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Abstract

GEO THERM is a computerized geothermal resources file developed by the U.S. Geological Survey. The file contains data on geothermal fields, wells, and chemical analyses from the United States and international sources.

The General Information Processing System (GIPSY) on the IBM 370/155 computer is used to store and retrieve data. The GIPSY retrieval program contains simple commands which can be used to search the file; select a narrowly defined subset, sort the records, and output the data in a variety of forms. Eight commands are listed and explained so that the GEO THERM file can be accessed directly by geologists. No programming experience is necessary to retrieve data from the file.

Introduction

GEO THERM is the operational computerized file, created by the U.S. Geological Survey, of national and international geothermal resource information. The data base covers geothermal physical and chemical data and is stored and retrieved by the General Information Processing System (GIPSY).

GEO THERM contains site-dependent geothermal information. The format is divided into three sections which contain information on three subtopics: Geothermal field/area, chemical analyses of geothermal fluids, and geothermal well/drill hole.

Section A: Geothermal field/area - This topic contains data on the locality, developments, subsurface dimensions, geology, heat content, etc. of a geothermal field or area.

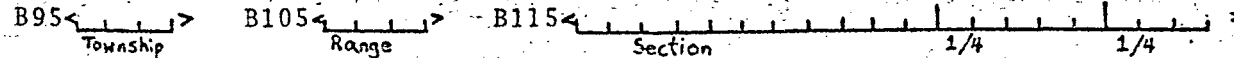
Section B: Chemical analysis - This topic includes chemical analysis data of geothermal fluids. Space is provided for three types of analyses--water, condensate, and residual gas. Data items include sampling conditions, solutes, and isotopes.

Section C: Geothermal well/drill hole - This topic contains information on geothermal wells. Data items include locality, temperature, pressure, enthalpy, and well flow.

The GEOTHERM input forms are illustrated in figures 1-3.

The rest of this paper is devoted to the use of the GEOTHERM file. No previous computer knowledge is required and the necessary job control language (JCL) is illustrated. Further details on the GIPSY program can be found in the GIPSY "Users Guide" and "Programmer Guide" (University of Oklahoma, 1975).

Township, Range, Section, 1/4, 1/4



Base & Meridian B125 < _____ >

Other Locality Information B83 < _____ >

General Description

Size of Surface Expression C10 < _____ units >

Elevation B140 < _____ units >

Resource Category C15 < _ >

Development Status C20 < _ >

Present Use & Developments C30 < _____ >

Potential Use C40 < _____ >

Inferred Heat Source C50 < _____ >

Depths to Production Zones

Zone 1 C70 < _____ units >

Zone 2 C80 < _____ units >

Thickness of Production Zones

Zone 1 C100 < _____ units >

Zone 2 C110 < _____ units >

Average Temperature of Production Zones

Zone 1 C114 < _____ units >

Zone 2 C115 < _____ units >

Surface Thermal Activity C120 < _____ >

Associated Deposits	C130 < _____ >
No. of Hot Springs	C135 < _____ >
Electric Power Capacity	C140 < _____ | _____ > units
Year Production Began	C150 < _____ >
Number of Wells	
Producing	C170 < _____ >
Injection	C180 < _____ >
Test	C190 < _____ >
Abandoned	C195 < _____ >
Other	C200 < _____ >
Total No. of Wells	C210 < _____ >
Principal Exploration Techniques	C220 < _____ >
Comments (General Description)	C230 < _____ >

Geothermal Characteristics

Main Reservoir Fluid	E10 < _____ >
Natural Surface Discharge	E20 < _____ | _____ > units
	E16 Measured E17 Estimated (Circle Label)
Total Calculated Discharge of Deep Water	E15 < _____ | _____ > units
Natural Recharge	E30 < _____ | _____ > units
Injection Recharge	E40 < _____ | _____ > units
Total Natural Heat Flux	E50 < _____ | _____ > units
Total Withdrawal Flux	E60 < _____ | _____ > units
Excess Withdrawal/Natural	E70 < _____ >

Page 4 - Section A

Heat Flow of Surrounding Area E75 < _____ | _____ >
units

Range of Spring Temperatures E76 < _____ | _____ > to E77 < _____ | _____ >
units units

Spring Description (if no temp. measured) E78 < Boiling Hot Warm > (Circle word)

Well information

Maximum Well Temperature E95 < _____ | _____ >
units

Depth Datum E96 < _____ | _____ >
units

Bottom-Hole Temperature E97 < _____ | _____ >
units

Depth Datum E98 < _____ | _____ >
units

Ave. Thermal Gradient E80 < _____ | _____ >
units

Comments E90 < _____ >

Reservoir Properties

Reservoir Temperatures R15 < _____ | _____ >
units

to R20 < _____ | _____ >
units

R30 Assumed R40 Measured (Circled Label)

Best Estimate R50 < _____ | _____ >
units

Based on R55 < _____ >

Subsurface Area R60 < _____ | _____ >
units

to R70 < _____ | _____ >
units

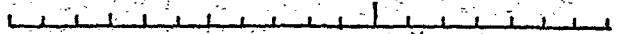

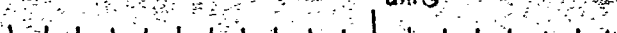
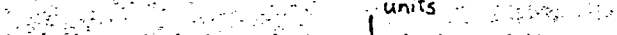
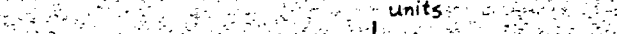

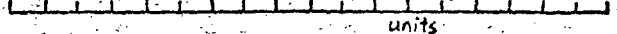
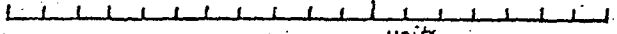
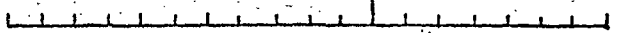

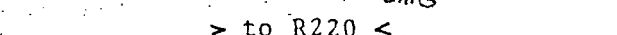

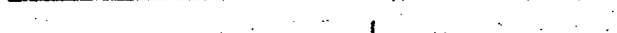

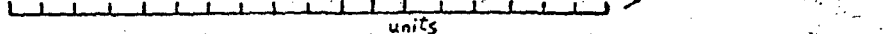
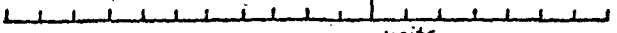


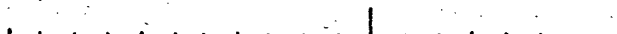

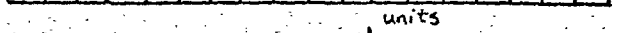
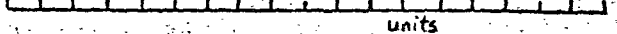
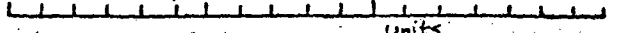
Best Estimate R100 < _____ | _____ >
units

Based on R110 < _____ >

Depth to Reservoir Top R120 < _____ | _____ >
units

to R130 < _____ | _____ >
units

Best Estimate R140 < _____ | _____ >
units

Depth to Reservoir Bottom	R145	<		>	
to	R146	<		>	
Best Estimate	R147	<		>	
Reservoir Thickness	R150	<		>	
to	R160	<		>	
Best Estimate	R170	<		>	
Reservoir Volume	R180	<		>	
to	R190	<		>	
Best Estimate	R200	<		>	
Porosity	R210	<		>	
Best Estimate	R230	<		>	
Ave. Well Flow (Mass)	R270	<		>	
to	R280	<		>	
Well Diameter	R290	<		>	
Comments	R300	<		>	
<u>Reserves</u>					
Total Stored Heat	F13	<		>	
to	F14	<		>	
Best Estimate	F10	<		>	
Depth Datum	F20	<		>	
Temperature Datum	F30	<		>	
Recoverable Heat	F40	<		>	
Depth Datum	F50	<		>	
Temperature Datum	F60	<		>	

Method Used F70 < _____ >
 Recoverable By-Product F80 < _____ >
 Potential By-Product F90 < _____ >
 Comments (Reserves): F100 < _____ >

Geology

General Rock Types G10 < _____ >

Cap Rock G30 < _____ >

Aquifer G40 < _____ >

Depth G50 < _____ >

Thickness G60 < _____ >

Cap Rock G70 < _____ >

Aquifer G80 < _____ >

Depth G90 < _____ >

Thickness G100 < _____ >

Other Horizons & Units G20 < _____ >

Comments (Horizons): G110 < _____ >

Hydrothermal Index Minerals G120 < _____ >

Important Control or Locus G140 < _____ >

Other Structures or Trends G130 < _____ >

Hydrology G150 < _____ >

Comments (Geology): G160 < _____ >

Geophysics

Gravity Survey Information	J20	<		>
Magnetic Survey Information	J30	<		>
Seismic Survey Information	J40	<		>
Electrical Resistivity	J50	<		>
Other Geophysical Resistivity	J60	<		>
Comments (Geophysics):	J70	<		>
Environmental Factors	H18	<		>

Primary Reference (Geothermal Field)

Author	K20	<		>
Date	K30	<		>
Title	K40	<		>
Reference	K50	<		>

References

1)	K70	<		>
2)	K80	<		>
3)	K90	<		>
4)	K100	<		>

Surface Sample Information

Source Type	S10	<	_____	>
Sample No.	M190	<	_____	>
Collection Date	M200	<	_____	>
Collector(s)	S20	<	_____	>
Point of Collection	N210	<	_____	>
Volume Flow Rate of Spring	M220	<	_____	>
Temperature	M210	<	_____	>
Qualitative Steam/Water Ratio	S40	<	_____	>
Deposits or Alteration	S30	<	_____	>

Water Treatment Data	M234	<	_____	>

Other Sample Information	S50	<	_____	>

References	M790	<	_____	>

Well Sample Information

Sample No.	M190	<	_____	>
Collection Date	M200	<	_____	>
Collector(s)	S20	<	_____	>
References	M790	<	_____	>
Wellhead Status	N10	<	_____	>
Wellhead Pressure	N30	<	_____	>
Water				
Point of Collection	P55	<	_____	>
Separation Pressures				
First	P60	<	_____	>
Second	P70	<	_____	>
Third	P80	<	_____	>
Water Sampling Temp.	M210	<	_____	>
Steam				
Point of Collection	P75	<	_____	>
Separation pressure	P65	<	_____	>
Steam Sampling Temp.	S60	<	_____	>
Steam Flow Rate (Mass)	N50	<	_____	>
Water Flow Rate (Mass)	M220	<	_____	>
Enthalpy of Total Flow	N60	<	_____	>
Water Treatment Data	M234	<	_____	>
Other sample information	S50	<	_____	>

units A/G

units A/G

units A/G

units A/G

units

units A/G

units

units

units

units

Water Analysis

Analysis Date

Analyst(s)

pH 1)

2)

Eh

Temperature

Specific Gravity

Specific Conductance

Temperature

Alkalinity

Total Dissolved Solids

Total Suspended Solids

Isotopic Data

Del O (18) of Water

Del D of Water

Del C (13) of Dissolved CO₂

Del O (18) of Dissolved SO₄

Del S (34) of Dissolved SO₄

Del S (34) of Dissolved H₂S

Tritium Content of Water

C(14) Content of CO₂

Other

A31 < W >

M233 < _____ >

M236 < _____ >

M20 < _____ > At M20A < _____>
Temp. units

M202 < _____ > At M202A < _____>
Temp. units

M221 < _____>
units

M222 < _____>
units

M91 < _____ >

M21 < _____>
units

M740 < _____>
units

M22 < _____>
units

M23 < _____>
units

M24 < _____>
units

Q270 < _____>
units

Q250 < _____>
units

Q150 < _____>
units

Q200 < _____>
units

Q190 < _____>
units

Q185 < _____>
units

Q186 < _____>
units

Q187 < _____>
units

Q310 < _____ >

Solute Analysis (Water)

Units Used M341 < _____ >

Li	M30	< _____ >	Mg	M70	< _____ >	Cu	M360	< _____ >	F	M90	< _____ >
Na	M40	< _____ >	Ca	M60	< _____ >	Zn	M390	< _____ >	Cl	M80	< _____ >
K	M50	< _____ >	Sr	M380	< _____ >	Hg	M440	< _____ >	Br	M350	< _____ >
Rb	M480	< _____ >	Ba	M330	< _____ >	B	M120	< _____ >	I	M490	< _____ >
Cs	M500	< _____ >	Ca+Mg	M180	< _____ >	HBO ₂	M170	< _____ >	O ₂	M610	< _____ >
Na+K	M300	< _____ >	Mn+3	M630	< _____ >	Al	M310	< _____ >	N ₂	M530	< _____ >
NH ₄	M150	< _____ >	Mn (TOT)	M520	< _____ >	Pb	M370	< _____ >	CO ₂	M570	< _____ >
NO ₃	M590	< _____ >	Fe+3	M620	< _____ >	As	M320	< _____ >	SO ₂	M540	< _____ >
PO ₄	M600	< _____ >	Fe (TOT)	M510	< _____ >	Sb	M470	< _____ >	H ₂ S	M160	< _____ >
SiO ₂	M130	< _____ >				U	M450	< _____ >	H ₂	M550	< _____ >
SO ₄	M110	< _____ >							CH ₄	M560	< _____ >
CO ₃	M580	< _____ >									
HCO ₃	M140	< _____ >									

Rare Earths Analyzed M750 < _____ >
 Actinides Analyzed M760 < _____ >
 Rare Gases Analyzed M770 < _____ >
 Other Solutes & Gases M780 < _____ >

Comments M800 < _____ >
 _____ >

Condensate Analysis

Analysis Date

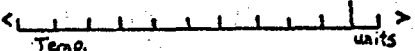
A32 < C >

S70 < _____ >

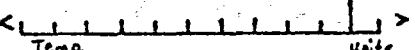
Analyst(s)

S80 < _____ >

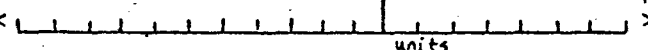
pH 1)

N191 < _____ > At N191A <  >

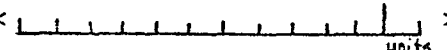
2)

S100 < _____ > At S100A <  >

Eh

S110 <  >

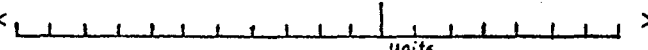
Temperature

S130 <  >

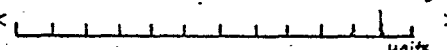
Specific Gravity

S140 < _____ >

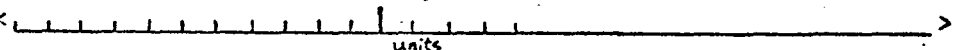
Specific Conductance

S150 <  >

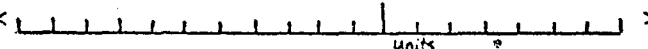
Temperature

S160 <  >

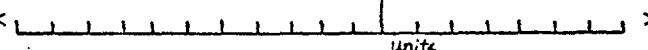
Alkalinity

S170 <  >

Total Dissolved Solids

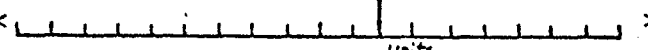
S180 <  >

Total Suspended Solids

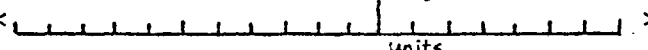
S190 <  >

Isotopic Data

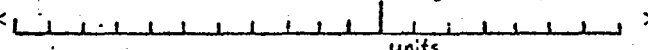
Del O (18) of Water

Q260 <  >

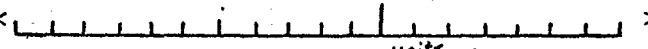
Del D of Water

Q240 <  >

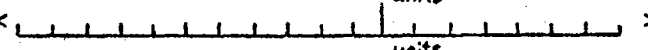
Del C (13) of Dissolved CO₂

S220 <  >

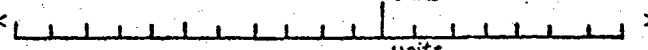
Del O (18) of Dissolved SO₄

S230 <  >

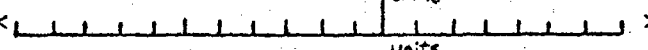
Del S (34) of Dissolved SO₄

S240 <  >

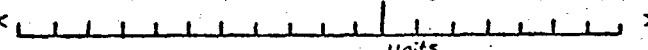
Del S (34) of Dissolved H₂S

S250 <  >

Tritium Content of Water

S260 <  >

C(14) Content of CO₂

S270 <  >

Other

S280 < _____ >

Solute Analysis (Condensate)

Units Used T500 < _____ >

Li	T10	< _____ >	Mg	T140	< _____ >	Cu	T230	< _____ >	F	T330	< _____ >
Na	T20	< _____ >	Ca	T150	< _____ >	Zn	T240	< _____ >	Cl	T340	< _____ >
K	T30	< _____ >	Sr	T160	< _____ >	Hg	T250	< _____ >	Br	T350	< _____ >
Rb	T40	< _____ >	Ba	T170	< _____ >	B	T260	< _____ >	I	T360	< _____ >
Cs	T50	< _____ >	Ca+Mg	T180	< _____ >	HBO ₂	T270	< _____ >	O ₂	T370	< _____ >
Na+K	T60	< _____ >	Mn+3	T190	< _____ >	Al	T286	< _____ >	N ₂	T380	< _____ >
NH ₄	T70	< _____ >	Mn(TOT)	T200	< _____ >	Pb	T290	< _____ >	CO ₂	T390	< _____ >
NO ₃	T80	< _____ >	Fe+3	T210	< _____ >	As	T300	< _____ >	SO ₂	T400	< _____ >
PO ₄	T90	< _____ >	Fe(TOT)	T220	< _____ >	Sb	T310	< _____ >	H ₂ S	T410	< _____ >
SiO ₂	T100	< _____ >				U	T320	< _____ >	H ₂	T420	< _____ >
SO ₄	T110	< _____ >							CH ₄	T430	< _____ >
CO ₃	T120	< _____ >									
HCO ₃	T130	< _____ >									

Rare Earths Analyzed T440 < _____ >

Actinides Analyzed T450 < _____ >

Rare Gases Analyzed T460 < _____ >

Other Solutes & Gases T470 < _____ >

_____ >

Comments T490 < _____ >

_____ >

Gas Analysis

A33 < G >

Analysis Date U10 < _____ >

Analyst(s) U20 < _____ >

Gas/H₂O Ratio (mol/mol) U30 < _____ >

Units Used N230 < _____ >

CO₂ N80 < _____ > H₂ N120 < _____ > Ar N183 < _____ >

H₂S N90 < _____ > CH₄ N130 < _____ > Rn N110 < _____ >

N₂ NI40 < _____ > C₂H₆ N182 < _____ > Hg N160 < _____ >

O₂ N150 < _____ > He N170 < _____ >

Other Hydrocarbons U40 < _____ >

Other U50 < _____ >

Isotopic Data

Del C (13) of CO₂ U60 < _____ units _____ >

C(14) Content of CO₂ U70 < _____ units _____ >

Del C (13) of CH₄ Q170 < _____ units _____ >

Del D of CH₄ U90 < _____ units _____ >

Del D of H₂ Q220 < _____ units _____ >

Del S (34) of H₂S U110 < _____ units _____ >

Ratio Ar(40)/Ar(36) Q290 < _____ >

Other U130 < _____ >

Comments U140 < _____ >

GEOHERMAL RESOURCES FILE (GEOHERM)

SECTION C - Geothermal Well/Drill Hole

Record Identification

Record No. A10 < _____ >
 Cross Index No. A20 < _____ >
 Record Type A30 < ___ >

Reporter

Name A50 < _____ >
 Date A60 < / >
Yr. Mo.
 Organization A70 < _____ >

Location

Geothermal Field B10 < _____ >
 GRA B11 < _____ >
 PI No. B12 < _____ >
 Well name B30 < _____ >
 Company B35 < _____ >
 Country Code B40 < >
 Country B50 < _____ >
 State B60 < _____ >
 County B65 < _____ >
 Latitude B70 < - - >
D M N/S
 Longitude B80 < - - >
D M E/W
 Township, Range, Section, $\frac{1}{4}$, $\frac{3}{4}$

B95 < > B105 < > B115 < >
TOWNSHIP RANGE SECTION 1/4 3/4

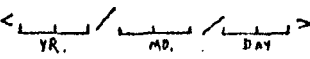
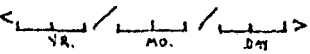
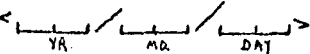
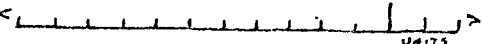
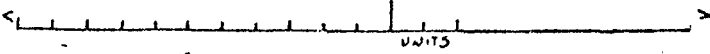
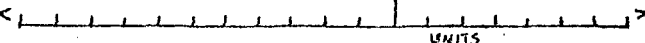
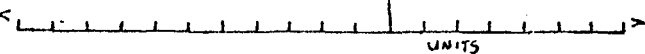
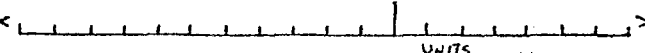
Base & Meridian B125 < _____ >

UTM Coordinate System

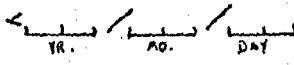
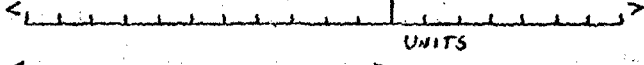
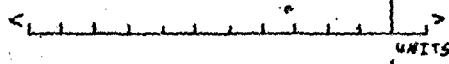
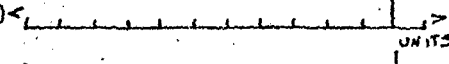
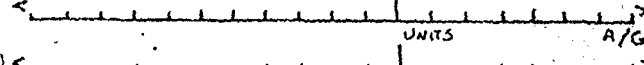
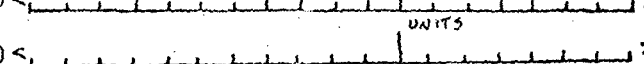
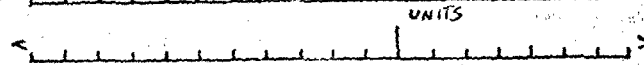
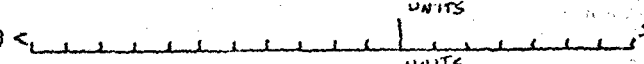

Northing B120 < _____ >
 Easting B110 < _____ >
 UTM Zone No. B130 < _____ >
 Map Reference B82 < _____ >

Other Locality Information B83 < _____ >
 _____ >

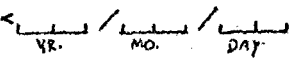
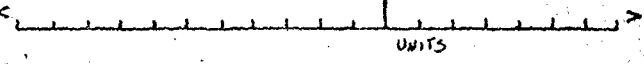
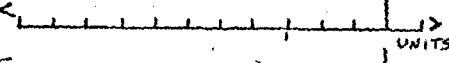
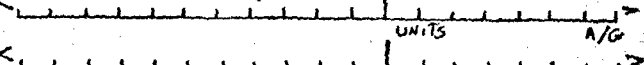
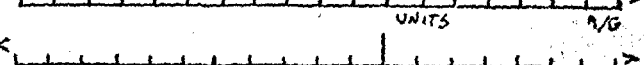

Drilling & Casing

Date Started	D11 <  >
Date Completed	D12 <  >
Date Abandoned	D13 <  >
Well Status	D10 < _____ >
Total Depth	D20 <  >
Elevation	B150 <  >
Casing	D45 < _____ >
<hr/>	
Producing Interval	D40 < _____ >
Water Level	D25 <  >
Drawdown	D26 <  >
Porosity	D27 < _____ >
Permeability	D28 <  >
Well Log Information	D29 < _____ >
<hr/>	
Comments	C230 < _____ >
<hr/>	

Logging & Completion Data

Production Type L61 < DRY STEAM HOT WATER >
 Measurements From L62 < INITIAL TEST SUBSEQUENT TEST >
 Date L63 <  >
 Flow Rate L64 <  >
 Orifice Plate Size D90 < _____ >
 Steam Quality D190 < _____ >
 Wellhead Temperature L65 <  >
 Bottom Hole Temperature D130 <  >
 Wellhead Pressure L67 <  >
 Enthalpy Of Steam D230 <  >
 Enthalpy Of Brine D240 <  >
 Enthalpy Of Total L66 <  >
 Production Rate D140 <  >
 Comments L68 < _____ >

Well Stem Test

Date L20 <  >
 Interval L25 < _____ >
 Flow Rate L26 <  >
 Fluid Recovery L27 < _____ >
 Fluid Temperature L40 <  >
 Final Flow Pressure L41 <  >
 Final Shut-in Pressure L42 <  >
 Final Hydrostatic Press. L43 <  >
 Comments L44 < _____ >

Primary Reference

Author K20 < _____ >
Date K30 < _____ >
Title K40 < _____ >
Reference K50 < _____ >
_____ >

Number References

1) K70 < _____ >

_____ >
2) K80 < _____ >

_____ >

GIPSY

The General Information Processing System (GIPSY), developed by the University of Oklahoma, is used for the storage and retrieval of GEOTHERM data. The GIPSY program provides for easy access to the file by a set of simple user commands. A retrieval setup consists of job control language (JCL) and GIPSY retrieval cards. The JCL needed to make a retrieval from GEOTHERM is listed in figure 4. The retrieval cards, which follow the JCL cards, contain the user commands and command parameters relating to a specific retrieval.

GIPSY commands are user-oriented so that no prior computer experience is necessary to make a retrieval. With a set of eight commands, the user can select, sort, and output information from the file. A successful retrieval can best be accomplished by using the following questions as a check list.

What kind of data is desired (e.g., geochemical, wells, or fields)?

Should the data be restricted by geographic locality, temperature, chemical constituents, etc.?

Should the data be sorted?

What data items are desired for output (all or a partial list of items)?

How should the output be organized (entire records, tables, lists, etc.)?

```
//      Job Card
//A EXEC QUESTRAN,DNAME=`A93400.AZ231.WG9B200.GEOD`,DVOL=CCD915,
//      DUNIT=3330,RNAME=`RIF.W0020.THERM1`,RVOL=CCD921,
//      UNIT=3330,CLOCK=15,SPACE=800,RGN=110K
//QUESTRAN.SYSRDR DD *
FORM
      GEOTHERM
      - GIPSY retrieval cards -

/*
//
```

Figure 4.--Job control language

The answers to these questions are important in formulating a search strategy and assembling a set of GIPSY retrieval cards.

The retrieval cards are a sequence of GIPSY commands and conditions. A command always begins in the first column of the computer card. Parameter statements that follow each command begin in Column 2. For example, the SELECT command is followed by parameter statements which define and list criteria for selection. The most common commands, and the function they perform, are listed in figure 5.

GIPSY Commands

FUNCTION

SELECT

ITERATE

BACK

SORT

SUM

PRINT LINESIZE=120

LIST

COPY

Search/Retrieval

Processing

Output

Figure 5.--GIPSY commands

The designators (A, B) are unique single alphabetic characters used to identify one characteristic in one search. Up to 26 designators can be listed for each use of the SELECT command. Following the designators are the data labels (B40, A30). These unique labels identify the data items of the file (see input forms for subtopics in figures 1-3).

"B40" is associated with country code and "A30" is associated with record type. Following the labels are restrictions which the user can impose. The first conditions (<US>) indicates that the country code, "US," is a factor in the search. The brackets (< >) enclose character strings. A list of variable description formats and options are illustrated in figure 6.

Logic Statement - The logic statement is the key to the search procedure. It links the variable descriptions using the boolean operators, "AND," "OR," and "NOT" (the symbols * (AND), + (OR), - (NOT) can be used also). In the example, both characteristics (i.e., geothermal field records from the United States) are required.

The logic statement is:

LOGIC A AND B

- A. A30
 - B. A30<~~BA~~>
 - C. A30<A>
 - D. A30<~~A~~>
 - E. A30<A>
 - F. A30<~~BA~~> THRU <~~BC~~>
 - G. A30<~~20~~>
 - H. A30.EQ 20
 - I. A30 GT 20
 - J. A30 LT 20
 - K. A30 10 THRU 20
 - L. A30 EQ A20
 - M. A30 LT A20
 - N. A30 GT A20
- A. Use only the label by itself when it is desired to select on existence (presence) of a data item. For example, the user may want to select analysis records only if they contain temperature data.
- B. This setup means the user wants any data with the word "~~BA~~" (a word is defined as a string of one or more characters or numbers bounded by blanks).
- C. This setup requires only the existence of the letter "A." All words that contain the letter "A" will be selected.

Figure 6.--Variable description formats and options.

- D. Use this setup for the prefix, "A." Records with "around" or "about" will be selected but not "Canada."
- E. Use to find the suffix, "A." Records with "Canada" or "Nevada" would be selected but not "average."
- F. The user can retrieve on a range of letters. In this example, the words "A," "B," and "C" will be retrieved.
- G. In this example, the character value of "20" would be selected. The string, "20.0," would not be selected.
- H. The numeric value, 20, would be selected whether it was 20.0, 020, or 20.
- I. Records with a numeric value greater than (GT) 20 will be selected.
- J. Records with a numeric value less than (LT) 20 will be selected.
- K. The user can select a range of numbers. In this case, all records with value of 10 through 20.
- L-N. Numbers under two labels can be compared. In these cases, the numeric values in labels A20 and A30 are compared. (EQ = equal, LT = less than, GT = greater than.)

Figure 6.--(cont'd)

Another logic statement could have been used with the same variable descriptions to select a different subset.

For example:

LOGIC A AND NOT B

This example would retrieve records from the United States but not if they were geothermal field records.

Parentheses may be used as in mathematical equations to eliminate ambiguities.

LOGIC A OR B AND C

LOGIC A OR (B AND C)

ITERATE.--The ITERATE command performs a function similar to the SELECT command. When the SELECT command is invoked the entire file is searched and all previous subsets are deleted. The ITERATE command is used to search a previously selected subset. The SELECT command produces a subset 1. The ITERATE command will often follow the SELECT command and it is used to search subset 1. The resultant subset is subset 2 which in turn can be searched using the ITERATE command a second time. These subsets are deleted when (1) the job is finished (2) the SELECT command is used again (3) the BACK command is used. The ITERATE command is used like the SELECT command and contains the same variable description and logic statements. For use of the ITERATE command see examples 2 and 3.

BACK.--The BACK command is used to return to a previously selected subset. That subset can be either searched with the ITERATE command or it can be sorted, printed, etc.

BACK

2

ITERATE

In this example, the user returns to subset 2 and then searches it. Subsets 3 and greater are deleted but subset 1 is still retained. The resultant subset in this case would be a new subset 3. See example 3 for use of the BACK command.

SORT.--The SORT or SORTD (descending sort) command is optional. Records can be sorted by any information item and the sorts can be nested.

SORT

B60 10

M130 5.2

The parameter-statements consist of a list of the sort fields and the number of characters involved in the sort. In the example, B60 and M130 refer to state and silica content respectively. The subset is first sorted on the first ten characters of state. The secondary sort is on silica content and is ordered numerically for five digits with two decimal places. See example 2 for use of the SORT command.

SUM.--The SUM command produces the following information.

1. The number of occurrences of the item in the selected subset
2. The arithmetic mean
3. The algebraic sum
4. Maximum value
5. Minimum value

This operation ignores text. The parameter statements consist of a list of the items to be processed.

SUM

M130

M40

This example would perform the SUM procedure for silica content (M130) and sodium content (M40) for the selected subset. See example 4 for use of the SUM command.

PRINT LINESIZE=120.--The PRINT command instructs the system to print the records from the selected subset. No parameter statements are required. Each record begins at the top of a computer page. The NOPAGE option which prevents beginning a new page for each record can be added.

```
PRINT LINESIZE=120  NOPAGE
```

See example 2 for use of the PRINT command.

LIST.--Sometimes the user only wishes to see a few data items. The LIST command is used to print designated portions of the selected records. The items are printed in their entirety and are continued on subsequent lines if there is an overflow. The parameters are a list of the data items to be printed.

```
LIST
```

```
M130
```

```
M40
```

```
M30
```

See example 3 for use of the LIST command.

COPY.--The COPY command is probably the most useful output command. Fixed-length records can be produced from GEOTHERM with this command. The system, therefore, has a report generating capability which can produce tables or formatted records for user-written processing programs. The COPY command is used in example 3.

Copy to Printer - The user may wish to produce tables from a subset of GEOTHERM records. The parameter statements that follow the command consist of a list of data items and character strings to be included in the table. A line is printed for each record of the subset. The parameter statements consist of the following types.

A10 x In this case the first "x" number of characters from A10 will be printed. Blanks are inserted if there is no data.

A10 x.y This format causes the first number in A10 to be printed with "x" number of digits and "y" decimal places. The decimal point is assumed.

`STRING` Literal character strings can be inserted by putting the string between single quotes. This character string would be printed for every record. Maximum length is 60 characters.

The first statement after the COPY command is a literal used for carriage control on the printer. The user has three choices of spacing:

- ` ` a blank provides single spacing
- `1` double space
- `-` triple space

If one of these three cards is not entered, then the first character of each line will be truncated. If output is going to disk then this card is unnecessary.

Copy for Extended Applications - The COPY command is very useful in producing formatted subfiles for further processing. For example, silica, sodium, potassium, and calcium concentrations from chemical analysis records can be extracted, formatted, and output to cards, tape or disk. Data that is extracted can be formatted to fit the needs of the user program.

Suppose the user had a program designed to process the following data input format.

<u>Column</u>	<u>Field</u>	<u>Data type</u>	<u>Length</u>
1	Geothermal field	Character	15
16	State	Character	15
31	County	Character	15
46	Silica	Decimal	5.2
51	Sodium	Decimal	5.2
56	Potassium	Decimal	5.2
61	Calcium	Decimal	5.2

The COPY output would be the following:

COPY

B10 15

B60 15

B65 15

M130 5.2

M30 5.2

M60 5.2

With the addition of one job control statement this data could go to cards, tape or temporary disk space. The extra statement would be inserted just before //QUESTRAN.SYSRDR DD*. This extra JCL card for each output is listed below:

Card Output

```
//QUESTRAN.SYSWRKO DD SYSOUT=B,DCB=(RECFM=FA,LRECL=80,BLKSIZE=80)
```

Temporary disk output

```
//QUESTRAN.SYSWRKO DD DSN=&&TEMP,UNIT=SYSDK,DISP=(MOD,PASS),  
// DCB=(RECFM=FB,LRECL=XX,BLKSIZE=XX),  
// SPACE=(CYL,(6,1),RLSE)
```

This example would create a data set (&&TEMP) on a system disk pack. The LRECL (record length) and BLKSIZE (block size) will vary with the total length issued from the COPY command. This GIPSY procedure could be followed by a program written in PL/1, FORTRAN, etc.

Tape Output

```
//QUESTRAN.SYSWRKO DD DSN=myset,UNIT=TAPE9,  
//    DISP=(,KEEP),DCB=(RECFM=FB,LRECL=XX,BLKSIZE=XX),  
//    LABEL=(1,SL)
```

In this example a data set called "myset" would be created on a standard label 9-tract tape. The LRECL (record length) and BLKSIZE (block size) will vary with the total length issued from the COPY command.

References cited

University of Oklahoma, 1975, General Information Processing System Users Guide, GIPSY documentation series, vol. 2:

University of Oklahoma, Office of Information Systems Programs.

University of Oklahoma, 1975, General Information Processing System Programmers Guide, GIPSY documentation series,

vol. 3: University of Oklahoma, Office of Information Systems Programs.

Examples

Example 1

Objective - The user wishes to get a count of chemical analysis (Analysis (A30=B) records from the states (B60) of California and Nevada with temperature (M210) greater than 35°C. In this case none of the output options will be selected.

Input setup

```
//      JCL
```

```
FORM
```

```
GEOTHERM
```

```
SELECT
```

```
A.  A30<B>
```

```
B.  B60<CALIFORNIA>
```

```
C.  B60<NEVADA>
```

```
D.  M210 GT 35
```

```
LOGIC A*(B+C)*D
```

```
/*
```

Figure 7.--Example 1

SELECT

- A. A30
RECORD TYPE.....
- B. B60<NEVADA>
STATE/PROVINCE.....
- C. B60<CALIFORNIA>
STATE/PROVINCE.....
- D. M210 GT 35
WATER SAMPLING TEMP....

LOGIC A*(B+C)*D

SEARCH

20:23:41.2 SEARCH BEGINNING
20:23:49.7 SEARCH COMPLETED

SEARCHED 1850

SELECTED 416 SUBSET 1

VARIABLES SATISFIED

A 1389

B 386

C 732

D 652

Example 2

Objective - The user wishes to select all records from the United States and then search that subset for Arizona records. The selected records are to be sorted by county (B65) and geothermal field (B10) and then are to be printed.

Input setup

```
//      JCL  
  
FORM  
  
GEO THERM  
  
SELECT  
  
A.  B40<US>  
  
LOGIC A  
  
ITERATE  
  
A.  B60<ARIZONA>  
  
LOGIC A  
  
PRINT LINESIZE=120  
  
/*
```

Note: It would actually be easier in this particular example to ask for the Arizona records directly. However, by selecting the U.S. records, the user has a smaller subset to deal with. Thus, another ITERATE command on the U.S. records could have followed the first. Search time and cost would be lower because the U.S. subset is searched instead of the entire file.

Figure 8.--Example 2

SFLECT

A. 840<US>
COUNTRY CODE.....

LOGIC A

SEARCH
23:23:49.8 SEARCH BEGINNING
20:24:06.0 SEARCH COMPLETED

SEARCHED 1860

SELECTED 1495 SUBSET 1

VARIABLES SATISFIED

A 1495

ITERATE

A. 860<ARIZONA>
STATE/PROVINCE.....

LOGIC A

SEARCH
23:24:06.2 SEARCH BEGINNING
20:24:17.1 SEARCH COMPLETED

SEARCHED 1495

SELECTED 11 SUBSET 2

VARIABLES SATISFIED

A 11

SORT

865 15

810 15
END OF SORT

PRINT LINESIZE=120

GEOHERMAL RESOURCES FILE (GEOHERM) REVISION 8

SECTION A.-- GEOHERMAL FIELD-AREA

RECORD IDENTIFICATION

RECORD NO..... 0000256
 CROSS INDEX NO.. CF0281
 RECORD TYPE..... A
 NAME..... J. RENNER
 DATE..... 75/05
 ORGANIZATION.. U.S.G.S.

GEOGRAPHIC LOCALITY

GEOHERMAL FIELD-AREA.. POWER RANCHES INC. WELLS
 COUNTRY CODE..... US
 STATE/PROVINCE..... ARIZONA
 LATITUDE..... 33-17-06N
 COUNTRY NAME..... UNITED STATES
 LONGITUDE..... 111-41-12W

TOWNSHIP RANGE SECTION 1/4 1/4
 02S 06E 1 SW

BASE & MERIDIAN..... GILA & SALT RIVER
 AVAILABLE MAPS OF AREA: HIGLEY 1:24,000

GENERAL DESCRIPTION

ELEVATION..... 408.43 M 1340. FT
 RESOURCE CATEGORY..... 'B'
 PRESENT USE & DEVELOPMENTS: 2 WELLS OF ABOUT 3KM DEPTH
 SURFACE THERMAL ACTIVITY..... FOUND BY DRILLING
 NO. OF HOT SPRINGS.....

GEOHERMAL CHARACTERISTICS

NATURAL SURFACE DISCHARGE..... 316.65 L/S 1.9000E+04 L/MIN ESTIMATED
 WELL INFORMATION
 MAXIMUM WELL TEMPERATURE..... 184. C TO 3200. M
 BOTTOM-HOLE TEMPERATURE..... 184.0 C TO 3200.00 M

RESERVOIR PROPERTIES

RESERVOIR TEMPERATURES..... 163. C TO 184. C MEASURED
 BEST ESTIMATE..... 160.0 C
 SUBSURFACE AREA..... 1.0 KM**2 TO 5.0 KM**2
 BEST ESTIMATE..... 2.5 KM**2
 BASED ON: DRILLING
 DEPTH TO TOP OF RESERVOIR.....
 BEST ESTIMATE..... 2000.00 M 2.000 KM
 DEPTH TO BOTTOM OF RESERVOIR.. 3000.00 M 3.000 KM TO 3000.00 M 3.000 KM
 BEST ESTIMATE..... 3000.00 M 3.000 KM
 THICKNESS OF RESERVOIR.....
 BEST ESTIMATE..... 1000.00 M 1.000 KM
 VOLUME OF RESERVOIR.....
 BEST ESTIMATE..... 2.500 KM**3
 COMMENTS: DEPTH TO BOTTOM OF RESERVOIR IS ASSUMED.

RESERVES

TOTAL STORED HEAT.....
 BEST ESTIMATE..... 8.3716E+17 J 1.9999E+17 CAL ABOVE 15. C

Figure 8.--Example 2 (cont'd)

PAGE 0002

GEOLOGY

GENERAL ROCK TYPES: VOLCANICS (AGE?)

PRIMARY REFERENCE:

AUTHOR..... D.E. WHITE & D.L. WILLIAMS, EDITORS
DATE..... 1975
TITLE..... ASSESSMENT OF GEOTHERMAL RESOURCES OF THE UNITED STATES - 1975
REFERENCE... U.S.G.S. CIRCULAR 726

RELATED REFERENCES:

1) PERS. COMM. MR MIKE O DONNELL & MR. WARD AUSTIN OF GEOTHERMAL KINETICS

Example 3

- Objectives:
- 1) Select U.S. records.
 - 2) Use the LIST command to print sample source (B20), temperature (M210), sodium (M40), potassium (M50), calcium (M60), and silica (M130).
 - 3) Search the U.S. subset and select chemical analyses records from Nevada.
 - 4) Produce a tabular format of the Nevada records including the same data elements from the LIST command.

In order to illustrate the BACK command in this example, the Nevada records will be selected from the U.S. subset and output in tabular form. The U.S. subset is then called back to be listed.

Input setup

```
//      JCL
FORM
GEO THERM
SELECT
A. B40<US>
LOGIC A
ITERATE
A. B60<NEVADA>
B. A30<B>
LOGIC A*B
```


COPY

B20 20

M210 14

M40 7

M50 7

M60 7

M130 7

BACK

1

LIST

B20

M210

M40

M50

M60

M130

Figure 9.--Example 3

SELECT

A. R40<US>
COUNTRY CODE.....

LOGIC A
SEARCH
20:24:51.1 SEARCH BEGINNING
20:24:56.5 SEARCH COMPLETED

SEARCHED 1860
SELECTED 1495 SUBSET 1
VARIABLES SATISFIED
A 1495

ITERATE

A. B60<NEVADA>
STATE/PROVINCE.....

B. A30<R>
RECORD TYPE.....

LOGIC A*B
SEARCH
20:24:56.7 SEARCH BEGINNING
20:25:22.9 SEARCH COMPLETED

SEARCHED 1495
SELECTED 340 SUBSET 2
VARIABLES SATISFIED
A 386
B 1203

COPY

..

R20 20

..

M210 14

M40 7

..

M50 7

..

Figure 9.--Example 3 (cont'd)

M60 7

• •

M130 7

BACK

1

LIST

320

M210

M40

M50

M60

M130

Figure 9.--Example 3 (cont'd)

	90.0	C	160.00	16.00	12.00	165.00
	90.0	C	1000.00	48.00	82.00	160.00
	95.0	C	110.00	2.60	1.30	98.00
						242.00
CARSON (SHAW) HOT SP	44.	C	85.9		10.9	44
MAIN GEYSER	BOILING				TRACE	418
SPRING 21-N			744	77	6	343
	95.6	C				
SPRING 8			682	103	6.8	311
			806	77	13	205
	85.	C	866	108	7	325
POWER'S MANSION, NEV	48:	C	37.8	5.7	6.7	44
SOUTH STEAMBOAT WELL	WARM		66	8.2		
SS-5	52.	C			15	
SS-5	97.	C			5.9	
SPRING 247			753	78	11	335
	97.	C				
UNNAMED HOT SPRING N						
MONTE NEVA						
UNNAMED HOT SPRING (
POWER'S HOT SPRING						
UNNAMED HOT SPRING N						
SHALLOW RESEARCH WEL						
UNNAMED HOT SPRING N			774.3	66.9	30	278.8
SMALL GEYSER			741	91	6	271
ALKALI SPRINGS	49-60.	C	282		46	42
ALKALI SPRINGS	60.	C	282		46	42
SPRING	77.	C	130.95	53.38	100.3	133.4
SMALL GEYSER	BOILING		239	33	2	449
LAS VEGAS SPRINGS	41.	C			56	13
STAVILLE WARM SPRIN			295	17	44	43
MELVIN HOT SPRINGS (	79.	C			57	54
WELL NEAR HOT SPRING	98.	C			37	
GEYSER RANCH SPRINGS	18-21.	C			44	11
HIND SPRING					52	35
PANACA WARM SPRING	29-31.	C			40	46
SHALLOW RESEARCH WEL						
UNNAMED HOT SPRING (	61.	C	300	31	75	105
"STEAM" WELL			250	38	1.3	500
	77.	C	540	80	95	150
	92.	C	160	13	8.8	135
UNNAMED HOT SPRING	29.	C	180	20	36	110
FLOWING WELL IN STILL	72.	C	1480	42	108	170
	97.	C	277	15	38	115
	88.	C	450	26	44	180
UNNAMED HOT SPRING	86.	C	170	8.4	4.8	110
	54.	C	81	1.0	.2	57
FLOWING WELL NEAR 'GE	80.	C	340	17	31	82
	86.	C	463	9.3	25	85
	56.	C	120	39	60	65
UNNAMED HOT SPRING	79.	C	45	16	60	70
	90.	C	390	41	49	84
	54.	C	230	58	53	67
	72.	C	44	14	56	68
	72.	C	200	36	43	77
	58.	C	288	33	29	80
	49.	C	250	34	45	80
	74.	C	130	22	33	66
	73.	C	165	26	110	65

Figure 10.--Example 4

SELECT

A. R50<NEVADA>
STATE/PROVINCE.....

B. A30<R>
RECORD TYPE.....

LOGIC A*B
SEARCH
23:35:29.9 SEARCH BEGINNING
20:35:41.6 SEARCH COMPLETED

SEARCHED 1860
SELECTED 340 SUBSET 1

VARIABLES SATISFIED

A 386

B 1399

SUM

LABEL	(N)	SUM
M210	234	15,768.5
M40	290	103,941.72
M50	275	9,575.67
M60	273	10,226.1
M130	260	30,768.65

AVE
67.38675
358.41972
34.82061
37.45824
118.34096

MAX
186
1,510
160
412
534

MIN
3
1.73
0.18
0
4.7

G I P S Y - UNIVERSITY OF OKLAHOMA 8:35 P.M. TUESDAY MARCH 8, 1977