the last point is picked depression of the righthand mouse button will close the polygon to the original starting point.

The menu option "mark" allows the user to get the x,y coordinates of a point by moving the cursor to the point and pressing the lefthand cursor button. Pressing the right-hand button completes the process.

"plotter" allows the user to enter the name of the plot control file. The default name is plot.

The "edit pl" window allows the user to change the contents of the file, plot. For example, if instead of plotting just the 2000 meter contour in the example in figure 8, we were to plot all of the contours, "edit pl" would be chosen and the contents of the file, plot, would be edited in the "edit pl" window to become:

```
    spac.grid bty*.ov.
```

by changing bty2000.ov to bty*.ov and completing the process with the DONE option. The ABORT option would terminate the process without any change.

After exiting from XZOOM by choosing the "quit" option the user can process the output file, digit, with the LEGEND command.

VII. CREATE MAP TEXT AND BORDER INFORMATION

CONMAP REQUIREMENTSMAPGEN ROUTINE(S)

BTR standards

LEGEND

In addition to labeling parts of the internal map, the LEGEND command is also used to create the information in the external map margins, for example, title, scale bars legends, etc. Some parameters used in LEGEND control files are:

```
-w = region of map to be used (full map area or internal map)
-L = line pattern to be used
-f = font
-p = pen number
-s = character size in centimeters
-j = justification (left, center, or right)
-l = leading
-t = all lines following are text
-b = scale bar generation
-x = x-coordinate location of character or start of line
-y = y-coordinate location of character or start of line
-T = incorporate block of troff-formated text
```

Note: It is sometimes advantageous to measure the coordinate distance to the point where a number or character will be placed from the upper righthand corner of the external map. If this is done use the > to indicate measurement from the upper righthand corner and give the measurement as a negative value. For example:

```
-x >-3.0
-y >-1.0
```

is located 3 cm in and one cm down from the upper righthand corner, while:

```
-x 3.0
-y 1.0
```

is 3 cm in and 1 cm up from the lower lefthand corner of the external map.

A very useful parameter is -x | which will center the character(s), for example:

```
-w d    ##data window
-x |    ##center of width of the data window
-y -.7  ##.7cm below window
-j c    ##center justify text
-t      ##text follows
```

will center the text that follows it .7cm below the data window.

The following file, inlgnd, was used to create the map border in figure 9.

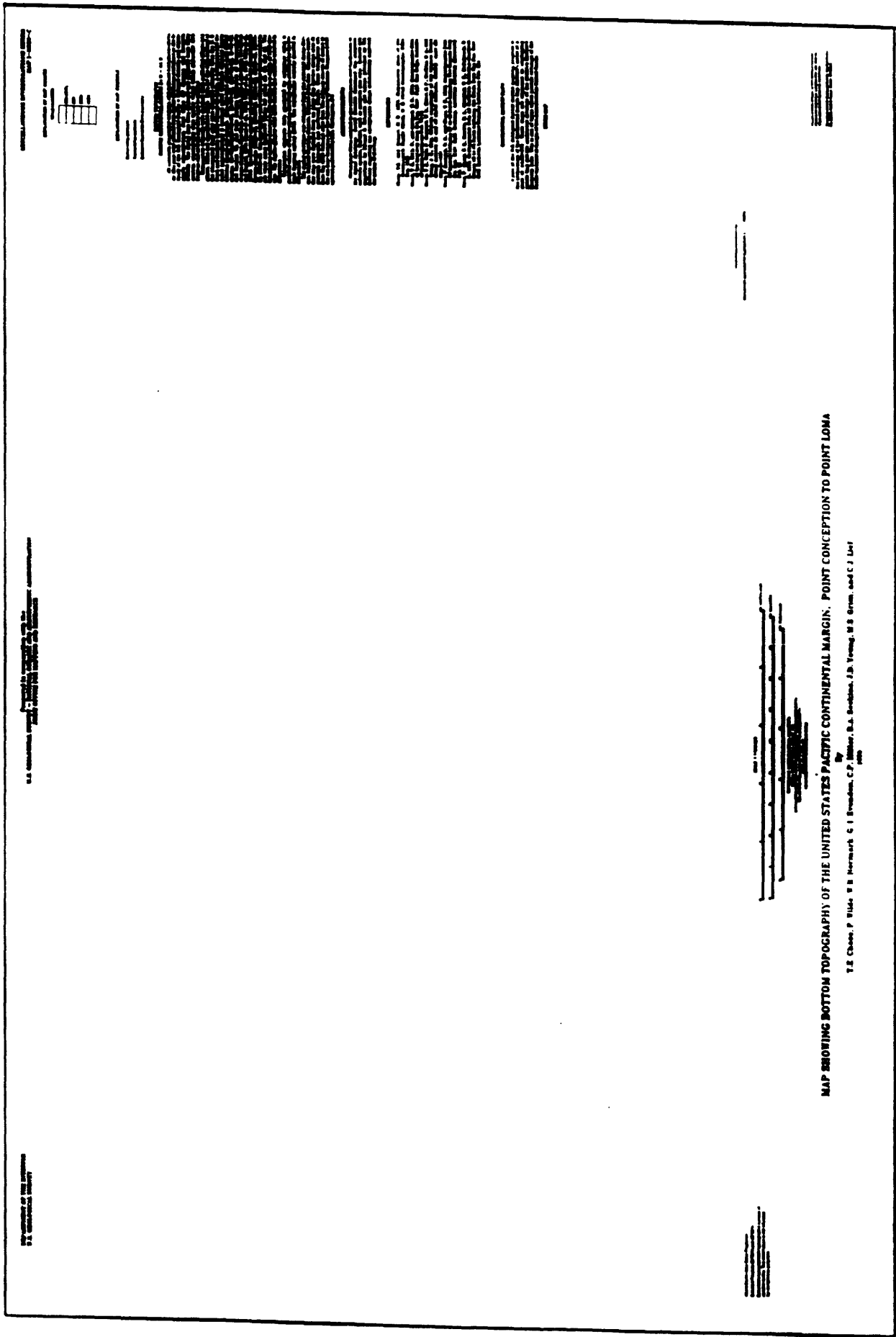


Figure 9. External map containing text and legend.

```

##-----
##-----
## CONMAP LEGEND FILE FOR SOUTHERN PACIFIC COAST PANEL
## BATHYMETRY MAP
##-----
##-----
## THIS BORDER LINE AROUND THE ENTIRE MAP IS USED FOR
## MEASURING AND EDITING AND SHOULD BE REMOVED FROM
## THE FINAL MAP
##-----
##      This section puts a line, delineating the
##      entire plot area, around the map.
##-----
##
-w p # select entire plot area as window
-L 0 # use pen 0
> 0 # start at lower right
> > # go to right and top
0 > # go to left and top
0 0 # go to left and bottom
> 0 # go to right and bottom
. # close line
##-----
##-----
##      The next section will place registration marks
##      on sheet.
##-----
## upper left
##-----
-w p # select entire plot area as window
-L 1 # use pen 1
1.0 >
0.0 >
0.0 >-1.0
.
##-----
## upper right
##-----
-w p
-L 1
>-1.0 >
> >
> >-1.0
.
##-----
## lower left
##-----
-w p
-L 1
0.0 1.0
0.0 0.0
1.0 0.0
.
##-----
## lower right
##-----
-w p
-L 1
>-1.0 0.0

```

```

> 0.0
> 1.0
.
##-----
##-----
## SCALE AND SCALE BARS
##-----
-w p
-f -          # default font selected
-p 5          # pen 5
-s .2         # character size = .2 cm
-x 46.4       # position along x-axis
-y 11.1       # position along y-axis
-j c         # center justified at x,y point
-t           # text follows
SCALE 1:1 000 000
.           # end text
##-----
## Place scale bars
##-----
-f -          # font selected is default
-p 5
-s .15        # size characters 0.15
-w p         # window selected is the entire plot sheet
-j c         # justify center
##-----
## NOTE - centering is based on the combined length of the
## scale bar plus its annotation
##-----
-x 39.5       # x location of center of nautical mile scale bar
-y 10.4       # y location of center of nautical mile scale bar
-b 25,kn,4,5  # nm scale bar: 25nm segments (4 right of 0; 5 left)
-x 37.5       #center of kilometer scale bar
-y 9.6        #center of kilometer scale bar
-b 25,km,8,5  # km scale bar: 25km segments (4 right of 0; 5 left)
-x 40.5       #center of mile scale bar
-y 8.8        #center of mile scale bar
-b 25,mi,4,5  # statute mile scale bar
##-----
##-----
##      topo and bathy contouring info
##-----
-f -
-p 5
-s 0.175      # character size 0.175
-l 0.30       # leading set to 0.30
-w p
-j c
-x 46.4
-y 8.40
-t
TOPOGRAPHIC CONTOUR INTERVAL 500 METERS
.
-x 46.4
-y 8.12
-s 0.150
-t
NATIONAL GEODETIC VERTICAL DATUM OF 1929
.

```

```

-x 46.4
-y 7.84
-s 0.175
-t
BATHYMETRIC CONTOUR INTERVALS 200 METERS TO 3000 METER DEPTH
100 METERS FROM 3000 METER DEPTH TO MAXIMUM DEPTH
.
-x 46.4
-y 7.27
-s 0.150
-t
DATUM: MEAN LOW WATER
.
-s 0.125
-x 46.4
-y 7.045
-t
THE RELATIONSHIP BETWEEN THE TWO DATUMS IS VARIABLE
.
##-----
##-----
##      Place title of map
##-----
-s .6          # set character size at 0.6 cm
-l .80        # leading size 0.80 cm
-f -tr       # set font style to tr
-w p
-x 46.4       # x coordinate for center of text
-y 5.45      # y coordinate for center of text
-j c         # center text relative to post position
-t           # begin text
MAP SHOWING BOTTOM TOPOGRAPHY OF THE UNITED STATES PACIFIC CONTINENTAL
MARGIN, POINT CONCEPTION TO POINT LOMA
.
##-----
-s .40
-w p
-x 46.4
-y 4.45
-j c
-t
By
.
##-----
-s .40
-w p
-x 46.4
-y 3.55
-j c
-t
T.E. Chase, P. Wilde, W.R. Normark, G. I. Evenden, C.P. Miller, B.A. Seekins
J.D. Young, M.S. Grim, and C.J. Lief
.
-s .3
-x 46.4
-y 2.80
-j c
-t
1989
.

```



```

##-----
##-----
## UPPER RIGHT CORNER LEGEND
##-----
-f -tr
-s .3
-w p
-j r
-x >-2.14
-y >-1.45
-t
MISCELLANEOUS INVESTIGATIONS SERIES
.
-f -tr
-s .3
-x >-2.14
-y >-1.95
-j r
-t
MAP I-2089-C
.
##-----
## UPPER LEFT LEGEND
##-----
-f -tr
-s .3
-w p
-x 5.8
-y >-1.45
-j l
-t
U.S. DEPARTMENT OF THE INTERIOR
.
-f -tr
-s .3
-x 5.8
-y >-1.95
-t
U.S. GEOLOGICAL SURVEY
.
##-----
## LOWER LEFT CORNER LEGEND
##-----
-f -
-p 5
-s .2
-w p
-x 3.0
-y 11.8
-j l
-t
Albers Equal-Area Conic Projection
.
-f -
-s .2
-w p
-x 3.0
-y 11.3
-j l

```

-t
Standard Parallels 29 3730'N and 45 3730'N

.
-f -
-s .2
-w p
-x 3.0
-y 10.8
-l 0.375
-j 1
-t

Bathymetry compiled from hydrographic surveys of variable quality. This information is not intended for navigational purposes.

.
##-----
LOWER RIGHT SECTION OF MAP
##-----
non-endorsement/sale information
##-----

-f -
-s .15
-w p
-x >-7.9
-y 6.5
-j 1
-l 0.30
-t

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For sale by U.S. Geological Survey, Map Distribution,
Box 25286, Federal Center, Denver, CO 80225

.
-f -
-s .10
-w p
-x 85.25
-y 12.65
-j 1
-t

INTERIOR-GEOLOGICAL SURVEY, RESTON, VA-1989

.
##-----
##director's approval
##-----

-f -
-s .20
-w p
-x 82.80
-y 12.00
-j 1
-t

Manuscript approved for publication (, 1989)

.
##-----
JOMAR title
##-----

```

-f -tr
-w p
-s .3
-l .5
-p 7
-x |
-y >-1.45
-j c
-t

```

Prepared in cooperation with the
 U.S. GEOLOGICAL SURVEY - NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
 JOINT OFFICE FOR MAPPING AND RESEARCH

```

.
##-----
## text
##-----
##map units: title
##-----
-f -
-s 0.20
-x >-7.80
-y >-3.85
-j c
-t
SCALE IN METERS
.
##-----
##map units: boxes
##-----
-w p
-L 3
>-9.30 >-4.35
>-7.90 >-4.35
>-7.90 >-7.35
>-9.30 >-7.35
>-9.30 >-4.35
.
#end line
-w p
-L 3
>-9.30 >-4.95
>-7.90 >-4.95
.
#end line
-w p
-L 3
>-9.30 >-5.55
>-7.90 >-5.55
.
#end line
-w p
-L 3
>-9.30 >-6.15
>-7.90 >-6.15
.
#end line
-w p
-L 3
>-9.30 >-6.75
>-7.90 >-6.75
.
#end line
##-----

```

```

##map units: box labels
##-----
-f -
-s 0.20
-j 1
-xy >-7.65 >-4.95
-t
SEA LEVEL
.
-f -
-s 0.20
-j 1
-xy >-7.65 >-5.55
-t
200
.
-f -
-s 0.20
-j 1
-xy >-7.65 >-6.15
-t
3000
.
-f -
-s 0.20
-j 1
-xy >-7.65 >-6.75
-t
4500
.
##-----
-f -
-s 0.20
-j 1
-xy >-11.9 >-9.85
-t
Bathymetric contours
.
-xy >-11.9 >-10.45
-t
Topographic contours
.
-xy >-11.9 >-11.05
-t
Exclusive Economic Zone boundary
.
##-----
##text
##-----
-f -tr
-s 0.20 -w p
-x >-13.6
-y >-2.95
-T intext

```

STEP 7 ==>

The following command created the legend overlay shown in figure 9:

```
legend -mo spac.def lgnd.ov inlgnd
```

VIII. MAKE A HARD COPY OF THE MAP

MAPGEN ROUTINE(S)

PLOTTER

To be plotted, the metagraphic overlay file must be translated to a device-dependent file. MAPGEN gives the user the option of creating an output file on disk in order to store the device-dependent plot file until it is sent to the output device, or, directing the output to the plotting device immediately.

The user can make a plot of one or several overlay files using this command.

```
plotter -d (I/Odev) -o (/dev/portID) file(s).ov
```

Figure 10 shows several overlays plotted on a map.

STEP 8 ==>

The command used to create a plot file which can later be sent to the Calcomp electrostatic plotter is:

```
plotter -d c5800 -o plotfile grid dat*.ov legend.ov
```

The device driver name c5800 refers to the Office of Energy and Marine Geology (OEMG) CALCOMP 5845 electrostatic plotter. Also available on the OEMG SUN IV MAPGEN system are:

c906	=	CALCOMP 906-format, 1044 line plotter
gol40	=	GraphOn GO-140 terminal
kong	=	KONGSBERG
tek4014sm	=	TEKTRONIX 4014
tk4010	=	TEKTRONIX 4010
gerber	=	GERBER
ps	=	PostScript

If the name of the output device is omitted the PLOTTER routine uses the device listed in the TERM or GTERM of the process' environment.

The output devices and driver names differ at each installation. The local system manager must be consulted for information on output devices.

An option available with the PLOTTER command is the ability to change pen numbers at plotting time. Pen 0 is the default. Other pen numbers may have been included in LINES and LEGEND control files. To change pen numbers the command line syntax is similar to that used in the following command which produced the plot in figure 11.

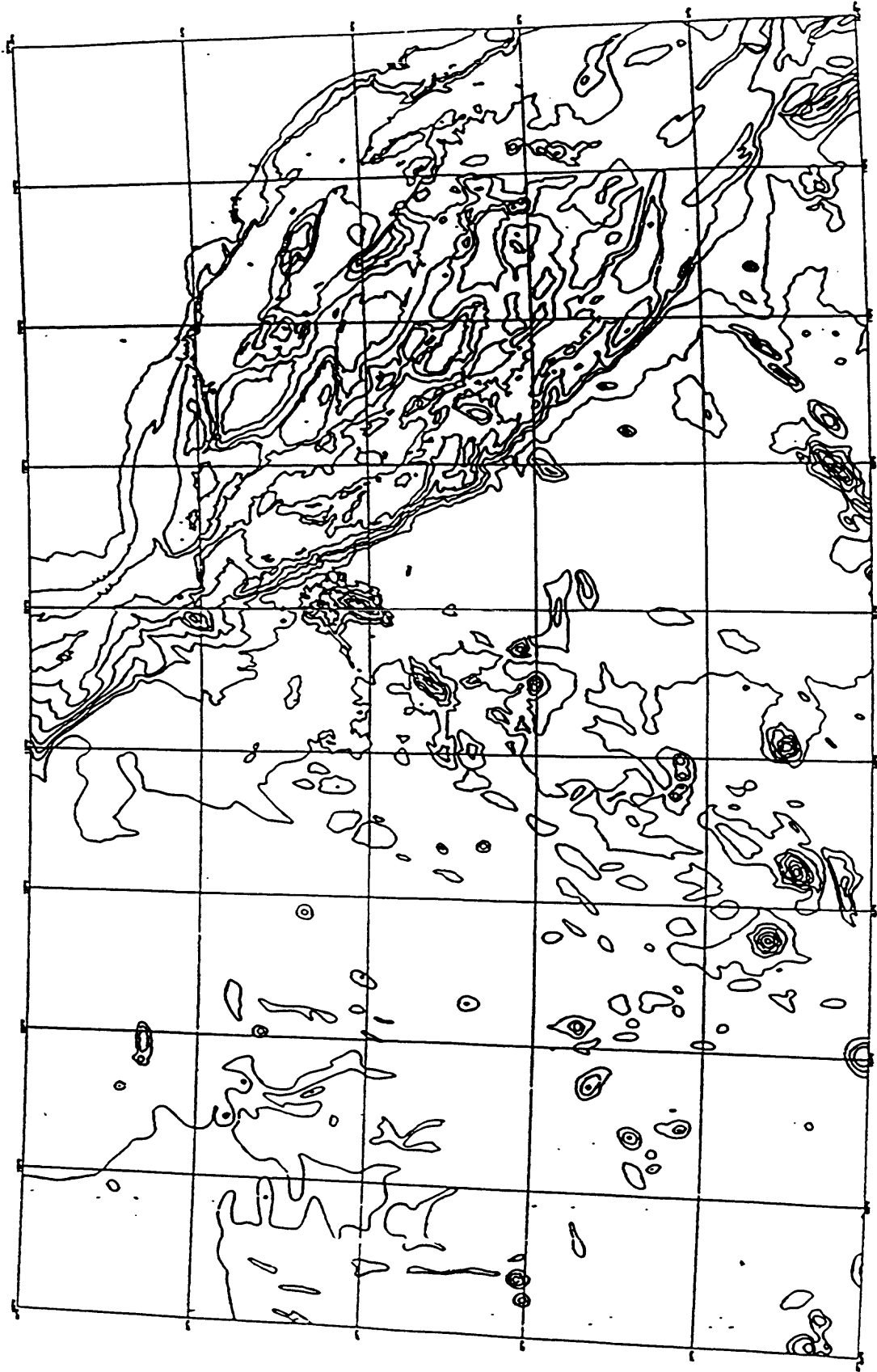
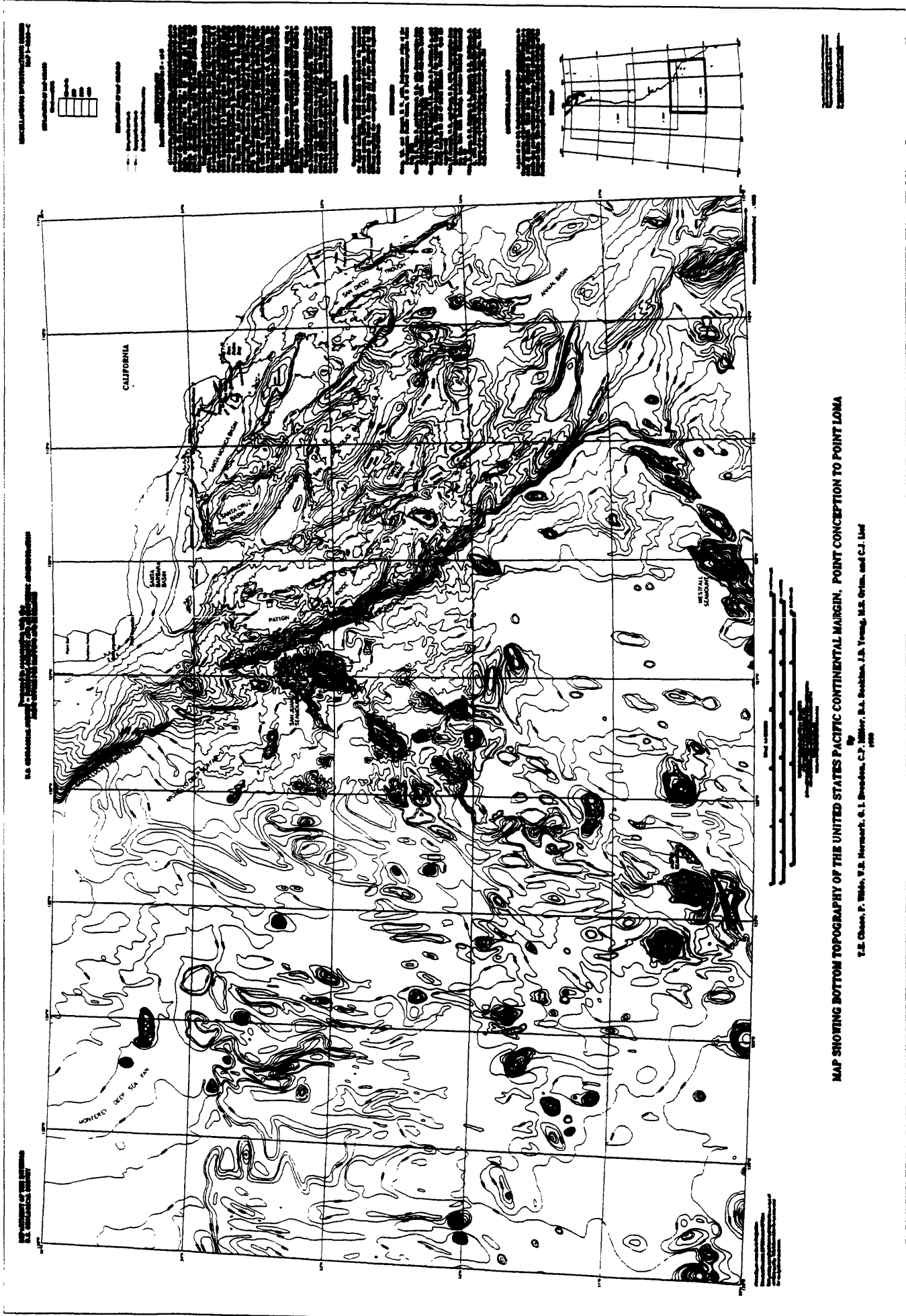


Figure 10. Map containing grid, coastline, and several bathymetric contour overlays.

```
plotter -d c5800 -o map.plt grid lgnd.ov indx*.ov geoglbl.ov  
mexbrdr.ov -p1:134 sealbl.ov -p0:134 socst.ov sbty*.ov bluln  
.ov btylbl.ov
```

The grid, legend (lgnd.ov), index map (indx*.ov), geographic names (geoglbl.ov), and Mexican border (mexbrdr.ov) were all plotted in the default, black pen 0.

Names of water bodies (sealbl.ov), the coastline (socst.ov), the bathymetry (sbty*.ov), and bathymetric labels (bluln.ov and btylbl.ov) were plotted in blue.



MAP SHOWING BOTTOM TOPOGRAPHY OF THE UNITED STATES PACIFIC CONTINENTAL MARGIN. POINT CONCEPTION TO POINT LOMA
 By
 U.S. Coast, P. White, U.S. Harcourt, G. I. Boudreau, C.P. Miller, R.A. Swoboda, J.A. Swoboda, M.S. Orlin, and C.I. Lind
 1959

Figure 11. Sample of complete map created using MAPGEN.

Acknowledgments

Comments and suggestions by Edward Escowitz, Gerald Evenden, Robert Hall, Barbara Seekins, Florence Wong, Evelyn Wright, Christopher Hines, and Carol Madison are gratefully acknowledged. Thanks are also extended to Adam Watson for assistance with the figures.

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APPENDIX A: Conversion from TEKNICAD to MAPGEN format

Appendix A describes the procedure for creating a MAPGEN format file from data output by the TEKTRONIX scanner TEKNICAD editor. Two routines which are not part of the MAPGEN system are invoked. These two routines, ink2mg and ndigtoll, are used to reformat scanner output data and to convert the Cartesian coordinate data to geographic equivalents. Ndigtoll makes use of the projection routine, PROJ, which is part of the MAPGEN system.

SAMPLE scanner output file: bty2000.TDA

```

1000
4
2
24-Apr-90 07:53:33
200m contour
1 1 2 2 2 1 3 5 1 6
1 1 1 1 2 1 5 0 0 0
1 1 0 0 3 7 0 0 1 3
6 1 1 1 0 1 0 0 0 0
0 0 0 0 0 0 0 0 0 0
1 1 1169 821 5.08
0 6.35 6.35 6.35 6.35
25.4 25.4 90 1 1
45 0 0 30 -30
1 1.5 .5 .3 1.5
0 0 1 1 1.5
0 0 0 0 0
0 0 0 0 0
0 0 0 0 0
0 0 0 0 0
0 100 0
120 50 100
240 50 100
0 50 100
300 50 100
70 50 100
180 50 100
150 50 100
197 42 100
276 50 100
330 50 100
40 42 100
87 50 100
0 33 0
0 67 0
0 0 0
180 60 80
0 75 0
160 60 90
-2.722912 503.6392 -11.12709 484.2108
0 1169 0 821
0 1169 0 821
0 1169 0 821
0 1169 0 821
0 1169 0 821

```

0 1169 0 821
 0 1169 0 821
 0 1169 0 821
 5 5 1
 5 5 1
 5 5 1
 5 5 1
 5 5 1
 5 5 1
 5 5 1
 5 5 1
 5 5 1
 0 0 0 0
 0 0 0 0
 0 0 0 0
 0 0 0 0
 0 0 0 0
 1.E30 1E30 233.8 1E30 1E30 1E30 818.3 1E30 1E30 1E30 1E30 1E30
 1.E30 1E30 246.3 1E30 1E30 1E30 410.5 1E30 1E30 1E30 1E30 1E30
 2 2 1 1 0 2 0 12 0
 6 1
 379.333 455.583 379.333 454.917 379
 453.667 378.25 452.083 376.75 450.5
 376.75 450.083
 2 2 1 1 0 2 0 10 0
 5 1
 379.583 448.75 379.333 447.833 377.917
 446.5 377.583 445.917 377.583 445.583
 2 2 1 1 0 2 0 14 0
 7 1
 377.667 444 377.333 443.083 377
 442.75 375.417 441.917 374.75 441.333
 374.083 439.667 374 439
 2 2 1 1 0 2 0 34 0
 17 1
 337.25 457.333 340.167 455.167 342.75
 452.583 344.167 451.917 344.833 451.25
 346.25 448.583 347 447.917 348.583
 446.917 349.667 445.417 353.917 441.583
 354.667 439.917 355.583 439 357
 438.25 358.667 437.667 360.5 435.417
 361.5 434.833 362.417 434.667
 2 2 1 1 0 2 0 12 0
 6 1
 363.917 434.5 364.917 434.333 366.917
 433.417 369.833 430.583 370.75 430.083
 371.167 430.083
 2 2 1 1 0 2 0 12 0
 6 1
 391.167 413.917 393.333 413.333 394.75
 412.667 397.083 411.25 398.083 410.25
 399.25 408.417
 2 2 1 1 0 2 0 18 0
 9 1
 390.333 413.333 390.333 413 390.75
 412.417 392.25 411.75 393.917 411.333
 395.25 410.75 397.75 408.417 398.5
 407.917 398.917 407.833

```

2 2 1 1 0 2 0 16 0
8 1
293.083 415.25 294.083 414.917 295.333
413.75 296 412.5 297 411.667
297.417 410.667 299.5 409 300.417
349.3415 456.333 349
0 0 0 0 0 0 0 0 0

```

The COMMAND:

```
ink2mg <bty2000.TDA>bty2000.mg
```

will reformat input file, bty2000.TDA, to output file, bty2000.mg, containing Cartesian coordinate data points in MAPGEN format.

The scanned file contains cartesian coordinate values for all vector end-points. To convert the cartesian coordinates to geographic coordinates four or more calibration points are required. They are usually the four geographic corners of the map. They must also be scanned and their x,y values saved in a separate file. In this sample, the file is named cal.xy.

The latitude-longitude equivalents of the calibration points are stored in file, cal.ll.

sample cal.xy file:

```

144.9167      63.08334
202.1667      952.0834
727.8334      939.6667
744.5000      51.16667

```

sample cal.ll file:

```

40.00      -131.00
48.00      -131.00
48.00      -124.00
40.00      -124.00

```

The COMMAND:

```
ndigtoll "+proj=tmerc +k=0.9998 +lon_0=-128.0" cal.ll cal.xy
bty2000.mg > bty2000.dat
```

where:

```

proj=tmerc    = scanned map projection = transverse mercator
k=0.9998     = transverse mercator latitude scaling factor **
lon_0=-128.0 = central meridian of map **
cal.xy       = file of calibration points for map conversion
cal.ll       = file of calibration-point geographic equivalents

```

will create the lat-lon MAPGEN format file, bty2000.dat.

** parameter is projection dependent and not used on all projections

APPENDIX B: Dashed-line patterns and blanking

Dashed lines:

A dashed line pattern can be created with the following command and control-files:

Command:

```
lines -mo def-file output-file.ov control-file input-file
```

Control-file:

```
# -l          # line plot data follows
# -p 1       # pen #1
# -lm 0X6666 # dashed-line mask
# -ls .1     # length of dash (cm)
# -ld        # select dashed-line mode
```

The -lm parameter indicates the mask; 6666 generates a line composed of even length dashes and spaces.

To change the pattern the line pattern mask must be changed. A dash-dot-dot pattern would have a 0X7575 mask. The mask can be derived as follows.

Picture the possible pattern as being composed of 16 segments, i.e., four 4-bit bytes. If a bit is "on" it is part of the line; if "off" it is a blank space. The "on" bit configuration is referenced in hexadecimal numbers as in the example below:

```
|8 4 2 1|8 4 2 1|8 4 2 1|8 4 2 1| (bit number - binary)
| | | | | | | | | | | | | | | |
| |o|o|o| |o| |o| |o|o|o| |o| |o| ("on" bits)
----- (pattern)
      7      5      7      5
dash dot-dot dash dot-dot
(hexadecimal value of "on" bits)
```

A special mask for state boundaries, which meets USGS mapping standards for length of dashes and spaces in a dashed line, is 0X667e, with .06 as the length of the dash.

Instead of a control file, the control parameters can be inserted directly into the data file using the #-L option. The order is pen number, mask, length of dash.

```
##-L 0,0x7777,.06
# -b # 2
32.008810      -121.496328
32.015196      -121.492629
32.019345      -121.486274
32.020132      -121.477477
32.018296      -121.468663
32.014576      -121.462478
32.009533      -121.458707
*              *
*              *
*              *
```

Blanking a portion of a line:

In figure 8, segments of contour lines have been blanked out for labels.

To blank out a portion of a line the user works interactively in XZOOM. The "poly" function is usually chosen. A polygon is drawn COUNTER CLOCKWISE around the portion of the line to be blanked. Depressing the left-hand mouse button will record each point on the polygon. Depressing the right-hand mouse button will close the polygon.

Blanking can also be done using the LINE function and selecting two points which define the diagonal of a rectangle that encompasses the area to be blanked. This method can cause problems in areas with closely spaced lines.

Once the polygon file is created it should be edited to the format of this sample control file:

sample control file:

```

#-x
47.59      61.66
47.72      62.42
45.44      62.38
46.58      61.58
47.59      61.66
.
#-x
52.91      54.65
53.55      55.50
52.28      56.30
51.22      56.21
52.91      54.65
.

```

The control file can be used in the command line or in the data file.

If used in the command line the syntax is:

```
lines -mo def-file blanked-file.ov control-file data-file.dat
```

If the control file is placed at the start of the data file, the command is:

```
lines -mo def-file blanked-file.ov data-file.dat
```

Either will create an overlay with portions of the lines blanked as in figure 8.

APPENDIX C: Font tables

Fonts available in MAPGEN:

Table C-1, compiled by Florence Wong (written communication, 1991), shows examples of the various fonts and symbols available in MAPGEN. The font table (table C-2) included here, from the version of MAPGEN in use in November, 1991, is an update of the table contained in the MAPGEN manual (Evenden and Botbol, 1985). The following introduction to the font table is copied directly from the MAPGEN manual (Evenden and Botbol, 1985).

"The complete set of MAPGEN fonts

The following type fonts are presently available in the MAPGEN system. The heading on each page is the name of the font, and each character in the tables is referenced by its ASCII character reference (when applicable) as well as the decimal and octal reference numbers. The only time that decimal or octal reference is necessary is for those symbols lacking an ASCII designation.

For example, in the -sr font, the letter A can be referenced by the letter A, 65 (decimal), or 101 (octal)."

Digraph Listing of Font —din

1/001	22/026	Ü	+ /43/053	+	@ /64/100	U /85/125	U	j /106/152	J
2/002	23/027	ä	, /44/054	,	A /65/101	V /86/126	V	k /107/153	K
3/003	24/030	ö	- /45/055	-	B /66/102	W /87/127	W	l /108/154	L
4/004	25/031	ü	. /46/056	.	C /67/103	X /88/130	X	m /109/155	M
5/005	26/032	ß	/ /47/057	/	D /68/104	Y /89/131	Y	n /110/156	N
6/006	27/033	≥	0 /48/060	0	E /69/105	Z /90/132	Z	o /111/157	O
7/007	28/034	≤	1 /49/061	1	F /70/106	[/91/133	[	p /112/160	P
8/010	29/035		2 /50/062	2	G /71/107	\ /92/134	\	q /113/161	Q
9/011	30/036		3 /51/063	3	H /72/110	] /93/135	]	r /114/162	R
10/012	31/037	→	4 /52/064	4	I /73/111	~ /94/136	~	s /115/163	S
11/013	/32/040		5 /53/065	5	J /74/112	_ /95/137	_	t /116/164	T
12/014	! /33/041	!	6 /54/066	6	K /75/113	` /96/140	`	u /117/165	U
13/015	" /34/042	"	7 /55/067	7	L /76/114	a /97/141	a	v /118/166	V
14/016	# /35/043	#	8 /56/070	8	M /77/115	b /98/142	b	w /119/167	W
15/017	\$ /36/044	\$	9 /57/071	9	N /78/116	c /99/143	c	x /120/170	X
16/020	% /37/045	%	: /58/072	:	O /79/117	d /100/144	d	y /121/171	Y
17/021	& /38/046	&	: /59/073	:	P /80/120	e /101/145	e	z /122/172	Z
18/022	' /39/047	'	< /60/074	<	Q /81/121	f /102/146	f	{ /123/173	{
19/023	(/40/050	(	= /61/075	=	R /82/122	g /103/147	g	| /124/174	|
20/024	) /41/051	)	> /62/076	>	S /83/123	h /104/150	h	} /125/175	}
21/025	* /42/052	*	? /63/077	?	T /84/124	. i /105/151	. i	~ /126/176	~