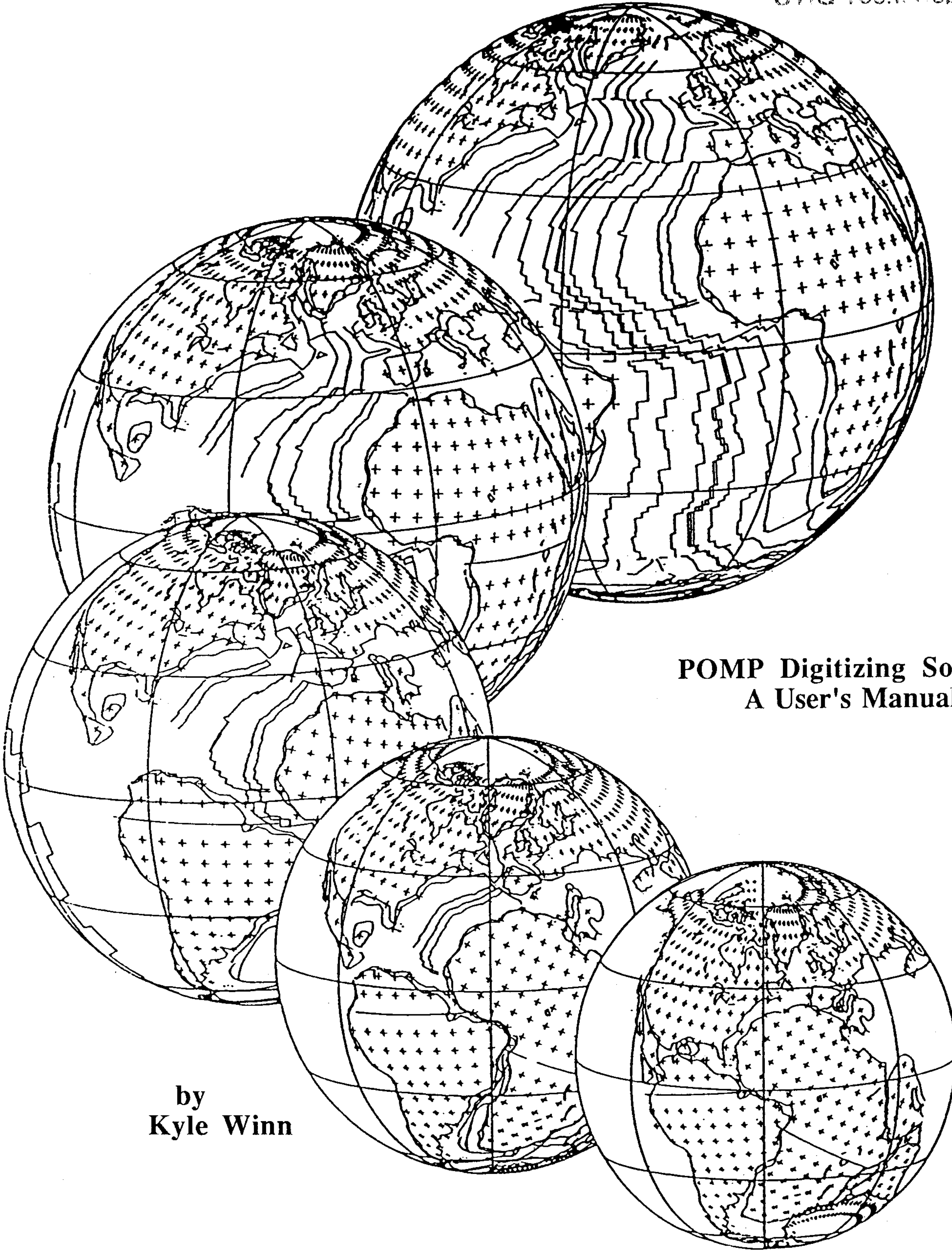
PALEOCEANOGRAPHIC MAPPING PROJECT
PROGRESS REPORT NO. 37-1287



POMP Digitizing Software: A User's Manual

by
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Introduction

To "digitize" is to convert existing analog data into digital form. More specifically, what is meant in the Paleoceanographic Mapping Project (POMP) by "digitizing" is the use of digitizing software to convert features from maps or figures to a digital computer data file.

Though digitizing hardware varies, the general function of such hardware is similar. The figure to be digitized is placed upon a digitizing table or tablet, underlying the surface of which is a fine wire grid responsive to magnetic pulses. A mouse or electronic pen is then positioned on a selected feature of the figure. When activated, the mouse (or pen) generates a magnetic pulse which is precisely located by the underlying two-dimensional grid. Thus the hardware and its lower level companion software record a raw grid position for the digitized point. The actual function of POMP digitizing software is to convert the raw grid positions of selected features to latitude and longitude coordinates and to give a body of such recorded coordinates meaningful descriptions.

Digitizing programs are used by POMP to create digital data bases of geological and tectonic information. These data bases are maintained with the program MEGAPOLY and used by PALEOMAP and MEGADRIFTER to produce various tectonic reconstructions. The flexibility of the digitizing software allows the user to select individual data features from a variety of independent sources and combine them as suits the user's needs. As new or better data become available, the data base can easily be appended or updated.

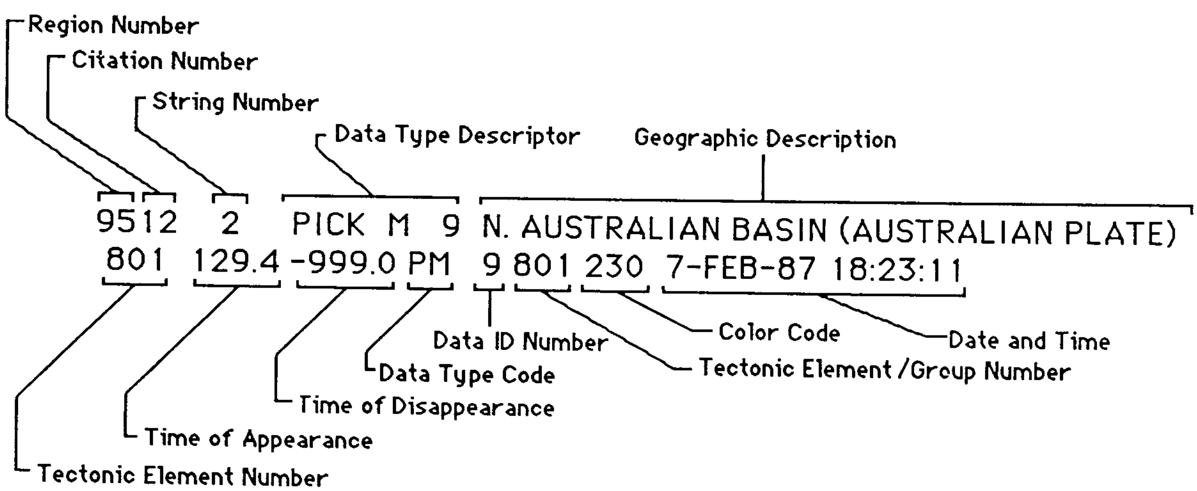
This manual is intended to give a comprehensive explanation of how to use POMP digitizing software. Definitions, descriptions,and suggestions build on one another throughout the manual. Therefore it is recommended that the initial reading be comprehensive. Only after such a reading may the user efficiently refer to single, specific sections.

Features common to all POMP digitizing software

The POMP digitizing programs are DIGMER, DIGMERE, DIGMERT, and DIGSTER and are used to digitize features from Mercator, Elliptical Mercator, Tranverse Mercator, and Stereographic Polar projections, respectively.

The Header

The format of output files produced by using any of the four programs is identical. Digitized files contain one or more string headers, each of which is followed by three columns of numerical data. The header serves as a compact description for the actual digitized data. An example of a digitized data file header, its components and their meaning, follows.



Region Number and Citation Number (String Reference Number)

The Region Number and Citation Number are used for bibliographic purposes. The String Reference Number is a four digit integer, the first two digits being the region number and the last two, the citation number. When a feature from a figure is digitized, a complete bibliographic entry of the figure must be recorded and assigned an arbitrary number, the citation number. All major continental and oceanic areas have been assigned unique numbers by POMP. In the header example above, "95" is the number assigned to features in the eastern Indian Ocean. A complete listing of the region numbers and their respective areas may be found in Appendix A.

The record of region numbers and citation numbers is separate; it is not maintained by the software. Keeping a notebook near the digitizing equipment for such reference entries is recommended. The following illustration is a sample of entries from POMP's "black book."

String Reference Number Citations

String Number

A header and the digitized data it describes constitute a string. Usually a data file is made up of several strings. Each time a new header is created it is automatically assigned an incremented String Number. The only time the user is required to select a string number is during the initialization of the data file (to be discussed in a later section).

Geographic Description

The Geographic Description is self-explanatory. It is a 54-character space available for the user to create a label, geographic or otherwise, for the feature to be digitized. The geographic description is an opportunity to include any information which cannot be otherwise incorporated into the header.

Data Type Descriptor

The Data Type Descriptor is a short (13 character) label describing the data type of the feature. Data type descriptors are found only in headers describing magnetic lineation, magnetic anomaly pic, and bathymetry contour features. When it does appear in the header, it is located to the left of the geographic descriptor. The digitizing program creates the data type descriptor; the user does not control its appearance.

Tectonic Element Number and Tectonic Element/Group Number

The Tectonic Element Number is a unique number assigned to a specific tectonic plate. Each feature digitized must have a tectonic element number. The tectonic element number appears as the leftmost entry of the second line and is read and used by PALEOMAP. The Tectonic

Element/Group Number is located between the data ID number and the color code and is used by an Evans & Sutherland interactive graphics computer. A current listing of the tectonic element number used by POMP may be found in Appendix B.

Times of Appearance and Disappearance

The Times of Appearance and Disappearance are the boundaries of an age range for a digitized feature. An example of a time of appearance is the birth of a volcanic complex, such as Iceland at 12 Ma. A time of disappearance may be used to record the known subduction time of a specific portion of oceanic crust.

Data Type Code

The Data Type Code is a two character abbreviation which serves the same purpose, though more compactly, as the Data Type Descriptor. All headers contain a data type code. A list of these one or two letter codes used by POMP may be found in Appendix C.

Data ID Number

The Data ID Number is an integer useful for distinguishing among several features which have the same data type code and have similar geographic descriptions. Basically, the numeric data code is a four digit code for the user's convenience. Example C, beginning on page XXX, makes frequent use of the data ID number.

Color Code

The Color Code is an integer ranging from 0 to 360. The value of the color code is used by an Evans & Sutherland graphics computer to assign a color to the feature digitized. Color code value assignments are a post-digitizing step made with the POMP program MEGAPOLY.

Date and Time

Completing the header are a Date and Time entry. The digitizing programs automatically enter the date and time; the user need do nothing. These two components indicate the date and time the string was digitized or when the file was last modified by MEGAPOLY, the POMP information management program.

The Numerical Data

As shown on the next page, a string's digitized data follow the header and are arranged in three columns. The left and center column indicate the latitude and longitude, respectively, of a digitized point. The right column consists of single digit pen plotting commands. The pen plotting commands instruct the plotter what to draw at or between discrete digitized points. Lines, for example, are created by drawing single line segments from one digitized point to the next in a series of digitized points. A complete explanation of pen plotting commands is given in Appendix D. It is recommended that the reader examines Appendix D before reading any of the examples A-E.

Note that within the aforementioned illustration only one of the headers contains a data type descriptor. This is because data type descriptors are incorporated into the header only for four specific data types.

```
7001    39  ANOMALY    A   5  GULF OF ADEN, FZ 10-11, (ARABIAN PLATE)
 503   10.6 -999.0     A   5 503 140  6-FEB-87 10:41:11
  15.3600     53.6900  3
  15.2900     53.9800  2
  99.0000     99.0000  3

7099   397 WESTERN RIFTED MARGIN OF SOMALIA PLATE
 709     0.0 -999.0 RI   0 709 120  6-FEB-87 10:41:11
  10.6300    44.4600   3
  10.5100    44.2100   2
  10.4400    44.0500   3
  10.3400    48.8200   2
  10.1900    43.4200   3
          etc.
  99.0000    99.0000   3
```

The Terminator

In any string, "`99.0000    99.0000    3`," is the final three-column line of digitized data. At the end of a data file, the line, "`99.0000    99.0000    3`," is followed by a carriage return. A "`99.0000    99.0000  3`," line is referred to as a Terminator. The terminator tells the program which reads the string that the end of the string has been reached and that the next line is either the end of the file or the beginning of a new string. These special formats are created automatically by the digitizing programs and are used by the program PALEOMAP.

Using POMP digitizing software

The following sections contain information about how to use each of the four POMP digitizing programs. Among the four, there is a great deal of similiarity. Digitizing techniques and strategies as well as header construction are virtually the same for all the programs. The principle differences seen by the user are how the maps are oriented during the "set up".

The first section, "Using DIGMERE", describes in detail how to initialize the data file, build an appropriate header, and, using several examples, how to approach and digitize features. The remaining sections instruct the user in how to use DIGMER, DIGSTER, and DIGMERT in as much as they are different from DIGMERE. Therefore, the heart of this manual is in, "Using DIGMERE," and even if the reader has no intention of using DIGMERE, the section describing its use should be read.

Using DIGMERE

Purpose

DIGMERE (DIGitize MERcator Elliptical) is used to digitize figures which are drawn using an elliptical Mercator projection.

"Setting up"

Once the figure is oriented upon the digitizing template according to individual hardware requirements, one may begin to run DIGMERE. The program's first prompt is,

1. New map setup

2. Use current setup.

The user responds by typing "1" or "2." By selecting *1. New map setup*, the user will go through a series of operations which establish the scale of the figure. From the terminal screen, DIGMERE will ask that the user, *Digitze 2 widely seperated points along a line of latitude.* The left point must be digitized first. Next, the program asks for the distance, in degrees of longitude, between these two points. When this distance has been entered via the keyboard, the program responds by writing a scale value (units are thousands of inches per degree of longitude) to the screen. It is useful to write this value on the margin or any unobtrusive space on the figure. If features from the figure are digitzed in a future session, the scale may be input directly, thus saving the user the scale calculation step. In such a case the user may select *2. Current map setup* at the first question. The program will then ask that the scale be entered at the keyboard.

Once the scale has been determined, a known reference point, a benchmark, referred to by the program as the local origin, needs to be identified and oriented. The program queries are *Enter at the keyboard the lat/long of the local origin* which, after entering the appropriate latitude and longitude values is followed by *Now digitize this point.* In choosing a local origin it is recommended that the point be centrally located among the features to be digitized. It is also recommended that the user digitize this point with care. The local origin is one of four critical pieces of information needed to convert raw grid positions to latitude and longitude positions. The four pieces are 1) the figure's orientation on the digitizing template, 2) the map projection, 3) the scale of the figure, and 4) a single known point (the local origin) relative to which the latitude and longitude positions of all other digitized points are determined. Obviously, even with a known projection and a precisely determined scale, an incorrectly determined local origin will cause the position of all other digitized points in the data file to be incorrectly determined.

The program's next three prompts are straightforward. First is, *Enter the name of the data file.* The name, of the user's choosing, is limited to 48 characters. It is recommended that the name bear some relationship to the type of data or the region digitized. Next is, *Enter the Region number,* which has been discussed in the header description (page XX). The third is, *Enter the citation number,* an explanation for which immediately follows that for the citation number on pages 2-3.

The Grid Check

The parts of the header constructed so far are almost all that is necessary to create the first string, the grid check. A grid check is simply a digitized string which is used to check the latitudinal and longitudinal grid which has been created in the initial setup. The grid check indicates how accurately features may be digitized and if kept with the digitized file, serves as a measure of accuracy for the file. A grid check is required for every new figure digitized. Once the string reference number has been entered, the header menu is displayed on the screen. An illustration of this menu appears on the following page.

Data Header Menu

1) Initialize File/Grid Check

2) Enter Data Type

3) Enter New Geographic Description for Label

4) Enter Tectonic Element Number

5) Enter Time Limits

6) Enter Color Code

8) Finished - Return to Digitizer

9) End of File

Selecting, *1) Initialize File/Grid Check,* from the header menu begins the grid check. The prompt which follows asks for a string number. Generally, a zero string number is used for grid checks. Later, when the reconstruction program PALEOMAP is used, any string numbered zero is not plotted, thus preventing the plotting of grid checks which were carelessly digitzed with a "pen-down" command (see Appendix D: Pen Commands). Next, the user is asked to enter a header label, which is the same as a geographic description. The user should enter, "Grid Check," at the keyboard. An appropriate grid check header is now complete. Choosing, *8) Finished - ready to digitize*, will bring a new menu, the digitizing menu, to the screen. An illustration of this menu follows on the next page.

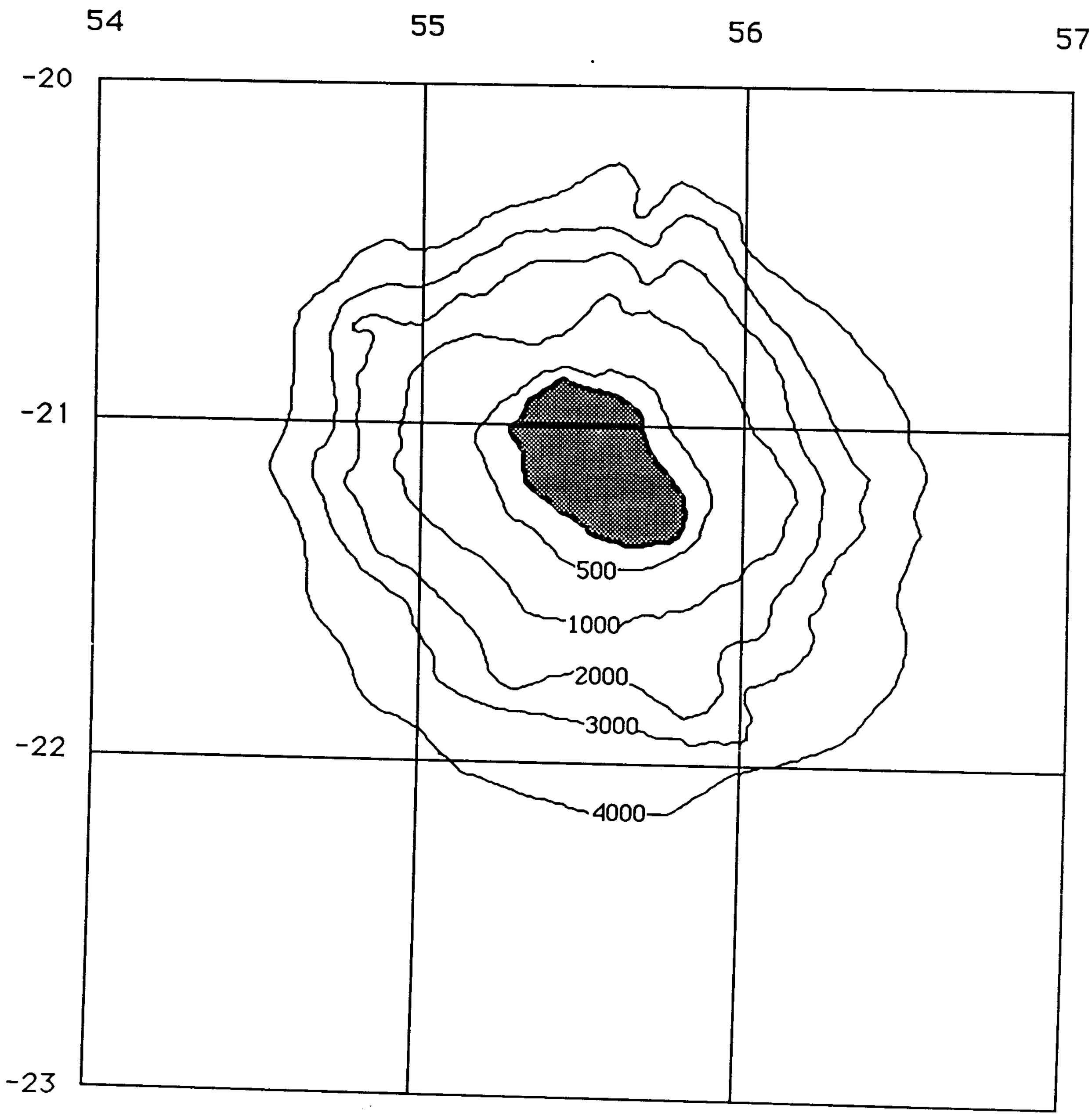
Begin Digitizing: *1) Draw to point digitized*
2) Skip to point digitized
3)Triangle
4) Circle
5) Plus Sign
6) Square
7) Increment String Number
8) Return to Menu

The program is now in the digitizing phase during which entries are made via the digitzing mouse. It is best to digitize the grid check using mouse button #2. It is also recommended that the local origin be the first grid check point to be digitized. Place the mouse cross hairs on the local origin and activate the mouse by pressing button #2, i.e. digitize the local origin. The latitude and longitude of this point will be displayed on the terminal screen. Several points, such as the four corners of the area to digitized and perhaps points along a single latitude and points along a single longitude, should be digitized and compared with their expected coordinate values. By comparing the coordinate values displayed on the screen with the expected values of the local origin, the user can determine the accuracy with which the features of that figure and setup may be digitized. If the difference between the expected and observed coordinate values exceeds the user's tolerance, a new setup and grid check should be attempted. With some figures, drafting or photocopying errors may cause the grid check/digitized data to exceed the user's tolerances. Appendix F offers an approach for digitizing such figures. When the grid check is complete, press button #8 on the mouse to return to the header menu.

Constructing the Header

Now a header for the feature to be digitized must be constructed. In the examples which follow, several specific headers are created. The sequence in which these headers are constructed are not the only sequence allowed. The user may enter header information in almost any order, but there is a consequence of order which the user should know. Whenever a new data type is selected, the times of appearance and disappearance are automatically reset to the default times or to times which correlate with the anomaly age of the feature. Thus, if a specific time range is entered before entering the data type, check after the data type entry to see if a resetting of the feature's times of appearance and disappearance is necessary.

Example A. Among the features that can be digitized with DIGMERE are coastlines and bathymetric contours. On the following page is a figure of Réunion Island. The figure is an elliptical mercator projection complete with lat/lon coordinates and labelled features. If the figure to be digitized does not include a lat/lon grid, it is recommended that the user draw one in pencil. Having a grid with which to perform a grid check is the easiest way to ascertain digitizing accuracy. An additional pre-digitizing preparation is labelling all features to be digitized. **Well-labelled features greatly improve the efficiency of any digitizing session.** Interupting a digitizing session to search for a feature name or characteristic can be time-consuming and frustrating. It must also be said that lengthy digitizing can easily be tiring. Once tired, one does not want to repeatedly stop and create unique and thorough labels for several similar features.



Réunion Island

The first feature to be digitized in this example is the 4000 meter bathymetry contour line. The initial entry in constructing the header is for the data type. Selecting *2. Data Type,* from the header menu will initiate the data type menu display. The data type menu is illustrated on the next page.

Choose Data Type
1) Magnetic Lineations
2) Magnetic Anomaly Pics
3) Ocean Floor Isochrons
4) Bathymetric Contours
5) Coastline Information
6) Paleogegraphic Boundaries
7) Tectonic Boundaries
8) Fracure Zone Segments
99) Other

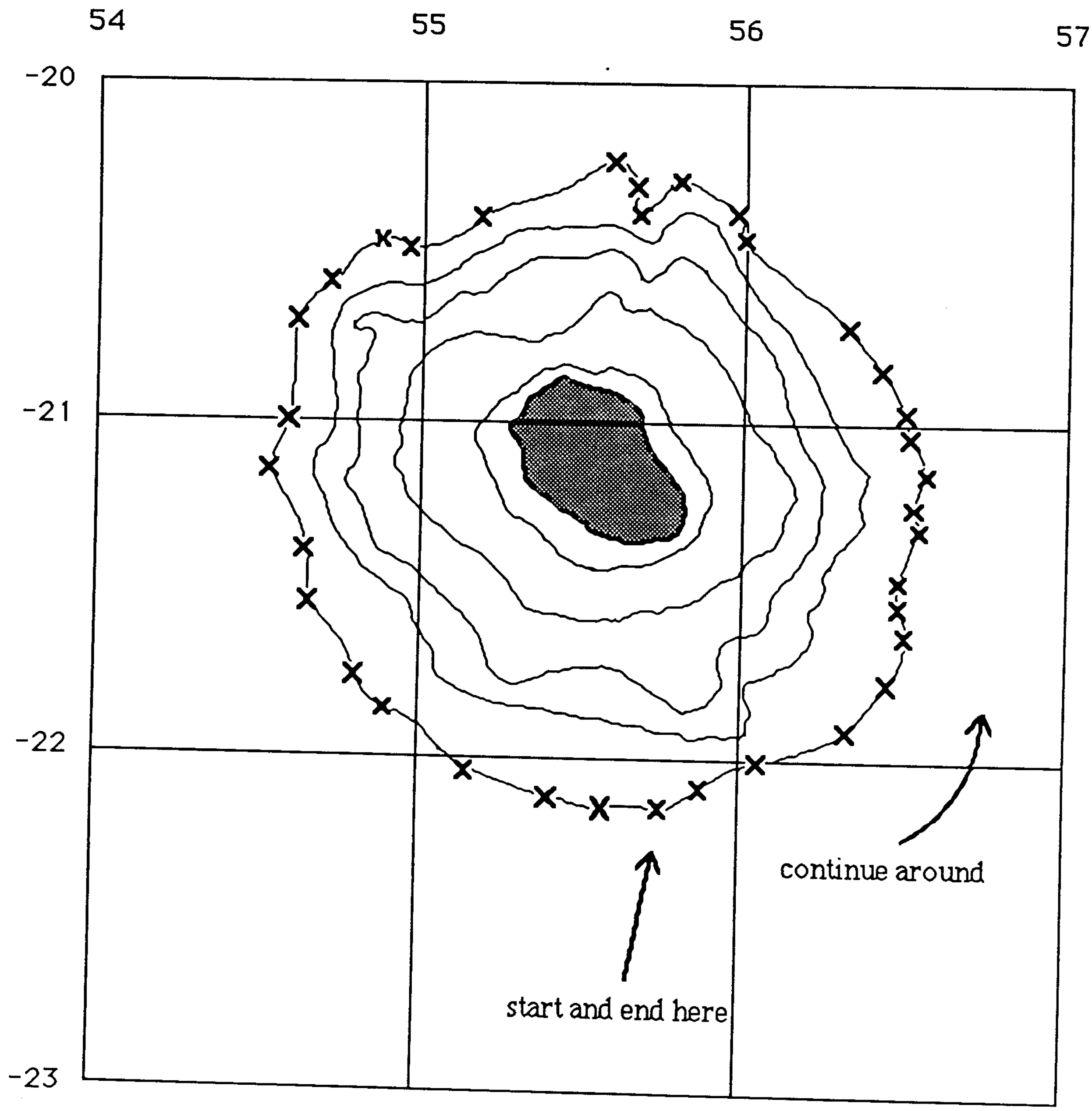
Upon entry of "4," for Bathymetric Contours, the program will reply with the prompt, *Enter Depth in Meters*, which in this case is 4000. After this entry the header menu will be displayed again. Each time the header menu appears, the header in its present stage of construction is displayed just above the menu. This conveniently allows the user to check for typographic errors, incorrect entries, or unfilled header components. Moving on with the header construction, choose *3) Geographic Description.* An appropriate geographic description for this feature is, "Reunion Island Bathymetric Contours." The next header component is the rotation ID number. Select *4. Tectonic Element Number*, and enter "701," the tectonic element number for the African craton. The age of Réunion Island is approximately 5 million years, and should be reflected in the header entry, *5. Time Range*. The correct response to the first Time Range prompt, *Enter Age of Appearance*, is "5." To the second prompt, *Enter Age of Disappearance*, the default time of -999.0 is the correct response. As mention earlier, color code assignments are a post-digitizing step and thus can be ignored in this example. The header for this example should resemble the header shown in the illustration

```
9414     1 4000 METERS        REUNION ISLAND BATHYMETRIC CONTOURS
 701     5.0 -999.0 BA4000  701    0 10/19/87: 1308
```

above.

This header is now complete and by selecting, *8) Finished - begin digitizing*, the program has completed the header construction phase and is now ready to digitize the contour line. The figure on the next page shows points along the contour line that the user might select to digitize. These points are marked by an "X." One should start at a point on the contour, preferrably one that the user has marked, and work around the contour line using mouse button #1 (draw to point) until returning to and redigitizing the starting point. After the line has digitized, select mouse button #8, which takes the user back to the header menu and allows a new header to be constructed for the next feature to be digitized.

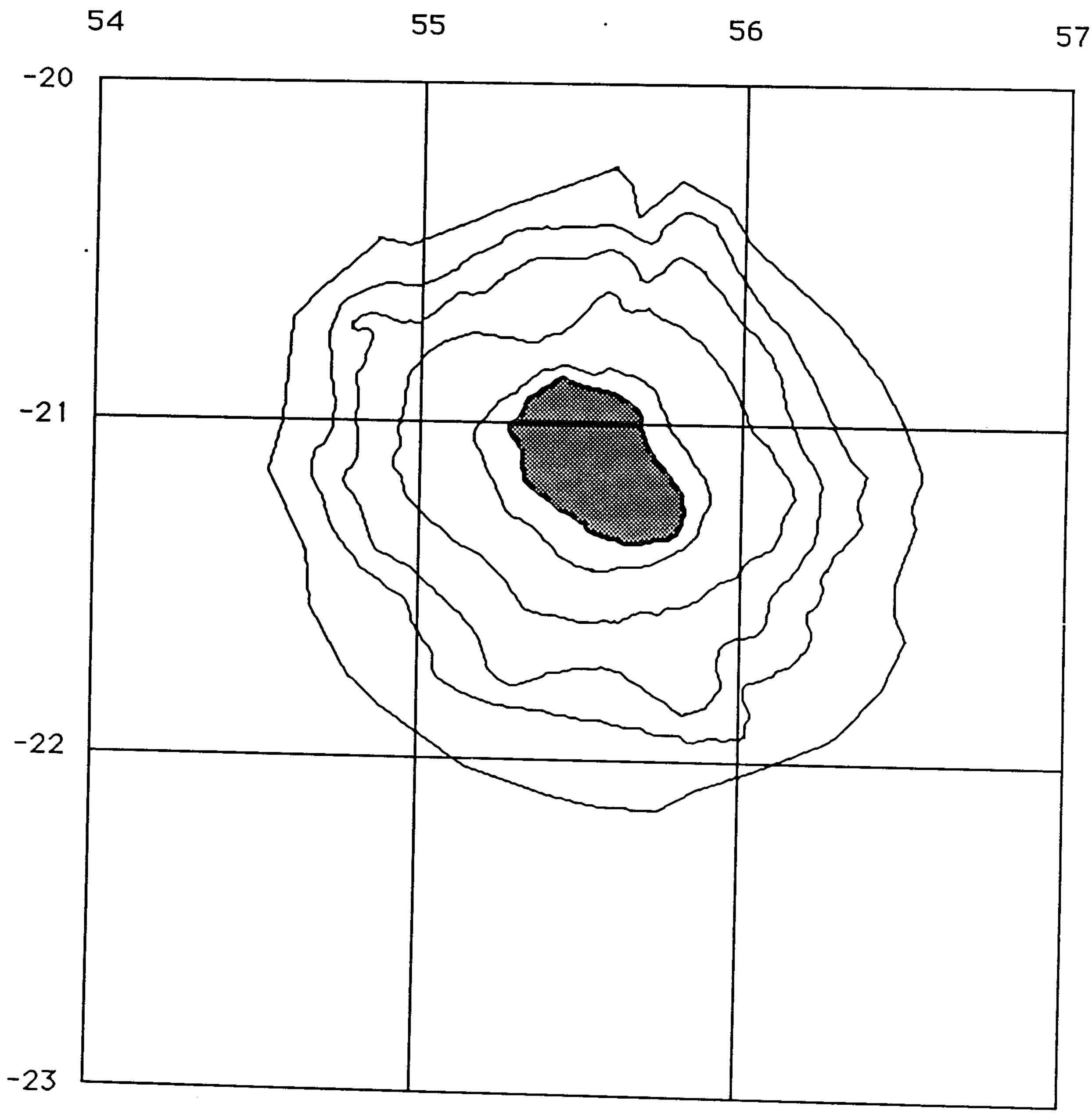
The remaining bathymetric contours may digitized in the same manner as the 4000 meter contour. The final feature to be digitized in this example is the Réunion Island coastline. In constructing the header, the data type entry should be *5) Coastline Information*. The succeeding prompt, *Data ID Number*, can be fulfilled by entering "1." In this case, the data ID number feature isn't useful since there aren't several similar coastlines which need to be distinguished from one another. There are many situations, however, in which the number is useful and for that reason one should overlook what can at times be a prompt for unecessary information. Any straightforward geographic description such as, "Réunion Island Coastline," is quite suitable. The tectonic element number and the time of appearance and disappearance remain unchanged from the previous header. They require no changes to properly digitize the island's coastline. The coastline header is now finished and by selecting *8. Finished - begin digitizing* the digitizing menu



appears and the program shifts into the digitizing mode.

A Note about Point Density

The number of points used to digitize a particular feature is decided by the user. Probably the two most important considerations in determining point density are 1) the required feature resolution and 2) the scale at which

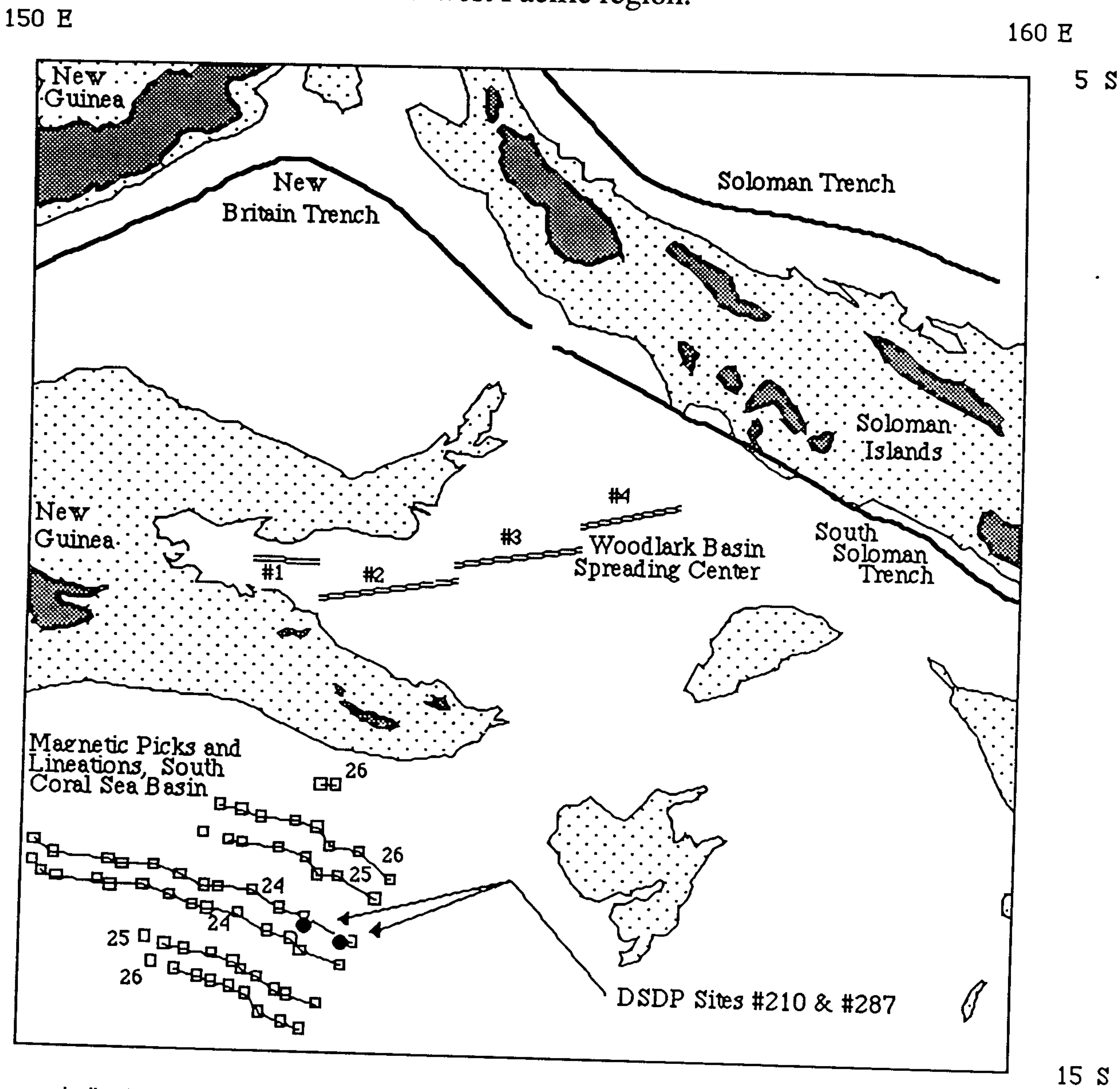


The outer bathymetry line has been reproduced using a digitized string of the "X-ed" points shown in the previous illustration.

the feature is to be reproduced relative to the scale at which it was digitized. Low feature resolution may be desirable for some files, e.g. draft quality coastline files, since they require less disk space and make for faster reconstructions when run through PALEOMAP. On the other hand, high resolution features are needed for precise reconstructions and for publishable figures.

If the 4000 meter contour line illustrated earlier were digitized at the X-ed points, the reconstructed contour line at the same scale would appear as shown on the preceding page. The feature is certainly less smooth than that in the original figure. If, however, the figure were reconstructed at a scale much larger than shown here, the angularity would diminish porportionally and the feature could sufficiently resemble a smooth, realistic bathymetric contour line.

Example B. A large variety of tectonic features can be digitized using DIGMERE. Several such features are shown in the illustration below, a 10° x 10° window in the Southwest Pacific region.



A "window glimpse" of some selected southwest Pacific features.

Darkly stippled portions denote landmasses and lightly stippled areas outline shallow areas. Solid white areas are deep water. Trenches are drawn using a heavy, thick line while spreading centers are recognized by closely spaced, thin parallel lines. Magnetic anomaly pics are represented by squares and the lines between the squares, magnetics anomaly lineations. Two darkly filled disks in the southern portion of the illustration mark DSDP sites.

The actual digitizing of the features in example B is similar to the digitizing in Example A, and to any feature which can be digitized. It shall be assumed that by now the user is familiar with operating the digitizing mouse and can make a decision in regard to digitizing point density. The disimilarities in digitizing the features in example B versus those found in example A lie in header constructions and string increments. Thus, example B shall serve to demonstrate how headers for several different tectonic features are created and how the string increment feature can modify a header to suit a succeeding string.

Occupying the northern half of the figure are three trenches, of which the New Britain Trench shall serve as our example. The initial header component, the data type, is entered by selecting, *7. Tectonic Boundaries,* from the data type menu. Two prompts follow, *Enter Data Type Code,* and *Enter Data ID Number.* A suitable binary letter code, as listed in Appendix C, is "TR." A data ID number of "1" will suffice. The geographic description, item #3 in the header menu, can be most any literal description such as "New Britain Trench." The tectonic element number for this feature is 829, representative of the South Soloman plate. Finally, the default appearance and disappearance times of 999.0 and -999.0 can remain unchanged, since the age of the New Britain Trench is unknown. The newly constructed header should resemble the one that appears below.

```
9623     1 NEW BRITAIN TRENCH
 829  999.0 -999.0 TR      1 829     0 10/24/87:0859
```

Centrally located in the figure is the Wodlark Basin Spreading Center. Like the New Britain Trench, the data type for this feature is a tectonic boundary, #7 in the data type menu. The data type code for active spreading centers is "RI," for ridge. Of course any other consistent and unique two letter code would serve just as well. Since four segments comprise this spreading center, one digitizing strategy is to give the segments a common geographic name and use the data ID number feature to differentiate the segments. The first segment to be digitized in this example is given a data ID number of "1." The other three segments will get data ID numbers of 2, 3, and 4. The next item in the header menu, *3. Geographic Description,* should be broad enough to describe all four segments of the spreading center yet note that there are four parts to the overall feature. Such a description would be, "Woodlark Basin Spreading Center (4 segments)." Again, the header menu appears and the next item to be entered, the tectonic element number, is "829," the ID for the South Soloman plate. Since this feature is an active spreading center, it should be assigned a recent time of appearance and a default time of desappearance. The header is now complete and should look like the one shown below.

```
9623      2 WOODLARK BASIN SPREADING CENTER (4 SEGMENTS)
 829      0.1 -999.0 RI      1 829     0 10/24/87:0904
```

Once the first segment is digitized, the header for the second segment should be the same with the exception of the data ID number. To change this portion of the header the user begins by choosing, *2) Data Type,* from the header menu. As with the first segment, select *7)Tectonic Boundaries,* and then enter "RI" for the data type code. At the prompt, *Enter Data ID Number,* the entry of "2" is that which characterizes this string's header. The header requires no further changes and should resemble the one shown below.

```
9623    3 WOODLARK BASIN SPREADING CENTER (4 SEGMENTS)
 829    0.1 -999.0 RI      2 829    0 10/24/87:0906
```

The user may now digitize the second segment and then proceed to the third and fourth segments, changing the data ID numbers in a similar manner.

An alternate strategy, requiring fewer keyboard entries, is to distinguish the segments using the geographic description. Only one keyboard entry is needed to change the geographic description of a header. Using labels such as "Woodlark B. Spreading Center (segment 1)," and "Woodlark B. Spreading Center (segment 2)," etc., is sufficient for most user needs.

Shown in the south Coral Sea Basin, the lower left section of the figure on page 18, are magnetic anomaly picks and magnetic lineations. Anomaly ages of the picks and lineations are labelled. Digitizing magnetic anomaly picks is very straightforward. The data type for the string's header should be #2 in the data type menu, *Magnetic Anomaly Picks.* Two prompts follow: *Are these M-sequence Anomalies? (Y/N),* and *Enter Anomaly Number.* In this example, there are no M-sequence (Mesozoic) anomalies and the first picks to be digitized are of anomaly 26 age. Thus the two prompts should be answered with "N" and "26." A digitizing strategy using a broad geographic description, covering a cluster of picks on the same plate, can make the digitizing very quick. Such a description would be, "South Coral Sea Basin Picks (Coral Sea plate)." After assigning the geographic description, enter a tectonic element number of "836," the Coral Sea element number. Note that the time of appearance for the feature is already complete. POMP digitizing programs automatically set the times of appearance for anomaly-dated features during the data type entries. The magnetic anomaly ages used by POMP are listed in Appendix E. An illustration of the complete header follows.

```
9631    6     PICK  A  26 SOUTH CORAL SEA BASIN PICKS(CORAL SEA PLATE)
 836   60.8 -999.0 PA  26 836     0 10/13/87:1422
```

The anomaly 26 picks are then digitized as single points using button #6 on the mouse. Button #6 is a pen command instructing the plotter to draw a square, the exact center of which is the point digitized. Squares designate magnetic anomaly picks in this example simply because of POMP convention. The actual pick locations are digitized as well as the interpreted magnetic lineations to give an idea of the density of data. Other users, of course, are likely to have their own symbol conventions.

After all of the anomaly 26 picks on the Coral Sea plate have been digitized, press mouse button #7 to increment the string number. The prompt, *Enter New anomaly number*, will be displayed. At the keyboard, enter "25," the anomaly number of the next series of picks to be digitized in this example. Once entered, the program shifts back to the digitizing phase where all entries are made via the mouse. When the anomaly 25 picks have been digitized, use the increment string number feature to modify the header as many times as necessary to digitize the remaining picks on that plate. To digitize the magnetic anomaly picks on the other plate, the user must return to the header menu and change the geographic description to "S. Coral Sea Basin (Coral Sea plate)" and change the tectonic element number to "836," representing the Coral Sea plate. Digitizing picks on the Coral Sea plate should proceed the same as for the South Soloman plate.

Lineations are drawn between magnetic anomaly picks of similar age. Digitizing these magnetic anomaly lineations is similar to digitizing their picks. For header construction, the data type is *Magnetic Lineations*. The succeeding two prompts are the same as those for picks: *Are these M-sequence anomalies? (Y/N)*, and *Enter Anomaly Number*. The correct responses for this example are "N" and "26." A comprehensive geographic description should mention something about magnetic lineations in the south Coral Sea Basin and should indicate on which plate the lineations are located. The tectonic element number will be "829" or "832," depending upon which plate the user begins to digitize. The header is now complete and by selecting *8. Finished - ready to digitize*, the user may proceed to digitize the lineations. Once all the lineations on the first plate have been digitized, a new header, reflecting the plate change, is created and the remaining lineations digitized.

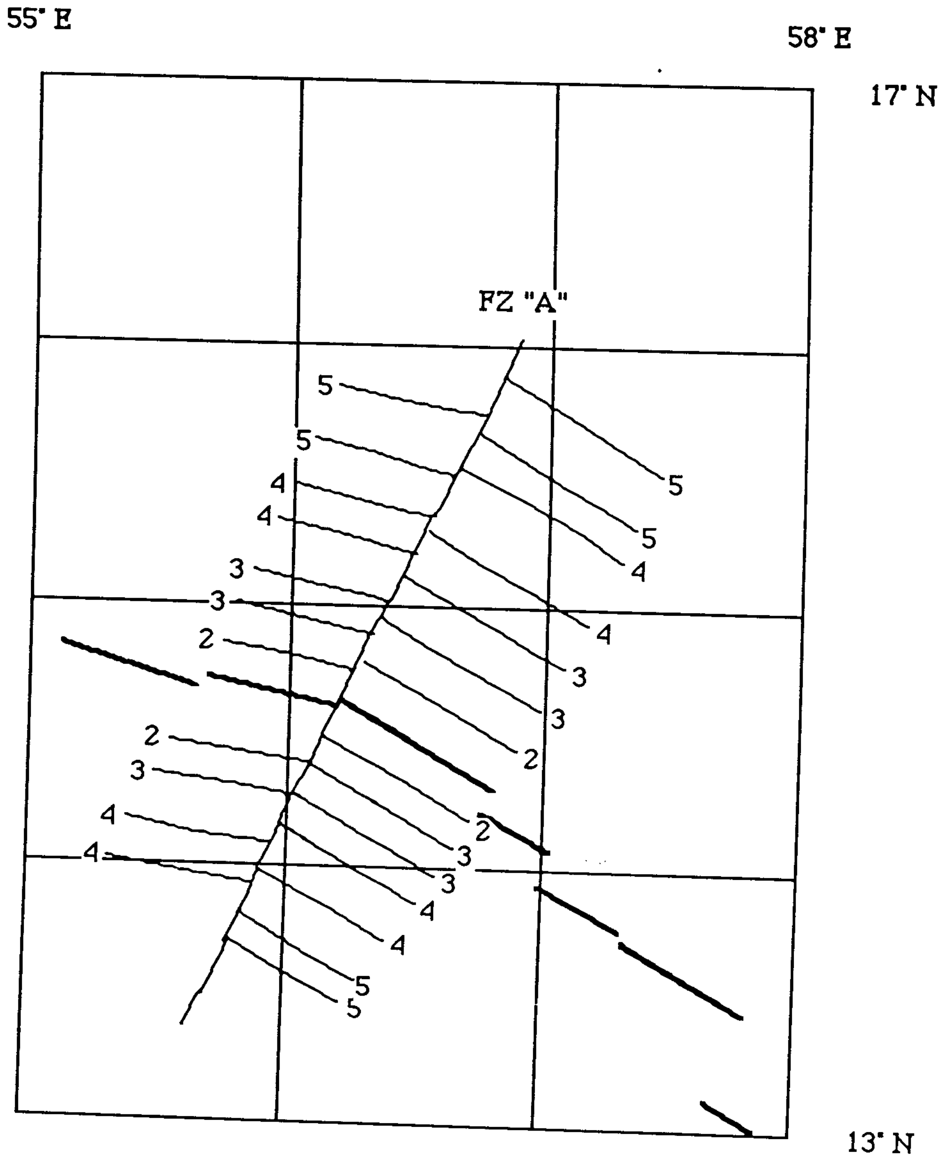
Finally, the user might elect to digitize the DSDP sites shown in the lower left portion of the original figure, among the picks and lineations. To digitize these sites, an appropriate data type selection and Data Type Code would be *99. Other*, and "DS," respectively. A DSDP site number should be represented by the data ID number. The DSDP leg and site number should be included in the geographic description. For the tectonic element number, it looks as though it is on the South Soloman plate, element number 829. If the basement age of the DSDP site is Below is a complete header for one of the sites shown in the figure.

```
9623    32 DSDP LEG 16, SITE #210
 829     0.1 -999.0 DS   210 829    0 10/24/87:0937
```

When digitizing the site, a symbol, such as a circle, serves well to mark its location. Like the squares used for the magnetic anomaly picks, a circle, plus sign, or triangle will be plotted such that the digitized point occupies the center of the symbol.

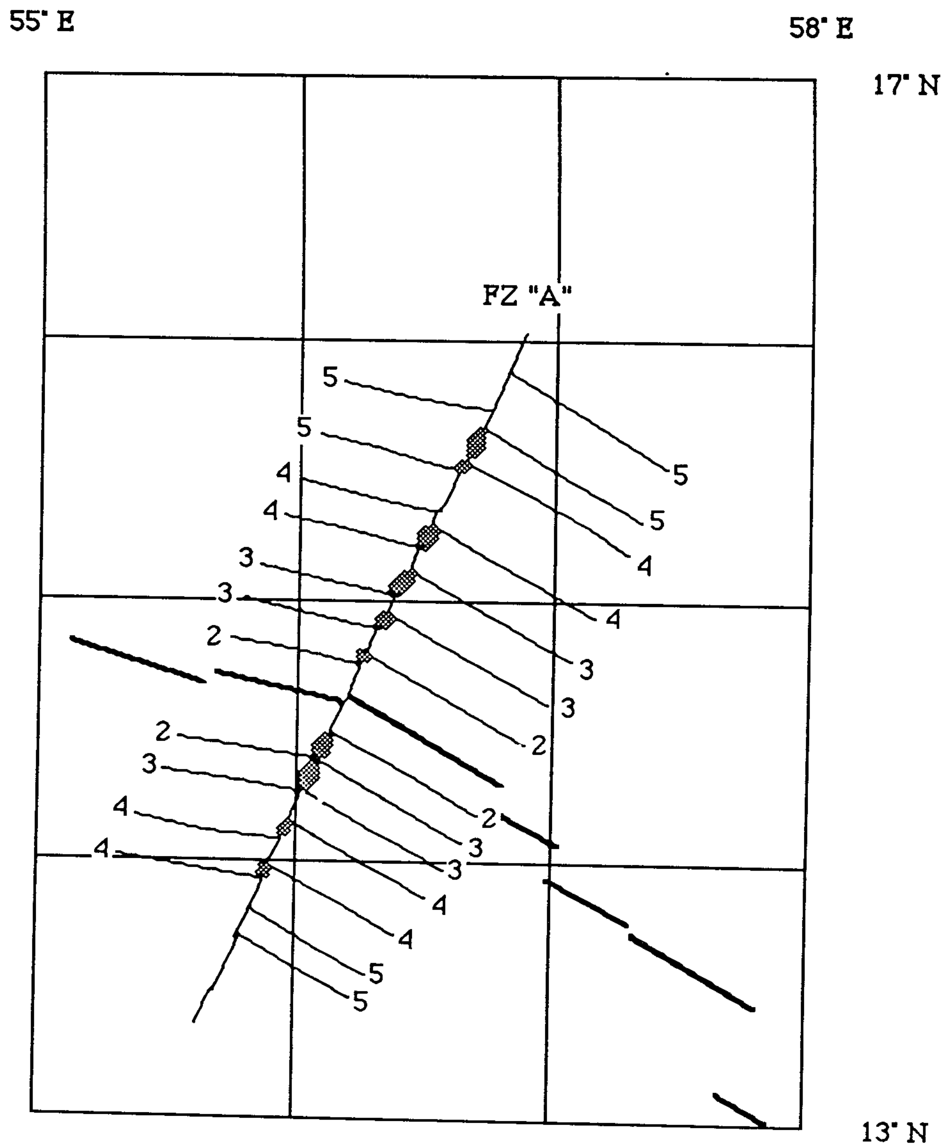
Example C. A more involved digitizing procedure is that used in digitizing fracture zone segments. As already shown, digitized features are given ages of appearance and disappearance. Likewise, a long transform fault, given appropriate age indicators (e.g. magnetic anomalies) may be divided into segments of different ages. The need for such divisions is found in fracture zone reconstructions. If the digitized fracture zone is broken up into age-specific segments, PALEOMAP reconstructions can depict the various stages of the fracture zone's evolution.

On the following page is a figure of a fracture zone found in the Gulf of Aden. For lack of a geographic name it shall be referred to as fracture zone A. Also shown are the ridge axes (represented by the thick lines) and magnetic lineations (with anomaly times labelled).



Fracture Zone "A"

Rough age constraints of various fault segments are made by extending the magnetic lineations until they intersect the fault. As is the nature of transform faults, the age constraints found on each side of the fault may



Fracture Zone "A" with contentious age segments shaded.

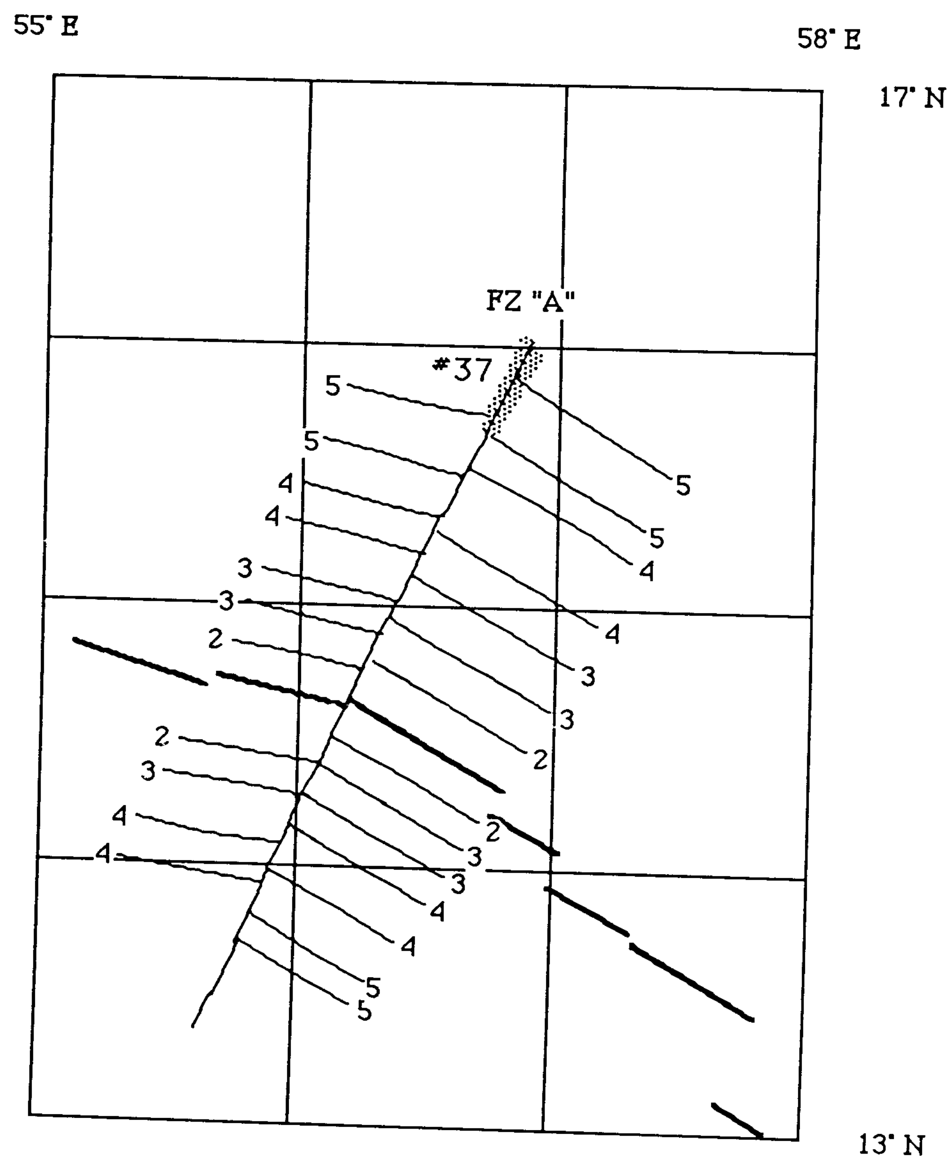
lead to ambiguous conclusions about the age of any particular segment. Such areas have been shaded in the figure shown above.

When digitizing such segments of the fracture zone, the younger of the two possible ages of appearance is always assigned to the segment. Since at least some of the feature is of the younger age, an early dating may be justified. If PALEOMAP reconstructions use features having the younger of the ambiguous ages, then the depiction of features known to exist at the time of reconstruction is ensured.

The first step in digitizing a series of fracture zone segments is constructing a header. One strategy is to digitize all the fracture zone segments of a tectonic plate before moving to the segments of another plate. Such a strategy requires the tectonic element number to be entered only as many times as there are tectonic plates with segments to be digitized. This saves a bit of time and, more importantly, reduces the chances that a feature will be digitized with the wrong tectonic element number. The example header begins with a tectonic element number entry of "503," the number for the Arabian plate.

Next, determine the data type by entering, *7. Fracture Zone Segments.* This entry is followed by the prompt, *Are these Fracture Zones Segments Bounded by M-Anomalies?*. The oldest segment of the selected fracture zone is not bounded by M-anomalies and thus "2" is entered at the keyboard. The succeeding prompt, *Enter Data ID Number*, allows the segment to be labelled with an arbitrary integer. When digitizing many segments from a single figure, it may be useful to label each fracture zone segment with a unique integer. With such a label one may, at a glance, match a digitized string with the feature from which it was constructed. The first segment to be digitized in this example has been assigned a data ID number of "37." The final data type entry, prompted by, *Enter Age at Young End of Fracture Zone Segment*, is straightforward. For segment #37 the anomaly age entered is "5."

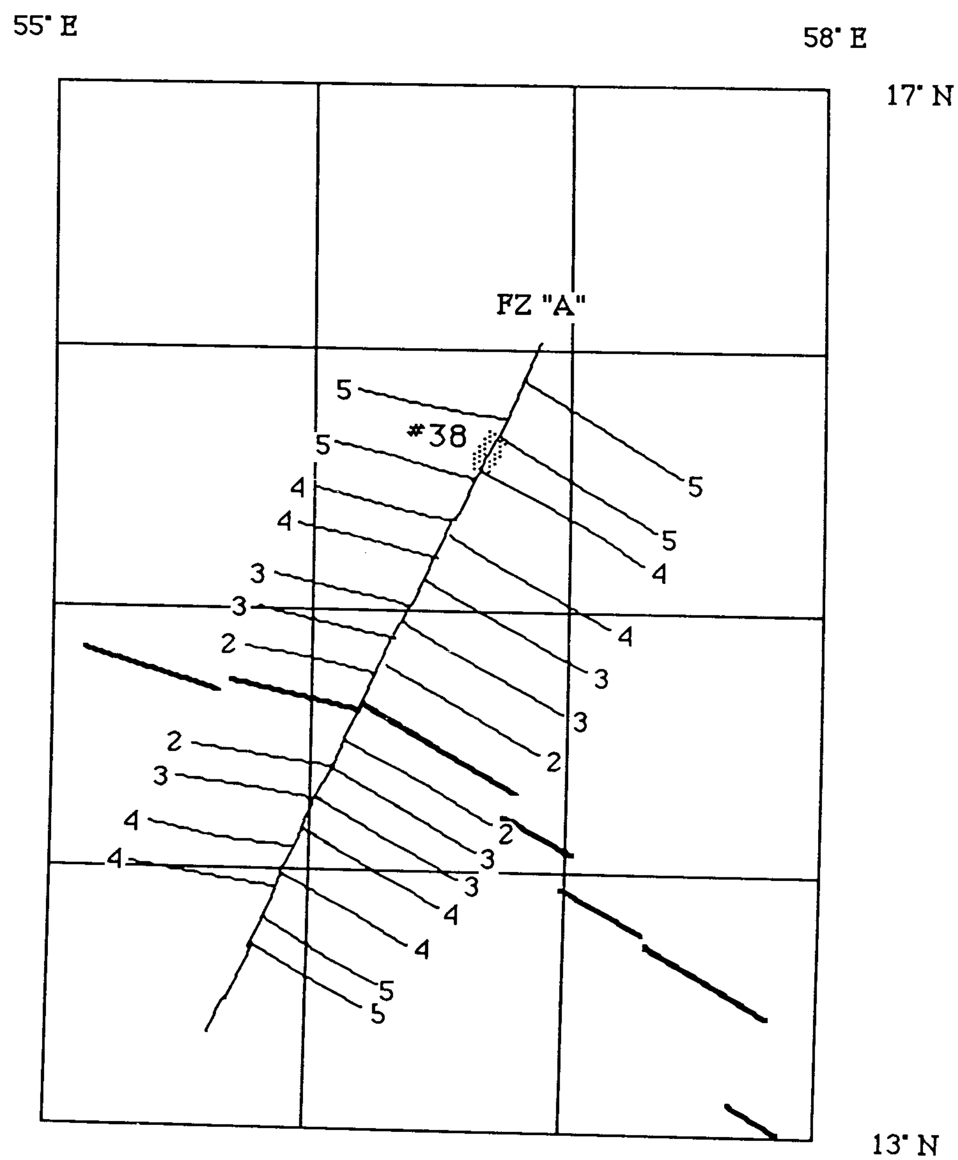
The header menu now appears and a geographic description is required. It is more efficient to choose a description that applies to all the segments of the fracture zone (i.e. the segments on a single plate). With a broad geographic description one can sufficiently renew the header for each new segment using the string increment feature. Otherwise a return to the main header menu and a construction of a header for each segment to be digitized is necessary.



Digitizing segment #37.

With these entries, the header is complete and the figure may now be digitized as shown on the preceding page.

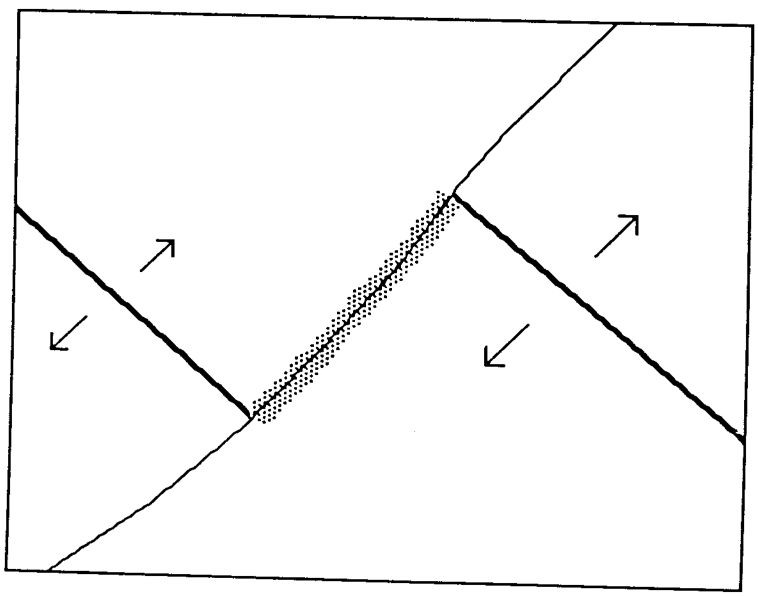
Once the last point of segment #37 has been digitized, the user may choose to increment the string number with mouse button #7 and answer, at the keyboard, the two prompts, *Enter Anomaly Number at Young End of*



Digitizing segment #38

Fracture Zone Segment, and *Enter Data ID Number*. In the example illustrated on the previous page, appropriate entries are "4" and "38." A header for segment #38 is now complete and the segment may now be digitized.

Using the same procedure, one may digitize the remaining segments approaching the ridge. In the ridge area it is likely that a fracture zone segment spans the offset between spreading ridges. Such a segment is part of fracture zone A and is depicted below.



The proper response to *Enter Anomaly Number at Young End of Fracture Zone Segment*, is "0" even though there is no younger end to the segment. One may wish to digitize this particular segment twice - once using the Arabian rotation ID number and once using the Somalian rotation ID number. Keeping this twice-digitized segment in the data base simply illustrates, in reconstructions, that the segment is part of both plates. For final reconstructed figures, of course, the user may wish to have only a single line for the segment.

Example E. The digitizing of geoid anomaly lineations will serve as a final digitizing example. Digitizing these lineations differs from any other only in header construction. When entering the data type the user should select *99. Other*. The prompt then asks for a data type code. For geoid anomalies the code is "GE." The next prompt, *Enter Data ID Number*, is satisfatied by a "1" or "2." For blue lineations (positive gravity gradient), 1 is the appropriate data ID number. For red lineations (negative gravity gradient), 2 is appropriate. PALEOMAP reads the data ID number and creates a plot file containing pen plotting assignments. PALEOMAP instructs the plotter to use pen #2 for a numeric descriptor of "1," and pen #3 for a data ID number of "2." Color code assignments for the Evans & Sutherland graphics computer are, just as for all other digitized data, made in a post-digitizing phase.

How to Quit

When the digitized data file is complete, the user may exit the program by returning to the header menu and selecting, *9) End of File*. The screen prompt asks if the user wishes to create an entirely new data file, e.g. a file containing different data types, or to end the session. A shortcut is to enter "9" instead of "8" (for *Return to Menu*) on the mouse. This bypasses the header menu and takes the user directly to the New File/End Session screen prompt.

Using DIGMER

Purpose

DIGMER (DIGitize MERcator) is used to digitize figures which are drawn using a Mercator projection.

DIGMER versus DIGMERE

DIGMER is identical to DIGMERE in all but the type of map upon which the program is to be used.

Using DIGSTER

Purpose

DIGSTER (DIGitize STEReographic) is used to digitize figures which are drawn using a stereographic polar projection.

"Setting up"

When using DIGSTER, the orientation of the figure to be digitized is different from that when using DIGMER or DIGMERE. Whereas the lines of latitude parellel the top and bottom margins of the digitizing table when using DIGMER, the 0° and 180° meridians parallel the top and bottom margins of the digitizing table when using DIGSTER. An easy way to remember the figure orientation for DIGSTER is to place the 0° meridan in the three o'clock position.

The program's first prompt, as shown below, asks which polar area is to be digitized. The second prompt, as follows, asks for a local origin.

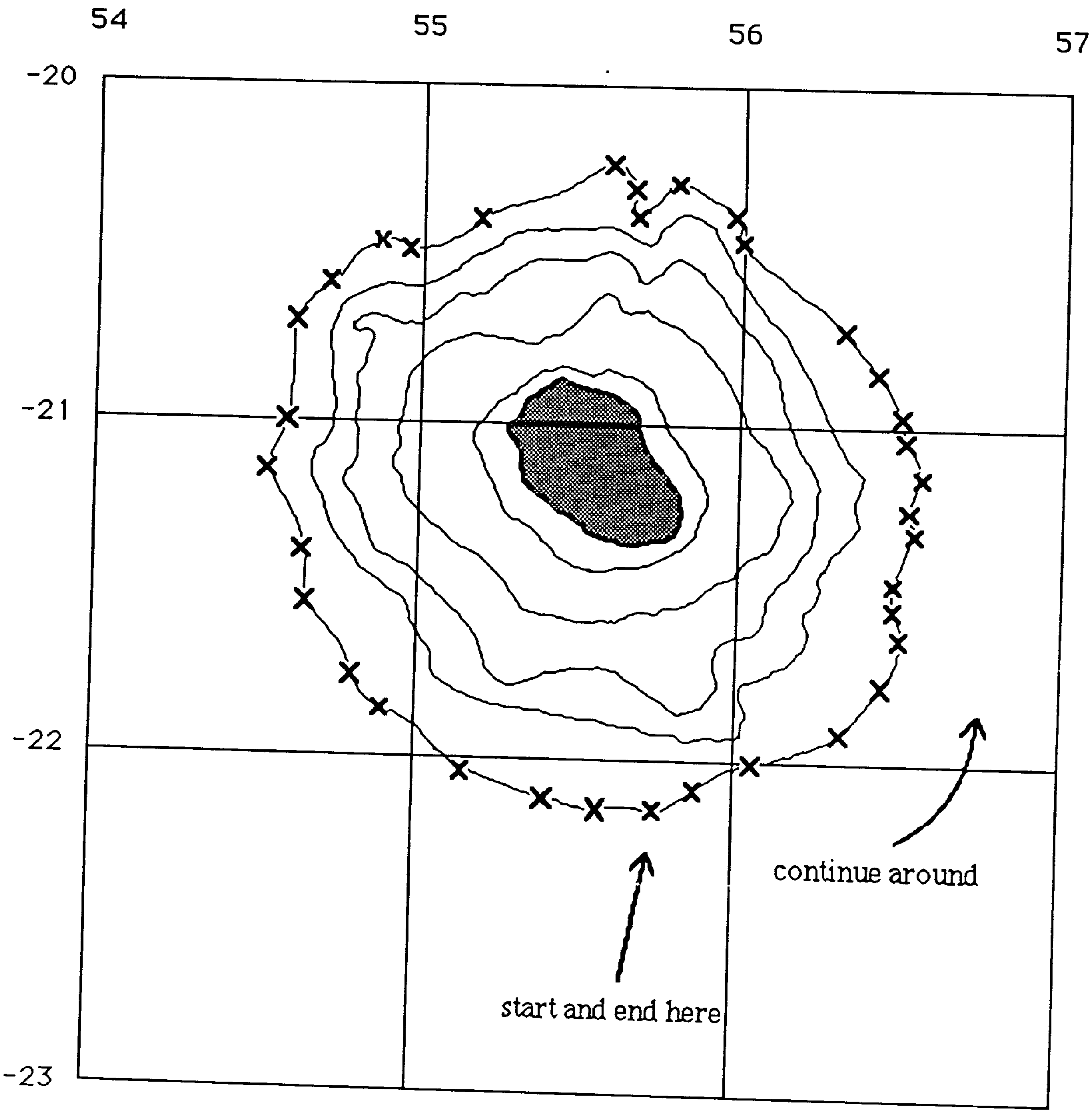
Choose: 1=North Polar, 2=South Polar
Enter at keyboard the Lat/Long of local origin,

The criterion for choosing a DIGSTER local origin is different from that used in DIGMER and DIGMERE. In the straight and elliptical mercator programs, the scale was determined by two arbitrary points along a same line of latitude. For reasons of accuracy, these two points are usually at the east and west extremes of the figure. An additional point, centrally located among the features to be digitized is then chosen for a local origin. In DIGSTER, however, the two points used to determine the scale are the pole (the central point) and the local origin. Thus, in order to get the most accurate scale calculation possible, it is recommended that the local origin be a known coordinate point as far from the pole as possible. An additional requirement is that the local origin be on the 0° meridian. The order in which the pole and local origin are to be digitized is indicated in the third prompt, shown on the following page.

Now Digitize:

1) The center of the map
2) The local origin.

DIGSTER, unlike DIGMER and DIGMERE, does not display a figure scale value for the user. The succeeding "set up" queries are identical to those of DIGMER and DIGMERE.



appears and the program shifts into the digitizing mode.

A Note about Point Density

The number of points used to digitize a particular feature is decided by the user. Probably the two most important considerations in determining point density are 1) the required feature resolution and 2) the scale at which

Digitizing the Features

Features are digitized with DIGSTER in exactly the same way as they are digitized using DIGMERE or DIGMER.

Using DIGMERT

Purpose

DIGMERT (DIGitize MERcator Transverse) is used to digitize figures which are drawn using a transverse mercator projection.

"Setting up"

Common to all transverse mercator figures is a prime meridian. When orienting the figure on the digitizing table, the prime meridian should be parallel to the upper and lower margins of the digitizing table and the North portion of the figure should be to the right. The initial prompt of DIGMERT,

Choose:

1) Set up new map

2) Use current map setup,

is identical to those in DIGMER and DIGMERE. Responses to the next two prompts (shown below) are used to determine the scale of the figure.

Digitize 2 widely seperated points along the prime meridian.

What is the <<longitidunal>> distance between these two points (in degrees)?

The program will then display a scale value in units of thousands of inches per degree of longitude. Next, the user must digitize a local origin and enter the coordinates of the origin. The screen prompts, illustrated below, instruct the user in how to choose the local origin and how to enter its lat/lon coordinates.

Digitize Origin of the Map:
i.e. the intersection of the prime meridian with the second orthoganal axis.

Enter the actual latitude and longitude (=prime meridian) of this point
for a polar projection enter
if Lat = +90 : Lon = +90 East
if Lat = -90 : Lon = -90 i(or 270 East)

The remaining set up steps are the same as those used for DIGMER and DIGMERE.

Digitizing features with DIGMERT is done in exactly the same way as features are digitized using DIGMERE, DIGMER, and DIGSTER.

Appendix A: Region Numbers

00 Global

1* North America

10	Greenland
11	E. Canada
12	W. Canada
13	Alaska
14	N.E. USA
15	S.E. USA
16	S. Central USA
17	N. Central USA
18	Rocky Mountains
19	Western States

2* Middle and South America

20	Mexico
21	Caribbean
22	N. South America
23	Central South America
24	S. South America

3* Europe

30	Scandinavia
31	British Isles
32	W. Europe
33	E. Europe
34	W. Mediterranean
35	E. Mediterranean

4* USSR and Mongolia

40	W. USSR
41	S. Central USSR
42	N. Central USSR
43	E. USSR
44	Mongolia

5* Mideast

50	Near East
51	"Persia"
52	Arabia
53	Indian subcontinent

6* Far East

60	Japan and Korea
61	NE.E. China
62	E. Central China
63	S.E. China
64	S.W. China
65	Indochina
66	Philippines
67	Indonesia
68	W. Pacific Marginal Basins

7* Africa

70	N.W. Africa
71	N.E. Africa
72	E. Africa
73	S. Africa
74	S. Central Africa
75	Central Africa
76	W. Central Africa

8* Australia and Antarctica

80	W. Australia
81	E. Australia
82	Melanesia
83	Tonga-Kermadec
84	New Zealand
85	W. Antarctica
86	E. Antarctica

9* World Oceans

90	Arctic Ocean
91	N. Atlantic Ocean
92	Central Atlantic Ocean
93	S. Atlantic Ocean
94	W. Indian Ocean
95	E. Indian Ocean
96	Central Pacific
97	S. Pacific Ocean
98	N. Pacific Ocean
99	Circum-Antarctic Ocean

Appendix B: Tectonic Element Numbers

100 North America

Number	Abbreviation	Description
101	NAM	N. American craton
102	GRN	Greenland
103	NSL	N. Slope Alaska
104	MEX	Mexico
105	BAJ	Baja California
106	ARC	Arctic Islands
108	AVA	Avalon-Acadia
109	PDM	Piedmont-Florida
110	ALR	Alpha Ridge
111	MNR	Mendeleev Ridge
112	CHP	Chukchi Plateau
113	NWR	Northwind Ridge
114	LMN	Lomonosov Ridge
116	MVR	Marvin Ridge
119	BRE	Brendon plate (NE Greenland)
120	CAI	Canadian Arctic Islands
199	PNA	Paleozoic N. America

200 South America and Caribbean

Number	Abbreviation	Description
201	SAM	S. American Craton
202	PRB	Parana Plate S. America
203	NWS	Northwest South America
204	HON	Honduras-Chortis
205	YUC	Yucatan
206	CUB	Cuba
208	CHI	Chiapas
209	CUC	Cuchumantanes
210	POM	Polochic-Motahua
211	SCR	Santa Cruz
212	GYP	Guayape
213	MGJ	Motagua-Jocotan
214	GDL	Golden Lane
215	GUE	Guerrero
216	CYR	Cayman Ridge
217	WCT	West Cayman Trough
218	ECT	East Cayman Trough
219	THK	Thunder Knoll
220	RSB	Rosiland Bank
221	PDB	Pedro Bank
222	JMC	Jamaica
223	QSN	Quinto Sueno
224	COF	Caribbean Ocean Floor
225	MRB	Maricaibo
226	RML	Romeral
227	STM	Santa Marta

228	PRJ	Perija
229	EPN	Eastern Panama
230	CPN	Central Panama
231	WPN	Western Panama
232	HSB	Hess Block
233	FLS	Florida Strait Block
234	LAA	Lesser Antilles Arc
235	AVR	Aves Ridge
236	SCB	Saint Christopher Block
237	PTR	Puerto Rico
238	EPR	E. Puerto Rican Trough
239	WPR	W. Puerto Rican Trough
240	MUT	Muertos Trough
241	GOT	Gulf of Tehuantepec
242	GOG	Guld of Gonave
243	ACC	Accreted Chortis
244	ACP	Accreted Chiapas
245	ACG	Accreted Guayape
246	AAB	Accreted Lesser Antilles Barbados
247	TGU	Transitional Guerrero
248	TLA	Transitional Lesser Antilles
249	TNA	Transition N. America
250	TMX	Transitional Mexico (Yaqui)
251	TYU	Transitional Yucatan
252	SHI	Southern Hispaniola
253	SJH	San Juan/Hispaniola
254	HCO	Hispaniola Cordillera
255	NHI	Northern Hispaniola
256	PDR	Pinar del Rio
257	YCB	Yucatan Basin
258	SEB	Southeastern Cuba
259	SMC	Sieraa Maestre de Cuba
260	TCB	Transitional Cuba
261	TSC	Transitional Southeastern Cuba
262	TSM	Transitional Sierra Maestre de Cuba
264	B2N	Beta=2, Northern Gulf of Mexico
265	B2S	Beta=2, Southern Gulf of Mexico
266	B3N	Beta=3, Northern Gulf of Mexico
267	B3C	Beta=3, Central Gulf of Mexico
268	B3S	Beta=3, Southern Gulf of Mexico
269	B4N	Beta=4, Northern Gulf of Mexico
270	B4S	Beta=4, Southern Gulf of Mexico
271	SIB	Sigsbee Block
272	B4C	Beta=4, Central Gulf of Mexico
273	PRT	Puerto Rico Trench
274	NCT	N. Cuban Thrust Sheet
275	SCT	S. Cuban Thrust Sheet
277	WSS	Western Scotia Sea
280	BDW	Burdwood
281	NSW	N. Scotia Ridge West
282	NSE	N. Scotia Ridge East
283	SRW	Shag Rock West
284	SRE	Shag Rock East
285	SGR	S. Georgia

286	SPW	Sandwich Plate West
287	SSI	S. Sandwich Islands
290	SSS	Salado subplate on S. America
291	CSS	Colorado subplate on S. America
299	SAS	S. American subplate

300 Europe

301	EUR	N European Craton
302	BAL	Baltic Shield
303	NHL	Northern Highlands (Scotland)
304	SPN	Iberia
305	CEU	Central (Hercynian) Europe
306	CSD	Corsica/Sardinia
307	ITL	Apulia
308	GRC	Greece
309	WSV	Western Svalbard
310	CSV	Central Svalbard
311	BAR	Barentsia
312	GRM	Grampian Highlands
313	MDV	Midland Valley
314	SUP	Sourthern Uplands
315	ENG	England-Brabant
317	ERK	East Rockall
318	WRK	West Rockall
319	MOS	Mosesia
320	BLE	Balearics
321	ALB	Alboran Plate
322	CAL	Calabria
323	SIC	Sicily
324	VPT	Vöring Plateau
330	TOB	Tornquist Block on Eurasia
331	UKB	United Kingdom Block on Eurasia

400 Soviet Union

401	SIB	Siberian Craton
402	KAZ	Kazahkstan
403	KOL	Kolyma
404	SAK	Sakhalin
405	VRK	Verkhoyansk
406	KAM	Kamchatk

500 India and the Middle East

501	IND	India
502	CEY	Ceylon-Sri Lanka
503	ARB	Arabia
504	TRK	Turkey
505	IRN	Iran
506	AFF	Afghanistan (Fara)

507	AFS	Afghanistan (Sistan)
508	SIN	Sinai
509	LEB	Lebanon

600 Southeast Asia

601	NCH	N. China Platform
602	SCH	S. China Platform
603	SEA	Malaya-Burma
604	ICH	Indochina
605	JAP	Japan
606	TIB	Tibet
607	MCH	Manchuria
608	NPS	N. Phillipine Sea
609	SPS	S. Phillipine Sea
610	EPV	E. Parece Vela
611	WPV	W. Parece Vela
612	NCS	Northside South China Sea
613	SCS	Southside South China Sea
614	KLM	Kalimantan
615	PNG	Papua-New Guinea
616	NTB	North Tibet
617	RDB	Reed Bank
618	MAC	Macclesfield Bank
619	SIK	Sikhate Alin
620	VLA	Vladivostok sliver
621	CSA	N. C. Sikhate Alin sliver
622	NSA	N. Sikhate Alin sliver
623	NMS	N-most Sikhate Alin sliver
624	SAK	Sakhalin
625	CHK	C. Hokkaido
626	WHK	W. Hokkaido
627	NEH	N. E. Honshu
628	CHN	C. Honshu
629	KAN	Kanto Region
630	SWH	S. W. Honshu
631	NWK	N. W. Kyushu
632	TSO	Tsoshima-Strati Block
633	NKO	N. Korean Plate
634	SKO	S. Korean Plate
635	KYR	Kita-Tamato Ridge
636	YAM	Yamato Ridge
637	OKI	Oki Ridge
638	SAD	Sado Ridge
639	NKM	N. Korean Margin Banks
640	NEM	N. E. Margin-Japan Basin
641	JBS	Japan Basin Spreading Center
642	YBS	Yamato Basin Spreading Center
643	LSM	Laptev Sea Margin
666	SUL	Sulu Basin
667	SES	Southeast Sulawesi
668	WSW	West Sulawesi
669	NES	Northeast Sulawesi

670	SLA	Sula
671	OKT	Okinawa Trough
672	BGB	Bangka-Belitung
673	NSM	North Sumatra
674	WPH	W. Philippines
675	SMB	Sumba
676	BLA	Bali-Alor
677	PAL	Palawan Block
678	EPH	E. Philippines
679	HAL	Halmahera
680	BUR	Buru
681	SER	Seram
682	KTB	Kep Tanimbar
683	WET	Wetar
684	TIM	Timor
685	GNA	General Asia
686	BSS	Barisan - S. Sumatra
687	AND	Andaman-Nicobar Ridge
688	WCB	S. West Caroline Basin
689	SEC	Southeast Caroline Basin
690	NEC	Northeast Caroline Basin
691	EAU	Eauripii Ridge
692	WCR	W. Caroline Ridge
693	CAR	Caroline Ridge
694	MAP	Mapia Ridge
695	AMM	Amami Plateau
696	BON	Bonin Ridge
697	NNG	North New Guinea
699	MAR	Mariana Ridge

700 Africa

701	AFR	African Craton
702	MAD	Madagascar
703	AGL	Agulhas
704	SEY	Seychelles
705	MAS	Saya de Maya-Mascarene
706	ORA	Oran Meseta
707	MOR	Moroccan Meseta
708	KAL	Kalbylies
709	SOM	Somalia plate
710	DAN	Danakil plate
711	PEP	Prince Edward plate
712	LVB	Lake Victoria block
713	NMZ	N. Mozambique
714	NWA	Northwest Africa
715	NEA	Northeast Africa
750	MAL	Malvinas Plate

800 Australia and Antarctica

801	AUS	Australian craton
802	ANT	E. Antarctic craton
803	WAP	W. Antarctic Peninsula
804	MBL	Marie Byrdland
805	ELL	Ellsworth Mts.
806	NNZ	N. New Zealand
807	SNZ	S. New Zealand
808	THR	Thurston Island
809	WHT	Whitmore Mts.
810	BRK	Berkner Island
811	STI	S. Shetland Islands
812	SOB	South Orkney Islands Block
813	CHT	Chatham Rise
814	BEL	Bellinghausen
815	BBK	Bruce Bank
816	DBW	Discovery Bank West
817	DBE	Discovery Bank East
818	HDB	Herdman Bank
819	OBW	Orkney Bank West
820	WSE	Western Scotia southeast
822	NLB	North Lau Basin
823	LAU	Lau Ridge
824	VIT	Vityaz
825	FIJ	Fiji
826	MNF	Mid-North Fiji (Basin)
827	NHB	New Hebrides
828	SLI	Solomon Islands
829	SSO	Woodlark Basin
830	BMK	South Bismark
831	NKG	North Kerguellen
832	BPT	Bellona Plateau
833	LHR	Lord Howe Rise
834	NFR	Norfolk Ridge
835	TKR	Three Kings Rise
836	NCS	North Coral Sea
837	STN	South Tonga (Ridge)
838	WST	West South Fiji
839	ESF	East South Fiji
840	ETS	East Tasman Sea
841	SLH	South Lord Howe Rise
842	MNF	Mid (piece) Norfolk (Ridge)
843	ENF	East Norfolk (Ridge)
844	NNF	North Norfolk (Ridge)
875	NAT	Naturaliste Plateau
880	WSC	West Scotia East (Central Scotia Sea)

900 World Oceans

901	PAC	Pacific plate
902	NAZ	Nazca plate
903	FAR	Farallon plate

904	ALU	Aluk
906	HHS	Henry Hudson
907	JMN	Jan Mayen
908	JNN	Jan Mayen North
909	COC	Cocos
910	JFC	Juan de Fuca
911	WHR	Wharton
912	NMG	North Magellan
913	SMG	South Magellan
914	CHK	Chinook
915	RIV	Rivera
916	MTH	Mathematician
917	GLP	Guadelupe
918	KUL	Kula
919	PHX	Phoenix
920	NIC	Nicobar
921	IDM	Indiaman
922	EAS	Easter
925	LEF	Leif plate

Appendix C: Data Type Codes

A	Anomaly (Cenozoic)
BA	Bathymetry (meters)
BO	Basement Offset
BS	Basin
CF	Continental Fragment
CM	Continental Margin
CO	Ocean-Continental Boundary
CS	Coastline
FZ	Fracture Zone
GE	Geoid Anomaly Lineation
GR	Gridmark
GV	Gravity Contour
HF	Heat Flow Contour
HS	Hot Spot
IA	Island Arc
IC	Ice Shelf
IS	Magnetic Isochron
IP	Isopach
M	Mesozoic Anomaly
MA	Magnetic Anomaly
NF	Normal Fault
OC	Outcrop
OP	Ophiolite Belt
PA	Anomaly Picks (Cenozoic)
PB	Plate Boundary
PL	Plateau
PM	Mesozoic Anomaly Pics
PO	Political Boundary
PR	Province, State Boundaries
QZ	Quiet Zone
RF	Reverse Fault
RI	Ridge Segments
RJ	Ridge Jump
RM	Restored Margin
RT	Reef Trend
RS	Rise
SH	Shelf Edge
SR	Slope/Rise
SS	Strike Slip
SU	Suture
TC	Transitional Crust
TF	Transform Fault
TH	Thrust Fault
TJ	Triple Junction
TL	Track Line
TO	Topographic Contour
TR	Trench
UN	Unknown
VO	Volcano
XR	Extinct Ridge
XX	Grid Check
ZE	Zero Edge

Appendix D: Pen Commands

The single digit numbers found in the third column of a ditized file are the pen commands. When plotting a digitized file with PALEOMAP, it is the pen commands which instruct the plotter what to draw at or between digitized points. The DIGMERE digitizing menu, as shown below, appears on the terminal screen once the user has completed constructing the header and enters, "8. Finished -- begin digitizing."

Begin Digitizing: *1) Draw to point digitized*
2) Skip to point digitized
3)Triangle
4) Circle
5) Plus Sign
6) Square
7) Increment String Number
8) Return to Menu

The first pen command option of the digitizing menu, *Draw to point digitized*, instructs the plotter to draw a line from the point previously digitized to the point presently digitized. The second option, *Skip to point digitized*, tells the plotter to draw the point presently digitized. A simple way to think of the two options is "pen-up" and "pen-down." As the plotter's pen moves from one point to the next, the pen is either in an "up" position (i.e. skip to point digitized) away from the paper, or in a "down" position (i.e. draw to point digitized), making contact and marking on the paper. Options 3 - 6 instruct the plotter to draw a symbol at the point digitized. Option #7, *Increment String Number*, begins a new string, complete with a new modified header. This is a short cut, allowing users to make minor modifications to a new string's header without going back to the header menu. The header modification, aside from an automatically incremented string number, is dependent upon the data type. For example, if the user is digitizing magnetic lineations, pressing button #7 wil bring the prompt, *Enter new anomaly number*, to the screen. A new anomaly number is entered at the keyboard and upon a carriage return, the user may begin digitizing a new magnetic lineation. In this case, the header modifications include an incremented string number, a new anomaly number, and a new Time of Appearance which reflects the change in anomaly number. The string increment feature is useful for digitizing several features of the same data type. Instead of returning to the header menu and reconstructing a header for each new feature, a quick and appropriate header modification can be made. By reducing the amount of keyboard entries made between digitizng features, the user can digitize with less interuption and with greater efficiency. Option #8, *Return to menu*, simply returns the user to the header menu to a new header or to exit from the program.

The pen command number found in the third column of the file's numeric data is the mouse button number used plus one. For example, if a square (mouse button #6) is selected for a digitized point, the pen command number recorded is "7." A possible exception is the first point of a string. The string's first pen command is "3" or higher. It cannot be "2," (draw to point digitized) since there is no previous point in the string from which to draw.

Appendix E: 1983 DNAG Timescale used in POMP

Anomaly #	Age (Ma)
1	0.9
2	1.9
2A	3.2
3	4.8
3A	5.9
4	7.4
5	10.6
6	20.5
6	23.0
7	26.0
8	27.7
9	29.2
10	30.3
11	32.1
12	32.9
13	35.9
15	37.7
16	39.9
17	41.1
18	42.7
19	44.1
20	46.2
21	50.3
22	52.6
23	54.7
24	56.1
25	59.2
26	60.8
27	63.5
28	65.1
29	66.2
30	68.4
31	69.4
32	71.7
33A	74.3
33B	80.2
34	84.0

Anomaly #	Age (Ma)
M0	118.7
M1	122.3
M2	123.0
M3	125.4
M4	127.1
M6	127.3
M7	128.0
M8	128.6
M9	129.4
M10	130.2
M11	133.5
M12	135.6
M13	137.1
M14	138.3
M15	139.6
M16	141.9
M17	143.8
M18	144.8
M19	146.4
M20	148.3
M21	149.9
M22	152.2
M23	154.2
M24	155.5
M25	156.6
M26	158.0
M27	158.9
M28	158.9
M29	160.3

Appendix F: Suggestions from a Veteran Digitizer

The easiest way to improve digitizing efficiency is to **profusely label all features to be digitized before the digitizing session.** Having all the needed labels prior to digitizing eliminates the possibility of having to search through reference material for proper feature names and chracteristics while in the midst of digitizing other features.

If the digitizing session is to be a long one, arrange the digitizing table, the keyboard and terminal, and the chair (if one is used) in such a way as to maximize comfort. Long digitizing sessions are easily tiring, especially if one has to stretch awkward distances to reach certain features.

When many features from a single figure are being digitized, a light pencil mark indicating which features have already been digitized can prevent features from being digitized twice or not at all. When digitizing closed polygon features, a light pencil mark indicating the initial digitized point of the feature lets the user return and redigitize the point, thus closing the polygon, with convenient certainty.

Some mercator and elliptical mercator projection figures have coordinates so distorted that a satisfactory grid check encompassing much or all of the figure is impossible to obtain. In such a case divide the figure into two or more regions of features to be digitized. Treat each region as if it were a seperate figure. Each region should be a seperate file having its own calculated scale, grid check, and local origin. Since none of the features in such regions are very far from the local origin, the digitizing error is minimized and is likely to be within the user's accceptable limits of error.

There are those within the POMP group who attribute their digitizing tenacity to "Jolt [lightening bolt] Cola." For the truly desperate ones among our destitute group, the chemical potency of Jolt Cola is known (it's in this month's Playboy Advisor) to be enhanced by disolving "Fire Stix" brand candy within the brew. Surely, such libations are not to be forgotten.

Appendix G: Outline of Digitizing Steps

I. "Setting Up"
   A. Orient figure on digitizing table.
   B. Digitize points for scale or input known scale.
   C. Choose local origin (already done if using DIGSTER).
   D. Enter initial header information.
      1) Data file name.
      2) Geographic Region ID Number.
      3) Reference ID Number.

II. Initialize the File/Grid Check
   A. Enter String Number and Header Label
   B. Digitize coordinate points for Grid Check.

III. Construct the Header
   A. Enter Data Type.
   B. Enter Geographic Description.
   C. Enter Rotation ID Number
   D. Enter Time Limits (if necessary)

IV. Digitize the Features
   A. Select *"Finished - return to digitizer"*
   B. Digitize a single feature.
   C. Continue with data file by
      1) Incrementing String Number and modify Header for next feature **or**
      2) Returning to Menu and construct a new Header for the next feature **or**
      3) Selecting *"End File"* and end the session.

Appendix H: Step-by-Step Instructions for the UTIG Calcomp 9000 Digitizing Table

Purpose

These instruction address how to orient a figure on the digitizing table so that features from the figure may digitized using POMP digitizing software.

Initial Reset Steps

It is recommended that the Calcomp equipment be reset each day before digitizing. If the hardware has not been reset earlier or if you are unsure, look under the digitizing table for a beige and black box labelled "Calcomp 9000." There are two large buttons on the box, one is marked "Power" and the other, "Reset." Pressing the reset button will reset the digitizing system. The system will respond with a high-pitched beep and a Calcomp 9000 message will be written to the terminal screen.

If the digitizing is being done on a VAX computer, the terminal now needs to be reset so that it will behave as normal VAX terminal. Pressing the keys **Shift**, **Esc**, **%**, and **E**, and holding all four down at the same time will reset the terminal. A successful reset is acknowledged by a second high-pitched beep.

Orientation Steps

The figure (using say, an elliptical mercator projection) to be digitized should be placed upon the table so that the lines of latitude approximately parallel the upper and lower margins of the table. Figures using transverse mercator or stereographic polar projections should be placed upon the table as indicated in the sections "Using DIGMERT" and "Using DIGSTER." Next, find three small square diagrams located on a plastic sheet taped to the left corner of the digitizing table.

With the digitizing mouse, digitize the middle of the three squares, marked "Erase Large Menu," and then digitize the leftmost square, "Locate Large Menu." A high-pitched beep will sound as each of these and all other points are digitized during the orientation process.

Above and to the right of the three squares is a sheet of plastic taped upon the table. This is the menu to which the three squares refer. Drawn on the menu is a grid, a portion of which is shaded in yellow and another portion of which is blue. The lower left square of the yellow grid is labelled "NUL." Digitize the lower left corner of the "NUL" square. Digitizing this corner locates the menu.

Along the top row of blue squares, third from the left, is a square marked "Rotation." Digitize any point within this square. This sets the Calcomp system ready to receive two digitized points used to calculate how the map is rotated relative to the upper and lower margins of the table. For Mercator projections the two points should be along a single line of latitude. For Sterographic Polar projections, the line should be parallel to the zero meridan. For Transvers Mercator projections the two points should be slected from the central meridian. Now digitize these two points, digitizing the left point first.

"Reorienting" the Map

After the initial map orientation and the start of a program such as DIGMERE, the user will digitize, for scale determination, two points along a line of latitude. If the program returns an error message indicating the map is improperly aligned, try digitizing the two points again. In the case of additional "improperly aligned" messages, repeat the orientation sequence. The orientation sequence is independent from the digitizing program and one can orient the figure at any time. Upon reorientation, simply resume the setup procedures for DIGMERE.

Hint: If the digitized points used to determine the scale of the map are taken from the same line of latitude as were the two "rotation" points, error messages indicating improper map alignment will be minimized.