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COMPUTER PLOTTING OF GEOCHEMICAL DATA IN PLAN VIEW

(PLANMAP.REV1 USER'S GUIDE)

by

Carol Withrow

July, 1980

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EARTH SCIENCE LABORATORY
University of Utah Research Institute
Salt Lake City, Utah

Prepared for
U.S. Department of Energy
Division of Geothermal Energy

DISCLAIMER

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ABSTRACT

PLANMAP is a program package that is used to plot geochemical data in plan. The program has no map projection capabilities and is used to plot relatively small work areas that can use a flat-earth approximation. Data are entered by keyboard input and can be listed, edited, and plotted. The plotting functions are performed by using a plotting library similar to a Calcomp subroutine library. This report is a user's guide to the two main programs that comprise PLANMAP.

INTRODUCTION

This report describes how to use PLANMAP to generate computer plots of geochemical data represented in plan. This is effected by executing two computer programs, PLAN-IO and PLAN-PLOT. The data are passed from one program to the other by means of referencing the same data file.

PLAN-IO allows creation of the data file by keyboard entry. It also provides for manipulating this file in various ways, including editing and moving the file into and out of a master file consisting of a number of data files. PLAN-PLOT is the program that actually generates the plotting instructions and results in a plot.

Robert W. Bamford provided the original concept of this system. Original programming was by D. T. Purvance. Enhancements and modifications were programmed by Carol Withrow.

USER'S GUIDE

I. PLAN-IO Usage.

Before running the program, one must manually index the data. The data include section corner coordinates to be plotted, sample location coordinates, and geochemical assay values. Indexing involves numbering map coordinates to be plotted in sequence from 1 to N, where N is the total number of values. Once indexing is completed, data must be entered into the computer in the same sequence as indexed. The purpose of indexing is to plot geochemical data at the proper map location.

Data (section coordinates, sample coordinates, and geochemical data) are stored individually on direct access data files that have records numbered 1 through 200. The following is a listing of what must be on records 1 through 6:

Record No.	Contents
1	X-coordinate of section corners to be plotted
2	Y-coordinate of section corners to be plotted
3	X-coordinate of sample locations
4	Y-coordinate of sample locations
5	Plot symbol codes for each sample location
	Note: plot symbol codes are: 1. = a triangle 2. = a circle 3. = a square 4. = a star
6	Percent silicate

Records 7 through 200 will store actual geochemical data. Therefore, a maximum of 194 sample attributes can be stored in one data file or "work file" (see Work File Format, Appendix B-2).

Initially the user is asked to select one of the following functions:

1. Terminate program
2. Initial input of data
3. Data additions
4. Data edit
5. Data list
6. Move records or files
7. Adjust data for silicate
8. Mathematical function mapping.

After performing one of the above (except 1) the program loops to the top and again presents the user with these eight options.

There are three kinds of keyboard input to be supplied by the user: alphanumeric input can be any keyboard characters; integer input consists of integers only; real input is a number with its decimal point. Both integers and real numbers may be preceded by a + or - sign.

Information required for each of the above program options is detailed as follows:

1. Terminate program exits PLAN-IO

2. Initial data input

   In addition to the records already discussed, there is a file header that consists of the project area name and a number that is the record number of the highest record written plus one.

   The user is first asked to supply the record number. For example, to input sample location X-coordinates the record number would be 3 (integer input). When the user initially inputs record 1, section corner X-coordinates, he is first asked to supply the project area name. At this time the program initializes the value of the number in the header that is mentioned in the previous paragraph. Therefore, record 1 should always be input first. If it is not, the number in the header may be corrected with the editor, to be discussed subsequently.

   If sample values have been entered from tape, this header record has been automatically created.

   For record 1 the following items are solicited for input: a, f, h.

   For records 2, 3, 4 and 5 the following items are solicited for input: f, h.

   For the data records numbered 6 through 200, items b through h are solicited.

   a) Project area name, maximum of 60 characters (alphanumeric input). This is input and output on two 30-character lines.

   b) Figure name, maximum of 36 characters (alphanumeric input).

   c) Figure number, maximum of 18 characters (alphanumeric input).

d) Sample type, maximum of 30 characters (alphanumeric input).

If the plot size, character size and number of characters in either element name or sample type are so chosen that these labels would extend beyond the right border of the plot, the labels are truncated so that no such extension occurs.

e) Analytical method, maximum of 12 characters (alphanumeric input).

f) Number of data values to input, maximum of 400 (integer input).

g) Number of digits to the right of the decimal place you want plotted (integer input). A maximum of 10 character positions is available. These character positions include the digits to the left of the decimal point, the decimal point itself, and the number of digits to the right of the decimal point. Enter 0 for records 1 - 5.

-1 = no decimal will be plotted (e.g., 123)
0 = no digits to right of decimal will be plotted (e.g., 123.)
1 = 1 digit to right of decimal will be plotted (e.g., 123.0)
2 = 2 digits to right of decimal will be plotted (e.g., 123.00).

h) Data values (real input).

Special character output features, where the value input is V:

Input	Output
$V \leq -1{,}000{,}000$	'ND'
$-1{,}000{,}000 < V < 0$	< V
$0 \leq V \leq 1{,}000{,}000$	V
$V > 1{,}000{,}000$	> (V-1,000,000)

3. Data additions

The user is asked to supply the number of the record (integer input) to which data is to be added. Next the number (integer input) of items to be added must be supplied, followed by the data values (real input). The user is prompted with the index number of each entry.

4. Data edit

The editor first asks for the record number (integer input) to edit. Any item listed under Initial Data Input may be changed.

To edit area name or number of records, the two items in the header, the record number to enter is 1.

A menu is presented from which the user selects the item to edit. The editor types the current value of the item before soliciting the new input, except for the data items themselves. For these the user must enter a pair of numbers for each correction: the index of the data item (integer input) and the corrected data value (real input). These two numbers may be entered on one line, separated by a comma. The program will continue to accept corrections until the pair of numbers 0, 0 is entered.

5. Data list

This option offers the following menu:

1 Index
2 Data List
3 LP List

The Index option gives the number of the highest record written and, optionally, a list of titles (figure names) and sample indices. The Data List option lists selected records; the user enters the number of records to list (maximum of 6, integer input) followed by the record numbers to be listed (integer input). Section corner coordinates to be plotted (records 1 and 2) should be listed alone, since the number of section corner coordinates and samples will usually be different. The number of data items listed is the number in the last record number typed.

Finally, the LP List option produces a line printer listing of all the information in the work file.

6. Move records or files

This option allows reading and rewriting of records within a file or the saving of an entire file on a master file called the merge file (see Merge File Format, Appendix B-3). Files that have been saved previously may be restored to the work space, overwriting the file that is there. A directory of the files in the merge file will be produced on request.

These various options are presented as the following menu:

1 Move 1 record
2 List merge file directory
3 Save work file
4 Restore work file
5 Initialize merge file
6 Exit this routine

Move 1 record: This capability enables the user to move a record in work file to a new location. The program solicits both input and output record numbers (integer input). It then reads the input record and writes this record on the output record. Any information already in the output record will be overwritten. The input record is unchanged.

List merge file directory: The merge file is a master back-up file. The directory shows what files are written in it and the number of data records contained in each file.

Save work file: The current file in the work space, called the work file, is backed up by writing it in the merge file. A subsequent list of the merge file directory will confirm that there is a new entry. At the end of each period of data input on a given project, the working file should be saved in the merge file, thereby permitting use of the program by other workers, if desired, without possible loss of your data. Several files containing partially similar data may thus be generated for a single project. These will be identified in the merge file by the merge file index number, the project name (one only for each project), and the number of records. The working file will remain intact after "saving" until it is overwritten.

Restore work file: The user will be asked the index number of the file to be read from the merge file and written into the work space. This index number can be seen on a listing of the merge file directory. Whatever is in the work space will be overwritten. The copy of the restored file that is backed up in the merge file remains unchanged. If a saved file is restored and changed, and it is desired to preserve this version in the merge file, then a new copy of the file is saved. This will appear in the directory as a new listing with a new index number to be used for restoring it to the work space. It should be noted that files cannot be selectively deleted from the merge file.

Initialize merge file: This option deletes the information in the merge file. The user must enter a password in order to use this option to prevent inadvertent destruction of data. Next the user is required to enter a file title, maximum 72 characters. This will be listed whenever a directory listing is made. The merge file will hold 800 records. When it is filled, a message will be produced directing the programmer to back up the merge file on magnetic tape. After this is done, the user may initialize the merge file. Another 800 records may then be saved.

Merge file contents can also be stored on tape selectively. When you have completed data input and plotting for a given project,

have the programmer back up the final file only. Do not initialize merge file at this time unless you are sure you are the only current user. Initialization of the merge file in no way affects the work file.

7. Adjust data for silicate

Any data record may be adjusted for silicate and the resulting corrected values saved as a new record. The program asks for the input record number and the output record number. The output number may be chosen to be the same as the input number, in which case the original data will be overwritten. When this adjusted data is subsequently plotted, the characters "CORR." will appear after the figure number.

The values are each adjusted according to the following formula, where S is the percent silicate for the sample as entered in record six:

$$\text{adjusted value} = \frac{\text{measured value}}{1 - S/100}$$

If the value of S is less than zero or greater than 90, the value is respectively reset to zero or 90 for this calculation.

8. Mathematical function mapping

This option allows the addition, subtraction, division, or multiplication of the sample values in two records or the polynomial mapping of the values in one record. The user is asked to enter the input record number(s) and the figure number and name. The old figure number(s) and name(s) are given as reminders. In the case of polynomial mapping, the user may enter the coefficients of the following replacement statement:

$$X = A + BX + CX^2$$

where X is the sample value. They are intialized to:

$$A = 0.$$
$$B = 1.$$
$$C = 0.$$

The computer types, "Update parameter number (I)." The user enters 1 to update the first coefficient, 2 to update the second, 3 to update the third, and 0 to procede to the next step. If 1, 2, or 3 is entered, the computer types the current value for that coefficient and asks for the new value to be entered.

9. Additional instructions

The work file contains a maximum of 200 data records plus a header. When it is saved on the merge file, only those records written are saved. Thus the number of files that may be saved on one merge file depends on the length of the individual files. It can be as few as four full files.

Note that record 6 is for silicate data only. If there is no data available, enter one data value of zero. In this case do not plot file 6.

II. Producing the Plot with PLAN-PLOT

Once data are properly edited and stored on computer data records, the plotting program retrieves these data and produces a plot. Before plotting, however, one must define the physical size of the plot, scale values, starting coordinate values, etc.

Refer to the diagram of the plot, Appendix A-3, for the general plot layout parameter definitions.

Notice that the actual area in which samples are plotted (XM by YM, described below) is about an inch smaller in both directions than the plot borders drawn. There is no automatic check in the program to determine if the user has mistakenly directed that samples be plotted outside this area.

The program will solicit the following information using the names on the left:

UNITS	1. if user units in feet 2. if user units in meters (real input)
SCALE	Scale factor, i.e., the number of feet or meters represented by one inch on the plot (real input)
XM	Horizontal length of plot in inches if user units are in feet, or in centimeters if user units are meters (<100" or <254 cm, real input)
YM	Vertical length of plot in inches if user units are in feet, or in centimeters if user units are in meters (<30.5" or <76.2 cm, real input)

CH	Data character height in inches (max=.2", min=.07", real input)
SBL	Scale bar length in inches or centimeters (real input)
XO, YO	Map coordinate of lower left hand corner of plotting area in feet or meters (real input)

The plotting program asks for the above plotting parameters and automatically records the first six records. It then asks for the number of plots to generate (integer input). Then the record numbers containing the geochemical data are entered. Each record number (integer) is followed by an integer 1 (yes) or 0 (no), to indicate whether or not the values are to be adjusted for silicate.

The same record may be plotted both with and without this silicate adjustment. In this case the record number is entered twice, each time followed by 1 or 0. This, of course, counts as two plots when responding to the above query about the number of plots to generate.

If a record that has already been adjusted for silicate is selected, it should be followed by 0. If such a record is selected and followed by 1, an error message results, since the correction for silicate has already been made.

The correction formula is the same as that for option 7. The characters "CORR." will be plotted after the figure number. Unlike the silicate adjustment in the input program above, there is no permanent record of the adjusted values saved.

The last information solicited by the plotting program concerns the pen to be used by the pen plotter. The user is asked to enter a pen number (which determines thickness) and a pen color. Numbers from 1 - 8 inclusive, excepting number 7, are accepted for the pen number. Red, blue, green, or black (typed in full) are accepted for the pen color.

If the resulting plot is small enough to fit on an 11" x 8.5" page, corner tics will be drawn to use as a cutting guide.

III. Conversion to Other Systems

PLANMAP should normally be adaptable to another computer system with only a moderate effort by a programmer familiar with his system. Although the programs described here are implemented on a UNIVAC 1108, their conversion to minicomputers should not present problems of program size or computational precision.

It is necessary, of course, for the system to have a digital plotting device. PLAN-PLOT uses a plotting library similar to the standard Calcomp plotting library. Any computer system that has a plotting capability similar to a Calcomp plotter will be able to provide the needed plotting functions.

Alphanumeric data storage may have to be modified for another system. The UNIVAC 1108 uses an internal six-bit character code called Fieldata. The word length is 36 bits, so alphanumeric characters are stored six to a word. If the number of characters to a word is different from six, both programs will have to be modified. The data file width may also have to be changed accordingly. In PLAN-IO, the dimensions of the following variables are tied to the number of characters per word: NAM1, NAM2, FNUM, SAMP, AM, FNAM, TT. The same variables, except the last one, appear in PLAN-PLOT.

The work file and the merge file are direct-access files. The files are described to the programs by means of the DEFINE FILE statement that appears at the beginning of the main programs. This syntactic element is an extension of standard FORTRAN IV that is available in most but not all versions of FORTRAN. The first argument is the file length in records, and the second argument is the file width in words. PLANMAP files are 420 words wide. The READ and WRITE statements that reference the files use IBM direct-access syntax. If PLANMAP is to be developed on a system that does not have direct-access file capability, it would be difficult to make modifications that would accommodate the substitution of another file type, such as a sequential file.

The subroutine GETPEN of PLAN-PLOT allows user-selected pen color and width, and will have to be modified on another system. It uses a routine, CALOPR, that sends a message to the person operating the plotter. The implementer may want to delete subroutine GETPEN altogether.

Subroutine MOVE of PLAN-IO requires a password to be entered before initializing a file. This password is represented in the program as the numerical contents of a word containing Fieldata characters. The implementer may want to supply his own password and number.

The function of passing control between programs is supplied by the subroutine CONTRL in the library used. There are equivalent subroutines in most computer systems. This function is used for just one purpose in PLANMAP. This occurs in subroutine MOVE of PLAN-IO, where the capability is provided of producing a line printer listing of the data file. To produce the listing, control is passed to another main program. Control is subsequently passed back to the main program of PLAN-IO.

APPENDIX A

Plot Format Information

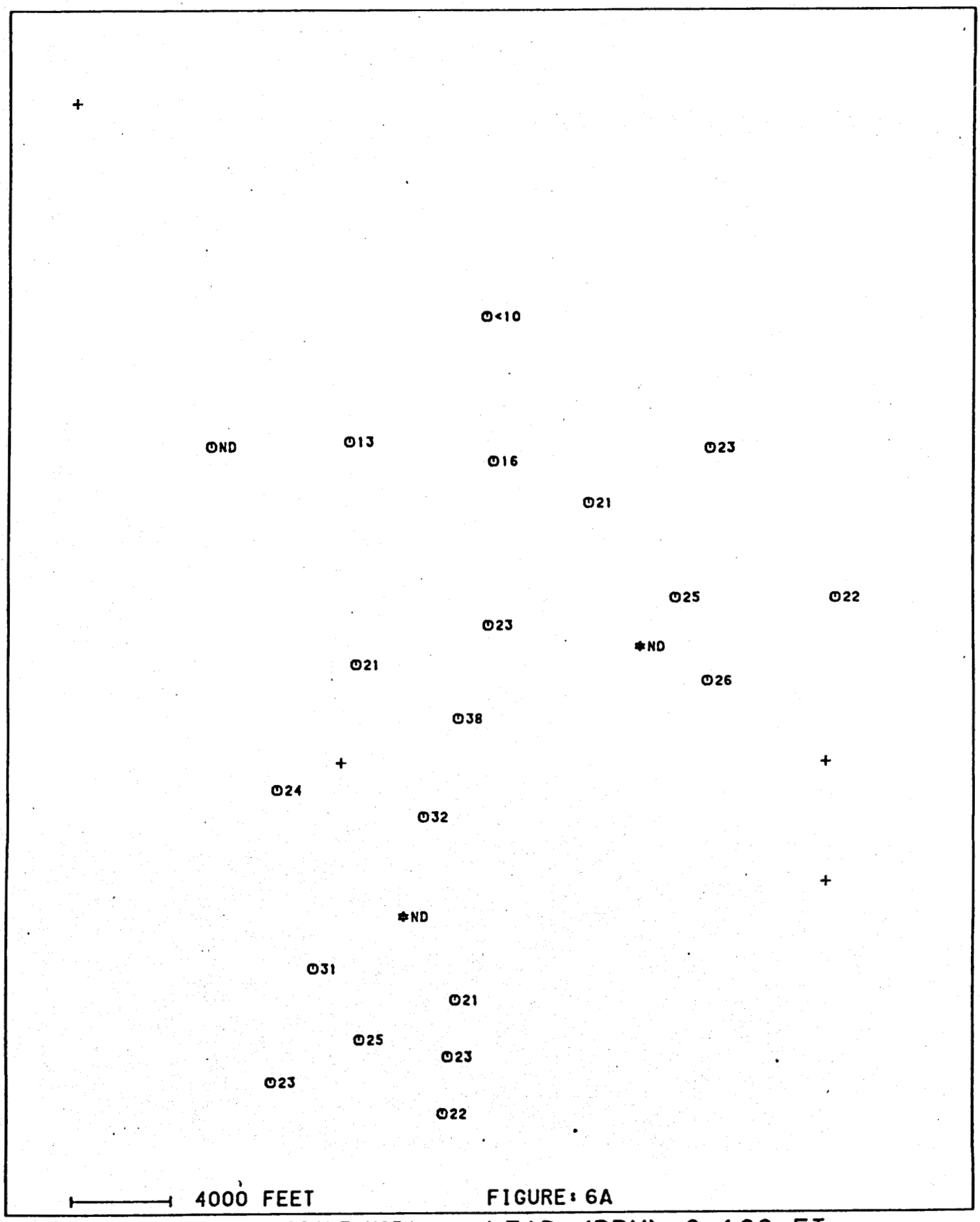
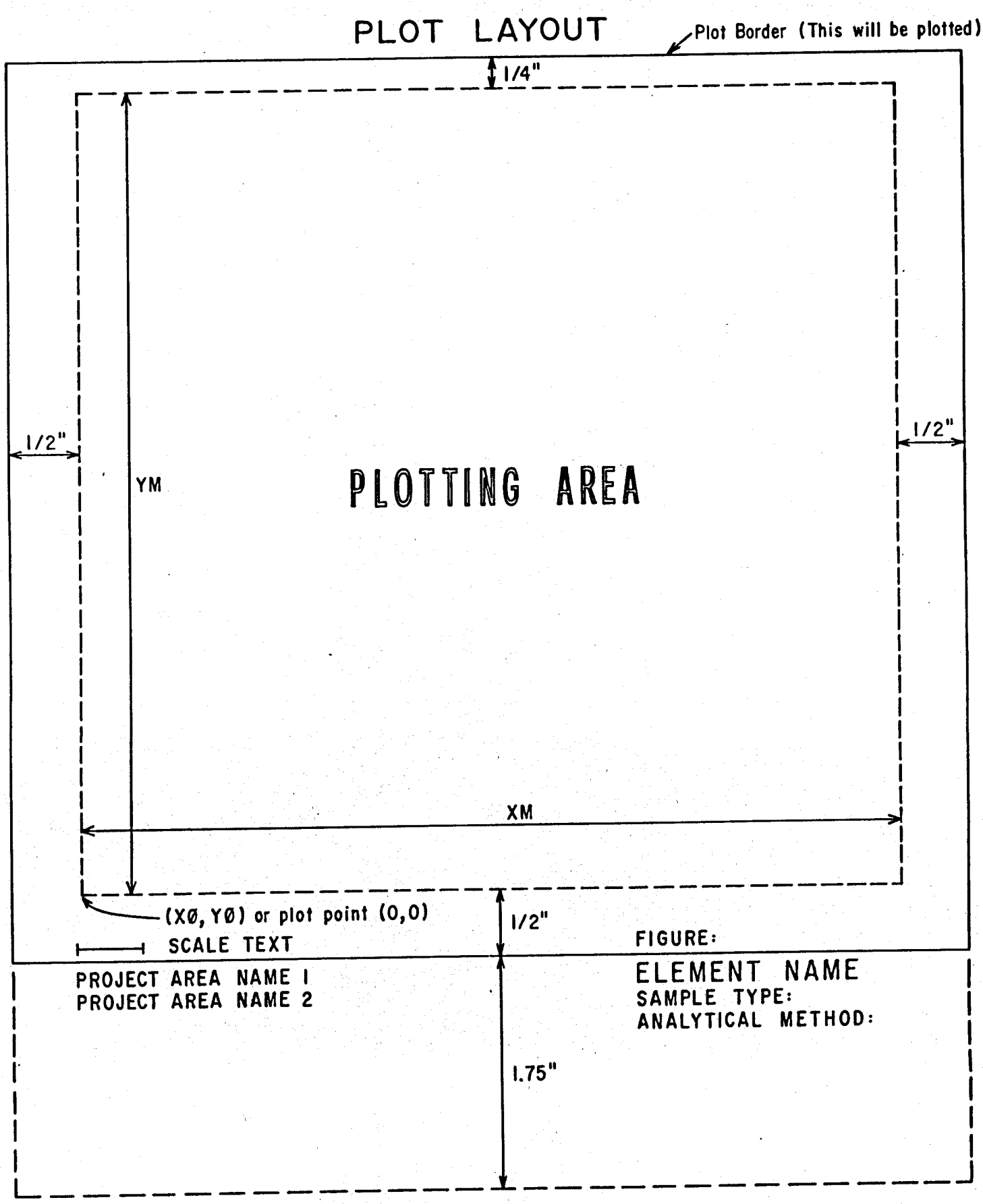


FIGURE: 6A

COVE FORT-SULPHURDALE KGRA
MILLARD & BEAVER COS., UTAH

LEAD (PPM) 0-100 FT.
SAMPLE TYPE: WHOLE ROCK
ANALYTICAL METHOD: ICPQ


PLOT LAYOUT
Plot Border (This will be plotted)
1/4"
1/2"
YM
PLOTTING AREA
1/2"
XM
(XØ, YØ) or plot point (0,0)
1/2"
SCALE TEXT
FIGURE:
PROJECT AREA NAME 1
PROJECT AREA NAME 2
ELEMENT NAME
SAMPLE TYPE:
ANALYTICAL METHOD:
1.75"

APPENDIX B

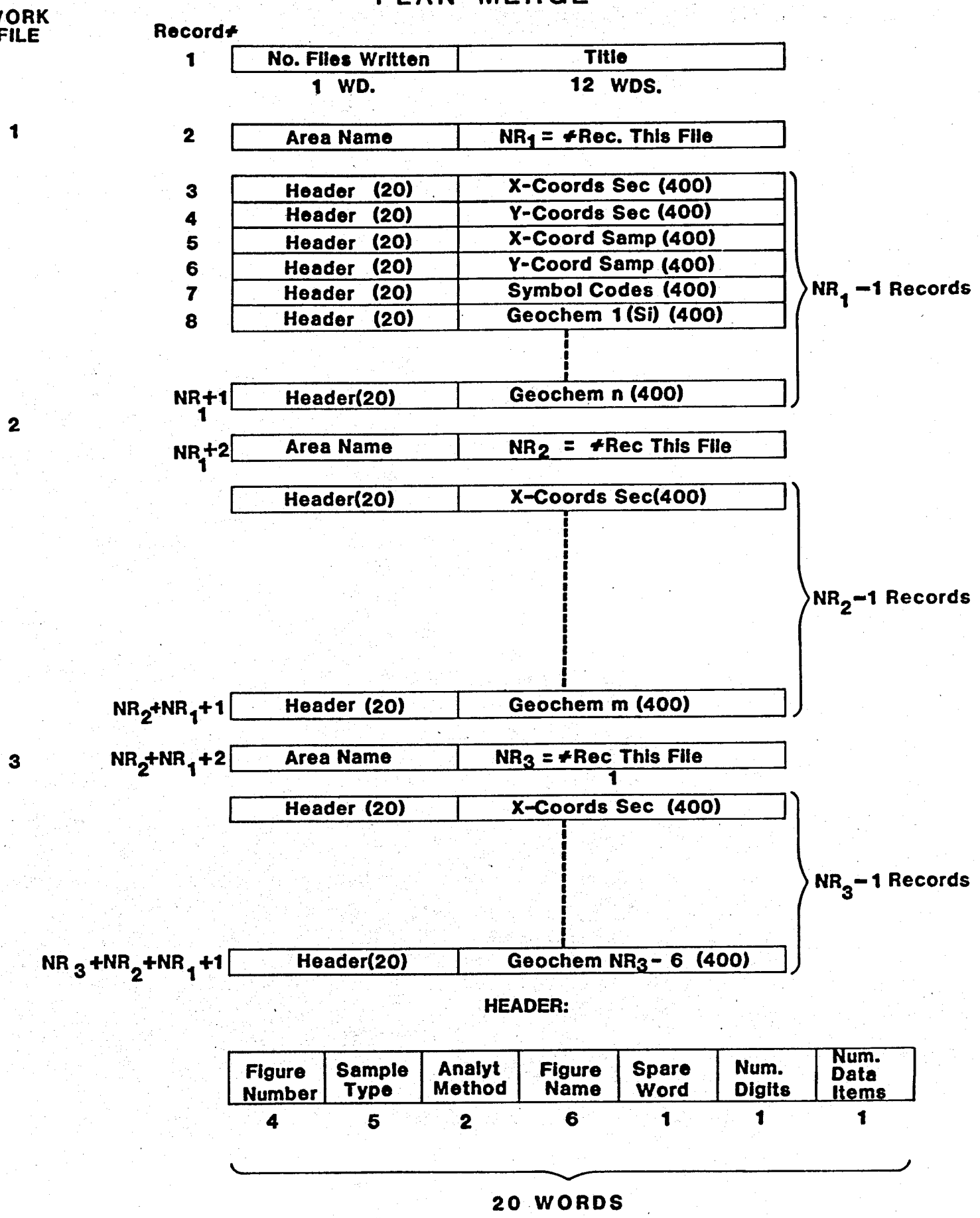
Data File Format Information

PLAN-DATA

NR 1	Area Name 10		Sample Indices 400					True Record No. IREC	User Record No. "I FILE"
Fig# 4	Samp Type 5	An Meth 2	Fig Name 6	Dummy 1	#Dig 1	NDAT 1	X Sec Corners 400	2	1
Fig#	Samp Type	An Meth	Fig Name	Dummy 1	#DIG	NDAT	Y Sec Corners 400	3	2
"	"	"	"	"	"	"	X DH Collar 400	4	3
"	"	"	"	"	"	"	Y DH Collar 400	5	4
"	"	"	"	"	"	"	Symbol Codes 400	6	5
"	"	"	"	"	"	"	Percent Silicate 400	7	6
"	"	"	"	"	"	"	Geochem #1 400	8	7
"	"	"	"	"	"	"	Geochem #2 400	9	8
							Last Record Written	NR	NR-1
								201	200

WORK FILE FORMAT

PLAN-MERGE



MERGE FILE FORMAT