UNITED STATES DEPARTMENT of the INTERIOR

GEOLOGICAL SURVEY

USER'S GUIDE TO THE RADIOMETRIC AGE DATA BANK (RADB)

Robert E. Zartman

James C. Cole

Richard F. Marvin

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Abstract

The Radiometric Age Data Bank (RADB) has been established by the U.S. Geological Survey, as a means for collecting and organizing the estimated 100,000 radiometric ages presently published for the United States. RADB has been constructed such that a complete sample description (location, rock type, etc.), literature citation, and extensive analytical data are linked to form an independent record for each sample reported in a published work. Analytical data pertinent to the potassium-argon, rubidium-strontium, uranium-thorium-lead, lead-alpha, and fission-track methods can be accommodated, singly or in combinations, for each record.

Data processing is achieved using the GIPSY program (University of Oklahoma) which maintains the data file and builds, updates, searches, and prints the records using simple yet versatile command statements. Searching and selecting records is accomplished by specifying the presence, absence, or (numeric or alphabetic) value of any element of information in the data bank, and these specifications can be logically linked to develop sophisticated searching strategies. Output is available in the form of complete data records, abbreviated tests, or columnar tabulations.

Samples of data-reporting forms, GIPSY command statements, output formats, and data records are presented to illustrate the comprehensive nature and versatility of the Radiometric Age Data Bank.

USERS' GUIDE TO THE RADB FILE

At present, there are an estimated 100,000 published radiometric age determinations for samples from the United States alone. To accommodate the continuing research in geochronology, an information collection and management system has been developed by the U.S. Geological Survey (see Fig. 1). The RADB (Radiometric Age Data Bank) presently contains data relating to all published age determinations for samples from the state of Wyoming, and data from references for other states are continuously being added by U.S. Geological Survey compilers. Organized reporting forms are being used to collate descriptive information regarding the location and nature of the samples, and analytical information pertaining to age determinations by the potassium-argon, rubidium-strontium, uranium-thorium-lead, lead-alpha, and fission track methods. Carbon-14 ages have not been included in this data bank since a program already exists at Yale University for the compilation of radio-carbon data (Flint and others, 1975). The capability exists within this system for storing very large amounts of data; therefore, it would be possible to use RADB in the future as a means of storing unpublished data. The U.S. Geological Survey is considering such a use for its own age determinations and, since this system would eliminate the compilation time, a much more current file could be maintained. It may also be possible to make direct reference to the RADB in future publications, so that less publication space need be devoted to the tabulation of analytical data.

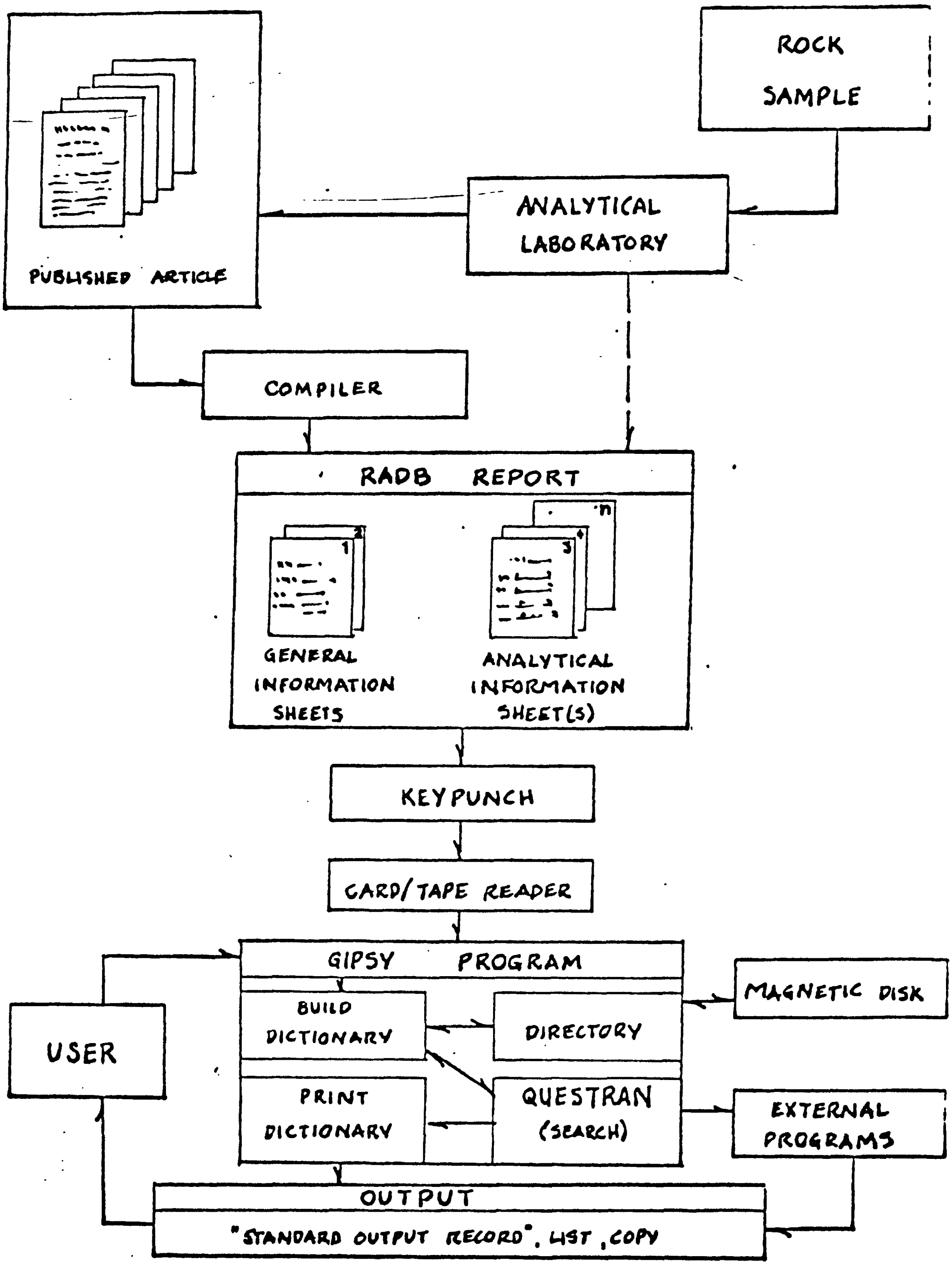


Figure.1. Information flow in the Radiometric Age Data Bank System.

Data in the RADB file are compactly stored on magnetic disk units, accessible by the U.S. Geological Survey computer network. An information handling program, GIPSY (General Information Processing System, developed at the University of Oklahoma), has been adapted to perform the functions of maintaining, correcting, manipulating, and searching the RADB file (Calkins and others, 1973). GIPSY has proved well-suited for handling diverse information of the type contained in the RADB file, and has also been applied to CRIB (Computerized Resources Information Bank; U.S. Geological Survey), to the Oil and Gas Pools File (U.S. Geological Survey), and to numerous other governmental and institutional data files (Office of Information Systems Programs, 1975).

This manual is intended for the users of the RADB file and should enable them, even with a limited background in computer applications and terminology, to utilize the advantages of the RADB system. It is anticipated that few users will have convenient access or sufficient time and interest to perform the direct manipulations required in using this computerized system. Requests for geochronological data can be handled by trained personnel at the U.S. Geological Survey who will make the actual inqueries through the computer, and pass the output on to the user. Whether the user elects this option or chooses to perform the computer work directly, this manual has been written to demonstrate the capabilities and limitations of the RADB system using GIPSY. It is essential for every user to understand the basic concepts behind the construction and use of the data bank so that reasonable interpretations can be made from the information obtained from it. The user who elects to do the programming and computation directly will find the manual provides sufficient instruction for performing routine procedures. It will be useful to obtain a copy of the GIPSY Users' Guide (see References) for more complex procedures.

The capabilities of GIPSY are such that they allow even the novice user the means for locating and comparing geochronological data selected on the basis of geographic, geologic, petrologic, and analytical parameters, or combinations of parameters. In addition, the RADB system can provide the user with computational and statistical subprograms, and a variety of printed output forms. These include complete data records, abbreviated lists of pertinent data, tables, and certain types of graphs, charts, and maps. Examples of searches and forms of output are discussed in the following sections and are displayed in the Appendices.

Through GIPSY, RADB will provide geologists with the means to assemble and examine radiometric age determinations without the necessity of locating individual literature sources. Furthermore, RADB contains nearly as much critical information as the original publication for each age determination, and should allow the user-geologist to evaluate the significance of the data. However, it must be emphasized that an information management system of this magnitude will contain a certain small percentage of human- and machine-related errors. In recognition of the fact that the published source is the final authority, complete reference information is available through RADB for all data in the system.

In general, each time geological information is retrieved from the data bank, it will be accompanied by a bibliography of the original published sources.

INPUT - the compilation process

The reporting forms used by the compilers are shown in Appendix A, and an examination of them will indicate the breadth of information encompassed by RADB. Coded and numerical information are entered in many places, and space has been made available for written (textural) entries as well, which serve to elaborate on various aspects of the age determination. One set of reporting forms is completed (by the compiler) for each age determination that is entered into the data bank and, while this often results in redundant input information, it is included for the complete description of the geochronological study of the sample, and to insure that the records are as independent as possible from each other.

Searches of the RADB file can be made on the basis of the presence, absence, or value of any of the pieces of information listed on the reporting forms; for example, the "Rock Name", "Petrographic Code", and "Description" entries in the sample description section. The coded entry forces a degree of standardization on the designation of the rock type; e.g., A170<A131> is defined as "basalt" (see Code List H - Petrographic Codes), and will be the coded entry for all mafic extrusive rocks. The written entry "Rock Name" contains the specific designation made by the author; e.g., A130<quartz tholeiite>, A130<high-alumina basalt>, etc. Additional information regarding the sample petrography can also be included in the "Description" entry, A140; e.g., A140<olivine, pigeonite, and andesine phenocrysts in a microcrystalline groundmass; analysis indicates 1.1% K_2O>. In this way, a search for information concerning basalts (based on the coded entry only) will retrieve the records for all mafic extrusive rocks, but the specificity of the author's original designation will be retained, and can be retrieved for inspection.

Information of an ancillary nature is also contained in the data bank, relating groups of records and groups of samples. Age determinations which together define an isochron age have been assigned a unique sample suite number and, by retrieving any one of the sample records, the other members of the suite can be located and examined. Provision has been made on the forms for relating earlier age determinations to more recent publications which supercede them, which re-interpret the results of the analytical investigation, or which supply additional information about the samples.

The radiometric ages listed in RADB are the same as in the published source. No attempt has been made to recalculate those radiometric ages which were calculated using values for decay constants that differ from those in use today. Therefore, direct comparison of recently-published radiometric ages with those published 5, 10, or more years ago could lead to serious interpretive errors if they have not all been calculated with the same decay-constant values.

Obvious typographical and author errors are corrected by the compilers before entry in the data bank (notation of such corrections is always made in the "comment" fields of the altered records). Thus, information in the data bank is as complete as possible, compatible with the time and effort necessary for compilation. The primary emphasis in the construction of the data bank has been on developing an information system that is scientifically useful and technically correct.

Structure of the Data Bank

The RADB file is formally divided into three sub-files which are integral parts of the data bank, and which are stored in separate locations on the magnetic disk. They are the records file, the dictionary file, and the selected records file.

*RADB Records File: This sub-file contains the actual data records. The records file consists of a continuous string (sequence) of letters, numbers, and symbols (referred to collectively as characters) which are stored on magnetic disks (see Fig. 1). The character string is subdivided into records, each with an identification number that is unique to a particular sample. The records are further subdivided into character fields, each of which has associated with it a label (field label), and a descriptive phrase (field name) that indicates the type of information stored in that field. Character fields may be of either fixed-length (only a specific number of characters is allowed; e.g., A80-Latitude) or variable-length (up to 32,000 characters are allowed; e.g., A90-Location Comment).

For example the character string "gabbro" or the character string "metagraywacke" could be entered in the variable-length field whose label is A130 and whose field name is ROCK NAME. However, the character string "BGRK" (or "ARDG" - see Code List F - Geologic Unit Codes) would be entered in the fixed-length field whose label is A150, and whose field name is GEOLOGIC UNIT.

Labels allow the computer to directly store and relocate the information in question without laboriously searching the entire data file. As in the example above, one could locate all information pertaining to schists by instructing the computer program to search for the field labeled A130 (Rock Name) for all records, and then to discriminate those containing the character string "schist", rather than searching the entire RADB file for the desired string.

*RADB Dictionary File: The dictionary file, as its name suggests, defines the contents of the data base at the time they are entered into the data bank (specifically, this function is performed by a subset of the dictionary file known as the BUILD dictionary form). It accomplishes this by recognizing the label for each data field when the punched cards (or other input source) are read, and by assigning the label a numerical address which is the location of the actual data on the magnetic disk (using numerical addresses greatly increases the efficiency of the searching operations).

In a separate segment of the disk, a directory is created which relates the field labels to their corresponding numerical addresses for future reference.

In addition to the BUILD dictionary form, several PRINT dictionary forms are now in use which control the format of the printed output; i.e., the horizontal and vertical arrangement of the information on a printed output record. The PRINT dictionary forms contain descriptive phrases associated with each data item which, when printed together, produce a standardized, readable record of the elements in the data bank ("standard output record"). Special PRINT dictionary forms can be constructed for groups of users with similar interests, so that only necessary information need be printed for each selected record. Individual users however, can design other short styles of printed output without having to construct new forms, and they are described below in the section on Output Commands.

*Selected Records File (SRF): During the course of a search of the data bank, the numerical addresses of those records that meet the selection criteria are placed in a SRF, forming a subset of all the records in the bank. In most searching strategies, additional inquiries of this subset will be required before the specifically desired group of data is located. A SRF saves computer time by limiting further searches to a previously-selected subset of relevant data. More than one SRF may be created during the selection process, and GIPSY allows the user to return to any subset of data and apply further selection criteria.

SRF's are generally only temporary and are destroyed at the end of a computer run. If it becomes apparent that certain subsets of the data bank are frequently selected, the SRF's can be converted into permanent files. With a knowledge of IBM Job Control Language (JCL), the sophisticated user can save specific SRF's and use them for more efficient searches in the future. Such permanent SRF's will limit searches of the data bank to only those items of particular interest to the individual user.

GIPSY Program - Search Procedures

In addition to performing the functions of establishing, maintaining, and updating the RADB file, the GIPSY program also supervises the searches of the data that are initiated by the user. The underlying philosophy of a GIPSY search is that the user, by establishing certain requirements, will select a relevant subset of information from the data bank. More restricting requirements can then be applied to this subset, resulting in the establishment of another subset, more refined to the user's desires than the first. The unique features of GIPSY are that it allows the user to interact with the selection process, to apply further criteria to any subset of the data, or to start again with new selection criteria for the entire data bank. At any stage of the process, the user can command several types of output to examine the results of the search. By examining this information, the user can then decide if the results of the search are satisfactory (and perhaps pass the data on to other programs for further processing), or if an iteration is required to select more specific information (see Fig. 2).

The GIPSY program can operate either in batch mode (punched cards submitted as input) or in teleprocessing mode (using a remote teletype terminal) with equal facility. In batch mode, the search strategy and the corresponding commands must be designed prior to the actual execution by the computer. The commands are then punched on data cards which, along with the job control commands (information supplied to the computer system for data structure and management purposes), constitute a "job" which is submitted to the U.S.G.S. computer network. Following execution by the program, the user receives several pages of printed information which catalogue the functions performed by the computer and list the results of the search(es) made. In the teleprocessing mode, the user can formulate and/or alter the search strategy at the time it is executed, and can obtain the results of the search immediately. Except where specifically noted below, all functions of the GIPSY program can be performed as well in either the teleprocessing or batch mode.

Search Techniques - QUESTRAN

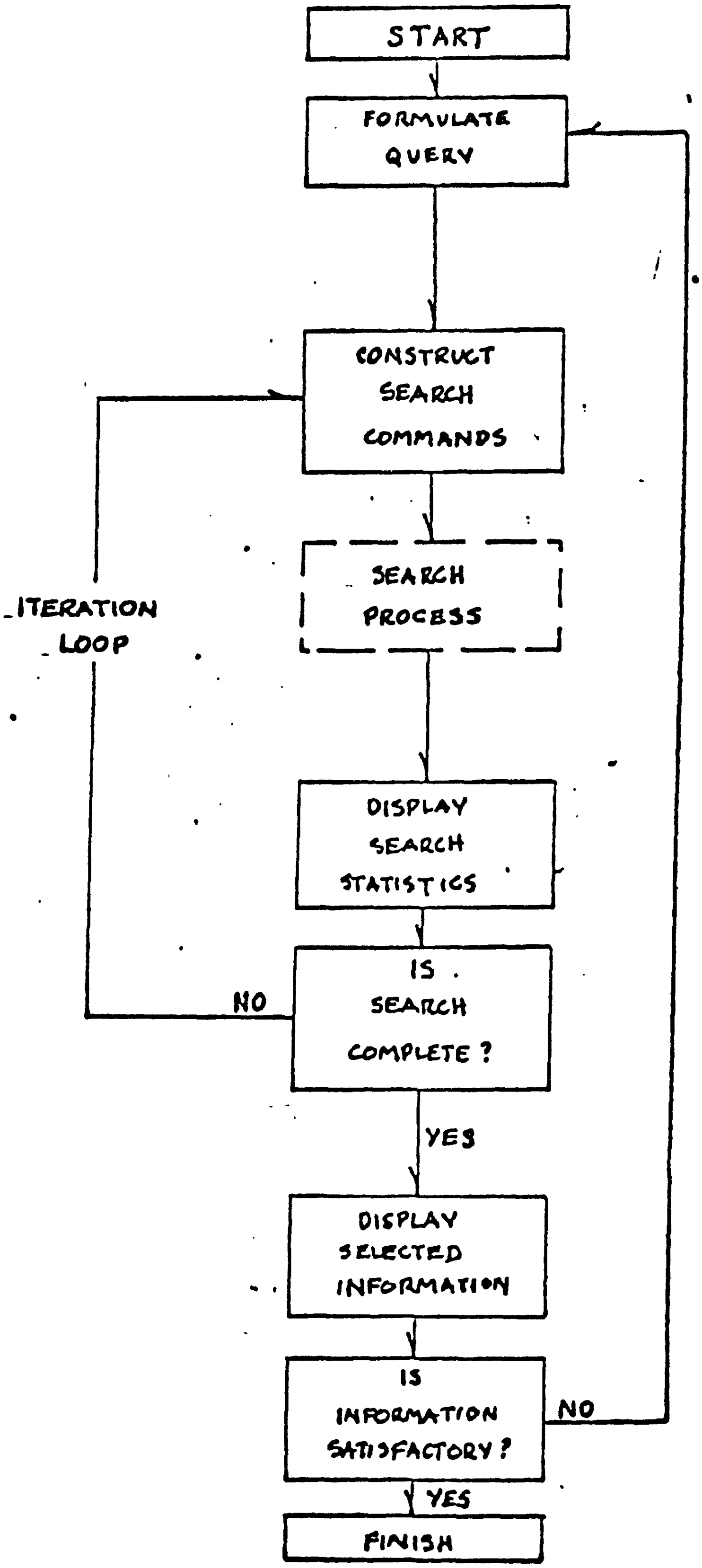
The language used by GIPSY to perform the searching functions is named QUESTRAN (QUEStion TRANslator). This language is especially suited to the novice user, as it employs natural words and phrases in English which correspond closely to the functions of the program. QUESTRAN emphasizes the user's professional expertise in the formulation of the search strategy, and minimizes the required knowledge of computer structures, functions, User identifies the data base.

User determines the information to be sought.

User controls the search process. For a general search, the user may select a broad subset of information from the total data bank, and refine subsequent subsets through use of the iteration loop.

At the completion of each search of the total data base or a selected subset, GIPSY will automatically respond with statistical details on the results of the search (the number of records searched, the number of records selected, and the number of records which satisfy each of the search criteria).

If statistical results appear satisfactory, the user may wish to display all or part of the selected records using one of the output commands. Otherwise, the user may further refine the selected subset, or pose a new question to the entire data base.



igure 2. Gipsy search procedures and decision points, (after Gipsy er's Guide, 1975).

and terminology. Furthermore, there are few syntactical restrictions (commas, periods, brackets, spacing, etc.) in QUESTRAN, such that one can easily acquire a working familiarity with it.

The structure of the QUESTRAN language consists of commands and parameters. The commands initiate program routines and the parameters, defined by the user, indicate what information is to be processed by those command routines (in batch mode or teleprocessing mode, commands must begin in column 1 of the line; parameters may begin in any column except column 1). The table below shows that there are three basic types of QUESTRAN commands which will be described in the following sections. Other special commands exist in the QUESTRAN language (and more can be added by the sophisticated user), but they are not described here. Interested users should refer to existing GIPSY documentation for details (see References).

QUESTRAN COMMANDS

Search/Retrieval	Intermediate Processing	Output
FORM	SORT	PRINT
SELECT	SORTD	LIST
ITERATE	SUM	COPY
BACK		

Search/Retrieval Commands

The FORM command indicates to the program which dictionary form will be used to locate and interpret the records for the QUESTRAN search procedures (this form must have the same name as the BUILD dictionary form used for entering the records into the data bank). The parameter for the FORM command is RADB, the name of the BUILD dictionary form. The FORM command will remain in effect throughout the computer run, unless it is re-issued with another parameter. For example, a special PRINT dictionary form may be desired to control the output format of the selected records, and it can be activated for use by supplying its name as the parameter for the FORM command.

The SELECT command initiates the QUESTRAN retrieval program, and assumes that the question(s) which follow are to be directed against the entire data base. The SELECT command must be issued at the beginning of a run, and may be issued subsequently if the user wishes to terminate one search strategy and begin with a new strategy of the whole data file. The parameters for the SELECT command consist of variable description(s) and logic statements.

The variable descriptions are short program statements which describe particular attributes of the data file which become the criteria for the selection of records. For example, if one wishes to select those records containing information about potassium-argon ages on basalts in Arizona and New Mexico, the user will choose on the basis of the following criteria:

A. sample from Arizona

B. sample from New Mexico

C. rock type = basalt

D. sample dated by K-Ar method

The variable description which conveys the first of these instructions to QUESTRAN takes on the form shown below, consisting of three parts.

A.	A40	<04>
variable designator	label (State)	condition description (State code 04 = Arizona)

The <u>variable designator</u> is a unique single letter of the alphabet used to designate this particular criterion (hence, up to 26 criteria may be specified within a single question). The <u>label</u> indicates to the program in which field in the record the search is to be made. In this case, A40 is the label corresponding to the entry "State Code" in the record. The <u>condition description</u> specifies the contents of the field which are required for the selection of any given record (in the example, the characters "04", representing Arizona, must be present in the field labeled A40 for the record to be selected). A condition description can be made either in the "word mode" or in the "number mode" as described below.

**<u>Word mode</u>: In this mode, QUESTRAN will search the entire contents of the field whose label has been specified for a particular word fragment, word, phrase, or word range. The string of characters to be sought is enclosed by delimiters (< >), and a record will be selected if precisely that string occurs within the field. A maximum of 29 characters can be specified in the word mode condition description. There are four means of specifying a condition description in the word mode.

<u>Prefix</u>: indicated by inserting a leading blank (ƀ) in the condition description. For example,

A. A60<ƀSLA>

will select records containing words beginning with SLA in the field labeled A60 (County name). Entries meeting this criterion would include "Slawson" and "Blue Slate", but not "Dresslar" or "James Lake".

Suffix: indicated by inserting a trailing blank in the condition description. For example,

D. A74<KERƀ>

will select records containing words ending with the characters KER in the field labeled A74 (Quadrangle name or number). This would select records with quad names "Haniker Ridge" or "Haymaker", but not "Lake Rome" or "Bakers Mountain".

Existence: indicated by inserting neither leading nor trailing blanks in the condition description. For example,

B. A140<AST>

will select records containing the character string AST in the field labeled A140 (sample description). This would select records with sample descriptions containing "astrophyllite", "clastic", or "porphyroblast", but not "as tremolite needles".

Word: indicated by inserting both leading and trailing blanks in the condition description. For example,

E. A90<ƀROADƀ>

will select records containing the word ROAD in the field labeled A90 (Location comment). This would select records containing "access road", but not "roadcut", "broad", or "Burro adit".

The four options discussed above also apply to:

Character range: indicated by specifying the two ends of the alphabetic range. For example,

E. A60<b̸CAR> THRU <b̸DUL>

will search for county names (A60) beginning with characters within the alphabetic range CAR through DUL (leading blanks specify this as a prefix search). If the second specification is longer than the first, it will be truncated to the length of the first; if the second is shorter, it will be padded with blanks on the right to equal the length of the first specification. This option is most commonly used in specifying a range of latitude (A80) or longitude (A85) for a geographic search, as shown below:

C. A80<b̸40-00> THRU <b̸40-30>

D. A85<b̸099-30> THRU <b̸102-15>

Word, rather than number mode, is required in this case because of the hyphenation and N/S, E/W designations used in specifying latitude and longitude. Note that, as shown, these two conditions together will select records within the bounding latitudes (40° 00' 00" through 40° 30' 59") and longitudes (99° 30' 00" through 102° 15' 59"); the extra 59" are included due to the prefix-search specification.

<u>Within word range</u>: indicated by inserting WIn between the two character set specifications (n is any integer no greater than 99). Records will be selected only if the character sets occur within the stated number of words from each other (a word is defined as one or more characters bounded by blanks or commas). This kind of search is limited to a single phrase (defined as a group of words bounded by the punctuation marks . or ! or ? or ; or :). Thus,

H. A140<ƀALK>WI2<ƀBASALTƀ>

would select records with rock descriptions (A140) containing the prefix ALK within two words of the word BASALT. This condition description would retrieve "alkali olivine basalt", "alkalic basalt", and "alkalic, nepheline-normative basalt", but not "alkalic; basalt" and not "alkalic extrusive rocks overlying basalt".

**Number mode: In this mode, QUESTRAN will search the designated entry until it encounters the first numerical character, and then compare it with the condition description. The program internally converts all numerical entries to an equivalent form such that "5", "5.", "05.0", and "+5.0000" are all considered equal (note that the number of significant figures is not a determining factor in the number mode). There are four options for specifying the number mode.

Equal: H. B40 EQ 75

will select records in which the year of publication of the reference (B40) is equal to 75.

Greater than: A. CH1 GT 85

will select records in which the percentage of radiogenic argon (CH1) is greater than 85.

Less than: D. HL1 LT 65

will select records in which the first fission track age (HL1) is less than 65 (million years).

Number range: G. A160 230 THRU 319

will select records for which the Lexicon age (Code List G) is in the numerical range 230-319 (i.e., Permian-Triassic, inclusive).

One other option available in the number mode is especially useful with this data file. Intra-record comparison allows one to select records based on a comparison of the numerical values in two fields within a given record. Allowable comparisons may use the operators greater than (GT), less than (LT), or equal to (EQ). For example,

P. DL1 GT CL1

will select records in which the first Rb-Sr age (DL1) has a greater numerical value than the first K-Ar age (CL1), for the same sample.

The logic statement is the final parameter to the SELECT command, nd serves to logically link the variable descriptions together to erform the desired selection. The arguments for the logic statement re the variable designators ascribed to the variable descriptions. In he example above, the user is seeking potassium-argon ages of basalts rom Arizona and New Mexico. The translation of this search into UESTRAN language is shown below.

Selection criterion	QUESTRAN SELECT parameter		
ample from Arizona	A.	A40<04>	(state code 04=Arizona)
ample from New Mexico	B.	A40<35>	(state code 35=New Mexico)
rock type=basalt	C.	A170<A131>	(petro. code A131=basalt)
dated by K-Ar method	D.	C10	(existence of K-Ar data)
	LOGIC (A OR B) AND C AND D		

In this way, the logic statement links the variable descriptions together such that records of samples from Arizona (A) or New Mexico (B) and coded as basalts (C) and dated by K-Ar method (D) will be selected (the parentheses are used for clarification, as discussed below).

In addition to the logical connectors AND and OR, NOT may be used to exclude records from the selected records file. For example, a search for all records of Colorado samples, excluding those in Kiowa county, would be constructed in the following manner:

```
SELECT
   A.  A40<08>       (State Code 08=Colorado)
   B.  A60<KIOWA>    (County Name)
   LOGIC A AND NOT B
```

The construction and use of the logic statement is perhaps the most difficult facet of QUESTRAN to master, but it is an extremely powerful device. The following discussion will familiarize the user with the fundamentals of Boolean logic and with the use of the logic statement in QUESTRAN.

Simply stated, the concept of Boolean logic (named for George Boole, nineteenth century British mathematician) revolves around the existence or non-existence of a particular characteristic within the elements of a set. The operators AND, OR, and NOT serve to connect characteristics such that any possible association between variables can be specified. In its simplest configurations, there are four means of establishing a subset using Boolean logic.

LOGIC A: This statement will establish a subset from the data file consisting of all records containing the characteristic A (a label and/or a condition description). This is schematically shown in Fig. 3a.

LOGIC A OR B: This statement establishes the subset of records containing either A or B (they may contain only A, both A and B, or only B), schematically shown in Fig. 3b.

LOGIC A AND B: This statement implies that both characteristic A and characteristic B must occur within the record in order for it to be selected. Fig. 3c is a representation of this statement.

LOGIC A AND NOT B: This statement specifies a subset of records in which characteristic A must be present, but excluding those which also contain characteristic B. This is schematically represented in Fig. 3d.

Any of these types of associations may be used singly or in combination within a logic statement. In complex constructions, parentheses must be used to avoid ambiguity. For example,

(A OR B) AND C

A OR (B AND C)

imply two entirely different subsets of data. In the first statement, C must be present along with either A or with B (Fig. 3e). The second demands that A be present, or that B and C be present together with or without A (Fig. 3f).

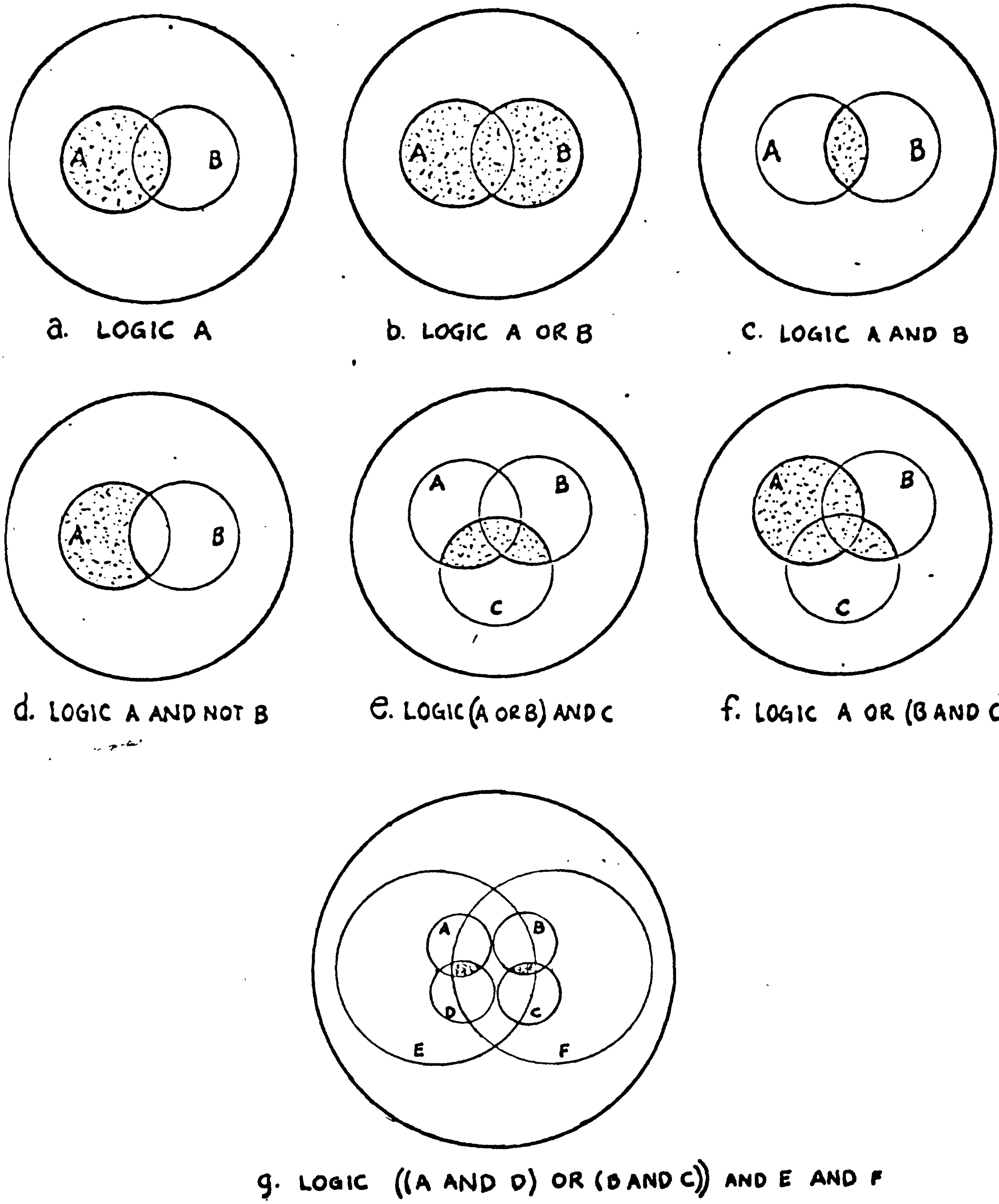


Figure 3. Schematic representation of LOGIC statements (see text).

By extrapolation, very complex logical associations can be specified in the selection of records. For example, a user is interested in locating records with the following attributes:

1. samples with fission track ages for both zircon and apatite
2. ages on both minerals less than 50 million years

The construction of a QUESTRAN search with these selection criteria would appear as shown below. The schematic representation of the logic statement is shown in Fig. 3g.

```
SELECT
   A.  HB15<HA3>      (first mineral = apatite)
   B.  HB25<HA3>      (second mineral = apatite)
   C.  HB15<MC1>      (first mineral = zircon)
   D.  HB25<MC1>      (second mineral = zircon)
   E.  HL1 LT 50      (first age less than 50 m.y.)
   F.  HL2 LT 50      (second age less than 50 m.y.)
   LOGIC ((A AND C) OR (B AND D)) AND E AND F
```

Not all of the specified variable descriptions need be incorporated into the logic statement. The QUESTRAN search routine maintains a tabulation of the number of records searched, the number of records selected (according to the structure of the logic statement), and the number of records satisfying each of the variable description criteria, whether they are incorporated in the logic statement or not. Additional logic statements (up to 8) may be included, and counts will be generated for the number of records satisfying them, but only the first logic statement will control the selection of records for a subset. The advantage gained by listing additional variable descriptions and logic statements is that considerable information regarding the data file can be obtained which will aid in the development of further search strategy. One can also use this technique to check on the completeness of the search; for example, if the search logic statement selects Precambrian Rb-Sr ages on the basis of the Lexicon age (A160), a second logic statement could be constructed to count all calculated ages (DL1, DL2, etc.) in excess of 570 million years, thus providing two specifications for the same set of records.

Upon the completion of each search, the program provides the user with the search statistics. These are particularly informative when using the teletype terminal, as the statistics allow the user to "look ahead" and anticipate variations in the search process. For example, the user wishes to establish the subset of records containing potassium-argon age determinations on biotite in the range 250-500 m.y. from Massachusetts, but is also interested in knowing if fission track studies have yielded similar ages. The SELECT command is constructed as follows:

```
SELECT
  A.  A40<25>             (state code 25=Massachusetts)
  B.  CB15<UA5>           (material analyzed UA5=biotite)
  C.  CL1 250 THRU 500    (K-Ar age; 250-500 million years)
  D.  HL1 250 THRU 500    (fission track age; 250-500 million years)
  LOGIC A AND B AND C
  LOGIC A AND D
```

The program responds with the following information:

```
SEARCH

  12:02:43.7  SEARCH BEGINNING

  12:02:46.2  SEARCH COMPLETED

   SEARCHED        2753

   SELECTED          41        SUBSET 1 (samples from Mass. for which
                                         the K-Ar age on biotite is
  VARIABLES       SATISFIED              in the range 250-500 m.y.)

      A             102        (samples from Massachusetts)

      B             569        (K-Ar determinations on biotite)

      C             411        (K-Ar ages, 250-500 m.y.)

      D              83        (fission track ages, 250-500 m.y.)

    LOGIC         SATISFIED

                     20        (samples from Massachusetts with
                                fission track ages in the range
                                250-500 m.y.)
```

As shown, a count is generated for the variable D and for the second logic statement, but they do not effect the selection of records. The fact that 20 records contain fission track ages within the specified range will assist the user in deciding whether or not a search should be performed to retrieve and examine this information.

The ITERATE command confines the search inquiry to some previously established subset of records. In the batch mode, only the subset which was created immediately before can be accessed with the ITERATE command (see BACK command, below), but using the teletype terminal, any other subset may be accessed (the program will ask the user to specify the subset number to be processed by the ITERATE command). The parameters for the ITERATE command are the same as for the SELECT command; the variable description(s) and the logic statement(s).

Example (batch mode):

```
SELECT
   A.  A40<32>                  (state code 32=Nevada)
   LOGIC A                                                      subset 1*
ITERATE
   A.  A60<CARSON>              (county name)
   B.  A130<GRANODIORITE>       (rock name)
   C.  C10                      (K-Ar age determination)
   LOGIC A AND B AND C                                          subset 2*
ITERATE
   A.  CB15<UA5>                (rock/mineral code - biotite)
   B.  CB15<PC5>                (rock/mineral code - hornblende)
   C.  CL1 125 THRU 155         (calculated age 125-155 million years)
   LOGIC (A OR B) AND C                                         subset 3*
```

*subset 1 = all age determinations from Nevada

*subset 2 = all K-Ar age determinations on granodiorite from Carson County, Nevada

*subset 3 = all K-Ar analyses of biotite or hornblende which yield ages in the range 125-155 m.y. from granodiorite in Carson County, Nevada

The BACK command can be used either in the batch mode or in the teleprocessing mode to return to a previously selected subset of data. The parameter for the BACK command is the number of the desired subset. Since this command only provides access to the subset, it must be followed by an intermediate processing command (SORT, SUM, etc.), an output command (PRINT, LIST, or COPY) or, if another inquiry is desired, by the ITERATE Command. Continuing with the example above, the following commands could be issued:

```
BACK
  2                         (returns to subset 2)
ITERATE
  A.  CB15 <UA5 >           (rock/mineral code - biotite)
  B.  CB15 <PC5 >           (rock/mineral code - hornblende)
  C.  CL1 155 THRU 185      (calculated age 155-185 million years)
  LOGIC (A OR B) AND C                                  subset 4*
BACK
  1                         (returns to subset 1)
ITERATE
  A.  A60<CARSON>           (county name)
  B.  A130<GRANODIORITE>    (rock name)
  C.  DP1 22 THRU 23        (Rb-Sr isochron analyses)
  D.  DL1 125 THRU 155      (calculated age 125-155 million years)
  LOGIC A AND B AND C AND D                             subset 5*
```

*subset 4 = all K-Ar analyses of biotite or hornblende which yield ages in the range 155-185 m.y. from granodiorite in Carson County, Nevada

*subset 5 = all Rb-Sr determinations (whole rock or whole rock-mineral isochrons) which yield ages in the range 125-155 m.y. from granodiorite in Carson County, Nevada

Search strategy: The two major constraints on the use of the QUESTRAN search are that it be efficient, and that it retrieve precisely the information being sought. In general, each time the SELECT command is issued, a complete search is performed on the entire data file, and the time taken for the search process varies almost directly as the length of the file. The RADB records file will be quite large by the time all published age determinations are incorporated, and it will continue to expand with the present research in geochronology. Therefore, the user should plan to limit the first search to a few variables which will create a more manageable subset for further manipulations.

This can be accomplished by imposing the most general criteria first, and then using the ITERATE command to increase the selectivity. Alternatively, the user might elect to impose the most constraining criteria first and, upon examining the results of that search, appraise the possibilities of success with a wider search. In either case, frequent use of the ITERATE command and of the "look ahead" features should be made, such that the QUESTRAN search routine continues to operate on smaller and smaller subsets of data.

QUESTRAN searches must also be specific in order to be useful; the user wishes to retrieve neither more nor less data than requested. In this regard, special care must be taken when searching textural entries in the word mode. One must anticipate variations in spelling due to conjugations, modifying suffixes, and singular/plural endings. The prefix and existence searches are well-suited to finding words with common roots. For example, a word search for <ƀGRANITEƀ> is highly specific, whereas an existence search for <GRANIT> will retrieve "granite" as well as "granitic", "granitoid", leucogranite", etc. Conversely, a prefix search for <ƀGRAN> might prove too general, as it will retrieve "granular", "granoblastic", "grand", and other superfluous entries.

In general, the textural entries in the RADB file contain informative data but, due to wide variations in terminology and usage in the earth sciences, searching for character strings in these fields can be imprecise and frustrating (the singular exception to this is the entry for "reference", in which the input format has been rigidly controlled to facilitate retrieval). For this reason, the broad features of the sample location, petrography and analysis have been specified in the data file with number-and-letter codes. Although these codes necessarily incorporate some generalizations and ambiguities, they are clearly superior criteria for the search routines. The efficiency of a search will be greatly improved if codes are used as variables in the process until the user is dealing with a relatively small subset of the records file. Additional iterations using word-mode specifications can then be used to remove the ambiguities and generalizations.

Intermediate Processing commands

The SORT and SORTD commands can be issued following the establishment of any subset (by the SELECT or ITERATE commands), and are used to reorder the selected records file into a desired sequence. These commands will take the specified characters from the left-most positions (excluding blanks) in one or more fields and sort them alphabetically and numerically into ascending or descending sequence. In batch mode, SORT is the command for the ascending sequence, and SORTD is for the descending sequence;

when the SORT command is issued in the teleprocessing mode, the program will inquire if it is to perform an ascending (enter A) or a descending (enter D) sort operation.

The parameters for the SORT and SORTD commands are the label(s) of the field(s), and the number of characters within them to be sorted. The parameters are entered in their order of priority (primary sorting is performed on the characters in the first field, secondary sorting on the second field, etc.). As many as 25 labels may be specified for sorting, providing that the total number of characters involved in the sort is less than 100. The command

SORT

A80 8 (8 characters from the field A80 - latitude)

A85 9 (9 characters from the field A85 - longitude)

will produce the following sequence from random entries:

32-22-06 N	100-41-56 W
38-17-44 N	92-25-00 W
38-17 44 N	92-25-08 W
38-17-44 N	92-26-53 W
40-00-39 N	105-57-28 W
40-01-18 N	105-57-28 W

Note that the first priority in the SORT is in the field containing latitude and that, for records with the same latitude, secondary sorting is performed on the longitude entry.

The SUM command provides the user with several statistical computations for fields containing numerical entries. SUM will add all of the numerical entries in the designated field (from records in the selected records file only) and produce a tabulation of:

1. the number of occurrences of a numerical entry in the field
2. the algebraic mean value
3. the algebraic sum of all values
4. the maximum value
5. the minimum value

The parameters for the SUM command are the labels of the desired fields. The primary use of the SUM command for RADB users will be the determination of maxima, minima, and the tabulation of the number of entries in a given field. The capability exists for producing SUM calculations for up to nine fields simultaneously. An example of the command and the output is shown below:

SUM

DL1 (first Rb-Sr age)

DL2 (second Rb-Sr age, same sample)

DL3 (third Rb-Sr age, same sample)

DL4 (fourth Rb-Sr age, same sample)

DL5 (fifth Rb-Sr age, same sample)

LABEL	(N)	SUM	AVE	MAX	MIN
DL1	25	2821	112.8400	126	107
DL2	16	1826	114.1250	120	108
DL3	8	903	112.8750	121	105
DL4	2	217	108.5000	109	108
DL5	2	218	109.0000	112	106

Output commands

The PRINT command generates a complete tabulation of all information that exists in the data bank for the selected record(s). It should be preceded by the FORM command specifying one of the print dictionary form names. The print dictionary forms contain descriptive phrases and symbols that are printed along with the entries to produce a readable document.

The PRINT command requires no parameters, in general, as it prints out the entire contents of the records contained in the selected records file. As an option in the batch mode, a heading may be included by providing a card containing the heading immediately following the PRINT command card. In the teleprocessing mode, a heading must be entered as instructed by the program.

An example of the PRINT-generated "standard output record" is shown in Appendix D.

The LIST command allows the user to print out selected entries from records in the selected records file. The LIST command may use a print dictionary form to control the output format, so that the descriptive phrases and symbols are included to produce a readable document. The parameters for the LIST command are the labels of the selected data fields, and up to 99 of them can be included in a single LIST command. Only those labels that occur within a record will have their contents printed. For example, the command

```
LIST

    B20     (record number)
    A40     (state code)
    A80     (latitude)
    A85     (longitude)
    A130    (rock name)
    C10     (K-Ar age determination)
    CB10    (rock/mineral analyzed)
    CL1     (calculated K-Ar age)
    H10     (fission track age determination)
    HB10    (rock/mineral analyzed)
    HL1     (calculated fission track age)
    HB20    (second rock/mineral analyzed)
    HL2     (second calculated fission track age)
```

will produce the following output:

```
RECORD NUMBER..........0000088
STATE..................32
LATITUDE...............37-42-00 N
LONGITUDE..............117-41-00 W
ROCK NAME:  QUARTZ MONZONITE
POTASSIUM-ARGON
ROCK/MINERAL:  BIOTITE
AGE IN MILLION YEARS  155
FISSION TRACK
ROCK/MINERAL:  ZIRCON
AGE IN MILLION YEARS  163

RECORD NUMBER..........0000141
STATE..................06
LATITUDE...............36-14-50 N
LONGITUDE..............117-27-36 W
ROCK NAME:  QUARTZ MONZONITE
FISSION TRACK
ROCK/MINERAL:  APATITE
AGE IN MILLION YEARS  178
ROCK/MINERAL:  ZIRCON
AGE IN MILLION YEARS  182

RECORD NUMBER..........0000153
STATE..................06
LATITUDE...............37-06-21 N
LONGITUDE..............118-22-07 W
ROCK NAME:  GRANODIORITE
POTASSIUM-ARGON
ROCK/MINERAL:  HORNBLENDE
AGE IN MILLION YEARS  151

.
.
.
```

Notice that the command cycles through the parameter list once for each record in the selected records file.

The COPY command is used to generate fixed-field, fixed-length files from the variable-length data records in the selected records file. The COPY command is primarily designed for passing information to other subprograms (statistical manipulation, plotting, etc.), but it can also be used to generate useful types of output (especially tabulated data). The COPY command does not employ the print dictionary form to control the output format, which implies that only the contents of the specified labeled fields will be printed; descriptive phrases and symbols ("literals") must be inserted by the user when constructing the COPY command. Therefore, the parameters for the COPY command consist of field labels and/or literals as described below.

A60 x	This will cause the first"x" characters (starting with the first non-blank character) in the field A60 (County) to be placed in the next "x" positions of the output file. If there are more than x characters in A60, the entry will be truncated; if there are fewer than x characters, blanks will be inserted to fill the space ($x \leq 131$).

CR1 'YES' 'NO' — This causes the first literal (YES) to be placed in the output file if the label CR1 exists in the data record; otherwise, the second literal is placed in the output file. This allows operations on the existance of a label. The maximum length for either literal is 10 characters, and both must be enclosed in single quotation marks.

'ANY LITERAL' — Up to 60 characters (including spaces) may be placed in the output file by enclosing them in single quotation marks.

NEW RECORD — This causes all output generated to this point to be printed (or passed) without reading more input. Thus, one can generate multiple-record output (for example, multiple print-out lines) from a single input record (the maximum number of spaces per line is 132; additional spaces for a record must be accommodated by using the NEW RECORD parameter).

The COPY command will function once for every record in the selected records file. The entire command will be executed, whether the particular labels exist for every record or not (c.f., LIST command). For example (where "b̸" denotes a blank space), the command

COPY

```
'b̸'                               blank for first column of output record*
B20 10                            record number - 10 spaces
A130 12                           rock name - 12 spaces
'b̸b̸'                              inserted literal
CL1 4                             first K-Ar age - 4 spaces
'b̸+/-b̸'                           inserted literal
CM1 6                             error - 6 spaces
CB10 10                           material analyzed - 10 spaces
NEW RECORD                        output skips down one line
'b̸b̸b̸b̸b̸b̸b̸b̸b̸b̸b̸b̸b̸SECONDb̸AGEb̸b̸'      inserted literal
CL2 4                             second K-Ar age - 4 spaces
'b̸+/-b̸'                           inserted literal
CM2 6                             error - 6 spaces
CB20 10                           material analyzed - 10 spaces
```

*Note: For most high-speed printers, the first character of an output record is used for spacing and/or page-control information and will not be printed. Thus, the first column must be left blank unless special output format is desired.

will generate the following output (the implied columnar headings are shown in parenthesis; the construction of the COPY command does not allow one to print these headings):

(Record number	Rock name	K-Ar age ±	Rock/mineral analyzed)
0000156	SCHIST	585 +/- 25	WHOLE ROCK
	SECOND AGE	580 +/- 25	MICROCLINE
0000168	GRANITE GNEI	1037 +/- 100	BIOTITE
	SECOND AGE	+/-	
0000173	AMPHIBOLITE	597 +/- 30	HORNBLENDE
	SECOND AGE	618 +/- 20	PLAGIOCLAS

Any of the output commands (PRINT, LIST, or COPY) may be used singly or in combination to obtain the desired information from the system. The order of the records in the output file will be determined by the sequence established in the previous SORT (or SORTD) operation.

A complete example of the use of the QUESTRAN facilities for a batch mode job is shown in the Appendices. Users engaged in the teleprocessing mode should consult the GIPSY documentation listed in the References for special instructions.

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GLOSSARY OF TERMS

Address, numerical address: the numerical name of the location at which a data element is stored on a magnetic disk (or other computer storage device).

Batch mode: a job submitted to the computer (usually as a deck of punched cards) which is executed when facilities are available (c.f. teleprocessing mode).

Boolean logic, Boolean operators: Boolean logic is a mathematical system for representing logical connections between variables by means of the operators AND, OR, and NOT. These operators, when employed by GIPSY, define the means for comparing elements of the data records with the search criteria for the selection of records.

Build dictionary form: the RADB dictionary form which interprets the input records, assigns numerical addresses corresponding to the field labels, and stores the data on magnetic disk.

Character, character string: a character is the smallest element of the data in RADB; the term is used collectively to refer to letters, symbols, and numbers. A character string is one or more characters (including blanks, or null characters) adjoining each other in the data record.

Coded element, coded information: any element of the data record which is represented symbolically by a small combination of numbers and/or letters. Coded information is standardized (see Code Lists A-L, Appendix A) for the purpose of searching the data bank.

Command: within the QUESTRAN language, commands activate a series of computer instructions which perform manipulations of the data records (e.g., FORM, SELECT, SORT, etc.). Commands generally are accompanied by one or more parameters which tell the computer which elements of the data will be operated upon by the command procedure.

Compiler: in the sense used in this report, a compiler is the person responsible for abstracting information from published literature sources, and entering the required information on RADB report forms for inclusion in the data bank.

Condition description: within the variable description parameter of a SELECT or ITERATE command, the condition description defines the character string (or character range) which must occur in the designated labeled field for any particular record to be selected.

Delimiters: the special symbols < and > which mark the beginning and end of data in RADB records. They can be used only for this purpose, and must not be used to denote "greater than" or "less than".

Dictionary file: a part of the RADB system composed of dictionary forms, which defines the data elements in the data bank for the purposes of input/search/output.

Directory: a part of the internal structure of the RADB system which maintains a list of the numerical addresses assigned to the labeled data fields at the time they are built into the data bank. When a QUESTRAN search is performed, the directory informs the program of the locations of all the fields specified in the variable descriptions; thus, the program does not have to search every field in every record.

Field: a term used to denote a part of the RADB record which is identified by a unique field label, and which contains coded, numerical, or written information enclosed by delimiters.

Field label, label: the letter-and-number combination which identifies the contents of the field, and which represents a particular type of information (e.g., B20, A80, CL1, etc.). Every element of data stored in the bank has an identifying label.

Field name: the descriptive term or phrase which corresponds to the type of information contained within a field (e.g., record number, latitude, calculated age, etc.). Field names are stored only in the print dictionary form and are printed along with the contents of the field (by the PRINT or LIST commands) to produce a readable document.

Fixed-length field: a field which can contain only a specified number of characters (e.g., A85 - Longitude).

Form: a subset of the dictionary file (identified by a unique form name) which defines the order of the labels in a record, assigns internal numerical addresses to the corresponding labels, and/or controls the format of the printed records generated by an output command. The dictionary form used when searching the records file must have the same name as the dictionary form employed for building the records into the data bank.

FORM: a QUESTRAN command which designates the name of the dictionary form which will be used for building/searching/printing the data file.

Format: this term refers to the arrangement of the characters in an output file; the horizontal and vertical spacing of the data elements with respect to each other on a printed output page.

GIPSY: General Information Processing SYstem, an information-handling program developed at the University of Oklahoma used for manipulating the Radiometric Age Data Bank (see References).

IBM job control language (JCL): a symbolic language used to pass information and instructions to the computer monitor and to peripheral computer elements. JCL defines and controls the files that are generated, entered, passed, deleted, etc. during the program execution.

Input, input file: input refers to the data entered into the data bank. The input file is a set of one or more RADB records (punched on cards or coded on magnetic tape) which are processed by the build dictionary form when they are inserted into the records file.

Logic statement: the parameter for the SELECT or iterate command which specifies the required logical connection(s) between the variable descriptions by which records are assigned to the selected records file.

Number mode: in this mode, QUESTRAN searches a specified field, ignoring all non-numeric characters, until it encounters the first numerical character, and then compares it (and subsequent numbers) with the condition(s) of the variable description.

Numerical element, numerical information: an element of the data record or of a data field which contains only numbers (e.g., analytical data), including blank spaces and decimal points.

Output, output file: output refers to data which have been processed by GIPSY and returned to the user. The name for the returned set of data is the output file.

Parameter: in the QUESTRAN language, the parameters designate the fields (or the relationship between the contents of fields; Logic parameter) which will be operated upon by one of the command procedures (search/retrieval; intermediate processing; output).

Permanent file: a data file which is preserved following a computer run (c.f. temporary file). Dictionary and record files are examples of permanent files.

Print dictionary form: the RADB dictionary form which controls the format of the "standard output record", producing a readable document from the data elements in the selected records file. Additional print dictionary forms can be constructed (designated by a unique form name) which will produce alternate types of output formats.

QUESTRAN: QUEStion TRANslator; the language (or the program) which performs searches of the RADB records file, manipulates the selected records, and generates several types of output for the user.

Record, records file: a record is a set of labeled data elements, identified by a unique record number, which together constitute the entire range of information concerning the age determination(s) of a sample in the data bank; the records file is the set of all records in RADB.

Sample: as used in this report, a sample designates a rock or mineral specimen, presumed to be representative of like material in the sampling locality, collected for the purpose of geochronological study. More than one age determination may be made of the sample or its constituent parts. One report form (and therefore, one RADB record) contains all pertinent information regarding the geochronological investigation of each sample.

Selected Records File (SRF): the file generated by a QUESTRAN search containing the addresses of all records which satisfy the conditions of the variable description(s) as they are related by the logic statement. More than one SRF may be created during the search procedure, and each is accessable for further searches (by means of the BACK and ITERATE commands), but the SRFs are generally temporary files which are destroyed at the end of each computer run.

Selection criterion: an informal name for the condition specified by the variable description in a QUESTRAN search. When used in the plural (selection criteria), it denotes the factors which determine the selection of records for the selected records file (i.e., the variable descriptions and the connections between them specified by the logic statement).

"Standard output record": the format of an entire data record generated by the PRINT command and controlled by the print dictionary form (see example, Appendix D).

Teleprocessing mode: interaction with a central computer by means of a remote teletype terminal. The job is processed at the time it is submitted to the computer ("on-line"), and the user interacts directly with the computer by entering commands and data as instructed by the program.

Temporary file: a data file which is destroyed at the end of a computer run (c.f. permanent file). The selected records file(s) and most output files are examples of temporary files.

Textural (written) information: data contained in variable-length fields which serve to comment upon or clarify various aspects of the report for a sample. There are no restrictions on the format of this data (except as noted), and parts of it may be searched upon by using the word mode of QUESTRAN.

User: any person who requests information from RADB by formulating a search strategy.

Variable description: a symbolic representation of a criterion used in selecting records for the selected records file. The variable description consists of the variable designator, a label, and a condition description.

Variable designator: a single unique alphabetic character used to identify each variable description in a QUESTRAN search. Variable designators are used as arguments in the logic statement.

Variable-length field: a data field which may contain any number of characters, up to 32,000.

Word mode: in this mode, QUESTRAN searches a specified field until it encounters the first occurrence of the character string contained in the condition description, and then it applies any other conditions required for selection (if QUESTRAN fails to locate the specific character string within a record, that record is not assigned to the selected records file).

APPENDIX A   RADB reporting forms and Code Lists A - L

Reporting form For RADIOMETRIC AGE DATA BANK

Sample identification: Record Number B20 < |_|_|_|_|_|_|_| >

Reference: B40 < |_|_| > (year) B60 < |_|_|_|_|_|_| > (reference number)

Laboratory(ies) B70 < |_|_| |_|_| |_|_| |_|_| > (code from list A)

Compiled by: Name B90 < ______________________________ >

Date B100 < |_|_| |_|_| > (year, month)

Location:

Country A20 < |_|_| > (enter code twice from list B)

State A40 < |_|_| > (enter code twice from list C)

County A60 < ______________________ >

Quad scale A72 < |_|_|_|_|_|_|_| >

Quad name or number A74 < ______________________ >

Latitude A80 < |_|_| - |_|_| - |_|_| |_| > (D D - M M - S S N/S)

Longitude A85 < |_|_|_| - |_|_| - |_|_| |_| > (D D D - M M - S S E/W)

Location comment A90 < ______________________________

____

______________________________ >

Precision of location A100 < |_| > (code from list D)

Source of sample A110 < |_| > (code from list E)

Record Number ( )

le description:

Rock name A130 < ______________________________ >

Description (if any) A140 < ____

____

____ >

Geologic unit A150 < |_|_|_|_| > (code from list F)

Lexicon age(s) A160 < |_|_|_| |_|_|_| |_|_|_| >
(code from list G)

Petrographic code A170 < |_|_|_|_| > (code from list H)

erence RA1 < _______________ _ _ _ _

Record Number ( )

POTASSIUM-ARGON C10 (circle)

ratory Sample Number CA1 < ____________________ >

Rock/Mineral CB10 < ____________________ >

(enter code from list J) CB15 < |_|_|_| >

Comments (concerning analyzed material) CC1 < ____________________

____ >

lytical Data

K_2O(%) CE1 < |_|_|_|_|_|_| >

40Ar-rad(mol/gm) CG1 < |_|_|_|_|_|_|_| > x 10^{-10}

% radiogenic argon CH1 < |_|_|_| >

Calculated age CL1 < |_|_|_|_|_|_| > ± CM1 < |_|_|_|_| > M.Y.

Type of analysis CP1 < |_|_| > (enter code from list K)

Analytical comments CP15 < ____________________

____ >

Sample suite CR1 < |_|_|_|_|_| >

e Comments CT1 (circle if any item is circled below)

CT101	CT102	CT103	CT104	CT105	CT106	CT107
CT108	CT109	CT110	CT111	CT112	CT113	CT114
CT115	CT120	CT121	CT124	CT125	CT128	CT130

(code is from list L)

other comments CT140 < ____________________

____ >

(if CT130 was circled, then the following is to be entered)

CT131 < |_|_|-|_|_|_|_|_| |_|_|-|_|_|_|_|_|_| >

RUBIDIUM-STRONTIUM D10 (circle)

oratory Sample Number DA1 < ______________________ >

Rock/Mineral DB10 < ______________________ >

(enter code from list J) DB15 < ______ >

Comments (concerning analyzed material) DC1 < ______________________

____ >

ılytical Data

Rb(ppm) DE1 < ______ >

Sr(ppm) DF1 < ______ > N1 or T1 (circle one)

87Sr-rad(ppm) DG1 < ______ >

% radiogenic 87Sr DH1 < ______ >

87Rb/86Sr DI1 < ______ >

87Sr/86Sr DJ1 < ______ >

Calculated age DL1 < ______ > ± DM1 < ______ > M.Y.

Initial 87Sr/86Sr DN1 < ______ >

Type of analysis DP1 < ______ > (enter code from list K)

Analytical comments DP15 < ______________________

____ >

Sample suite DR1 < ______ >

e comments DT1 (circle if any item is circled below)

DT101	DT102	DT103	DT104	DT105	DT106	DT107
DT108	DT109	DT110	DT111	DT112	DT113	DT114
DT115	DT120	DT121	DT124	DT128	DT130	(code is from list L)

other comments DT140 < ______________________

____ >

(if DT130 was circled, then the following is to be entered)

DT131 < ______ ______ >

Record Number (   )

URANIUM-THORIUM-LEAD E10 (circle)

Laboratory Sample Number EA1 < ____________________ >

Rock/Mineral EB10 < __________________________ >

(enter code from list J) EB15 < |_|_|_| >

Comments (concerning analyzed material) EC1 < ______________________

____ >

Analytical Data

U (ppm) EE1 < |_|_|_|_|_|_| >

Th (ppm) EF1 < |_|_|_|_|_|_| >

Pb (ppm) EG1 < |_|_|_|_|_|_| >

Isotopic composition of lead (atom percent)

^{204}Pb EH15 < |_|_|_|_|_|_| > ^{206}Pb EH16 < |_|_|_|_|_|_| >

^{207}Pb EH17 < |_|_|_|_|_|_| > ^{208}Pb EH18 < |_|_|_|_|_|_| >

Calculated ages (in million years)

^{206}Pb/^{238}U age EL10 < |_|_|_|_|_|_| > ± EM10 < |_|_|_|_| >

^{207}Pb/^{235}U age EL11 < |_|_|_|_|_|_| > ± EM11 < |_|_|_|_| >

^{207}Pb/^{206}Pb age EL12 < |_|_|_|_|_|_| > ± EM12 < |_|_|_|_| >

^{208}Pb/^{232}Th age EL13 < |_|_|_|_|_|_| > ± EM13 < |_|_|_|_| >

Concordia intercept age (in million years)

EL15 < |_|_|_|_|_|_| > ± EM15 < |_|_|_|_| >

Initial lead isotopic composition (X, Y, Z)

EN1 < ____________, ________________, ________________ >

Analytical Comments EP15 < ______________________________________

____ >

Sample suite ER1 < |_|_|_|_|_| >

Record Number (   )

Age comments ET1 (circle if any item is circled below)

ET101	ET102	ET103	ET104	ET105	ET106	ET107
ET108	ET109	ET110	ET111	ET112	ET113	ET114
ET115	ET120	ET121	ET124	ET128	ET130	

(code is from list L)

other comments ET140 < ____

____

____

____

(if ET130 was circled, then the following is to be entered)

ET131 <|_|_|_|_|_|_|_|_| |_|_|_|_|_|_|_|_|>

Record Number (   )

LEAD-ALPHA G10 (circle)

oratory Sample Number GA1 < ____________________ >

Rock/Mineral GB10 < ____________________ >

(enter code from list J) GB15 < [| | |] >

Comments (concerning analyzed material) GC1 < ____________________

____ >

alytical Data

Alpha/mg-hr GE1 < [| | | | |] >

Pb(ppm) GF1 < [| | | | |] >

Calculated age GL1 < [| | | | | |] > ± GM1 < [| | | |] > M.Y.

Analytical comments GP15 < ____________________

____ >

Comments GT1 (circle if any item is circled below)

GT101 GT102 GT103 GT104 GT105 GT106 GT107

GT108 GT109 GT110 GT111 GT112 GT113 GT114

GT115 GT120 GT121 GT124 GT130 (code is from list L)

other comments GT140 < ____________________

____ >

(if GT130 was circled, then the following is to be entered)

GT131 < [| | - | | | | | |] [| | - | | | | | |] >

Record Number (

FISSION-TRACK H10 (circle)

Laboratory Sample Number HA1 < ______________________ >

Rock/Mineral HB10 < ______________________ >

(enter code from list J) HB15 < |_|_|_| >

Comments (concerning analyzed material) HC1 < ______________________

____

Analytical Data

ρ_s(tracks/sq. cm.) HE1 < |_|_|_|_|_|_| > x10^6

Fossil tracks counted HF1 < |_|_|_|_|_|_| >

ρ_i(tracks/sq. cm.) HG1 < |_|_|_|_|_|_| > x10^6

Induced tracks counted HH1 < |_|_|_|_|_|_| >

ρ_s/ρ_i HJ1 < |_|_|_|_|_|_| >

Calculated age HL1 < |_|_|_|_|_|_| > ± HM1 < |_|_|_|_| > M.Y.

Neutron flux density(n/sq. cm.) HN1 < |_|_|_|_| > x 10^{15}.

U(ppm) HP1 < |_|_|_|_|_|_| >

Calculation constant lambda$_F$ HQ1 < |_|_|_|_| >x 10^{-17} yr^{-1}

Analytical Comments HP15 < ______________________

____

Age comments HTi (circle if any item is circled below)

HT101 HT102 HT103 HT104 HT105 HT106 HT107

HT108 HT109 HT110 HT111 HT112 HT113 HT114

HT115 HT120 HT121 HT122 HT124 HT130 (code is from list L

other comments HT140 < ______________________

____

(if HT130 was circled, then the following is to be entered)

HT131 < |_|_|-|_|_|_|_|_| |_|_|-|_|_|_|_|_| >

CODE LIST A - ANALYTICAL LABORATORIES

CODE*	
AB	Univ. Alberta
AZ	Univ. Arizona
BC	Univ. British Columbia
BØ	Brookhaven
BR	Brown Univ.
CB	Univ. Calif., Berkeley
CD	Univ. Calif., San Diego
CH	Univ. Chicago
CI	Calif. Inst. Tech.
CL	Univ. Calif., Los Angeles
CS	Univ. Calif., Santa Barbara
CW	Case Western Reserve
DT	Dept. Terr. Magnetism
FS	Florida State Univ.
GA	Univ. Georgia
GC	Geochron
GP	Geophys. Lab.
GU	Gulf Research
IN	Univ. Northern Illinois
IS	Isotopes, Inc.
KA	Univ. Kansas
KS	Kansas State Univ.
LA	Lamont (Columbia)
MA	Univ. Manitoba
MI	Univ. Minnesota
MT	Mass. Inst. Tech.
NB	S. U. N. Y., Buffalo
NC	Univ. North Carolina
NM	Univ. New Mexico
NS	S. U. N. Y., Stony Brook

CODE	
ØB	Oberlin College
ØH	Ohio State Univ.
ØR	Univ. Oregon
ØS	Oregon State Univ.
ØX	Oxford University
PA	Univ. Penna.
PB	Univ. Pittsburgh
PU	Penna. State Univ.
RI	Rice Univ.
SC	Geol. Survey of Canada
SD	U. S. G. S., Denver
SM	U. S. G. S., Menlo Park
SØ	Socony-Mobil
SW	U. S. G. S., Reston
TA	Univ. Texas, Austin
TD	Univ. Texas, Dallas
VP	Virginia Poly. Inst.
YA	Yale University

*Note: For analytical laboratories not listed here, contact RADB for a new code assignment.

CODE LIST B - COUNTRY CODES

CODE	
US	United States

CODE LIST C - STATE CODES

CODE		CODE	
01	Alabama	29	Missouri
02	Alaska	30	Montana
04	Arizona	31	Nebraska
05	Arkansas	32	Nevada
06	California	33	New Hampshire
08	Colorado	34	New Jersey
09	Connecticut	35	New Mexico
10	Delaware	36	New York
11	District of Columbia	37	North Carolina
12	Florida	38	North Dakota
13	Georgia	39	Ohio
15	Hawaii	40	Oklahoma
16	Idaho	41	Oregon
17	Illinois	42	Pennsylvania
18	Indiana	44	Rhode Island
19	Iowa	45	South Carolina
20	Kansas	46	South Dakota
21	Kentucky	47	Tennessee
22	Louisiana	48	Texas
23	Maine	49	Utah
24	Maryland	50	Vermont
25	Massachusetts	51	Virginia
26	Michigan	53	Washington
27	Minnesota	54	West Virginia
28	Mississippi	55	Wisconsin
		56	Wyoming

CODE LIST D - PRECISION OF LOCATION

CODE	
1	Latitude/longitude accurate to within 1 second (~100 feet)
2	Latitude/longitude accurate to within 0.1 minute (~500 feet)
3	Latitude/longitude accurate to within 1 minute (~1 mile)
4	Latitude/longitude accurate to within 5 minutes (~5 miles)
5	Latitude/longitude accurate to within 30 minutes (~30 miles)
6	Location not given (or only in terms less accurate than category 5)

CODE LIST E - SOURCE OF SAMPLE

CODE	
1	Outcrop or artificial surface exposure
2	Core or cutting
3	Quarry
4	Mine
5	Float
6	Unknown

Code List F - Geologic Unit Codes

(example: Nevada)

NAME CODE	#	STRATIGRAPHIC NAME, LITHOLOGY, AND RANK
AMPK	01	ADAM PEAK,FM
AMPK	02	ADAM PEAK,FM
AGRT	01	AGORT,CHERT
AGRT	02	AGORT,CHERT
AMRG	03	ALAMO RANGE,FM
ADCS	01	ALDRICH STATION,FM (WASSUK GP)
ADCS	02	ALDRICH STATION,FM (W SSUK GP)
ALTA	01	ALTA,ANDESITE
ALTA	02	ALTA,FM
AMCF	01	AMERICAN FLAT,BASALT
AMRV	01	AMERICAN RAVINE,ANDESITE PORPHYRY
AMTK	01	AMMONIA TANKS,MBR (TIMBER MOUNTAIN TUFF)
ANCR	04	ANCHOR,MBR (MONTE CRISTO DOL)
ANCR	05	ANCHOR,MBR (MONTE CRISTO LS)
ANDR	06	ANDORNO,FM
ADRM	03	ANDREWS MOUNTAIN,MBR (CAMPITO FM)
ALPV	02	ANTELOPE VALLEY,LS (POGONIP GP)
ALPV	04	ANTELOPE VALLEY,LS (POGONIP GP)
ALPK	01	ANTLER PEAK,LS
ALPK	02	ANTLER PEAK,LS
APEX	03	APEX,FM
ARCR	01	ARCTURUS,FM
ARCR	02	ARCTURUS,LS
APCN	02	ARROW CANYON,FM
ARRD	02	ARROWHEAD,MBR (MONTE CRISTO LS)
ASDN	01	* ASHDOWN,TUFF
ABRY	02	AUBREY,GP
ABRY	03	AUBREY,GP
AGSM	01	AUGUSTA MOUNTAIN,FM
AURA	01	AURA,FM
AYSS	01	AYSEES,MBR (ANTELOPE VALLEY LS)
AYSS	02	AYSEES,MBR (ANTELOPE VALLEY LS)
AZTC	01	AZTEC,GRANODIORITE
AZTC	02	AZTEC,GRANODIORITE
AZTC	03	AZTEC,SS
BDGV	01	BADGER VALLEY,BASALT
BLCK	22	BAILEY CREEK,MBR (SCHOONOVER FM)
BSPG	28	BAILEY SPRING,LS
BSPG	30	BAILEY SPRING,LS
BLDM	05	BALD MOUNTAIN,LAKE BEDS MBR (ESMERALDA FM)
BLDM	06	BALD MOUNTAIN,LAKE BEDS MBR (ESMERALDA FM)
BNBR	03	BANBURY,BASALT (IDAHO GP)
BNBR	04	BANBURY,FM (IDAHO GP)
BDDM	02	BANDED MOUNTAIN,MBR (BONANZA KING FM)
BDDM	03	BANDED MOUNTAIN,MBR (BONANZA KING FM)
BNNR	02	BANNER,FM
BNNR	03	BANNER,LS
BRTN	14	* BARTINE,MBR (MCCOLLEY CANYON FM)
BRNC	05	BARTON CANYON,MBR (WINDFALL FM)
BSCO	01	BASCO,FM
BSLN	02	BASELINE,SS
BSTL	01	BASTILLE,LS MBR (MASKET SH)
BSMN	01	* BATES MOUNTAIN,TUFF
BTTL	02	BATTLE,CGL
BTTL	03	BATTLE,FM
BLPW	01	BATTLESHIP WASH,FM (BIRD SPRING GP)

CODE LIST G - LEXICON AGES

Era, Period, Epoch	Code	Radiometric Age of Boundary (m.y.)*
Cenozoic	100	
Quaternary	110	
Recent	111	
Pleistocene	112	
		- - - - - - - - 1.8
Tertiary	120	
Pliocene	121	
Miocene	122	- - - - - - - - 5
Oligocene	123	- - - - - - - - 22.5
Eocene	124	- - - - - - - - 37-38
Paleocene	125	- - - - - - - - 53-54
		- - - - - - - - 65
Mesozoic	200	
Cretaceous	210	
Late	211	
Gulf	212	
Early	217	
Comanche	218	
Coahuila	219	
		- - - - - - - - 136
Jurassic	220	
Late	221	
Middle	224	
Early	227	
		- - - - - - - - 190-195
Triassic	230	
Late	231	
Middle	234	
Early	237	
		- - - - - - - - 225
Paleozoic	300	
Permian	310	
Late	311	
Ochoa	312	
Guadalupe	313	
Early	317	
Leonard	318	
Wolfcamp	319	
		- - - - - - - - 280
Pennsylvanian	320	
Late	321	
Virgil	322	
Missouri	323	
Middle	324	
Des Moines	325	
Atoka	326	
Early	327	
Morrow	328	
		- - - - - - - 320

CODE LIST G - LEXICON AGES (cont'd)

Era, Period, Epoch	Code	Radiometric Age of Boundary (m.y.)*
		320
Mississippian	330	
Late	331	
Chester	332	
Meramee	333	
Early	337	
Osage	338	
Kinderhook	339	
		345
Devonian	340	
Late	341	
Chautauquan	342	
Senecan	343	
Middle	344	
Erian	345	
Early	347	
Ulsterian	348	
		395
Silurian	350	
Late	351	
Cayugan	352	
Middle	354	
Niagaran	355	
Early	357	
Alexandrian	358	
		430-440
Ordovician	360	
Late	361	
Cincinnatian	362	
Middle	364	
Champlainian	365	
Early	367	
Canadian	368	
		500
Cambrian	370	
Late	371	
Middle	374	
Early	377	
		570
Precambrian	400	
Precambrian Z	410	
		800
Precambrian Y	420	
		1600
Precambrian X	430	
		2500
Precambrian W	440	

*modified from Geological Society of London, 1964

CODE LIST II - PETROGRAPHIC CODES

CODE

A100 Igneous-Extrusive
A110 tuffs, ashes, pyroclastic deposits, glasses
A111 obsidian, pitchstone, pumice, vitrophyre, perlite
A112 bentonite

A120 felsite
A121 rhyolite, rhyodacite
A122 trachyte
A123 quartz latite, latite
A124 dacite, andesite

A130 trap rock
A131 basalt
A132 phonolite

B200 Igneous-Intrusive
B210 hypabyssal intrusive
B211 porphyries (rhyolite porphyry, dacite porphyry, rhomb porphyry, quartz porphyry, etc.)
B212 diabase, dolerite
B213 keratophyre
B214 tinguaite
B215 lamprophyre (minette, vogesite, malchite, kersantite, spessartite, odinite, camptonite, monchiquite, alnoite, fourchite, ouachitite)

B220 granitpid (phaneritic)

B225 pegmatite

B230 aplite

B235 vein

B240 granite, alaskite, microgranite, granite porphyry

B245 syenite, shonkinite

B250 quartz monzonite, adamellite

B255 monzonite

B260 granodiorite

B265 quartz diorite, tonalite, trondhjemite

B270 diorite

CODE	
B275	gabbro, norite, quartz gabbro
B280	anorthosite
B285	ultramafic rocks (pyroxenite, peridotite, hornblendite, serpentinite, dunite, kimberlite, picrite, lherzolite, etc.)
B290	nepheline syenite, nepheline diorite
C300	Metamorphic rock
C310	gneiss (granitic gneiss, augen gneiss, orthogneiss, etc.)
C320	schist (biotite schist, garnetiferous schist, etc.)
C330	argillite, slate, phyllite
C335	mylonite
C340	quartzite
C345	marble, tactite, skarn
C350	hornfels, granofels
C360	amphibolite
C370	granulite, eclogite, charnockite
C375	migmatite
C380	metaigneous, greenstone (metarhyolite, metagabbro, etc.)
C385	serpentine, soapstone
C390	metasedimentary (metagraywacke, etc.)
D400	Sedimentary rock
D410	clay, mud, shale, siltstone, claystone
D420	sandstone, graywacke, arkose
D430	conglomerate, breccia, talus
D440	carbonate, limestone, dolomite, travertine
D450	evaporite, salt, gypsum, anhydrite
D460	coal, iron ore, phosphorite, sulfur
E500	Impactite

CODE LIST J - ROCK/MINERAL CODES*

A00 Non-mineral substances
- AA0 Whole-rock
- AB0 Glass

CB1 Galena
DB1 Fluorite
ED3 Magnetite

F00 Carbonates
- FA0 Calcite group
  - FA1 Calcite
  - FA2 Dolomite
  - FA3 Magnesite
  - FA4 Ankerite
  - FA5 Siderite
  - FA6 Rhodochrosite
  - FA7 Smithsonite
- FB0 Aragonite group
  - FB1 Aragonite
  - FB2 Witherite
  - FB3 Cerussite
  - FB4 Strontianite

G00 Niobates and Tantalates
- GA0 Pyrochlore-Microlite
- GB0 Columbite-Tantalite
- GC0 Yttrotantalite
- GD0 Samarskite

H00 Phosphates and Uranites
- HA0 anhydrous phosphates
  - HA1 Xenotime
  - HA2 Monazite
  - HA3 Apatite
- HF0 Uranites
  - HF1 Torbernite
  - HF2 Autunite
  - HF3 Carnotite

J00 Borates and Uranates
- JB0 Uranates
  - JB1 Uraninite
  - JB2 Thorianite

M00 Neso- and Sorosilicates
- MC0 Zircon group
  - MC1 Zircon
  - MC2 Thorite
- MD0 Sphene
- ME0 Garnet group

N00 Cyclosilicates
- NB0 Tourmaline

P00 Chain structures
- PA0 Pyroxene group
  - PA1 Enstatite
  - PA2 Hypersthene
  - PA3 Pigeonite
  - PA4 Diopside-Hedenbergite
  - PA5 Augite-Ferroaugite
  - PA6 Aegerine (Acmite)
  - PA7 Jadeite
  - PA8 Spodumene
- PC0 Amphibole group
  - PC1 Anthophyllite-Gedrite
  - PC2 Cummingtonite-Grunerit
  - PC3 Tremolite
  - PC4 Actinolite
  - PC5 Hornblende
  - PC6 Lamprobolite
  - PC7 Riebeckite
  - PC8 Glaucophane
- PD0 Epidote group
  - PD3 Epidote
  - PD5 Allanite

Q00 Silica minerals
- QA0 Quartz

R00 Feldspars
- RA0 Alkali feldspars
  - RA1 Microcline
  - RA2 Orthoclase
  - RA3 Sanidine
  - RA4 Adularia
- RB0 Anorthoclase
- RC0 Plagioclase feldspars
  - RC1 Albite
  - RC2 Oligoclase
  - RC3 Andesine
  - RC4 Labradorite
  - RC5 Bytownite
  - RC6 Anorthite

S00 Feldspathoids
- SA0 Leucite group
  - SA1 Leucite
  - SA2 Pseudoleucite
- SB0 Nepheline group
- SE0 Scapolite

U00 Mica group

- UA0 Common micas
  - UA1 Muscovite
  - UA2 Sericite
  - UA3 Paragonite
  - UA4 Glauconite
  - UA5 Biotite
  - UA6 Phlogopite
  - UA7 Lepidolite

V00 Misc. layer Silicates

- VA0 Stilpnomelane
- VD0 Chlorite group

W00 Clay minerals

- WB0 Illite group
  - WB1 Illite
  - WB2 Phengite
- WD0 Vermiculite

* This code list has been condensed from a more extensive mineral coding scheme; if the rock/mineral listed in the reference does not appear in the code list above, contact RADB for the assignment of an appropriate code.

CODE LIST K - TYPE OF ANALYSIS

CODE	
10	Conventional K-Ar
11	39Ar-40Ar incremental (plateau)
12	39Ar-40Ar total fusion
13	40Ar/36Ar-40K/36Ar isochron
14	40Ar - 40K isochron
15	37Ar-41Ar total fusion
16	40Ar/36Ar - 39Ar/36Ar isochron
20	Conventional Rb-Sr (assumed initial 87Sr/86Sr)
21	Conventional Rb-Sr (measured initial 87Sr/86Sr)
22	87Sr/86Sr - 87Rb/86Sr isochron (whole rock)
23	87Sr/86Sr - 87Rb/86Sr isochron (mineral - whole rock)

CODE LIST L - AGE COMMENTS

CODES*					
				Fission	
K-Ar	Rb-Sr	U-Th-Pb	Pb-α	Track	Meaning
CT101	DT101	ET101	GT101	HT101	age of intrusion
CT102	DT102	ET102	GT102	HT102	minimum age of intrusion
CT103	DT103	ET103	GT103	HT103	maximum age of intrusion
CT104	DT104	ET104	GT104	HT104	age of sedimentation/volcanism
CT105	DT105	ET105	GT105	HT105	minimum age of sedimentation/ volcanism
CT106	DT106	ET106	GT106	HT106	maximum age of sedimentation/ volcanism
CT107	DT107	ET107	GT107	HT107	age of metamorphic crystalliza'n
CT108	DT108	ET108	GT108	HT108	minimum age of metamorphic crystallization
CT109	DT109	ET109	GT109	HT109	maximum age of metamorphic crystallization
CT110	DT110	ET110	GT110	HT110	age of later metamorphism
CT111	DT111	ET111	GT111	HT111	material inherited from source rock; maximum age for unit.
CT112	DT112	ET112	GT112	HT112	age of uplift and cooling
CT113	DT113	ET113	GT113	HT113	age meaning uncertain (analysis questionable)
CT114	DT114	ET114	GT114	HT114	age meaning uncertain (geologic factors)
CT115	DT115	ET115	GT115	HT115	age not evaluated
CT120	DT120	ET120	GT120	HT120	initial age disturbed by later metamorphism
CT121	DT121	ET121	GT121	HT121	initial age disturbed by weathering
CT122				HT122	may denote delayed cooling
CT124	DT124	ET124	GT124	HT124	sample contains inherited material; age is too old.
CT125					sample contains excess argon; age is too old.
CT128	DT128	ET128			anomolous initial isotopic composition; age questionable.
CT130	DT130	ET130	GT130	HT130	for additional information, see reference(s)
CT131	DT131	ET131	GT131	HT131	references (__ __ - __ __ __ __)
CT140	DT140	ET140	GT140	HT140	other comments

*For a second age determined on the same sample, CT101 becomes CT201, DT101 becomes DT201, ET101 becomes ET201, etc. For a third age on the same sample, CT301 is used, and for a fourth age, CT401 is used, etc. This labeling procedure applies to the other age comments as well.

APPENDIX B QUESTRAN search and output using the COPY command

```
G I P S Y  -  UNIVERSITY OF OKLAHOMA  12:56 P.M. FRIDAY    MAY        29,1976

FORM

 RADB

SELECT

 A. 32
       NV

 B. A60< ESMERALDA >
       CNTY

 LOGIC A AND B
    SEARCH
12:56:32.6 SEARCH BEGINNING
12:56:38.0 SEARCH COMPLETED

 SEARCHED    1252

 SELECTED      53      SUBSET    1

 VARIABLES  SATISFIED

     A        128

     B         53

ITERATE

 A. A170< A>
       PTRCOD

 LOGIC A
    SEARCH
12:56:38.2 SEARCH BEGINNING
12:56:38.6 SEARCH COMPLETED

 SEARCHED      53

 SELECTED      38      SUBSET    2

 VARIABLES  SATISFIED

     A         38

SORT

 B40 2

 B60 5

 A170 4
END OF SORT
```

```
COPY

 ' '

 A80 15

 A85 15

 A130 10

 ' '

 A150 6

 CL1 7

 CL2 7

 ML1 7

 ML2 7

 B40 3

 B60 7

 B20 7
```

LATITUDE	LONGITUDE	ROCK NAME	GEOL UNIT CODE	K-AR AGE 1	K-AR AGE 2	FISSION TRACK AGE 1	FISSION TRACK AGE 2	REFERENCE NUMBER	RECORD NUMBER
36-22-00 N	117-42-00 W	TUFF (?)	EMLD	11.5				64 00002	0000978
37-56-00 N	118-04-20 W	TUFF	EMLD	11.1				64 00002	0000966
37-56-00 N	118-04-20 W	TUFF	EMLD	11.4				64 00002	0000973
36-23-00 N	117-42-00 W	TUFF	EMLD	10.7				64 00002	0001022
36-00-05 N	117-51-00 W	TUFF	EMLD	12.7				64 00005	0001189
37-41-11 N	117-09-57 W	DACITE		21.1				68 00005	0001244
37-48-00 N	117-50-00 W	TUFF		6.0				68 00006	0001246
37-39-00 N	117-49-00 W	TUFF		6.1				68 00006	0001245
37-51-00 N	117-38-00 W	TUFF		6.9				68 00006	0001250
37-59-00 N	117-54-00 W	TUFF		21.5				68 00006	0001249
37-42-00 N	117-45-00 W	TUFF		5.9				68 00006	0001248
36-01-00 N	118-06-00 W	TUFF		22.8				68 00006	0001251
37-43-00 N	118-02-00 W	BASALT		4.8				68 00006	0001247
38-38-00 N	117-07-00 W	TUFF		20.7				70 00002	0001243
37-41-40 N	117-14-20 W	TUFF	SPRD	6.7	6.8			72 00006	0001198
37-51-20 N	117-08-25 W	DACITE		21.6	21.8			72 00006	0001207
37-47-10 N	117-12-40 W	ANDESITE		13.5				72 00006	0001202
37-41-45 N	117-14-40 W	BASALT	MLPS	8.7				72 00006	0001197
37-41-45 N	117-14-45 W	BASALT	MLPS	8.0				72 00006	0001195
37-41-4[illegible] N	117-14-50 W	BASALT	MLPS	7.6				72 00006	0001194
37-41-45 N	117-14-40 W	BASALT	MLPS	6.8				72 00006	0001196
37-25-00 N	117-40-00 W	TUFF		4.5				72 00008	0001235
37-41-10 N	117-11-23 W	TUFF	MEDA	17.8				72 00008	0001234
37-41-17 N	117-11-38 W	TUFF	SBRT	14.2				72 00008	0001233
38-00-57 N	117-17-01 W	TUFF	SBRT	15.5				72 00008	0001232
37-57-00 N	117-15-00 W	QUARTZ LAT	BRGR	16.2	16.2			72 00008	0001237
36-05-00 N	117-42-00 W	ANDESITE	GLBR	15.1				72 00008	0001236
37-44-30 N	117-11-16 W	ANDESITE	MLTN	21.5				72 00008	0001239
37-43-24 N	117-13-36 W	TUFF	KNOL			31.1		73 00006	0001215
37-43-54 N	117-11-18 W	TUFF				21.2		73 00006	0001213
37-45-00 N	117-12-54 W	TUFF				31.1	27.7	73 00006	0001212
37-44-12 N	117-12-06 W	TUFF	VDCR			33.0		73 00006	0001211
37-43-18 N	117-10-36 W	LATITE				33.5		73 00006	0001214
37-43-42 N	117-08-16 W	RHYODACITE				19.8	20.1	73 00006	0001217
36-13-53 N	117-36-21 W	OBSIDIAN		7.0				75 00001	0001218
38-06-35 N	117-26-08 W	RHYOLITE		14.7				75 00001	0001229
37-54-06 N	117-12-12 W	RHYOLITE		10.5				75 00001	0001224
38-07-58 N	117-42-29 W	ANDESITE		15.1	13.6			75 00001	0001220

APPENDIX C QUESTRAN search and output using the LIST command

```
BACK
1

ITERATE

 A. A170< 6>
       PTHCOD

 B. A160 < 220> THRU < 300>
       LEXAGE

 LOGIC A AND B
    SEARCH
12:57:04.3 SEARCH BEGINNING
12:57:13.1 SEARCH COMPLETED

 SEARCHED      53

 SELECTED       6      SUBSET    2.

 VARIABLES  SATISFIED

     A         14

     B          6

SORT

 A160 3
END OF SORT

FORM

 FULREC
```

```
LIST

 B20
 A74
 A90
 A130
 A140
 C10
 CB10
 CL1
 H10
 HB10
 HL1
 HB20
 HL2
```

QUADRANGLE NUMBER OR NAME GILBERT
LOCATION COMMENT......... SEC. 28, T4N, R38E (UNSURVEYED), MONTE CRISTO MOUNTAINS
ROCK NAME: QUARTZ MONZONITE
DESCRIPTION: ALTERED QUARTZ MONZONITE PORPHYRY WITH BIOTITE AND FELDSPAR ALTERED TO SERICITE. ROCK CONSISTS OF QUARTZ, SERICITE, AND MINOR LIMONITE AFTER PYRITE.
POTASSIUM-ARGON
ROCK/MINERAL: SERICITE
AGE (M.Y.) 194

RECORD NUMBER............ 0001188
QUADRANGLE NUMBER OR NAME MAGRUDER MOUNTAIN
LOCATION COMMENT......... SOUTHERN PART OF SYLVANIA MOUNTAINS
ROCK NAME: QUARTZ MONZONITE
DESCRIPTION: PORPHYRITIC, WITH 35% ORTHOCLASE PHENOCRYSTS, 40% PLAGIOCLASE (AN25), 15% QUARTZ, 0-5% HORNBLENDE, 0-5% BIOTITE, 0-3% SPHENE, APATITE, AND MAGNETITE. THIS UNIT HAS BEEN CALLED THE SYLVANIA ADAMELLITE BY MCKEE (1962) AND THE "UNCLE SAM" QUARTZ MONZONITE PORPHYRY BY SCHILLING (1962).
POTASSIUM-ARGON
ROCK/MINERAL: BIOTITE
AGE (M.Y.) 155

RECORD NUMBER............ 0001187
QUADRANGLE NUMBER OR NAME MAGRUDER MOUNTAIN
LOCATION COMMENT......... NW 1/4 SEC. 34, T5S, R38E: ALONG PALMETTO WASH, JUST SOUTH OF STATE HIGHWAY 3, SYLVANIA MOUNTAINS
ROCK NAME: QUARTZ MONZONITE
DESCRIPTION: INEQUIGRANULAR, WITH COARSE-GRAINED ORTHOCLASE (35%) IN A "GROUNDMASS" OF MEDIUM-GRAINED PLAGIOCLASE (35%), QUARTZ (20%), BIOTITE (5%), HORNBLENDE, SPHENE, APATITE, AND MAGNETITE. THIS UNIT HAS BEEN CALLED THE SYLVANIA ADAMELLITE BY MCKEE (1962) AND THE "UNCLE SAM" QUARTZ MONZONITE PORPHYRY BY SCHILLING (1962).
POTASSIUM-ARGON
ROCK/MINERAL: BIOTITE
AGE (M.Y.) 153

RECORD NUMBER............ 0001210
QUADRANGLE NUMBER OR NAME GOLDFIELD
LOCATION COMMENT......... SE 1/4 SW 1/4 NW 1/4 SEC. 30, T2S, R43E
ROCK NAME: QUARTZ MONZONITE
DESCRIPTION: MEDIUM-GRAINED BIOTITE QUARTZ MONZONITE FROM "VINDICATOR PLUTON"
FISSION-TRACK
ROCK/MINERAL: SPHENE
AGE (M.Y.) 170
ROCK/MINERAL: APATITE
AGE (M.Y.) 19.6

RECORD NUMBER............ 0001190
QUADRANGLE NUMBER OR NAME TONOPAH
LOCATION COMMENT......... NE 1/4 SEC. 34, T5N, R39E: 2 MILES EAST OF CROW SPRINGS, SOUTHERN CEDAR MOUNTAINS
ROCK NAME: GRANODIORITE
DESCRIPTION: PORPHYRITIC GRANODIORITE FROM THE SMALL CROW SPRINGS PLUTON: THE

GRANODIORITE CONSISTS OF PLAGIOCLASE, QUARTZ, 10-15% HORNBLENDE, AND HIGHLY VARIABLE ABUNDANCES OF COARSE POTASH FELDSPAR PHENOCRYSTS.
POTASSIUM-ARGON
ROCK/MINERAL: HORNBLENDE
AGE (M.Y.) 202

RECORD NUMBER............. 0001192
QUADRANGLE NUMBER OR NAME GOLDFIELD
LOCATION COMMENT......... CENTER OF WEST 1/2 SEC. 30, T2S, R43E; IN VALLEY BETWEEN RUBY HILLS AND VINDICATOR MOUNTAIN, GOLDFIELD MINING DISTRICT (LATITUDE INCORRECTLY LISTED AS 37 DEGREES, 51 MINUTES, 39 SECONDS--COMPILER)
ROCK NAME: GRANITE
DESCRIPTION: COARSE-GRAINED GRANITE FROM THE VINDICATOR PLUTON
POTASSIUM-ARGON
ROCK/MINERAL: BIOTITE
AGE (M.Y.) 173

APPENDIX D QUESTRAN search and output using the PRINT command ("standard output record")

```
FORM

 RAD3

SELECT

 A. A40<55>
      STCOD

 LOGIC A
    SEARCH
12:58:36.5 SEARCH BEGINNING
12:58:41.5 SEARCH COMPLETED

 SEARCHED     1252

 SELECTED      355      SUBSET    1

 VARIABLES  SATISFIED

     A         355

ITERATE

 A. A60<CARBON>
      CNTY

 B. A150<BGRK>
      GUNIT

 C. DB15<AAO>
      R/MCOD

 LOGIC A AND B AND C
    SEARCH

 LOGIC B AND C
    A
12:58:41.7 SEARCH BEGINNING
12:58:43.7 SEARCH COMPLETED

 SEARCHED      355

 SELECTED        9      SUBSET    2

 VARIABLES  SATISFIED

     A          43

     B          10

     C          89

 LOGIC SATISFIED

     A           9

 A. B20<0000140>
      RNUM

 LOGIC A
    SEARCH
12:58:44.0 SEARCH BEGINNING
12:58:44.2 SEARCH COMPLETED

 SEARCHED        9

 SELECTED        1      SUBSET    3

 VARIABLES  SATISFIED

     A           1

FORM

 FULREC

PRINT
```

```
RADIOMETRIC AGE DATA BANK, USGS BRANCH OF ISOTOPE GEOLOGY

                                        SAMPLE IDENTIFICATION
                                          RECORD NUMBER............  0000140
                                          REFERENCE................  68-00003
                                          LABORATORY(IES)..........  MI YA

                                        COMPILED BY
                                          NAME:  MARVIN, R. F.
                                          DATE:  74 07

 LOCATION
   COUNTRY CODE.............  US
   COUNTRY..................  UNITED STATES

   STATE CODE...............  56
   STATE....................  WYOMING

   COUNTY...................  CARBON

   QUAD SCALE          QUAD NO. / NAME
    1: 24000             COW CREEK

   LATITUDE.................  41-18-30 N
   LONGITUDE................  106-44-30 W

   LOCATION COMMENT.........  MEDICINE BOW MOUNTAINS

   PRECISION OF LOCATION: 3
        SOURCE OF SAMPLE: 1

 SAMPLE DESCRIPTION
              ROCK NAME: ADAMELLITE
            DESCRIPTION: BAGGOT ROCKS GRANITE.  WEATHERED, MEDIUM-GRAINED,
              FLUORITE-BIOTITE ADAMELLITE.  MINOR MUSCOVITE; PLAGIOCLASE
              CONTAINS 15-20% ANORTHITE.
          GEOLOGIC UNIT: BGRK
         LEXICON AGE(S):  430
     PETROGRAPHIC CODE: 8250

 RUBIDIUM-STRONTIUM

   LABORATORY SAMPLE NUMBER:  M22                 WHOLE-ROCK
     ROCK/MINERAL CODE: AA0
   COMMENT: 87RB/86SR RATIO CALCULATED BY COMPILER.
   ANALYTICAL DATA:
     RB (PPM)................     286
     SR (PPM)................     78.7   T
     87SR RAD (PPM)..........
     % RADIOGENIC............
     87RB/86SR...............    11.17
     87SR/86SR...............    1.088
     CALCULATED AGE.......................    2340 +/- 50   MILLION YEARS
     INITIAL 87SR/86SR.......  0.7036
```

TYPE OF ANALYSIS.......... 22
SAMPLE SUITE: 00016

COMMENTS:
AGE OF INTRUSION

REFERENCE.... HILLS, F.A., GAST, P.W., HOUSTON, R.S., AND SWAINBANK, I.G., 1968, PRECAMBRIAN GEOCHRONOLOGY OF THE MEDICINE BOW MOUNTAINS, SOUTHEASTERN WYOMING: GEOL. SOC. AMERICA BULL., V. 79, P.1757-1784.

APPENDIX E Sample page of the RADB dictionary file

INTERNAL	EXTERNAL	SPACING	OPTION	USASI	CLEAR TEXT
00010	TITLE	001	1		RADIOMETRIC AGE DATA BANK, USGS BRANCH OF ISOTOPE GEOLOGY
01000	B10	040	1	0	SAMPLE IDENTIFICATION
01010	B20	042	1		RECORD NUMBER............
01020	B30	042	1		REFERENCE...............
01030	B40	069	2	*	YEAR (_ _)
01040	B50	071	1	*	-
01050	B60	072	2	*	NUMBER (_ _ _ _ _)
01060	B70	042	1		LABORATORY(IES)..........
01070	B80	040	1	0	COMPILED BY
01075	B90	042	1		NAME:
01080	B100	042	1		DATE:
01100	A10	002	1	0	LOCATION
01105	A20	004	1		COUNTRY CODE............
01110	A30	004	1		COUNTRY.................
03000	AF	031	1	*	AFGHANISTAN
03032	CA	031	1	*	CANADA
03124	MX	031	1	*	MEXICO
03213	US	031	1	*	UNITED STATES
03231	NM	031	1	*	NAMIBIA
01115	A40	004	1	0	STATE CODE..............
01120	A50	004	1		STATE...................
03500	01	031	1	*	ALABAMA
03501	02	031	1	*	ALASKA
03502	04	031	1	*	ARIZONA
03503	05	031	1	*	ARKANSAS
03504	06	031	1	*	CALIFORNIA
03505	08	031	1	*	COLORADO

This dictionary is used both as the BUILD dictionary and as the PRINT dictionary for RADB data.

Columnar headings refer to:

INTERNAL: code employed by the GIPSY program

EXTERNAL: field label

SPACING: controls the left margin of the entry during output

OPTION:, USASI: control the line spacing during output (see GIPSY User's Guide, 1975)

CLEAR TEXT: descriptive phrases which are printed out along with the data