SELECTED DATA FOR HYDROTHERMAL CONVECTION SYSTEMS IN THE UNITED STATES WITH ESTIMATED TEMPERATURES $\geq 90^\circ$C:
BACK-UP DATA FOR U.S. GEOLOGICAL SURVEY CIRCULAR 790

By

R.H. Mariner, C.A. Brook
J.R. Swanson, and D.R. Mabey

Open-File Report 78-858

This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards and nomenclature

Menlo Park, California
December, 1978
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Explanation of data sheets</td>
<td>1</td>
</tr>
<tr>
<td>Data sheets</td>
<td>9</td>
</tr>
<tr>
<td>Alaska</td>
<td>11</td>
</tr>
<tr>
<td>Arizona</td>
<td>69</td>
</tr>
<tr>
<td>California</td>
<td>81</td>
</tr>
<tr>
<td>Colorado</td>
<td>161</td>
</tr>
<tr>
<td>Hawaii</td>
<td>185</td>
</tr>
<tr>
<td>Idaho</td>
<td>193</td>
</tr>
<tr>
<td>Montana</td>
<td>267</td>
</tr>
<tr>
<td>Nevada</td>
<td>285</td>
</tr>
<tr>
<td>New Mexico</td>
<td>369</td>
</tr>
<tr>
<td>Oregon</td>
<td>383</td>
</tr>
<tr>
<td>Utah</td>
<td>441</td>
</tr>
<tr>
<td>Washington</td>
<td>457</td>
</tr>
<tr>
<td>Wyoming</td>
<td>465</td>
</tr>
<tr>
<td>References</td>
<td>475</td>
</tr>
</tbody>
</table>
INTRODUCTION

This report presents a compilation of data used by Brook and others (1979) in determining the accessible resource base for identified hydrothermal convection systems > 90°C in the United States (U.S. Geological Survey Circular 790, Assessment of Geothermal Resources of the United States — 1978). Geographic, geologic, chemical, isotopic, volumetric, and bibliographic data and calculated thermal energy contents are listed for all vapor-dominated and hot-water systems with estimated reservoir temperatures > 90°C and reservoir depths less than 3 km known to the authors in mid 1978. Systems with lower temperatures are discussed by Sammel (1979) in Circular 790. Much of the data is the same as that presented by Renner and others (1976), but numerous revisions have been made and additional information has been added to update the data base. Data presented here is stored in the U.S. Geological Survey's geothermal computer file GEOTHERM (Swanson, 1977).

Data for individual hydrothermal convection systems in each State are arranged geographically from north to south and west to east without regard to the type or temperature of the system. Locations of the systems and corresponding reference numbers are shown on map 1 accompanying U.S. Geological Survey Circular 790. All references are listed in a single bibliography at the end of this report.

EXPLANATION OF THE DATA SHEETS

The various entries contained in the data sheets are generally self-explanatory. Scientific notation is used throughout the report and is symbolized as follows: \( \text{km}^2 = \text{km}^2 \); \( \text{km}^3 = \text{km}^3 \); and \( 10^{18} = 10^{18} \). All temperatures are in degrees Celsius (°C). Individual entries are discussed below. Only entries containing information are displayed.

Field Name. — Either the name of the geothermal field, the principal hot spring, or a nearby geographic feature which identifies the hydrothermal convection system. Names are taken from published literature and topographic maps. Alternate names are given in parenthesis.

KGRA or Other Name. — The name of the KGRA (Known Geothermal Resources Area) which includes the hydrothermal convection system, or other names which have been used for the system.
Circular Reference. — An arbitrary number assigned to the system for bookkeeping and map location purposes. The circular reference corresponds to the number assigned to each system listed by Brook and others (1979) in Circular 790.

Geographic Locality

The geographic location of the spring, well, or field is given by state, county, latitude, longitude, the most detailed topographic map covering the area, township, range, section, quarter section, and the reference base and meridian. Longitude and latitude locations are given to the nearest tenth of a minute.

General Information

Waring Number. — and Waring Figure. — The figure and spring or well number assigned to the system by Waring (1965).

Elevation. — Surface elevations were taken from USGS topographic maps and converted to meters from feet by multiplying by 0.3048.

Area of surface expression. — Areal extent of hot springs, hot spring deposits, or surface alteration are given in square kilometers (km**2). This area is not the result of geophysical measurements. Areas are not reported for single springs or wells or where the data is insufficient to indicate areal extent.

Surface activity. — The type of surface activity related to the geothermal system: hot springs, geysers, fumaroles, and acid-sulfate springs.

Associated deposits. — Lists the deposits associated with the spring or occurring in the area: usually travertine or sinter.

Number of springs. —, Spring temperature. —, and Discharge (L/MIN). —The number of thermal springs issuing in a system, their reported range of temperatures (in °C), and the total discharge (liters per minute) of all the thermal springs and wells in the system.

Number of wells. —, Well depths. —, and Maximum well temperature (°C). —These items list the number of thermal wells and their depths in meters. The maximum well temperature (in °C) includes the depth at which the maximum temperature was encountered if this depth differs from the maximum depth of the well.

Rock types. — The dominant rock types in the area.

Geophysics. — The types of geophysical information available in the area.
Chemistry

This section includes the sample source, collection date, chemical composition, isotopic composition, and discharge rate of the sampled spring or well. Chemical compositions are in milligrams per liter. Isotopic compositions for the water and the dissolved sulfate are expressed in the \( \delta \) notation (listed as DEL in the tables):

\[
\delta = \frac{R_X - R_{\text{std}}}{R_{\text{std}}} \times 10^3, \tag{1}
\]

where \( R_X = (D/H)_X \) or \( \frac{^{18}O}{^{16}O}_X \) of the sample and \( R_{\text{std}} \) is the corresponding ratio for Standard Mean Ocean Water (SMOW). Total alkalinity is reported as bicarbonate \( (\text{HCO}_3^-) \) or distributed as carbonate \( (\text{CO}_3^-) \) and bicarbonate \( (\text{HCO}_3^-) \) at the spring temperature and pH. Appreciable noncarbonate alkalinity is present in some of the high pH waters.

Geothermometers

The silica and cation geothermometers are calculated from equations given in Fournier (1975). The geothermal equations have all been derived using molal concentrations. However, chemical analyses are generally reported in terms of milligrams per liter which is a molarity concentration. The difference between molarity (moles of solute per 1000 milliliters of solution) is insignificant except in brines and was ignored. Molarity units (mg/L and moles/L) were used in the silica and cation geothermometers, respectively. Equations for the individual geothermometers are listed below:

Cation Geothermometers

**Na-K-Ca geothermometer**

\[
t_{\text{OC}} = \frac{1647}{\log (\text{Na/K}) + \beta \log (\sqrt{\text{Ca/Na}}) - 2.24}, \tag{2}
\]

where \( \beta = 1/3 \) for water equilibrated above 100°C, and \( \beta = 4/3 \) for water equilibrated below 100°C.
Na-K geothermometer

\[ t_{OC} = \frac{777}{0.47 + \log (\text{Na/K})} - 273.15 \]  \hspace{1cm} (3)

Silica Geothermometers

Quartz adiabatic

\[ t_{OC} = \frac{1522}{5.75 - \log \text{SiO}_2} - 273.15 \]  \hspace{1cm} (4)

Quartz conductive

\[ t_{OC} = \frac{1309}{5.19 - \log \text{SiO}_2} - 273.15 \]  \hspace{1cm} (5)

Chalcedony

\[ t_{OC} = \frac{1032}{4.69 - \log \text{SiO}_2} - 273.15 \]  \hspace{1cm} (6)

Alpha-cristobalite

\[ t_{OC} = \frac{1000}{4.78 - \log \text{SiO}_2} - 273.15 \]  \hspace{1cm} (7)

Opal (i.e. amorphous-silica)

\[ t_{OC} = \frac{731}{4.52 - \log \text{SiO}_2} - 273.15 \]  \hspace{1cm} (8)
Sulfate-Water Isotope Geothermometers

The equations for the sulfate-water isotope geothermometers are discussed in some detail by McKenzie and Truesdell (1977). The calculations were carried out using the following equations:

\[
\alpha_{SO_4-H_2O} = \frac{1000 + \delta^{18}O_{SO_4}}{1000 + \delta^{18}O_{H_2O}}
\]

and

\[
1000 \ln \alpha_{SO_4-H_2O} = \left( \frac{288 \times 10^6}{T^2} \right) - 4.1
\]

where \( T \) is in Kelvin (K).

Conductive heat loss

Conductive heat loss was assumed in nonboiling springs and total condensed samples from steam wells. Temperatures may be calculated for these systems by using equations (9) and (10).

One-step steam loss

One-step steam loss occurs in geysers and steam wells with two phase (steam-water) discharge where only the water fraction is sampled. In order to use equations (9) and (10), the oxygen isotopic composition of the reservoir water must be calculated.

The oxygen isotopic composition of the reservoir water can be calculated from the equation

\[
\frac{1000 + \delta^{18}O_{(H_2O)r}}{1000 + \delta^{18}O_{(H_2O)s}} = \eta + (1 - \eta) \frac{1}{\alpha_{lv}} \approx \alpha_{lv} \left( \eta - 1 \right)
\]
where

\[ \alpha^{18}O_{(H_2O)r} = \alpha^{18}O \text{ value of the geothermal reservoir water} \]
\[ \alpha^{18}O_{(H_2O)s} = \alpha^{18}O \text{ value of surface water} \]
\[ \eta = \text{fraction liquid} = (H_{vs} - H_{lr})/(H_{vs} - H_{ls}) \]
\[ H_{lr} = \text{enthalpy of liquid water at the reservoir temperature} \]
\[ H_{ls} = \text{enthalpy of liquid water at the spring temperature} \]
\[ H_{vs} = \text{enthalpy of steam at the spring temperature} \]
\[ l_v = (\frac{18O/16O}{18O/16O}) H_2O \text{ liquid}/(\frac{18O/16O}{18O/16O}) H_2O \text{ vapor.} \]

Values of \( \alpha_{lv} \) can be expressed over the range 3°C to 360°C by

\[ 1000 \ln \alpha_{lv} = -3.494 + 1.2051 (10^3/T) + 0.7664 (10^6/T^2), \quad (12) \]

where T is in Kelvin (K). The temperature used in equation (12) is the temperature of steam-water separation.

The value of \( \alpha^{18}O (H_2O)r \) calculated from the above equations can then be used to calculate the \( \alpha_{SO_4-H_2O} \) factor (equation 9) which is then used in the temperature dependent \( ^{18}O \) fractionation equation (10).

**Continuous steam loss**

The continuous steam-loss model should only be used in areas where steam has continuously separated from the thermal water as it rose to the surface. In such situations, fumaroles and steaming ground are physically separated from the hot springs.

The temperature of isotopic equilibrium is determined by iteration of the equations:

\[ \ln \frac{1000 + \alpha^{18}O_{(H_2O)r}}{1000 + \alpha^{18}O_{(H_2O)s}} = \int_{H_{ls}}^{H_{lr}} (1 - 1/\alpha_{lv}) \frac{dH}{H_{vs} - H}, \quad (13) \]
Reservoir Properties

This section lists values for the primary reservoir variables — temperature, area, and thickness — which are used to calculate the thermal energy content (that is, the accessible resource base) for each system. Minimum, maximum, and most likely values for each variable are a result of our judgment based on geology, geothermometry, geophysics, and (or) downhole measurements. A geothermal reservoir is a complex, heterogenous volume of rock and water. We assume that each of the values estimated for the geothermal reservoir represents an integrated value that is characteristic for the reservoir as a unit. That is, it is probable that an estimated value is no less than the minimum or no greater than the maximum when the entire reservoir is considered, even though higher or lower values, especially temperature, may be locally encountered. Minimum and maximum values thus are not total ranges of the reservoir variables. The most likely value is thought to be the most representative estimate for the entire reservoir. The mean and standard deviation (STD. DEV.) for each variable are calculated from the minimum, maximum, and most likely values.

Subsurface temperature (°C). — Each temperature estimate is coded to indicate which geothermometer or other source was used. If no code is given, the temperature was subjectively estimated considering several lines of evidence. For alkaline waters with pH of 8 and above, the quartz conductive and chalcedony geothermometers were corrected to compensate for the effects of dissociated silicic acid (see discussion in Brook and others, 1979). If the quartz or chalcedony geothermometer was reduced by 10°C or more, the pH-corrected value was either used as an estimate or recorded in the comment section. This pH correction was not used where the spring or well discharged carbon dioxide. Magnesium corrections on the Na-K-Ca geothermometer were carried out using preliminary graphs provided by R.O. Fournier. Fournier and Potter (1978) have subsequently developed an equation for the correction. Values calculated from their equation may differ slightly from those reported here.

Depth to top (km). — Depth to the top of the reservoir is based on drill data where available. Otherwise, standard estimates of 0.5, 2.0, and 1.5 km are assumed.

Thickness (km). — Thickness estimates are based on drill data where available. Otherwise, standard estimates of 1.0, 2.5, and 1.5 are assumed for the minimum, maximum, and most likely, respectively. Base depth of the reservoir is considered to be 3 km unless drill data indicate otherwise.
**Subsurface area (km²).** -- Extent of the reservoir in the subsurface within the temperature limits defined for the reservoir. The area is generally determined from various geological and geophysical data which is given on the following line. If data was not available, standard estimates of 1, 3, and 2 km² were assumed for the minimum, maximum, and most likely, respectively.

**Volume (km³).** -- Mean volume is calculated from the mean thickness and mean subsurface area. The method of calculating the standard deviation is given by Nathenson (1978).

**Thermal energy (10¹⁸ Joules).** Thermal energy (Q) of each system is calculated from the equation:

\[ Q = \rho_c \cdot V \cdot (T - T_o) \]  

(13)

where

- \(\rho_c\) = volumetric specific heat of rock plus water 
  (= 2.7 J/cm³ - °C)
- \(V\) = mean volume (converted to cm³)
- \(T\) = mean temperature (°C)
- \(T_o\) = reference temperature (15°C)

The volumetric specific heat (\(\rho_c\)) is calculated assuming the rock specific heat to be 2.5 J/cm³-°C and the reservoir porosity to be 15 percent. The method of calculating the standard deviation is given in Nathenson (1978).

**Comments**

Comments about the springs, the geothermal system, thermal wells, geothermometers, unusual chemical constituents, and other miscellaneous items.

**References**

The principal references containing data or descriptions used to prepare the data sheets.
DATA SHEETS
Alaska
## Geographical Locality

**State**: Alaska  
**Latitude**: 69°18' N  
**Longitude**: 144°02' W

**Maps**: NT. Michelson B-1 1163-350

## General Information

**Surface Activity**: Hot Spring  
**Spring Temperatures (°C)**: 48.5

## Chemistry

<table>
<thead>
<tr>
<th>Sample Source</th>
<th>Temp (°C)</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
<th>C</th>
<th>DEL O (18)</th>
<th>DEL D H₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miller</td>
<td>48.5</td>
<td>5.6</td>
<td>9.8</td>
<td>120</td>
<td>4.5</td>
<td>85</td>
<td>31</td>
<td>200</td>
<td>0.1</td>
<td>31</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**F B pH**

**Cl**

**SO₄**

**H₂O**
GEOTHERMOMETERS (C)

CATION
- \( \text{NA-K-CA (1/3)} \) ........ 133
- \( \text{NA-K-CA (4/3)} \) ........ 90
- \( \text{NA-K} \) ................. 92

SILICA
- \( \text{ADIABATIC} \) ............. 107
- \( \text{CONDUCTIVE} \) .......... 107
- \( \text{CHALCEDONY} \) .......... 78
- \( \text{CRISTOBALITE} \) .......... 57
- \( \text{opal} \) .................. -9

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
- MINIMUM ........ 78 (D)
- MAXIMUM ........ 107 (A)
- MOST LIKELY ..... 90 (I)
- MEAN ............ 92
- STD. DEV. ........ 6

UNCOOLED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, NG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
- MINIMUM ........ 0.5
- MAXIMUM ........ 2.0
- MOST LIKELY ..... 1.5
- MEAN ............ 1.7
- STD. DEV. ........ 0.3

THICKNESS (KM)
- MINIMUM ........ 1.0
- MAXIMUM ........ 2.5
- MOST LIKELY ..... 1.5
- MEAN ............ 2.0
- STD. DEV. ........ 0.4

SUBSURFACE AREA (KM**2)
- MINIMUM ........ 1
- MAXIMUM ........ 3
- MOST LIKELY ..... 2

BASED ON STANDARD ESTIMATE

VOLUME (KM**3)
- MINIMUM ........ 3.3

THermal ENERGY \( \times 10^{18} \) J.
- MINIMUM ........ 0.69

REFERENCES: MILLER, UNPUB. DATA

COMPILeD BY: BROOK, C.

OKPILAK SPRINGS, ALASKA
FIELD NAME.................. SERPENTINE SPRINGS (ARCTIC)
CIRCULAR REFERENCE........ 002

GEOPHYSICAL LOCALITY
STATE...................... ALASKA
LATITUDE.................. 65°51' N
LONGITUDE............... 164°42' W
MAPS...................... BENDLEBEN D=6, J163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05N 25W 12 KATEEL RIVER

GENERAL INFORMATION
WARING FIGURE.............. 9
WARING NUMBER.............. 4
AREA OF SURFACE EXPRESSION (KM²), 0.2
ELEVATION (M).............. 122
SURFACE ACTIVITY............ HOT SPRINGS
ASSOCIATED DEPOSITS......... SINTER, TRAVERTINE
NO. OF SPRINGS................ 2 GROUPS 0.8 KM APART
SPRING TEMPERATURES (C)..... 60 TO 77
DISCHARGE (L/MIN).......... 133
ROCK TYPES: GRANITE NEAR FAULT CONTACT WITH METASEDIMENTS

CHEMISTRY
SAMPLE SOURCE............ MILLER AND OTHERS, 1975
FLOW (L/MIN)............. 132

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>90</td>
<td>75</td>
<td>0.35</td>
<td>800</td>
<td>41</td>
<td>57</td>
<td>1.3</td>
<td>1</td>
<td>1450</td>
</tr>
</tbody>
</table>

F A PH DEL 0(18) SO₄ DEL 0(18) H₂O DEL D H₂O

7.91
GEOTHERMOMETERS (C)
CATION
NA-K-CA (1/3)............ 161
NA-K-CA (4/3)............ 151
NA-K..................... 117
SILICA
ADIABATIC................ 128
CONDUCTIVE............... 131
CHALCEDONY............... 104
CRISTOBALITE.............. 81
OPAL....................... 12

RESERVOIR PROPERTIES
SUBSURFACE TEMP (C) MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
104 (D) 161 (I) 131 (A) 132 12

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE F) CRISTOBALITE
B) QUARTZ CONDUCTIVE, PH-CORRECTED G) AMORPHOUS SILICA
C) QUARTZ ADIABATIC H) NA-K
D) CHALCEDONY I) NA-K-CA
E) CHALCEDONY, PH-CORRECTED J) NA-K-CA; MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPTH TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM**2) 1 3 2

BASIS ON STANDARD ESTIMATE

VOLUME (KM**3)............. 3.3 STD. DEV. = 0.9
THERMAL ENERGY(10**18 J) 1.05 STD. DEV. = 0.31

REFERENCES: WARING, 1917; 1965; SAINSBURY AND OTHERS, 1969; MILLER, 1973; MILLER AND OTHERS, 1975

COMPILTED BY: BHOOK, C.

SERPENTINE SPRINGS (ARCTIC) * ALASKA
FIELD NAME: PILGRIM (KRUZGAMEPA) HOT SPRINGS
KGRA OR OTHER NAME: PILGRIM SPRINGS KGRA
CIRCULAR REFERENCE: 003

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 65°06' N
LONGITUDE: 164°55' W
MAPS: BENDLEBEN A-6, 1163, 360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
04S 31W 36 SE OF SE KATEEL RIVER

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 6
AREA OF SURFACE EXPRESSION (KM²): 0.2
ELEVATION (M): 5
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (°C): 55 TO 88
DISCHARGE (L/MIN): LT 50
ROCK TYPES: QUATERNARY ALLUVIUM OVERLYING GRANITIC-METAMORPHIC COMPLEX
GEOPHYSICS: AEROMAGNETIC

CHEMISTRY
SAMPLE SOURCE: MILLER AND OTHERS, 1975
FLOW (L/MIN): 38

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>100</td>
<td>530</td>
<td>1.4</td>
<td>1450</td>
<td>61</td>
<td>30.1</td>
<td></td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL O H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7</td>
<td>6.75</td>
<td></td>
<td>-14.91</td>
<td>-121.9</td>
<td></td>
</tr>
</tbody>
</table>
## GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>146</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>101</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| SILICA             |            |            |            |            |
| ADIABATIC          | 133        |            |            |            |
| CONDUCTIVE         | 137        |            |            |            |
| CHALCEDONY         | 110        |            |            |            |
| CRISTOBALITE       | 87         |            |            |            |
| OPAL               | 17         |            |            |            |

## RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>110 (D)</td>
<td>146 (I)</td>
<td>137 (A)</td>
<td>131</td>
<td>8</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM²)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**BASED ON STANDARD ESTIMATE**

| VOLUME (KM³) | 3.3 | STD. DEV. = 0.9 |

| THERMAL ENERGY (10¹⁸ J) | 1.04 | STD. DEV. = 0.30 |

**COMMENTS:** 0.25 KM² AREA PERMANENTLY THAWED. THERMAL WATER USED IN BATH HOUSES AND FOR AGRICULTURE.

**REFERENCES:** WARRING, 1917, 1965; SAINSBURY AND OTHERS, 1969; MILLER, 1973; MILLER AND OTHERS, 1975; RENNER AND OTHERS, 1976

**COMPiled BY:** BROOK, C.

**Pilgrim (Kruzhamepa) Hot Springs, Alaska**
FIELD NAME................ LAVA CREEK
CIRCULAR REFERENCE........ 004

GEOGRAPHIC LOCALITY
STATE...................... ALASKA
LATITUDE.................... 65-13, N
LONGITUDE................... 162-54, W
MAPS......................... BENELEBEN A-2, 1163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03S 21W KATEEL RIVER

GENERAL INFORMATION
ELEVATION (M)................. 244
SURFACE ACTIVITY.............. HOT SPRING
SPRING TEMPERATURES (C)....... 50 TO 65
ROCK TYPES: QUARTZ MONZONITE NEAR CONTACT WITH PRECAMBRIAN MIGMATITE

CHEMISTRY
SAMPLE SOURCE........... MILLER AND OTHERS, 1975
COLLECTION DATE........ 1974/00/00

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>84</td>
<td>2.0</td>
<td>LT 0.1</td>
<td>79</td>
<td>1.8</td>
<td>120.9</td>
<td>5</td>
<td>53</td>
<td>5.9</td>
</tr>
</tbody>
</table>

F 6 PH 8.6 DEL 0(18) SO4 DEL 0(18) H2O DEL 0 H2O
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) .......... 117
- NA-K-CA (4/3) .......... 90
- NA-K .................... 59

SILICA
- ADIABATIC ............... 125
- CONDUCTIVE .............. 128
- CHALCEDONY ............. 100
- CRISTOBALITE .......... 77
- OPAL ..................... 8

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>90 (E+1)</td>
<td>128 (A)</td>
<td>90 (E+1)</td>
<td>103</td>
<td>9</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Subsurface Area (km**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>Volume (km**3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Dev. = 0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Thermal Energy (10**18 J) | 0.79 | Std. Dev. = 0.24 |

REFERENCES: Miller and Others, 1975

COMPILED BY: Brook, C.

Lava Creek, Alaska
FIELD NAME: CLEAR CREEK
CIRCULAR REFERENCE: 005

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 64°51' N
LONGITUDE: 162°18' W
MAPS: SOLOMON D-1, 1163, 360

GENERAL INFORMATION
ELEVATION (M): 183
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2
SPRING TEMPERATURES (°C): 60 to 67
DISCHARGE (L/MIN): 1000
ROCK TYPES: QUARTZ MONZONITE

CHEMISTRY
SAMPLE SOURCE: MILLER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>83</td>
<td>2.0</td>
<td>0.1</td>
<td>55</td>
<td>1.6</td>
<td>10.2</td>
<td>27</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

F  pH  DEL O(18)  S04  DEL O(18)  H2O  DEL D  H2O
8.3
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CAUTION</th>
<th>NA-K-CA (1/3)</th>
<th>122</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NA-K-CA (4/3)</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>NA-K</td>
<td>74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ADIABATIC</td>
<td>124</td>
</tr>
<tr>
<td></td>
<td>CONDUCTIVE</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>CHALCEDONY</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>CRISTOBALITE</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>OPAL</td>
<td>8</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>82 (I)</td>
<td>127 (A)</td>
<td>99 (D)</td>
<td>103</td>
<td>9</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th></th>
<th>VOLUME (KM**3)</th>
<th>THERMAL ENERGY (10**18 J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>0.79</td>
</tr>
</tbody>
</table>

STD. DEV. = 0.9
STD. DEV. = 0.24

COMMENTS: HIGH FLOW RATE SUGGESTS THAT SUBSURFACE TEMPERATURES MAY BE NEARER MINIMUM TEMPERATURE.


COMPILED BY: BROOK, C.

CLEAR CREEK, ALASKA
FIELD NAME................. SOUTH
CIRCULAR REFERENCE........... 006

GEOGRAPHIC LOCALITY
STATE....................... ALASKA
LATITUDE.................... 66-09. N
LONGITUDE................... 157-07. W
MAPS........................ SHUNGNAK 11250,000

TOWNSHIP RANGE SECTION
ION 06E

BASE & MERIDIAN
KATEEL RIVER

GENERAL INFORMATION
ELEVATION (M).................... 244
NO. OF SPRINGS.................... SEVERAL
SPRING TEMPERATURES (C)........... 50
ROCK TYPES: QUARTZ MONZONITE

CHEMISTRY
SAMPLE SOURCE.... MILLER AND OTHERS; 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>65</td>
<td>5.9</td>
<td>0.01</td>
<td>83</td>
<td>2.1</td>
<td>122</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>115</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>72</td>
</tr>
<tr>
<td>Na-K</td>
<td>65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>113</td>
</tr>
<tr>
<td>Conductive</td>
<td>114</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>86</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>64</td>
</tr>
<tr>
<td>Opal</td>
<td>-3</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>72 (I)</td>
<td>114 (A)</td>
<td>86 (D)</td>
<td>91</td>
<td>9</td>
</tr>
</tbody>
</table>

*Uncoded temperature indicates subjective judgement*

- A) Quartz Conductive
- B) Quartz Conductive, Ph-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, Ph-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0,5</td>
<td>2,0</td>
<td>1,5</td>
<td>1,7</td>
<td>0,3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,0</td>
<td>2,5</td>
<td>1,5</td>
<td>2,0</td>
<td>0,4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2,0</td>
<td>0,4</td>
</tr>
</tbody>
</table>

### Volume (km³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,3</td>
<td></td>
<td></td>
<td>2,0</td>
<td>0,9</td>
</tr>
</tbody>
</table>

### Thermal Energy (10¹⁸ J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0,68</td>
<td></td>
<td></td>
<td>0,68</td>
<td>0,21</td>
</tr>
</tbody>
</table>

### References

- Miller and Others, 1975
- Renner and Others, 1976

Compiled by: Brook, C.

South Alaska
FIELD NAME................. DULRI
CIRCULAR REFERENCE........ 007

GEOGRAPHIC LOCALITY
STATE..................... ALASKA
LATITUDE.................. 65-16. N
LONGITUDE................. 155-16. W
MAPS...................... MELOZITNA B-5, 1:63,360

TOWNSHIP RANGE SECTION
03S 18E 067

GENERAL INFORMATION
SURFACE ACTIVITY............ HOT SPRINGS
NO. OF SPRINGS................ SEVERAL
ROCK TYPES: HORNFELSIC GRAYWACKE AND MUDSTONE

CHEMISTRY
SAMPLE SOURCE........ USGS FILE DATA
COLLECTION DATE........ 1974/09/24

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>82</td>
<td>15</td>
<td>LT 1</td>
<td>200</td>
<td>12</td>
<td>80</td>
<td>280</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

F 8 PH
22 2.3 8.3
DEL 0(18) SO4 DEL 0(18) H2O DEL 0 H2O
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>159</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>123</td>
</tr>
<tr>
<td>NA-K</td>
<td>131</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>124</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>126</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>99</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>76</td>
</tr>
<tr>
<td>OPAL</td>
<td>7</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>99 (D)</td>
<td>159 (I)</td>
<td>126 (A)</td>
<td>128</td>
<td>12</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.5</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| VOLUME (KM**3).......... | 3.3     | STD, DEV, = 0.9 |
| THERMAL ENERGY(10**18 J) | 1.02    | STD, DEV, = 0.31 |

COMMENTS: MAY BE A MIXED WATER
REFERENCES: MILLER AND OTHERS, 1975

COMPiled BY: BROOK, C.

DULABI, ALASKA
FIELD NAME: MELOZI (MELOZITNA) HOT SPRINGS
CIRCULAR REFERENCE: 008

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 65°08' N
LONGITUDE: 154°40' W
MAPS: MELOZITNA A-4, 1163, 360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
04S 20E 23 KATEEL RIVER

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 10
ELEVATION (M): 275
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: ONE MAIN SPRING
SPRING TEMPERATURES (C): 55 TO 56
DISCHARGE (L/MIN): 498
ROCK TYPES: QUARTZ MONZONITE

CHEMISTRY
SAMPLE SOURCE: MILLER AND OTHERS, 1975
FLOW (L/MIN): 498
COLLECTION DATE: 1959/00/00

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI</th>
<th>O2</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>78</td>
<td>11</td>
<td>2.8</td>
<td></td>
<td></td>
<td></td>
<td>32</td>
<td>31</td>
<td>61</td>
<td>92</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)
SILICA
ADIBATIC.............. 121
CONDUCTIVE............. 124
CHALCEDONY............. 96
CHRISTOBALITE.......... 73
OPAL................... 5

RESERVOIR PROPERTIES
SUBSURFACE TEMP (C)   MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
92 (D) 124 (A) 124 (A) 113 8

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIBATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHARDISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5
SUBSURFACE AREA (KM**2) 1 3 2

VOLUME (KM**3)........... 3.3 STD. DEV. = 0.9
THERMAL ENERGY (10**18 J) 0.88 STD. DEV. = 0.26

COMMENTS: H2S ODOR
REFERENCES: WARING, 1917, 1965; MILLER AND OTHERS, 1975
COMPILED BY: BROOK, C.

MELOZI (MELOZITNA) HOT SPRINGS, ALASKA
FIELD NAME................ LITTLE MELOZITNA HOT SPRINGS
CIRCULAR REFERENCE........ 009

GEOGRAPHIC LOCALITY
STATE..................... ALASKA
LATITUDE.................. 65°28' N
LONGITUDE.................. 153°20' W
MAPS...................... MELOZITNA B-l, 1163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
01N 27E 29 NW OF SW KATEEL RIVER

GENERAL INFORMATION
WARING FIGURE...................... 9
WARING NUMBER...................... 11
ELEVATION (M)...................... 275
SURFACE ACTIVITY............... HOT SPRINGS
NO. OF SPRINGS..................... 5
SPRING TEMPERATURES (C)......... 38
ROCK TYPES: GRANITE

CHEMISTRY
SAMPLE SOURCE.... WARING, 1917

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

**Silica**
- Adiabatic: 122
- Conductive: 125
- Chalcedony: 97
- Cristobalite: 74
- Opal: 6

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>97 (D)</td>
<td>125 (A)</td>
<td>125 (A)</td>
<td>116</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

### Depths to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate.

### Volume (km³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thermal Energy (10**18 J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.91</td>
<td>STD. DEV. = 0.26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: H2S odor. Chemical analysis may be unreliable.

References: Waring, 1917, 1965; Miller and others, 1975

Compiled by: Brook, C.

Little Melozitna Hot Springs, Alaska.
FIELD NAME: REED RIVER HOT SPRING
CIRCULAR REFERENCE: 010

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 67-17. N
LONGITUDE: 154-55. W
MAPS: SURVEY PASS 11250.000

GENERAL INFORMATION
SURFACE ACTIVITY: HOT SPRING
SPRING TEMPERATURES (C): 50
ROCK TYPES: GRANITIC ROCK INTRUDING LIMESTONE

CHEMISTRY
SAMPLE SOURCE: MILLER, UNPUB. DATA

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>82</td>
<td>24</td>
<td>1.1</td>
<td>160</td>
<td>12</td>
<td>360</td>
<td>50</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

F B PH DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O
8.2 7.8
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3)........ 163
- NA-K-CA (4/3)........ 108
- NA-K.................... 153

SILICA
- ADIABATIC.............. 124
- CONDUCTIVE............. 126
- CHALCEDONY.............. 99
- CRISTOBALITE........... 76
- OPAL....................... 7

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)  
- MINIMUM: 99 (D)  
- MAXIMUM: 126 (A)  
- MOST LIKELY: 126 (A)  
- MEAN: 117  
- STD. DEV.: 6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) PENNER AND OTHERS, 1976

DEPTH TO TOP (KM)  
- MINIMUM: 0.5  
- MAXIMUM: 2.0  
- MOST LIKELY: 1.5  
- MEAN: 1.7  
- STD. DEV.: 0.3

THICKNESS (KM)  
- MINIMUM: 1.0  
- MAXIMUM: 2.5  
- MOST LIKELY: 1.5  
- MEAN: 1.7  
- STD. DEV.: 0.26

SUBSURFACE AREA (KM**2)  
- MINIMUM: 1  
- MAXIMUM: 3  
- MOST LIKELY: 2  
- MEAN: 2.0  
- STD. DEV.: 0.4

VOLUME (KM**3)........ 3.3  
- STD. DEV. = 0.9

THERMAL ENERGY (10**18 J)  
- 0.92  
- STD. DEV. = 0.26

COMMENTS: NA-K-CA TEMPERATURES PROBABLY UNRELIABLE BECAUSE OF CARBONATE BEDROCK.

REFERENCES: MILLER, UNPUB. DATA, MULL AND OTHERS, 1976

COMPiled BY: BROOK, C.

REED RIVER HOT SPRING, ALASKA
FIELD NAME............... KANUTI
CIRCULAR REFERENCE....... 011

GEOGRAPHIC LOCALITY
STATE..................... ALASKA
LATITUDE.................. 66-20, N
LONGITUDE.................. 150-48, W
MAPS........................ BETTLES, 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
1AN 15W 36 FAIRBANKS

GENERAL INFORMATION
ELEVATION (M)................. 290
SURFACE ACTIVITY.............. HOT SPRINGS
NO. OF SPRINGS................ SEVERAL
SPRING TEMPERATURES (C)........ 66
ROCK TYPES: MAFIC VOLCANIC ROCKS COVERED BY ALLUVIUM

CHEMISTRY
SAMPLE SOURCE........ MILLER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>MC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>2.7</td>
<td>0.3</td>
<td>111</td>
<td>3.7</td>
<td>169</td>
<td>21</td>
<td>28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)........ 136
NA-K-CA (4/3)........ 114
NA-K................... 84

RESERVOIR PROPERTIES
SUBSURFACE TEMP (°C)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) QUARTZ CONDUCTIVE</td>
<td>F) CRISTOBALITE</td>
<td>K) SULFATE GEOTHERMOMETER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B) QUARTZ CONDUCTIVE, pH-CORRECTED</td>
<td>G) AMORPHOUS SILICA</td>
<td>L) SURFACE TEMPERATURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C) QUARTZ ADIABATIC</td>
<td>H) NA-K</td>
<td>M) WELL TEMPERATURE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D) CHALCEDONY</td>
<td>I) NA-K-CA</td>
<td>N) MIXING MODEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E) CHALCEDONY, PH-CORRECTED</td>
<td>J) NA-K-CA, MG-CORRECTED</td>
<td>O) RENNER AND OTHERS, 1976</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>VOLUME (KM³)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THERMAL ENERGY (10¹⁸ J)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.84</td>
<td>STD. DEV. = 0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: STRONG H₂S ODOR. ONLY A PARTIAL CHEMICAL ANALYSIS IS AVAILABLE.

REFERENCES: MILLER AND OTHERS, 1975

COMPiled BY: BROOK, C,

KANUTT, ALASKA
FIELD NAME................... TOLUVANA
CIRCULAR REFERENCE......... 012

GEOGRAPHIC LOCALITY
STATE......................... ALASKA
LATITUDE..................... 65-16. N
LONGITUDE.................... 148-50. W
MAPS.......................... LIVENGOOD B-4, 1163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05N 06W 07 SE FAIRBANKS

GENERAL INFORMATION
WARING FIGURE................... 9
WARING NUMBER................... 17
ELEVATION (M)................... 297
SURFACE ACTIVITY................ HOT SPRINGS
NO. OF SPRINGS................... SEVERAL
SPRING TEMPERATURES (C)........... 52 TO 60
DISCHARGE (L/MIN)............... SMALL
ROCK TYPES: MUDSTONE

CHEMISTRY
SAMPLE SOURCE........ ANDERSON, 1970

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>75</td>
<td>02</td>
<td>1.2</td>
<td>321</td>
<td>23</td>
<td>49</td>
<td>40</td>
<td>615</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F DEL O(18) S04 DEL O(18) H2O DEL D H2O
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>162</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>148</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upal</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Surface Temp (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>93 (D)</td>
<td>162 (I)</td>
<td>122 (A)</td>
<td>126</td>
<td>14</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive

B) Quartz Conductive, PH-Corrected

C) Quartz Adiabatic

D) Chalcedony

E) Chalcedony, PH-Corrected

F) Cristobalite

G) Amorphous Silica

H) Na-K

I) Na-K-CA

J) Na-K-CA, Mg-Corrected

K) Sulfate Geothermometer

L) Surface Temperature

M) Well Temperature

N) Mixing Model

O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

### Volume (km³)

<table>
<thead>
<tr>
<th>VOLUME (km³)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thermal Energy (10¹⁵ J)

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10¹⁵ J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>STD. DEV. = 0.31</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** Geothermometers are questionable due to small flow of spring.

**References:**

- Waring, 1917, 1965
- Anderson, 1970
- Chapman and Others, 1971
- Miller and Others, 1975

**Compiled by:** Brook, C.

**Toovana, Alaska**
FIELD NAME................ MANLEY (BAKER) HOT SPRINGS
CIRCULAR REFERENCE......... 013

GEOGRAPHIC LOCALITY
STATE..................... ALASKA
LATITUDE.................. 65-00, N
LONGITUDE.................. 150-38, W
MAPS...................... TANANA A-2, 1163,360
TOWNSHIP RANGE SECTION BASE & MERIDIAN
02N 15W 17 NE FAIRBANKS

GENERAL INFORMATION
WARING FIGURE............... 9
WARING NUMBER.............. 14
ELEVATION (M).............. 107
SURFACE ACTIVITY........... HOT SPRINGS
NO. OF SPRINGS............. 3
SPRING TEMPERATURES (C)..... 56 TO 59
DISCHARGE (L/ MIN)......... 550
ROCK TYPES: BLACK HORNFELS INTRUDED BY GRANITE

CHEMISTRY
SAMPLE SOURCE........... MILLER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>65</td>
<td>4</td>
<td>1</td>
<td>130</td>
<td>4.5</td>
<td>89.6</td>
<td>0.4</td>
<td>54</td>
<td>134</td>
</tr>
</tbody>
</table>

F 8  Ph  DEL 0(18) SO4  DEL 0(18) H2O  DEL 0 H2O
8.5 7.7  -18.09  -141.9
GEOTHERMOMETERS (C)
CATION
NA-K-CA (1/3) .... 137
NA-K-CA (4/3) .... 113
NA-K- ................ 86
SILICA
ADIABATIC .......... 113
CONDUCTIVE ......... 114
CHALCEDONY .......... 86
CHISTOBALITE ......... 64
UPAL ............. -3

RESERVOIR PROPERTIES
SUBSURFACE TEMP (C)
MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD, DEV.
83 (J)    114 (A)    86 (D)    94    7

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)  THICKNESS (KM)  SUBSURFACE AREA (KM*2)
MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD, DEV.
0.5      2.0      1.5      1.7      0.3
1.0      2.5      1.5      2.0      0.4

BASED ON STANDARD ESTIMATE
VOLUME (KM*3) ......... 3.3  STD. DEV. = 0.9
THERMAL ENERGY (10**18 J)  0.71  STD. DEV. = 0.21

COMMENTS: WATER USED FOR BATH HOUSE AND IRRIGATION. WARING (1917) REPORTS ABOUT 0.25 KM**2 UNDER CULTIVATION.
REFERENCES: WARING, 1917, 1965; MILLER AND OTHERS, 1975
COMPILED BY: BROOK, C.
MANLEY (HAKER) HOT SPRINGS, ALASKA
FIELD NAME: CHENA
CIRCULAR REFERENCE: 014

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 65-03. N
LONGITUDE: 146-03. W
MAPS: CIRCLE A-S, 1163, 360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03N 08E 26 SW OF SE FAIRBANKS

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 18
ELEVATION (M): 396
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SULFUR
NO. OF SPRINGS: 10
SPRING TEMPERATURES (C): 22 TO 67
DISCHARGE (L/MIN): 830
ROCK TYPES: GRANITIC ROCK, SCHIST

CHEMISTRY
SAMPLE SOURCE: MILLER, 1973
FLOW (L/MIN): 830

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>85</td>
<td>1.3</td>
<td>0.13</td>
<td>110</td>
<td>3.3</td>
<td>115</td>
<td>14</td>
<td>68</td>
<td>29</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H2O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.6</td>
<td>9.1</td>
<td></td>
<td>-19.30</td>
<td>-153.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) 137
- NA-K-CA (4/3) 129
- NA-K 76

SILICA
- ADIABATIC 125
- CONDUCTIVE 128
- CHALCEDONY 101
- CRISTOBALITE 78
- OPAL 9

SUBLIMATION PROPERTIES
- SUBSURFACE TEMP (C)
  - MINIMUM: 67 (E)
  - MAXIMUM: 137 (I)
  - MOST LIKELY: 97 (8)

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (Km^2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>BASED ON: STANDARD ESTIMATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VOLUME (Km^3) .......... 3.3  STD. DEV. = 0.9

THERMAL ENERGY (10^18 J) 0.77  STD. DEV. = 0.25

COMMENTS: TEMPERATURE ESTIMATED FROM THE NA-K-CA GEOTHERMOMETER MAY BE TOO HIGH. HIGH FLOW RATE SUGGESTS THAT SUBSURFACE TEMPERATURE MAY BE NEARER TO THE MINIMUM ESTIMATE. SULFUR DEPOSITION. WARING (1965) REPORTS THAT THE WATER IS USED FOR BATHING AND IRRIGATION.

REFERENCES: WARING, 1917; 1965; MILLER, 1973; RENNER AND OTHERS, 1976

COMPiled BY: BRooK, C.

CHENA, ALASKA
FIELD NAME............... CIRCLE
CIRCULAR REFERENCE....... 015

GEOGRAPHIC LOCALITY
STATE...................... ALASKA
LATITUDE.................. 65-29. N
LONGITUDE.................. 144-39. W
MAPS...................... CIRCLE B-2, 1163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
08N 15E 34 FAIRBANKS

GENERAL INFORMATION
WARING FIGURE...................... 9
WARING NUMBER..................... 19
ELEVATION (M)...................... 274
SURFACE ACTIVITY................... HOT SPRINGS
ASSOCIATED DEPOSITS............... SINTER, TRAVERTINE, SULFUR, ALUM
NO. OF SPRINGS..................... 11
SPRING TEMPERATURES (C)............. 38 TO 57
DISCHARGE (L/MIN).................. 494
ROCK TYPES: SCHIST AND INTRUDED GRANITE

CHEMISTRY
SAMPLE SOURCE........ MILLER, 1973
FLOW (L/MIN)..... 494

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>95</td>
<td>20.8</td>
<td>0.3</td>
<td>230</td>
<td>9.8</td>
<td>185</td>
<td>96</td>
<td>249</td>
<td></td>
</tr>
</tbody>
</table>

F  B  PH  DEL 0(18) SO4  DEL 0(18) H2O  DEL 0 H2O
9.7 1.1 7.6 -20.6 -162.1
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>143</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>108</td>
</tr>
<tr>
<td>Na-K</td>
<td>102</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>130</td>
</tr>
<tr>
<td>Conductive</td>
<td>134</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>107</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>84</td>
</tr>
<tr>
<td>Opal</td>
<td>14</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>107 (D)</td>
<td>143 (I)</td>
<td>134 (A)</td>
<td>128</td>
<td>8</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Reservoir Properties (km)

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on Standard Estimate

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>STD, DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10⁶ J)</th>
<th>Minimum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.02</td>
<td></td>
<td>0.29</td>
</tr>
</tbody>
</table>

### Comments

- Waring (1965) reports that the water is used for bathing and irrigation.

### References

- Waring, 1917, 1965
- Miller, 1973

### Compiled by

- Hook, C.

**Circle, Alaska**
<table>
<thead>
<tr>
<th>Field Name</th>
<th>Great Sitkin Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic Locality</td>
<td>Alaska</td>
</tr>
<tr>
<td>Latitude</td>
<td>52° 04' N</td>
</tr>
<tr>
<td>Longitude</td>
<td>176° 05' W</td>
</tr>
<tr>
<td>Maps</td>
<td>Adak 1:250,000</td>
</tr>
<tr>
<td>General Information</td>
<td></td>
</tr>
<tr>
<td>Warning Figure</td>
<td>9</td>
</tr>
<tr>
<td>Warning Number</td>
<td>9</td>
</tr>
<tr>
<td>Area of Surface Expression (km²)</td>
<td>0.1</td>
</tr>
<tr>
<td>Elevation (m)</td>
<td>610</td>
</tr>
<tr>
<td>Surface Activity</td>
<td>Fumaroles, hot springs</td>
</tr>
<tr>
<td>No. of Springs</td>
<td>12</td>
</tr>
<tr>
<td>Spring Temperatures (°C)</td>
<td>88 to 99</td>
</tr>
<tr>
<td>Rock Types</td>
<td>Andesite, Basalt</td>
</tr>
<tr>
<td>RESERVOIR PROPERTIES</td>
<td>MINIMUM</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>100 (0)</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM²)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>VOLUME (KM³)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10¹¹ J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.14</td>
<td></td>
<td></td>
<td></td>
<td>0.38</td>
</tr>
</tbody>
</table>

COMMENTS: NO WATER CHEMISTRY, AREA OF HOLOCENE VOLCANISM,


COMPILED BY: BROOK, C.

GREAT SITKIN ISLAND, ALASKA
FIELD NAME................ HOT SPRINGS COVE
KGRA OR OTHER NAME.......... GEYSER SPRING BASIN KGRA
CIRCULAR REFERENCE......... 017

GEOGRAPHIC LOCALITY
STATE......................... ALASKA
LATITUDE..................... 53-14. N
LONGITUDE.................... 168-21. W
MAPS.......................... UMNAK 1:250,000

GENERAL INFORMATION
WARING FIGURE.................. 9
WARING NUMBER.................. 43
AREA OF SURFACE EXPRESSION (KM^2) 0.01
ELEVATION (M).................. 60
SURFACE ACTIVITY................ HOT SPRINGS, GEYSERS
NO. OF SPRINGS.................. 5
SPRING TEMPERATURES (C)........ 35 TO 89
DISCHARGE (L/Min)............... 360
ROCK TYPES: ANDESITE, ARGILLITE, KERATOPORE, DIABASE

CHEMISTRY
SAMPLE SOURCE........ BYERS AND BRANNOCK, 1949

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>110</td>
<td>170</td>
<td>1.2</td>
<td>680</td>
<td>32</td>
<td>71</td>
<td></td>
<td>49</td>
<td>1250</td>
</tr>
<tr>
<td>F</td>
<td>0.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH</td>
<td>6.86</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEL 0(18) SO4 = -8.99
DEL 0(18) H2O = -67.2
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>148</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>114</td>
</tr>
<tr>
<td>Na-K</td>
<td>110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>137</td>
</tr>
<tr>
<td>Conductive</td>
<td>143</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>116</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>92</td>
</tr>
<tr>
<td>Opal</td>
<td>22</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std, Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>143 (A)</td>
<td>200 (N)</td>
<td>148 (I)</td>
<td>164</td>
<td>13</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std, Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>1.0</th>
<th>2.5</th>
<th>1.5</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Based On: Spring Distribution**

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>3.3</th>
<th>Std, Dev. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10¹⁰ J)</td>
<td>1.34</td>
<td>Std, Dev. = 0.39</td>
</tr>
</tbody>
</table>

**Comments:** Located near Okmok Caldera. Thermal springs also occur at beach 1 km to north.

**References:** Waring, 1917; 1965; Byers, 1959; Byers and Brannock, 1949; Beikman, 1975

**Compiled By:** Brook, C.

HOT SPRINGS COVE, ALASKA
FIELD NAME: GEYSER BIGHT
KGRA OR OTHER NAME: GEYSER SPRING BASIN KGRA
CIRCULAR REFERENCE: 018

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 53-13, N
LONGITUDE: 168-28, W
MAPS: UNMAK 1:250,000

GENERAL INFORMATION
WARNING FIGURE: 9
WARNING NUMBER: 41
AREA OF SURFACE EXPRESSION (KM²): 3.5
ELEVATION (M): 60-305
SURFACE ACTIVITY: HOT SPRINGS, FUMAROLES, Geyser
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: 22
SPRING TEMPERATURES (°C): 53 TO 102
DISCHARGE (L/Min): 4200
ROCK TYPES: ANDESITE

CHEMISTRY
SAMPLE SOURCE: MILLER, UNPUBLISHED DATA

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>102</td>
<td>255</td>
<td>20</td>
<td>LT 0.1</td>
<td>480</td>
<td>32</td>
<td>52</td>
<td>170</td>
<td>640</td>
<td></td>
</tr>
</tbody>
</table>

F | A | PH | DEL O(18) SiO₂ | DEL O(18) H₂O | DEL O H₂O
| 1.2 | 50 | 8.3 | -4.05 | -8.06 |
### Geothermometers (°C)

**Cation**
- $Na-K-CA (1/3)$: 177
- $Na-K-CA (4/3)$: 174
- $Na-K$: 141

**Silica**
- Adiabatic: 182
- Conductive: 197
- Chalcedony: 179
- Cristobalite: 148
- Opal: 73

**Sulfate**
- Conductive: 322
- One-step steam loss: 264
- Continuous steam loss: 282

### Reservoir Properties

**Subsurface Temp (°C)**
- Minimum: 177 (°C)
- Maximum: 264 (°K)
- Most Likely: 182 (°C)
- Mean: 208
- Std. Dev.: 20

**Uncoded Temperature Indicates Subjective Judgement**
- A) Quartz Conductive
- B) Quartz Conductive, Ph-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, Ph-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>6.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume (km³)</td>
<td>10.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal Energy (10⁻¹⁸ J)</td>
<td>5.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** 3 thermal areas in zone 2 km long. Fumaroles located at higher elevations.

**References:** Waring, 1917; Byers, 1959; Byers and Brannock, 1949; Beikman, 1975; Miller, Unpub. Data

**Compiled by:** Brook, C.

**Geyser Hight, Alaska**
FIELD NAME: HOT SPRING ON UMNAK ISLAND
KGRA OR OTHER NAME: GEYSER SPRING BASIN KGRA
CIRCULAR REFERENCE: 019

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 53°14', N
LONGITUDE: 168°18', W
MAPS: UMNAK 1:250,000

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 42
ELEVATION (M): 25
SURFACE ACTIVITY: HOT SPRING
NO. OF SPRINGS: 1
SPRING TEMPERATURES (C): 65
ROCK TYPES: ARGILLITE, KERATOPHYRE, DIABASE

CHEMISTRY
SAMPLE SOURCE: MILLER, UNPUB. DATA

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>93</td>
<td>220</td>
<td>2.8</td>
<td>460</td>
<td>16</td>
<td>77</td>
<td>LT1</td>
<td>150</td>
<td>960</td>
</tr>
</tbody>
</table>

F, R, PH:
F: 0.8, R: 36, PH: 6.4
DEL 0(18) SO4: -8.48
DEL 0(18) H2O: -68.4
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ........... 127
NA-K-CA (4/3) ........... 78
NA-K .................... 87

SILICA
ADIABATIC ............... 129
CONDUCTIVE ............. 133
CHALCEDONY .......... 106
CHRISTOBALITE .......... 83
UPAL ..................... 13

SUBSURFACE TEMP (C)
78 (I) 133 (A) 106 (D) 106 11

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

Depth to Top (km) 0.5 2.0 1.5
Thickness (km) 1.0 2.5 1.5
Subsurface Area (km**2) 1 3 2

VOLUME (km**3) .......... 3.3
THERMAL ENERGY(10**18 J) 0.82

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.

COMMENTS: LOCATED ABOUT 2.5 KM SOUTHEAST OF HOT SPRINGS COVE THERMAL AREA. THE 2 AREAS MAY BE RELATED.

REFERENCES: WARING, 1965; BEIKMAN, 1975; MILLER, UNPUB. DATA

COMPILED BY: BROOK, C.

HOT SPRING ON UMNAK ISLAND, ALASKA
FIELD NAME: HOT SPRINGS BAY (AKUTAN ISLAND)
CIRCULAR REFERENCE: 020

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 54°10' N
LONGITUDE: 165°50' W
MAPS: UNIMAk 1:250000

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 46
SURFACE ACTIVITY: HOT SPRINGS, FUMAROLES
NO. OF SPRINGS: 4
SPRING TEMPERATURES (°C): 67 TO 84
ROCK TYPES: BASALT, ANDESITE

CHEMISTRY
SAMPLE SOURCE: HYERS AND BARTH, 1953

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>83</td>
<td>128</td>
<td>9.9</td>
<td>1.4</td>
<td>288</td>
<td>21</td>
<td>192</td>
<td>39</td>
<td>350</td>
<td></td>
</tr>
</tbody>
</table>

F B PM DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O
7.0
GEOTHERMOMETERS (C)

CATION
- Na-K-Ca (1/3) = 179
- Na-K-Ca (4/3) = 167
- Na-K = 150

SILICA
- Adiabatic = 145
- Conductive = 151
- Chalcedony = 126
- Cristobalite = 101
- Opal = 30

RESEVOIR PROPERTIES

MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV.
--- | --- | --- | --- | ---

SUBSURFACE TEMP (C)
- Minimum = 126 (D)
- Maximum = 151 (A)
- Most Likely = 136 (J)
- Mean = 138

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, pH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-Ca
J) Na-K-Ca, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

DEPTH TO TOP (KM)
- Minimum = 0.5
- Maximum = 2.0
- Most Likely = 1.5
- Mean = 1.7
- STD. DEV. = 0.3

THICKNESS (KM)
- Minimum = 1.0
- Maximum = 2.5
- Most Likely = 1.5
- Mean = 2.0
- STD. DEV. = 0.4

SUBSURFACE AREA (KM^2)
- Minimum = 1
- Maximum = 3
- Most Likely = 2
- Mean = 2
- STD. DEV. = 0.9

VOLUME (KM^3)
- Minimum = 3.3
- STD. DEV. = 0.9

THERMAL ENERGY (10^18 J)
- Minimum = 1.10
- STD. DEV. = 0.31

COMMENTS: Located near active Akutan Volcano

REFERENCES: Waring 1917, 1965; Byers and Barth, 1953; Beikman, 1975

COMPILED BY: B. C. Brook, C.

HOT SPRINGS BAY (AKUTAN ISLAND), ALASKA
FIFLO NAME................ EAST OF COLD BAY
CIRCULAR REFERENCE........ 021

GEOGRAPHIC LOCALITY
STATE..................... ALASKA
LATITUDE.................. 55-13. N
LONGITUDE................. 162-29. W
MAP'S...................... COLD BAY 11250,000

GENERAL INFORMATION
ELEVATION (M)...................... NEAR SEA LEVEL
SURFACE ACTIVITY................... HOT SPRINGS
SPRING TEMPERATURES (C)............ 54
ROCK TYPES: ANDESITE

CHEMISTRY
SAMPLE SOURCE.... MİLLER, 1973

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>68</td>
<td>229</td>
<td>7</td>
<td>780</td>
<td>34</td>
<td>694</td>
<td>1390</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F  B  PH
7.5
DEL O(18) SO4  DEL O(18) H2O  DEL D H2O
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>104</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>115</td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>CHISTOBALITE</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 (D)</td>
<td>144 (I)</td>
<td>117 (A)</td>
<td>116</td>
<td>11</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM^2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>VOLUME (KM^3)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10^18 J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.91</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.28</td>
</tr>
</tbody>
</table>

COMMENTS: AEA OF HOLOCENE VOLCANISM.

REFERENCES: MILLER, 1973; BEIKMAN, 1975

COMPILED BY: BROOK, C.

EAST OF COLD BAY, ALASKA
FIELD NAME ................. NORTH END OF TENAKEE INLET
CIRCULAR REFERENCE ....... 022

GEOGRAPHIC LOCALITY
STATE ..................... ALASKA
LATITUDE .................. 58°02’, N
LONGITUDE .................. 136°01’, W
MAPS ........................... MT. FAIRWEATHER A-1, 1163, 360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
44S 57E 247 COPPER RIVER

GENERAL INFORMATION
WARING FIGURE ..................... 9
WARING NUMBER ..................... 64
ELEVATION (M) ..................... 85
SURFACE ACTIVITY .................. HOT SPRINGS
ASSOCIATED DEPOSITS ................ TRAVERTINE
NO. OF SPRINGS ..................... 12
SPRING TEMPERATURES (°C) ........... 27 TO 82
DISCHARGE (L/MIN) .................. 38
ROCK TYPES: DIORITE, GRANITE

CHEMISTRY
SAMPLE SOURCE .......... WARING, 1917
FLOW (L/MIN) ............. 38

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>119</td>
<td>21</td>
<td>2.3</td>
<td>137</td>
<td>4.1</td>
<td>48</td>
<td>226</td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

**CATION**
- \( \text{Na-K-CA (1/3)} \)........... 120
- \( \text{Na-K-CA (4/3)} \)........... 72
- \( \text{Na-K} \).................. 76

**SILICA**
- \( \text{ADIABATIC} \).............. 141
- \( \text{CONDUCTIVE} \)............. 147
- \( \text{CHALCEDONY} \)............. 122
- \( \text{CRISTOBALITE} \)......... 97
- \( \text{OPAL} \)................... 26

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>120 (I)</td>
<td>147 (A)</td>
<td>122 (D)</td>
<td>130</td>
<td>6</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**
- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Additional Measurements

<table>
<thead>
<tr>
<th>Depth to Top (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (KM**2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Based On Standard Estimate**

<table>
<thead>
<tr>
<th>Volume (KM**3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy(10**18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.03</td>
<td></td>
<td></td>
<td>1.03</td>
<td>0.29</td>
</tr>
</tbody>
</table>

**References:** Waring, 1917, 1965; Miller, 1973

**Compiled By:** Brook, C.

**North End of Tenakee Inlet, Alaska**
FIELD NAME........................ Hooniah Hot Springs (White Sulphur Springs)
CIRCULAR REFERENCE.............. 023

GEOGRAPHIC LOCALITY
STATE............................. ALASKA
LATITUDE.......................... 57-48 N
LONGITUDE.......................... 136-20 W
MAPS................................. SITKA D-8 1163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
47S 56E 09 COPPER RIVER

GENERAL INFORMATION
WARING FIGURE...................... 9
WARING NUMBER...................... 65
ELEVATION (M)...................... 12
SURFACE ACTIVITY................... HOT SPRINGS
ASSOCIATED DEPOSITS................ TRAVERTINE
NO. OF SPRINGS...................... 3
SPRING TEMPERATURES (C)............ 29 TO 44
DISCHARGE (L/MIN).................. 114

ROCK TYPES: SCHIST

CHEMISTRY
SAMPLE SOURCE........ WARING 1917
FLOW (L/MIN)........ 114

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>S</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>98</td>
<td>85</td>
<td>18</td>
<td>35</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>109 (D)</td>
<td>136 (A)</td>
<td>136 (A)</td>
<td>127</td>
<td>6</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

**Geothermometers (°C)**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
<td>132</td>
<td>136</td>
<td>85</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**Reservoir Properties**

<table>
<thead>
<tr>
<th>Silica</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td></td>
<td></td>
<td></td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td></td>
<td></td>
<td></td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td></td>
<td></td>
<td></td>
<td>109</td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td></td>
<td></td>
<td></td>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

**Subsurface Temp (°C)**

- Minimum: 109 (D)
- Maximum: 136 (A)
- Most Likely: 136 (A)
- Mean: 127
- Std. Dev.: 6

Uncoded temperature indicates subjective judgement.

**Quartz Conductive**

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, MG-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

**Depth to Top (km)**

- Minimum: 0.5
- Maximum: 2.0
- Most Likely: 1.5
- Mean: 1.7
- Std. Dev.: 0.3

**Thickness (km)**

- Minimum: 1.0
- Maximum: 2.5
- Most Likely: 1.5
- Mean: 2.0
- Std. Dev.: 0.4

**Subsurface Area (km²)**

- Minimum: 1
- Maximum: 3
- Most Likely: 2
- Mean: 2.0
- Std. Dev.: 0.4

**Volume (km³)**

- Minimum: 3.3
- Mean: 3.3
- Std. Dev.: 0.9

**Thermal Energy (10¹¹ J)**

- Minimum: 1.01
- Mean: 1.01
- Std. Dev.: 0.29

**Comments:** Water used for bathing.

**References:** Waring, 1917, 1965; Miller, 1973

**Compiled by:** Brook, C.

Hooniah Hot Springs (White Sulphur Springs), Alaska
FIELD NAME: NEAR FISH BAY
CIRCULAR REFERENCE: 024

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 57-22. N
LONGITUDE: 135-23. W
MAPS: SITKA B-5 1/63,360

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 68
ELEVATION (M): NEAR SEA LEVEL
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 24
SPRING TEMPERATURES (C): 17 TO 47
DISCHARGE (L/MIN): 95
ROCK TYPES: FAULTED SCHIST

CHEMISTRY
SAMPLE SOURCE: WARING, 1917

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>47</td>
<td>110</td>
<td>13</td>
<td>2.4</td>
<td></td>
<td></td>
<td>43</td>
<td>24</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

SILICA
-ADIABATIC............. 137
-CONDUCTIVE............. 143
-CHALCEDONY............. 116
-CHRISTOBALITE......... 92
-OPAL................... 22

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
- MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
- 70     143 (A)  143 (A)  119     17

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
- MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
- 70     143 (A)  143 (A)  119     17

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
- MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
- 0.5     2.0     1.5     1.7     0.3

THICKNESS (KM)
- MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
- 1.0     2.5     1.5

SUBSURFACE AREA (KM**2)
- MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
- 1       3       2       2.0     0.4

BASED ON STANDARD ESTIMATE
VOLUME (KM**3)............. 3.3  STD. DEV. = 0.9
THERMAL ENERGY(10**18 J) 0.93  STD. DEV. = 0.31

COMMENTS: MINIMUM TEMPERATURE VALUE IS ESTIMATED. WATER USED FOR BATHING.
REFERENCES: WARING, 1917, 1965; MILLER, 1973

compiled by: BROOK, C.

NEAR FISH BAY, ALASKA
FIELD NAME: GODDARD HOT SPRINGS (SITKA)
CIRCULAR REFERENCE: 025

GEOPHYSICAL LOCALITY
STATE: ALASKA
LATITUDE: 56-50. N
LONGITUDE: 135-22. W
MAPS: PORT ALEXANDER D-5 1161-360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
SHS 64E COPPER RIVER

GENERAL INFORMATION
WARING FIGURE: 9
WARING NUMBER: 70
ELEVATION (M): NEAR SEA LEVEL
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 3
SPRING TEMPERATURES (C): 51 TO 65
DISCHARGE (L/MIN): 49
ROCK TYPES: GRANITE CUT BY DIABASE DIKES

CHEMISTRY
SAMPLE SOURCE: MILLER, 1973
FLOW (L/MIN): 49

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>C03</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>120</td>
<td>300</td>
<td>1</td>
<td>1500</td>
<td>61</td>
<td>8</td>
<td></td>
<td>110</td>
<td>2780</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4</td>
<td>7.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEL O(18) SO4 | DEL O(18) H2O | DEL D H2O
-11.10 | -82.8 |
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)............ 147
NA-K-CA (4/3)............. 129
Na-K..................... 98

SILICA
ADIABATIC................. 141
CONDUCTIVE.............. 148
CHALCEDONY............... 122
CHRISTOBALITE............ 97
OPAL..................... 26

RESERVOIR PROPERTIES

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUSCRIPTION TEMP (C) 122 (D) 148 (A+1) 148 (A+1) 139 6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPT TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5
SUBSURFACE AREA (KM**2) 1 3 2
BASD ON STANDARD ESTIMATE
VOLUME (KM**3).............. 3.3 STD. DEV. = 0.9
THERMAL ENERGY(10**18 J). 1.12 STD. DEV. = 0.32

COMMENTS: BATHING RESORT

REFERENCES: WARING, 1917, 1965; MILLER, 1973

COMPILED BY: BROOK, C.

GOODARDO HOT SPRINGS (SITKA) - ALASKA
FIELD NAME: SHAKES SPRINGS (CHIEF SHAKES)
CIRCULAR REFERENCE: 026

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 56°43' N
LONGITUDE: 132°02' W
MAPS: PETERSBURG C-1, 1163, 360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
59S 85E 28 SW OF SW COPPER RIVER

GENERAL INFORMATION
WAKING FIGURE: 9
WAKING NUMBER: 73
ELEVATION (M): 30
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (C): 52
DISCHARGE (L/MIN): 380
ROCK TYPES: GRANITE

CHEMISTRY
SAMPLE SOURCE: WARING, 1917
FLOW (L/MIN): 380

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>108</td>
<td>13</td>
<td>0.2</td>
<td>87</td>
<td>9.2</td>
<td>43</td>
<td>142</td>
<td>6.5</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>175</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>105</td>
</tr>
<tr>
<td>NA-K</td>
<td>190</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>136</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>142</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>115</td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>91</td>
</tr>
<tr>
<td>OPAL</td>
<td>21</td>
</tr>
</tbody>
</table>

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>115 (D)</td>
<td>175 (I)</td>
<td>142 (A)</td>
<td>144</td>
<td>12</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ ADIABATIC
- C) CHALCEDONY
- D) CHALCEDONY, PH-CORRECTED
- E) CHALCEDONY, PH-CORRECTED, NA-K-CA
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

- VOLUME (KM**3) .......... 3.3
- THERMAL ENERGY (1U**18 J) 1.16

COMMENTS: CHEMICAL DATA MAY NOT BE RELIABLE, USED IN BATH HOUSE.

REFERENCES: WARING, 1917; 1965; MILLER, 1973

COMPILED BY: BROOKS, C.

SHAKES SPRINGS (CHIEF SHAKES), ALASKA
FIELD NAME................ BAILEY BAY HOT SPRINGS
CIRCULAR REFERENCE........ 027

GEOGRAPHIC LOCALITY
STATE..................... ALASKA
LATITUDE.................. 55-59.0 N
LONGITUDE................. 131-39.5 W
MAPS...................... KETCHIKAN D-5, 1163,360

TOWNSHIP RANGE SECTION
68S 69E 09 SE OF SW COPPER RIVER

GENERAL INFORMATION
WARING FIGURE............... 9
WARING NUMBER............... 76
AREA OF SURFACE EXPRESSION (KM**2) 145
ELEVATION (M).............. NEAR SEA LEVEL
SURFACE ACTIVITY............ HOT SPRINGS
NO. OF SPRINGS............... 9
SPRING TEMPERATURES (C).... 63 TO 88
DISCHARGE (L/MIN)......... 314
ROCK TYPES: GRAVITE

CHEMISTRY
SAMPLE SOURCE........ USGS FILE DATA

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>88</td>
<td>160</td>
<td>2</td>
<td>0</td>
<td>78</td>
<td>4.2</td>
<td>118</td>
<td>44</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>R</td>
<td>PH</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PH 7.22
### GEOTHERMOMETERS (C)

| CATION | NA-K-CA (1/3) | 155 |
|        | NA-K-CA (4/3) | 122 |
|        | NA-K          | 121 |

| SILICA |                  |     |
|        | ADIABATIC       | 156 |
|        | CONDUCTIVE      | 165 |
|        | CHALCEDONY      | 142 |
|        | CHALCEDONY, PH-CORRECTED | 115 |
|        | UPAL            | 42  |

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>155 (1)</td>
<td>165 (A)</td>
<td>165 (A)</td>
<td>162</td>
<td>2</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNERS AND OTHERS, 1976

### DEPTH TO TOP (KM)

- MINIMUM: 0.5
- MAXIMUM: 2.0
- MOST LIKELY: 1.5
- MEAN: 1.7
- STD. DEV.: 0.3

### THICKNESS (KM)

- MINIMUM: 1.0
- MAXIMUM: 2.5
- MOST LIKELY: 1.5
- MEAN: 2.0
- STD. DEV.: 0.4

### SUBSURFACE AREA (KM**2)

- MINIMUM: 3.3
- MAXIMUM: 2.0
- MOST LIKELY: 1.7
- MEAN: 1.32
- STD. DEV.: 0.9

### VOLUME (KM**3)

- MINIMUM: 3.3
- MAXIMUM: 2.0
- MOST LIKELY: 1.7
- MEAN: 1.32
- STD. DEV.: 0.9

### THERMAL ENERGY (10**18 J)

- MINIMUM: 3.3
- MAXIMUM: 2.0
- MOST LIKELY: 1.7
- MEAN: 1.32
- STD. DEV.: 0.9

**COMMENT:** WATER USED FOR BATHING.

**REFERENCES:** WARING, 1917; 1965; MILLER, 1973

**COMPILED BY:** BROOK, C.

**HAILEY BAY HOT SPRINGS, ALASKA**
FIELD NAME: BELL ISLAND HOT SPRINGS
CIRCULAR REFERENCE: 020

GEOGRAPHIC LOCALITY
STATE: ALASKA
LATITUDE: 55-56, N
LONGITUDE: 131-34, W
MAPS: KETCHikan D-5, 1163,360

TOWNSHIP RANGE SECTION BASE & MERIDIAN
68S 90E 31 COPPER RIVER

GENERAL INFORMATION
WAKING FIGURE: 9
WAKING NUMBER: 79
ELEVATION (M): NEAR SEA LEVEL
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 5
SPRING TEMPERATURES (°C): 43 TO 72
DISCHARGE (L/MIN): 38
ROCK TYPES: GRANITE CUT BY PEGMATITE DIKES

CHEMISTRY
SAMPLE SOURCE: USGS FILE DATA

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA (mg/l)</th>
<th>MG (mg/l)</th>
<th>NA (mg/l)</th>
<th>K (mg/l)</th>
<th>HCO3</th>
<th>CO3 (mg/l)</th>
<th>S04</th>
<th>CL (mg/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td></td>
<td>125</td>
<td>10</td>
<td>0</td>
<td>197</td>
<td>6.6</td>
<td>53</td>
<td>79</td>
<td>189</td>
</tr>
</tbody>
</table>

F | B | PH | DEL 0(18) S04 | DEL 0(18) H2O | DEL D H2O
8.95
## Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uopal</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>93 (E)</td>
<td>150 (A)</td>
<td>135 (I)</td>
<td>126</td>
<td>12</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, pH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>Volume (km³³)</th>
<th>Minimum</th>
<th>Std. Dev. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10¹⁸ J)</th>
<th>Minimum</th>
<th>Std. Dev. = 0.30</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

## References

- Waring, 1917, 1965
- Miller, 1973

Compiled by: Brook, C.

Bell Island Hot Springs, Alaska
Arizona
FIELD NAME: POWER RANCHES INC. WELLS

CIRCULAR REFERENCE: 039

GEOGRAPHIC LOCALITY
STATE: ARIZONA
COUNTY: MARICOPA
LATITUDE: 33-17.1 N
LONGITUDE: 111-41.2 W
MAPS: HIGLEY 1124,000
TOWNSHIP RANGE SECTION BASE & MERIDIAN
03S 06T 01 SW GILA AND SALT RIVER

GENERAL INFORMATION
ELEVATION (M): 1,409
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
DISCHARGE (L/MIN): 190,000
WELL DEPTHS (M): 2,808 TO 3,184
MAXIMUM WELL TEMP (C): 184 AT DEPTH (M) 3,184
ROCK TYPES: ALLUVIUM OVERLYING ANDESITE (?) OR GRANITE (?)
### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>150</td>
<td>180</td>
<td>165</td>
<td>165</td>
<td>6</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

A) Quartz Conductive  
B) Quartz Conductive, pH-Corrected  
C) Quartz Adiabatic  
D) Chalcedony  
E) Chalcedony, PH-Corrected  
F) Cristobalite  
G) Amorphous Silica  
H) Na-K  
I) Na-K-CA  
J) Na-K-CA, Mg-Corrected  
K) Sulfate Geothermometer  
L) Surface Temperature  
M) Well Temperature  
N) Mixing Model  
O) Renner and Others, 1976

### Other Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>2.0</td>
<td>2.5</td>
<td>2.0</td>
<td>2.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>3.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**Volume (km³)**

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.8</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**Thermal Energy (10^12 J)**

<table>
<thead>
<tr>
<th>Thermal Energy</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.12</td>
<td>0.36</td>
</tr>
</tbody>
</table>

**Comments**

Two wells about 1 km apart and about 3 km deep. Bottom hole temperatures of 163 and 184 °C.

**References**

Renner and Others, 1976  
Hahman and Others, 1978

**Compiled by**

C. Brook  
Power Ranches Inc., Wells, Arizona
FIELD NAME: EAGLE CREEK
CIRCULAR REFERENCE: 030

GEOGRAPHIC LOCALITY
STATE: ARIZONA
COUNTY: GREENLEE
LATITUDE: 33°02.8' N
LONGITUDE: 109°26.4' W
MAP'S: CLIFTON U.S. 500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
04S 20E 35 NW OF NE GILA AND SALT RIVER

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 167
ELEVATION (M): 1122
SURFACE ACTIVITY: WARM SPRINGS
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 32° to 36°
DISCHARGE (L/MIN): LT 10 L/MIN
ROCK TYPES: TERTIARY (?) BASALT
GEOPHYSICS: GRAVITY, MAGNETIC

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977
FLOW (L/MIN): LOW
COLLECTION DATE: 1974/12/00

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>SO4</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td>64</td>
<td>16</td>
<td>2.1</td>
<td>190</td>
<td>7.8</td>
<td>283</td>
<td>45</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>0.12</td>
<td>8.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F 8 PH DEL 0(10) SO4 DEL 0(10) H20 DEL D H20
10 0.12 8.24 -12.01 -89.0
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>140</td>
<td>7</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>7</td>
</tr>
<tr>
<td>NA-K</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>95</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>113</td>
<td>113</td>
<td>113</td>
<td>113</td>
<td>7</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>114</td>
<td>114</td>
<td>114</td>
<td>114</td>
<td>7</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>85</td>
<td>7</td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>63</td>
<td>7</td>
</tr>
<tr>
<td>OPAL</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>-4</td>
<td>7</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>85 (D)</td>
<td>114 (A)</td>
<td>85 (D)</td>
<td>95</td>
<td>7</td>
</tr>
</tbody>
</table>

*Uncoded temperature indicates subjective judgement.*

A) Quartz Conductive

B) Quartz Conductive, PH-Corrected

C) Quartz Adiabatic

D) Chalcedony

E) Chalcedony, PH-Corrected

F) Cristobalite

G) Amorphous Silica

H) NA-K

I) NA-K-CA

J) NA-K-CA, Mg-Corrected

K) Sulfate Geothermometer

L) Surface Temperature

M) Well Temperature

N) Mixing Model

O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Based on: Standard Estimate

### Volume (km³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

### Thermal Energy (10⁴ J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.72</td>
<td>0.72</td>
<td>0.72</td>
<td>0.72</td>
<td>0.21</td>
</tr>
</tbody>
</table>

### Comments:
Geothermometers may be unreliable because of very low flow rate. Equilibrium with amorphous silica possible at surface temperature. Supersaturated with calcite. Temperature of reservoir may be lower than reported here.

### References:
- Lihgren, 1905
- Sauck and Sumner, 1970
- West and Sumner, 1973
- Renner and Others, 1976
- Mariner and Others, 1977

### Compiled By:
- Brook, C.

Eagle Creek, Arizona
FIELD NAME: NORTH OF CLIFTON
CIRCULAR REFERENCE: 031

GEOGRAPHIC LOCALITY
STATE: ARIZONA
COUNTY: GREENLEE
LATITUDE: 33°04.7' N
LONGITUDE: 109°18.2' W
MAPS: CLIFTON 1:62,500

TOWNSHIP RANGE SECTION
045 30E 18 SW OF SW
BASE & MERIDIAN
GILA AND SALT RIVER

GENERAL INFORMATION
ELEVATION (M): 1068
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: NONE
NO. OF SPRINGS: 2
SPRING TEMPERATURES (°C): 44 to 59
ROCK TYPES: QUARZITE OVERLYING GRANITE
GEOPHYSICS: GRAVITY, MAGNETIC

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977
FLOW (L/MIN): VERY LOW
COLLECTION DATE: 1974/12/00

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>95</td>
<td>740</td>
<td>20</td>
<td>2600</td>
<td>170</td>
<td>145</td>
<td>68</td>
<td>5500</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>2.8</th>
<th>PH</th>
<th>DEL O(18)</th>
<th>DEL O(18)</th>
<th>DEL D</th>
<th>DEL D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>7.07</td>
<td></td>
<td>SO4</td>
<td>H2O</td>
<td>H2O</td>
<td>H2O</td>
</tr>
</tbody>
</table>
GEOThERMOMETERS (C)

CATION

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>174</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>165</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>139</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SILICA

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>130</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>107</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>107 (D)</td>
<td>164 (N,J)</td>
<td>164 (N,J)</td>
<td>145</td>
<td>13</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THICKNESS (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM*2)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (KM*3)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

THERMAL ENERGY (10^18 J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.17</td>
<td></td>
<td></td>
<td></td>
<td>0.35</td>
</tr>
</tbody>
</table>

COMMENTS: WATER MAY BE PRECIPITATING CALCITE. PROBABLY A MIXED WATER. WARM SPRINGS (39 C) IN CLIFTON KGRA 3 KM TO SOUTH MAY BE PART OF THIS SYSTEM.


COMPILED BY: WHOOK, C.

NORTH OF CLIFTON, ARIZONA
FIELD NAME................. GILLARD HOT SPRINGS
KGRA OR OTHER NAME........ GILLARD HOT SPRINGS KGRA
CIRCULAR REFERENCE........ 032

GEOGRAPHIC LOCALITY
STATE..................... ARIZONA
COUNTY.................... GREENLEE
LATITUDE.................. 32-58.5 N
LONGITUDE................. 109-21.0 W
MAPS...................... GUTHRIE 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05S 29E 27 NE OF NE GILA AND SALT RIVER

GENERAL INFORMATION
ELEVATION (M).................. 1025
SURFACE ACTIVITY................ HOT SPRINGS
NO. OF SPRINGS................. 5
SPRING TEMPERATURES (C)....... 82

ROCK TYPES: TERTIARY BASALT AND INTERBEDDED FANGLOMERATE
GEOPHYSICS: GRAVITY, MAGNETIC

CHEMISTRY
SAMPLE SOURCE............. MARINER AND OTHERS, 1977
COLLECTION DATE........... 1974/12/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>95</td>
<td>22</td>
<td>0.8</td>
<td>450</td>
<td>14</td>
<td>216</td>
<td>180</td>
<td>490</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>( \Delta \phi )</th>
<th>PH</th>
<th>DEL ( \Delta(18) ) SO4</th>
<th>DEL ( \Delta(18) ) H2O</th>
<th>DEL ( \Delta ) H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0.41</td>
<td>7.35</td>
<td>-0.31</td>
<td>-10.87</td>
<td>-86.5</td>
</tr>
</tbody>
</table>
**Geothermometers (C)**

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>138</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>130</td>
</tr>
<tr>
<td>Na-K</td>
<td>79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>130</td>
</tr>
<tr>
<td>Conductive</td>
<td>134</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>107</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>84</td>
</tr>
<tr>
<td>Opal</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sulfate</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>149</td>
</tr>
<tr>
<td>One-step steam loss</td>
<td>157</td>
</tr>
<tr>
<td>Continuous steam loss</td>
<td>159</td>
</tr>
</tbody>
</table>

**Reservoir Properties**

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>107 (D)</td>
<td>169 (K)</td>
<td>134 (A)</td>
<td>137</td>
<td>13</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10^18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.09</td>
<td>STD. DEV. = 0.33</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**References:**
- Hem, 1950
- Sauck and Sumner, 1970
- West and Sumner, 1973
- Mariner and Others, 1977
- Renner and Others, 1976

**Compiled by:**
- Hooke, C., and Mariner, R.

**Gillard Hut Springs, Arizona**
FIELD NAME................ SAN SIMON WELL
CIRCULAR REFERENCE........... 033

GEOGRAPHIC LOCALITY
STATE......................... ARIZONA
COUNTY....................... COCHISE
LATITUDE...................... 32-24.0 N
LNGITUDE...................... 109-18.0 W
MAPS......................... MARTIN WELL 1124.000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
125 30E 08 SE GILA AND SALT RIVER

GENERAL INFORMATION
SURFACE ACTIVITY............... NONE. FOUND BY DRILLING
NO. OF WELLS...................... 1
MAXIMUM WELL TEMP (C).............. 1951
ROCK TYPES: ALLUVIUM OVERLYING GRANITIC (?) ROCKS
<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>125</td>
<td>145</td>
<td>134 (M)</td>
<td>135</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNSCOOEf) TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT</td>
<td>A) QUARTZ CONDUCTIVE</td>
<td>F) CRISTOBALITE</td>
<td>K) SULFATE GEOTHERMOMETER</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B) QUARTZ CONDUCTIVE, PH-CORRECTED</td>
<td>G) AMORPHOUS SILICA</td>
<td>L) SURFACE TEMPERATURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C) QUARTZ ADIABATIC</td>
<td>H) NA-K</td>
<td>M) WELL TEMPERATURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D) CHALCEDONY</td>
<td>I) NA-K-CA</td>
<td>N) MIXING MODEL</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E) CHALCEDONY, PH-CORRECTED</td>
<td>J) NA-K-CA, MG-CORRECTED</td>
<td>O) RENNER AND OTHERS, 1976</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
<td>1.2</td>
<td>0.1</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>1.5</td>
<td>1.0</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOLUME (KM³3)</td>
<td>2.3</td>
<td></td>
<td></td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY(10¹¹8 J)</td>
<td>0.75</td>
<td></td>
<td></td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMMENTS: REPORTED LOCATION MAY BE IN ERROR. MINIMUM AND MAXIMUM TEMPERATURES ARE SUBJECTIVE ESTIMATES.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REFERENCES: SWANBERG AND OTHERS, 1977</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMPILED BY: MARINER, R. AND HROOK, C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAN SIMON WELL, ARIZONA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
California
FIELD NAME: FORT HIDEWELL AREA
CIRCULAR REFERENCE: 034

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: MODOC
LATITUDE: 41°51.8 N
LONGITUDE: 120°09.6 W

TOWNSHIP RANGE SECTION BASE & MERIDIAN
46N 16E 17 NW OF NE MT DIABLO

GENERAL INFORMATION
WAGING FIGURE: 8
WAGING NUMBER: 12
ELEVATION (M): 1414
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 5
SPRING TEMPERATURES (C): 36 TO 45
ROCK TYPES: TERTIARY RHYOLITE

CHEMISTRY
SAMPLE SOURCE: REED; 1975
FLOW (L/MIN): 400
COLLECTION DATE: 1973/06/26

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>S</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>45.1</td>
<td>82</td>
<td>4.2</td>
<td>0.1</td>
<td>110</td>
<td>9.5</td>
<td>131</td>
<td>86</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>0.61</td>
<td>7.85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEL 0(18) S04  DEL 0(18) H2O  DEL 0 H2O
### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>99 (D)</td>
<td>179 (I)</td>
<td>126 (A)</td>
<td>135</td>
<td>17</td>
</tr>
<tr>
<td>Uncoded Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Quartz Conductive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B) Quartz Conductive, PH-Corrected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C) Quartz Adiabatic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D) Chalcedony</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E) Chalcedony, PH-Corrected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F) Cristobalite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G) Amorphous Silica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H) Na-K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I) Na-K-CA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J) Na-K-CA, Mg-Corrected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K) Sulfate Geothermometer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L) Surface Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M) Well Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N) Mixing Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O) Renner and Others, 1976</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Volume (km³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

### Thermal Energy (10¹¹ J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.08</td>
<td></td>
<td></td>
<td></td>
<td>0.34</td>
</tr>
</tbody>
</table>

### Comments

Low surface temperature and high flow rate suggests that surface temperatures may be nearer to minimum estimate or that the water may be mixed.  

### REFERENCES

Duffield and Fournier, 1974  
Reed, 1975

Compiled by: Brook, C.

Fort Bidwell Area, California
**FIELD NAME**................ SURPRISE VALLEY AREA  
**KGRA OR OTHER NAME**........ LAKE CITY-SURPRISE VALLEY KGRA  
**CIRCULAR REFERENCE**......... 035

**GEOGRAPHIC LOCALITY**  
STATE..................... CALIFORNIA  
COUNTY.................... MODOC  
LATITUDE.................. 41°40.0' N  
LONGITUDE................. 120°12.0' W  
MAPS...................... CEDARVILLE 1:62,500

<table>
<thead>
<tr>
<th>TOWNSHIP</th>
<th>RANGE</th>
<th>SECTION</th>
<th>BASE &amp; MERIDIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>44N</td>
<td>15E</td>
<td>24</td>
<td>SW OF NE MT, DIABLO</td>
</tr>
</tbody>
</table>

**GENERAL INFORMATION**  
WARING FIGURE...................... 8  
WARING NUMBER...................... 14-18  
AREA OF SURFACE EXPRESSION (KM²). 1  
ELEVATION (M)....................... 1366  
SURFACE ACTIVITY................... HOT SPRINGS (VIOLENT MUD ERUPTION IN 1951)  
ASSOCIATED DEPOSITS................ SINTER  
NO. OF SPRINGS..................... MORE THAN 15 IN 4 GROUPS  
SPRING TEMPERATURES (C)............. 62 to 98  
DISCHARGE (L/MIN)................... 1350  
NO. OF WELLS........................ 8  
WELL DEPTHS (M)..................... 28 to 2085  
MAXIMUM WELL TEMP (C).............. 160 AT DEPTH (M) 1155  
ROCK TYPES: ALLUVIUM OVERLYING TERTIARY RHYOLITE  
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, AMT

**CHEMISTRY**  
SAMPLE SOURCE.... REED, 1975 (SEYFERTH HOT SPRINGS)  
FLOW (L/MIN)..... 500  
COLLECTION DATE.. 1973/07/26

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>110</td>
<td>20</td>
<td>LT 0.1</td>
<td>300</td>
<td>9.0</td>
<td>63</td>
<td>0</td>
<td>370</td>
<td>220</td>
</tr>
<tr>
<td>F</td>
<td>5.4</td>
<td>7.6</td>
<td>7.66</td>
<td>-5.62</td>
<td>-14.05</td>
<td>-121.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PH</td>
<td>UEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>129</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>101</td>
</tr>
<tr>
<td>NA-K</td>
<td>76</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>137</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>143</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>116</td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>92</td>
</tr>
<tr>
<td>OPAL</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>205</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>185</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>189</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>129 (I)</td>
<td>185</td>
<td>143 (A)</td>
<td>152</td>
<td>12</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, pH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>250</td>
<td>95</td>
<td>128.3</td>
<td>44.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Based on estimates of Renner and Others (1976) and water quality hazard area.

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>213.9</td>
<td></td>
<td></td>
<td></td>
<td>85.3</td>
<td>44.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10¹¹ J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>79.31</td>
<td></td>
<td></td>
<td></td>
<td>32.5</td>
<td>30</td>
</tr>
</tbody>
</table>

Comments: The system includes mud volcano area, Seyfert Hot Springs, Leondard Hot Springs, and Hot Springs Motel. Water chemistry for the 4 spring groups is similar, suggesting a single system. Reported well temperature is from the mud volcano area. Water quality area is defined by high boron concentrations.

References: White, 1955; Waring, 1965; Duffield and Fournier, 1974; Reed, 1975; California Department of Water Resources, 1963; Chapman and Bishop, 1968

Compiled by: Hrook, C.

Surprise Valley Area, California
FIELD NAME: WEST VALLEY RESERVOIR HOT SPRING
CIRCULAR REFERENCE: 036

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: MODOC
LATITUDE: 41°11.5' N
LONGITUDE: 120°23.1' W
MAPS: TULE MOUNTAIN 1:24,000
TOWNSHIP RANGE SECTION BASE & MERIDIAN
J9N 14E 29 NW OF NE MT, DIABLO

GENERAL INFORMATION
ELEVATION (M): 1460
SURFACE ACTIVITY: HOT SPRING
NO. OF SPRINGS: 1?
SPRING TEMPERATURES (C): 77.3
DISCHARGE (L/MIN): 12
ROCK TYPES: BASALT

CHEMISTRY
SAMPLE SOURCE: REED, 1975
FLOW (L/MIN): 12
COLLECTION DATE: 1973/07/24

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SIO2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>77.3</td>
<td>130</td>
<td>19</td>
<td>LT 0.1</td>
<td>330</td>
<td>11</td>
<td>63</td>
<td>0</td>
<td>510</td>
<td>150</td>
</tr>
<tr>
<td>F</td>
<td>4.0</td>
<td>4.5</td>
<td>PH</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H2O</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>7.79</td>
<td>-14.13</td>
<td>-118.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA \((1/3)\) .......... 138
- NA-K-CA \((4/3)\) .......... 120
- NA-K- .................. 84

**SILICA**
- ADIABATIC................ 145
- CONDUCTIVE................ 152
- CHALCEDONY................. 127
- CRISTOBALITE.............. 102
- OPAL...................... 31

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>138 (I)</td>
<td>152 (A)</td>
<td>138 (I)</td>
<td>143</td>
<td>3</td>
</tr>
</tbody>
</table>

**SUBSURFACE TEMP (°C)**
- MINIMUM: 138 (I)
- MAXIMUM: 152 (A)
- MOST LIKELY: 138 (I)
- MEAN: 143
- STD. DEV.: 3

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**
- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**
- MINIMUM: 0.5
- MAXIMUM: 2.0
- MOST LIKELY: 1.5
- MEAN: 1.7
- STD. DEV.: 0.3

**THICKNESS (KM)**
- MINIMUM: 1.0
- MAXIMUM: 2.5
- MOST LIKELY: 1.5
- MEAN: 2.0
- STD. DEV.: 0.4

**SUBSURFACE AREA (KM^2)**
- MINIMUM: 1
- MAXIMUM: 3
- MOST LIKELY: 2

VOLUME (KM^3), ............. 3.3
THermal ENERGY(10^18 J), 1.15

REFERENCES: REED, 1975

COMPILED BY: BROOK, C.

WEST VALLEY RESERVOIR HOT SPRING, CALIFORNIA
FIELD NAME............... RASSETT HOT SPRING
CIRCULAR REFERENCE..... 037

GEOGRAPHIC LOCALITY
STATE...................... CALIFORNIA
COUNTY..................... LASSEN
LATITUDE................... 41-08.7 N
LONGITUDE.................. 121-06.6 W
MAPS......................... HIERF 1162, 500

TOWNSHIP RANGE SECTION
38N 07E 12 NW OF SE M1, DIABLO

GENERAL INFORMATION
WARING FIGURE................... H
WARING NUMBER................... 74
ELEVATION (M)................... 1265
SURFACE ACTIVITY................ HOT SPRING
NO. OF SPRINGS................... 17
SPRING TEMPERATURES (C)........... 74
DISCHARGE (L/MIN)............. 200
ROCK TYPES: SANDSTONE OVERLYING HASALT (?)

CHEMISTRY
SAMPLE SOURCE........ RFED: 1975
FLOW (L/MIN)............ 200
COLLECTION DATE........ 1973/08/14

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SIO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>MgO3</th>
<th>CaO</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td>64</td>
<td>30</td>
<td>Li</td>
<td>0.1</td>
<td>220</td>
<td>3.2</td>
<td>30</td>
<td>1</td>
<td>370</td>
</tr>
</tbody>
</table>

F  2.0
PH 2.5
8.53

DEL 0(1A) S04  DEl 0(1A) H2O  DEL D H2O
-14.67
-116.2
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) .......... 96
- NA-K-CA (4/3) .......... 62
- NA-K- .................. 33

SILICA
- ADIABATIC ............... 115
- CONDUCTIVE ........... 117
- CHALCEDONY ........... 88
- CRISTOBALITE ......... 66
- OPAL ................... -1

RESEVOIR PROPERTIES

SUBSURFACE TEMP (C)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>88 (D)</td>
<td>117 (A)</td>
<td>88 (D)</td>
<td>98</td>
<td>7</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>B)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

THICKNESS (KM)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>B)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>B)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON: STANDARD ESTIMATE

VOLUME (KM**3)

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A)</td>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B)</td>
<td>0.74</td>
<td>STD. DEV. = 0.22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES: WARING, 1965; REED, 1975

COMPILED BY: BROOK, C.

BASSETT HOT SPRING, CALIFORNIA
FIELD NAME: KELLY HOT SPRING
CIRCULAR REFERENCE: 038

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: MODOC
LATITUDE: 41°27.5' N
LONGITUDE: 120°50.0' W
MAPS: CANRY 1162,500

TOWNSHIP
RANGE
SECTION
42N
10E
29
NE OF NW

BASE & MERIDIAN
MT, DIABLO

GENERAL INFORMATION
WARNING FIGURE: 8
WAKING NUMBER: 8
ELEVATION (M): 1326
SURFACE ACTIVITY: HOT SPRING
NO. OF SPRINGS: 1
SPRING TEMPERATURES (C): 91.5
DISCHARGE (L/MIN): 1250
NO. OF WELLS: 2
WELL DEPTHS (M): 978 TO 1035
MAXIMUM WELL TEMP (C): 116 AT DEPTH (M) 1035

ROCK TYPES: PLIOCENE (?) PYROCLASTICS AND BASALT FLOWS

GEOPHYSICS: GRAVITY

CHEMISTRY
SAMPLE SOURCE: REED, 1975
FLOW (L/MIN): 1250
COLLECTION DATE: 1973/07/23

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>91.5</td>
<td>110</td>
<td>20</td>
<td>LT 0.1</td>
<td>250</td>
<td>6.5</td>
<td>45</td>
<td>1</td>
<td>300</td>
<td>160</td>
</tr>
</tbody>
</table>

F 8
PH 3.8
S04 DEL 0(18) 1
HC03 DEL 0(18) 1
S04 DEL 0 H2O
H20 DEL 0 H2O

-4.73
-13.54
-115.1
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-Ca (1/3)</td>
<td>123</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-Ca (4/3)</td>
<td>95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>67</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>198</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-step Steam Loss</td>
<td>181</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Steam Loss</td>
<td>185</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95 (I)</td>
<td>143 (A)</td>
<td>116 (D,M)</td>
<td>118</td>
<td>10</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT**

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-Ca
J) Na-K-Ca, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.9</td>
<td>2.0</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |

| SUBSURFACE AREA (KM**2) | 1 | 3 | 2 | 2.0 | 0.4 |

**VOLUME (KM**3)** | 3.3 | STD. DEV. = 0.9

**THERMAL ENERGY (10**18 J)** | 0.93 | STD. DEV. = 0.27

**COMMENTS:** Chalcedony temperature (most likely) corresponds to maximum reported well temperature. High temperature calculated from the sulfate geothermometer, temperatures may be inaccurate. Mixing calculations with a low silica (30 mg/L) cold water (10 C) indicate a possible temperature of 185 C. However, proof of mixing is not available.

**REFERENCES:** Duffield and Fournier, 1974; Reed, 1975; Chapman and Others, 1978

**Compiled By:** Brook, C.

Kelly Hot Spring, California
FIELD NAME: BIG BEND HOT SPRINGS
CIRCULAR REFERENCE: 039

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: SHASTA
LATITUDE: 41°01.3' N
LONGITUDE: 121°55.1' W
MAPS: BIG BEND 1:162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
37N 01W 36 SW OF NE MT. DIABLO

GENERAL INFORMATION
WARNING FIGURE: 8
WARNING NUMBER: 24
ELEVATION (M): 512
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 6
SPRING TEMPERATURES (C): 38 TO 82
DISCHARGE (L/MIN): 341
ROCK TYPES: QUARTZ DIORITE DIKE IN SEDIMENTARY STRATA

CHEMISTRY
SAMPLE SOURCE: BERKSTRESSER, 1968
FLOW (L/MIN): 37.8

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>73</td>
<td>88</td>
<td>0.6</td>
<td>565</td>
<td>20</td>
<td>40</td>
<td>276</td>
<td>850</td>
<td></td>
</tr>
</tbody>
</table>

F 8    PH 8.1  DEL 0(18) SO4  DEL 0(18) H2O  DEL D H2O
### GEOTHERMOMETERS (C)

#### CATION
- NA-K-CA (1/3)........... 137
- NA-K-CA (4/3) .......... 110
- NA-K................... 88

#### SILICA
- ADIABATIC.............. 118
- CONDUCTIVE............. 120
- CHALCEDONY............. 92
- CRISTOBALITE........... 70
- OPAL................... 2

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>92 (D)</td>
<td>137 (I)</td>
<td>120 (A)</td>
<td>116</td>
<td>9</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Anhedral Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsurface Area (km*2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Based On Standard Estimate**

<table>
<thead>
<tr>
<th>Volume (km*3)</th>
<th>3.3</th>
<th>Std. Dev. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10**18 J)</td>
<td>0.91</td>
<td>Std. Dev. = 0.27</td>
</tr>
</tbody>
</table>

**References:**
- Waring, 1965
- Berkstresser, 1968

**Compiled By:**
- Brook, C.

**Big Bend Hot Springs, California**
FIELD NAME: LASSEN
KGRA OR OTHER NAME: LASSEN VOLCANIC NATIONAL PARK
CIRCULAR REFERENCE: 040

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: SHASTA, PLUMAS, TEHAMA
LATITUDE: 40°26.0' N
LONGITUDE: 121°26.0' W
MAPS: LASSEN VOLCANIC NATIONAL PARK AND VICINITY 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
30N 05E 21 SW MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 25-27, 34-38
AREA OF SURFACE EXPRESSION (KM**2): 2
ELEVATION (M): 1830
SURFACE ACTIVITY: HOT SPRINGS, FUMAROLES, ROCK ALTERATION
NO. OF SPRINGS: ABOUT 75
SPRING TEMPERATURES (C): 50 TO 95
DISCHARGE (L/MIN): 735
ROCK TYPES: ANDESITE, DACITE, RHYOLITE
## RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>215</td>
<td>255</td>
<td>240</td>
<td>237</td>
<td>8</td>
</tr>
</tbody>
</table>

**Uncooked Temperature Indicates Subjective Judgement**

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Additional Data

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>70</td>
<td>47</td>
<td></td>
<td>42.3</td>
<td>12.4</td>
</tr>
</tbody>
</table>

Based on: Renner et al., 1976 (Distribution of Vent Areas)

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>70.6</th>
<th>Std. Dev. = 24.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10⁸ J)</td>
<td>42.23</td>
<td>Std. Dev. = 14.92</td>
</tr>
</tbody>
</table>

**Comments:** Probably the only major vapor-dominated system in the U.S. outside of the Geysers. Geothermometers are not applicable because of acid-sulfate spring waters. Temperature estimates based on comparison with the Geysers as surface expressions and low-Cl waters are similar to the Geysers. Area withdrawn from commercial exploration or development because of National Park Status.

**References:**
- Day and Allen, 1924, 1925
- Williams, 1932
- Waring, 1965
- Renner and Others, 1976
- Bowen, 1978

**Compiled By:** Brook, C.

**Lassen, California**
FIELD NAME................ MORGAN SPRINGS-GROWLER SPRINGS AREA
KGRA OR OTHER NAME........ LASSEN KGRA
CIRCULAR REFERENCE....... 041

GEOGRAPHIC LOCALITY
STATE....................... CALIFORNIA
COUNTY...................... TEHAMA
LATITUDE................... 40-23.0 N
LONGITUDE.................. 121-31.0 W
MAP'S........................ LASSEN VOLCANIC NATIONAL PARK AND VICINITY 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
29N 04E 11 MT, DIABLO

GENERAL INFORMATION
WARING FIGURE.............. 8
WARING NUMBER................ 33
AREA OF SURFACE EXPRESSION (KM**2)........ 3
ELEVATION (M)................ 1495
SURFACE ACTIVITY................ HOT SPRINGS
ASSOCIATED DEPOSITS......... SINTER
NO. OF SPRINGS.............. 25
SPRING TEMPERATURES (C).... 32 TO 95
DISCHARGE (L/MIN).......... 350
ROCK TYPES: DACITE, ANDESITE

CHEMISTRY
SAMPLE SOURCE........ J. THOMPSON, UNPUB, DATA

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>231</td>
<td>80</td>
<td>0.05</td>
<td>1450</td>
<td>203</td>
<td>65</td>
<td>73</td>
<td>2273</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.95</td>
<td>-3.58</td>
<td>-9.14</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

- NA-K-CA (1/3)........ 230
- NA-K-CA (4/3)........ 254
- NA-K.................. 227

SILICA

- AOIABATIC.............. 176
- CONDUCTIVE............. 190
- CHALCEDONY.............. 170
- CRISTOBLITE............. 141
- OPAL,.................. 66

SULFATE

- CONDUCTIVE............. 272
- OHF-STEP STEAM LOSS..., 235
- CONTINUOUS STEAM LOSS., 245

RESERVOIR PROPERTIES

SUBSURFACE TEMP (°C)

- MINIMUM 176 (°C)
- MAXIMUM 245 (°K)
- MOST LIKELY 230 (°C)
- MEAN 217

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ AOIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBLITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS* 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.

DEPTH (100 (KM)) 0,5 2,0 1,5
THICKNESS (KM) 1,0 2,5 1,5 1,7 0,1
SUBSURFACE AREA (KM²) 285 5,0 1,2
BASED ON SPRING DISTRIBUTION AND ESTIMATES OF RENNER ET AL, 1976
VOLUME (KM³)................. 8,3
STD. DEV. = 2,6
THERMAL ENERGY(10¹⁸ J) 4,54
STD. DEV. = 1,46

COMMENTS: TWO GROUPS OF THERMAL SPRINGS ABOUT 1,2 KM APART. CHEMICAL ANALYSIS FROM GROWLER SPRINGS. WATER CHEMISTRY OF BOTH SPRINGS IS SIMILAR. SULFATE GEOTHERMOMETER FOR MORGAN SPRING GIVES 234 °C. SILICA GEOTHERMOMETERS MAY BE UNRELIABLE, SYSTEM MAY BE LARGER AND IS PROBABLY RELATED TO THE ADJACENT LASSEN VAPOR-DOMINATED SYSTEM.

REFERENCES: MAKING, 1965; RENNER AND OTHERS, 1976

COMPILATION: BROOK, C.

MORGAN SPRINGS-GROWLER SPRINGS AREA, CALIFORNIA
FIELD NAME ............... WENDEL-AMÉDEE AREA
KGRA OR OTHER NAME ...... WENDEL-AMÉDEE KGRA, HONEY LAKE
CIRCULAR REFERENCE ....... 042

GEOGRAPHIC LOCALITY
STATE .................. CALIFORNIA
COUNTY ................. LASSEN
LATITUDE ............. 40°18'0" N
LONGITUDE ........... 120°11'0" W
MAPS ...................... WENDEL 11625001 LITCHFIELD 1162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
21N 16E 08 MT. DIABLO

GENERAL INFORMATION
WARING FIGURE ...................... 8
WARING NUMBER ............... 30, 31
AREA OF SURFACE EXPRESSION (KM²) ........ 1.0
ELEVATION (M) .............. 1231
SURFACE ACTIVITY .............. HOT SPRINGS
ASSOCIATED DEPOSITS .......... TRAVERTINE
NO. OF SPRINGS .............. 10
SPRING TEMPERATURES (°C) ....... 71 TO 96
DISCHARGE (L/MIN) .............. 3596
NO. OF WELLS ................. 6
WELL DEPTHS (M) .............. 58 TO 1538
MAXIMUM WELL TEMP (°C) ........ 107 AT DEPTH (M) 338
ROCK TYPES: PLIOCENE BASALT

CHEMISTRY
SAMPLE SOURCE ........ MARINER AND OTHERS, 1976
FLOW (L/MIN) .............. 1200

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>S102</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>95.5</td>
<td>125</td>
<td>20</td>
<td>0.1</td>
<td>280</td>
<td>8.0</td>
<td>53</td>
<td>340</td>
<td>185</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>R</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2</td>
<td>5.6</td>
<td>8.26</td>
<td>-14.09</td>
<td>-118.8</td>
<td></td>
</tr>
</tbody>
</table>
### GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>128</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>104</td>
</tr>
<tr>
<td>NA-K</td>
<td>73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>143</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>150</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>125</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>100</td>
</tr>
<tr>
<td>OPAL</td>
<td>29</td>
</tr>
</tbody>
</table>

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>107 (H)</td>
<td>143 (C)</td>
<td>128 (I)</td>
<td>126</td>
<td>7</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE; PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.3</td>
<td>2.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>4</td>
<td>10</td>
<td>5</td>
<td>6.3</td>
<td>1.3</td>
</tr>
</tbody>
</table>

**COMMENTS:**

- CHEMICAL ANALYSIS AND TEMPERATURE CALCULATIONS FOR WENDEL HOT SPRINGS. CHEMICAL COMPOSITION OF AMDEE HOT SPRINGS IS SIMILAR. WELL TEMPERATURES MAY BE HIGHER THAN REPORTED HERE (107 C). FLOW RATE AND ISOTOPIC DATA FROM REED (1975).

**REFERENCES:**

- WARING, 1965
- KOENIG, 1970
- REED, 1975
- MARINER AND OTHERS, 1976
- USGS FILE DATA

**COMPILED BY:**

- BROOK, C.

**WENDEL-AMDEE AREA, CALIFORNIA**
FIELD NAME: SIERRA VALLEY AREA
CIRCULAR REFERENCE: 043

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: PLUMAS, SIERRA
LATITUDE: 39-42.7 N
LONGITUDE: 120-19.3 W
MAPS: PORTOLA 1162,5001 SIERRAVILLE 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
22N 15E 32 MT. DIABLO

GENERAL INFORMATION
WARNING FIGURE: a
WARNING NUMBER: 41A
ELEVATION (M): 1417
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
NO. OF WELLS: 8
WELL DEPTHS (M): 997 TO 680
ROCK TYPES: LACUSTRINE DEPOSITS OVERLYING RHYOLITE TUFF AND BRECCIA GRANITE BASEMENT

CHEMISTRY
SAMPLE SOURCE: REED, 1975
FLOW (L/MIN): 50
COLLECTION DATE: 1973/06/20

| TEMP (°C) | SI02 | CA  | MG   | NA   | K    | HC03 | CO3 | SO4 | CL
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>94.2</td>
<td>98</td>
<td>39</td>
<td>0.1</td>
<td>450</td>
<td>13</td>
<td>50</td>
<td>1</td>
<td>370</td>
<td>540</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td></td>
<td>DEL 0(18)</td>
<td>504</td>
<td>DEL D H2O</td>
<td>-117.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>8.8</td>
<td>7.97</td>
<td></td>
<td>DEL 0(18)</td>
<td>H2O</td>
<td>DEL D H2O</td>
<td>-117.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) ............. 131
- NA-K-CA (4/3) ............. 112
- NA-K ................... 74

SILICA
- ADIABATIC ............... 132
- CONDUCTIVE ............. 136
- CHALCEDONY ............ 109
- CRISTOBALITE .......... 85
- OPAL .................. 16

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>109 (D)</td>
<td>136 (A)</td>
<td>131 (I)</td>
<td>125</td>
<td>6</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) SULFATE GEOTHERMOMETER
I) NA-K
J) NA-K-CA
K) NA-K-CA, MG-CORRECTED
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1.0</td>
<td>0.5</td>
<td>1.0</td>
<td>0.2</td>
</tr>
</tbody>
</table>

THICKNESS (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
<td>0.2</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>16</td>
<td>10</td>
<td>10.0</td>
<td>2.4</td>
</tr>
</tbody>
</table>

BASED ON: WELL DISTRIBUTION AND GEOLOGY

VOLUME (KM³) ............... 10.0 STD. DEV. = 3.2

THERMAL ENERGY (10¹⁸ J) .... 2.98 STD. DEV. = 0.98

COMMENTS:
- AREA INCLUDES MARBLE HOT SPRINGS (WELLS).
- 1 GEOTHERMAL TEST WELL; OTHER 7 WELLS ARE ARTESIAN AND USED FOR STOCK WATERING.
- SURFACE TEMPERATURES RANGE FROM 39 TO 94 C. TOTAL DISCHARGE EXCEEDS 240 L/MIN.

REFERENCES:
- REED, 1975

COMPILED BY G. BROOKS, C.

SIERRA VALLEY AREA, CALIFORNIA
FIELD NAME .................. WILBUR SPRINGS AREA
CIRCULAR REFERENCE ........ 044

GEOGRAPHIC LOCALITY
STATE ................. CALIFORNIA
COUNTY ............. COLUSA
LATITUDE ........... 39°02.2' N
LONGITUDE .......... 122°25.2' W
MAPS ............... WILBUR SPRINGS 1I62»500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
14N 05W 28 MT. DIABLO

GENERAL INFORMATION
WAKING FIGURE ............. 8
WAKING NUMBER ............. 66-69
ELEVATION (M) ............... 412
SURFACE ACTIVITY .......... HOT SPRINGS, SULFUR FUMING
ASSOCIATED DEPOSITS ......... TRAVERTINE AT SOME SPRINGS
NO. OF SPRINGS ............. 20 IN 4 GROUPS
SPRING TEMPERATURES (C) .... 18 TO 67
DISCHARGE (L/MIN) ........... LT 100
NO. OF WELLS ............... 2
WELL DEPTHS (M) ............. 374 TO 1146
MAXIMUM WELL TEMP (C) ....... 141 AT DEPTH (M) 1132
ROCK TYPES: SERPENTINITE, CHERT, GRAYWACKE, ALTERED BASALT

CHEMISTRY
SAMPLE SOURCE ........... BARNES AND OTHERS, 1973
FLOW (L/MIN) .......... 60
COLLECTION DATE ......... 1969/12/02

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>200</td>
<td>2.8</td>
<td>38</td>
<td>8500</td>
<td>440</td>
<td>7130</td>
<td></td>
<td>390</td>
<td>9700</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>310</td>
<td>6.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEL O(18)</th>
<th></th>
<th>DEL O(18)</th>
<th></th>
<th>DEL O(M2O)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S04</td>
<td>+4.9</td>
<td>H2O</td>
<td></td>
<td>-24.8</td>
<td></td>
</tr>
<tr>
<td>DEL D H2O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>781</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>118</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SILICA

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>168</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>180</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>159</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>130</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>56</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>141 (M)</td>
<td>150</td>
<td>141 (M)</td>
<td>144</td>
<td>2</td>
</tr>
</tbody>
</table>

*INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)        MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THICKNESS (KM)          MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM**2)  MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BASED ON DISTRIBUTION OF THERMAL SPRINGS AND HG MINERALIZATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>15</td>
<td>6</td>
<td>8.3</td>
</tr>
</tbody>
</table>

VOLUME (KM**3)............ 12.5     | STD. DEV. = 4.0

THERMAL ENERGY (10**8 J)  4.35     | STD. DEV. = 1.40

COMMENTS: WATER BELIEVED TO BE IN PART CONNATE. GEOTHERMOMETRY IS NOT RELIABLE BECAUSE OF NEAR-SURFACE REACTION BETWEEN WATER AND SERPENTINE. MAXIMUM TEMPERATURE IS ESTIMATED.

REFERENCES: WARING, 1965; BARNES AND OTHERS, 1973; WHITE AND OTHERS, 1973

COMPILED BY: B. ROOK, C.

WILBUR SPRINGS AREA, CALIFORNIA
**FIELD NAME**................. CHALK MOUNTAIN AREA  
**KGRA OR OTHER NAME**......... GEYSERS-CALISTOGA KGRA  
**CIRCULAR REFERENCE**......... 045  

**GEOGRAPHIC LOCALITY**  
**STATE**....................... CALIFORNIA  
**LATITUDE**.................... 39-04.8 N  
**LONGITUDE**................... 122-35.0 W  
**MAPS**......................... CLEARLAKE OAKS 1162,500  

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**  
14N 07W 12 SW MT. DIABLO  

**GENERAL INFORMATION**  
**WARING FIGURE**................... 8  
**WARING NUMBER**................ 51A  
**AREA OF SURFACE EXPRESSION (KM**2)**............. 0.3  
**ELEVATION (M)**.................. 366  
**SURFACE ACTIVITY**............... WARM SPRINGS, FUMAROLES  
**ASSOCIATED DEPOSITS**............. TRAVERTINE  
**NO. OF SPRINGS**................... 3  
**SPRING TEMPERATURES (C)**........... 20 TO 24  
**DISCHARGE (L/MIN)**................ 11  
**ROCK TYPES** ALTERED DACITE  

**CHEMISTRY**  
**SAMPLE SOURCE**............ THOMPSON AND OTHERS, 1978  
**FLOW (L/MIN)**............. 0.4  
**COLLECTION DATE**........... 1976/06/26  

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>91</td>
<td>66</td>
<td>495</td>
<td>1600</td>
<td>196</td>
<td>3300</td>
<td>32</td>
<td>2410</td>
<td></td>
</tr>
</tbody>
</table>

**F**  0  PH  6.6  
DEL 0(18) SO4  DEL 0(18) H20  DEL D H20
**GEOTHERMOMETERS (C)**

**CATION**
- NA-K-CA (1/3) .......... 225
- NA-K-CA (4/3) .......... 263
- NA-K ................. 209

**SILICA**
- ADIABATIC .............. 128
- CONDUCTIVE ............ 132
- CHALCEDONY .......... 105
- CRISTOBALITE .......... 81
- OPAL ................. 12

**RESEVOIR PROPERTIES**

**SUBSURFACE TEMP (C)**
- MINIMUM 105 (D)
- MAXIMUM 128 (C)
- MOST LIKELY 105 (D)
- MEAN 113
- STD. DEV. 5

Uncoded temperature indicates subjective judgement.
- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**
- MINIMUM 0.5
- MAXIMUM 2.0
- MOST LIKELY 1.5
- MEAN 1.7
- STD. DEV. 0.3

**THICKNESS (KM)**
- MINIMUM 1.0
- MAXIMUM 2.5
- MOST LIKELY 1.5
- MEAN 2.0
- STD. DEV. 0.4

**SUBSURFACE AREA (KM**2)**
- MINIMUM 1
- MAXIMUM 2
- MOST LIKELY 2
- MEAN 1.7
- STD. DEV. 0.3

**VOLUME (KM**3)**
- MINIMUM 3.3
- MAXIMUM 3.3
- MOST LIKELY 3.3
- MEAN 3.3
- STD. DEV. 0.9

**THERMAL ENERGY (10**18 J)**
- MINIMUM 0.88
- MAXIMUM 0.88
- MOST LIKELY 0.88
- MEAN 0.88
- STD. DEV. 0.25

**COMMENTS:** Presence of sulfur fuming and hydrothermally altered rock suggests a hydrothermal system even though surface temperatures are quite low. Geothermometry is probably not reliable because of low flow rate, high Mg and HCO3, and likelihood of near-surface water-rock reactions. Temperatures may be higher or lower than reported here. May have heat source in the Clear Lake volcanic field.

**REFERENCES:** THOMPSON AND OTHERS, 1978; WARING, 1965

**COMPILED BY:** BROOK, C.

**CHALK MOUNTAIN AREA, CALIFORNIA**
FIELD NAME................ SULPHUR BANK MINE (HOT HOLATA)
KGRA OR OTHER NAME........ GEYSERS-CALISTOGA KGRA
CIRCULAR REFERENCE........ 046

GEOGRAPHIC LOCALITY
STATE..................... CALIFORNIA
COUNTY.................... LAKE
LATITUDE.................. 39-01.0 N
LONGITUDE.................. 122-39.0 W
MAPS...................... CLEARLAKE OAKS 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
13N 07W 05 SW MT. DIABLO

GENERAL INFORMATION
WAKING FIGURE...................... B
WAKING NUMBER...................... 57
AREA OF SURFACE EXPRESSION (KMSq), 0.5
ELEVATION (M)...................... 396
SURFACE ACTIVITY................... HOT SPRINGS, FUMAROLRS
ASSOCIATED DEPOSITS................ CINNABAR AND SULFUR
NO. OF SPRINGS...................... 10
SPRING TEMPERATURES (C)............ 28 TO 69
NO. OF WELLS....................... 4
WELL DEPTHS (M).................... 161 TO 1215
MAXIMUM WELL TEMP (C)............. 186 AT DEPTH (M) 427
ROCK TYPES: ALTERED QUATERNARY BASALT FLOWS OVERLYING FRANCISCAN ROCKS
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY

CHEMISTRY
SAMPLE SOURCE........ BERKSTRESSER, 1968

<table>
<thead>
<tr>
<th></th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMP(C)</td>
<td>99</td>
<td>203</td>
<td>26</td>
<td>23</td>
<td>1340</td>
<td>44</td>
<td>2600</td>
<td>680</td>
<td>900</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) Si04</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.4</td>
<td>828</td>
<td>8.1</td>
<td></td>
<td>DEL 0(18) Si04</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H2O</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>+4.58</th>
<th></th>
<th>-26.6</th>
</tr>
</thead>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>156</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>201</td>
</tr>
<tr>
<td>Na-K</td>
<td>83</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>169</td>
</tr>
<tr>
<td>Conductive</td>
<td>181</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>160</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>131</td>
</tr>
<tr>
<td>Opal</td>
<td>57</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>186 (M)</td>
<td>210</td>
<td>186 (M)</td>
<td>194</td>
<td>6</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, pH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>4.0</td>
<td>0.8</td>
</tr>
</tbody>
</table>

### Subsurface Area (KM²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6</td>
<td>4</td>
<td>4.0</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Based on estimates of Renner et al (1976).

### Volumetric (KM³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td>STD. DEV. = 1.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thermal Energy (10¹⁸ J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.22</td>
<td>STD. DEV. = 0.91</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comments:
Believed to be mixture of meteoric and metamorphic waters. Geothermometry is not reliable.

Maximum temperature based on comparison to Clear Lake volcanic field to which Sulphur Bank may be related.

Isotopic data from White and Others (1973).


Compiled by: Brook, C.

Sulphur Bank Mine (Hot Bolata), California.
FIELD NAME................ CLEAR LAKE VOLCANIC FIELD AREA
KGRA OR OTHER NAME........ GEYSERS-CALISTOGA KGRA
CIRCULAR REFERENCE........ 047

GEOGRAPHIC LOCALITY
STATE.................... CALIFORNIA
COUNTY.................... LAKE
LATITUDE.................. 38°55.0' N
LONGITUDE................. 122°43.0' W
MAPS...................... CLEARLAKE HIGHLANDS 1:24,000 KELSEYVILLE 1:24,000

GENERAL INFORMATION
WARNING FIGURE...................... 4
WARNING NUMBER...................... 55, 56, 58, 59
ELEVATION (M)...................... 760
SURFACE ACTIVITY..................... HOT SPRINGS, FUMAROLES
ASSOCIATED DEPOSITS................ SULFUR
NO. OF SPRINGS..................... SEVERAL IN 4 OR 5 MAIN GROUPS
SPRING TEMPERATURES (C)............. 30° TO 52°
DISCHARGE (L/MIN).................. GREATER THAN 2000
NO. OF WELLS....................... 2
MAXIMUM WELL TEMP (C)............. 210° AT DEPTH (M) 2000
ROCK TYPES: QUATERNARY RHYOLITE, DACITE, BASALT
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY

CHEMISTRY
SAMPLE SOURCE........ GOFF AND OTHERS, 1977 (HOWARD SPRING)
FLOW (L/MIN).............. 250

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>160</td>
<td>32</td>
<td>320</td>
<td>240</td>
<td>23</td>
<td>1660</td>
<td>2</td>
<td>460</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>39</td>
<td>6.58</td>
<td>-7.26</td>
<td>-57.8</td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Formula</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>179</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>156</td>
<td>Adiabatic</td>
</tr>
<tr>
<td>165</td>
<td>Conductive</td>
</tr>
<tr>
<td>142</td>
<td>Chalcedony</td>
</tr>
<tr>
<td>115</td>
<td>Cristobalite</td>
</tr>
<tr>
<td>42</td>
<td>Opal</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>165 (A)</td>
<td>210 (N)</td>
<td>195 (N)</td>
<td>190</td>
<td>9</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>10</td>
<td>100</td>
<td>40</td>
<td>50.0</td>
<td>18.7</td>
</tr>
</tbody>
</table>

**Based on: Geology, Spring Distribution, and Gravity**

<table>
<thead>
<tr>
<th>Property</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (km³)</td>
<td>83.3</td>
</tr>
<tr>
<td>Thermal Energy (10⁻¹⁸ J)</td>
<td>39.37</td>
</tr>
</tbody>
</table>

**Comments:** Geothermometry may not be reliable for this and other surface waters in the Clear Lake area because of high CO₂ and Mg concentrations and likelihood of water reacting with serpentine. Maximum and most likely temperatures are reported by Goff and others (1977). Maximum temperature corresponds to their calculated well temperature (210°C). Temperatures as high as 270°C (unconfirmed hearsay) supposedly occur at about 3000 m in another well. Although the area may be larger, there is no evidence that the volcanic field is underlain by a single hydrothermal system. Rather, there may be several isolated systems separated by hot, dry rock. Area along Konocti Bay fault zone may be most likely target.

**References:** Waring, 1965; Stanley and others, 1973; Chapman, 1975; Hearn and others, 1976; Goff and others, 1977; Iyer and others, 1978

**Compiled by:** Hooke, C.

Clear Lake volcanic field area, California
FIELD NAME: THE GEYSERS
KGRA OR OTHER NAME: GEYSERS-CALISTOGA KGRA
CIRCULAR REFERENCE: 048

GEOGRAPHIC LOCALITY

STATE: CALIFORNIA
COUNTY: SONOMA AND LAKE
LATITUDE: 38-48.0 N
LONGITUDE: 122-48.0 W
MAPS: GEYSERS H24000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
1N 09W 13 NE MT. DIABLO

GENERAL INFORMATION

WARNING FIGURE: 8
WARNING NUMBER: 62, 63, 72, 73, 74
AREA OF SURFACE EXPRESSION (KM²): 1
ELEVATION (M): 550
SURFACE ACTIVITY: FUMAROLES, HOT SPRINGS, ROCK ALTERATION
NO. OF SPRINGS: 20
SPRING TEMPERATURES (C): 20 TO 101
DISCHARGE (L/MIN): 100
NO. OF WELLS: MORE THAN 210
WELL DEPTHS (M): 60 TO 2900
MAXIMUM WELL TEMP (C): 240 AT DEPTH (M) 1200
ROCK TYPES: FRANCISCAN ASSEMBLAGE (SERPENTINE, GRAYWACKE, GREENSTONE)
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, MICROEARTHQUAKE, SEISMIC NOISE
## Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>215</td>
<td>255</td>
<td>240</td>
<td>237</td>
<td>8</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- **A** Quartz conductive
- **B** Quartz conductive, PH-corrected
- **C** Quartz adiabatic
- **D** Chalcedony
- **E** Chalcedony, PH-corrected
- **F** Cristobalite
- **G** Amorphous silica
- **H** Na-K
- **I** Na-K-Ca
- **J** Na-K-Ca, Mg-corrected
- **K** Sulfate geothermometer
- **L** Surface temperature
- **M** Well temperature
- **N** Mixing model
- **O** Renner and others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.04</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
<td>120</td>
<td>120</td>
<td>100</td>
<td>14.1</td>
</tr>
</tbody>
</table>

Based on well distribution, gravity survey, geology.

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>166.7 STD. DEV. = 39.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10¹² J)</td>
<td>99.75 STD. DEV. = 23.85</td>
</tr>
</tbody>
</table>

Comments: Vapor-dominated system. Water chemistry not applicable to geothermometer calculations. Temperatures based on and extrapolated from temperature-depth curves (Hite and Fehlberg, 1976). Over 200 wells have been drilled since the 1950's. Reservoir probably continues deeper than 3 km. Current installed generating capacity is 66.3 MW. Heat production about 80 times estimated natural heat flow. Total generating capacity of field is estimated in excess of 1800 MW by year 2000.


Compiled by: Brook, C.

The Geysers, California
FIELD NAME.............. SKAGGS HOT SPRINGS
CIRCULAR REFERENCE..... 049

GEOGRAPHIC LOCALITY
STATE.................... CALIFORNIA
COUNTY.................... SONOMA
LATITUDE.................. 38-41.5 N
LONITUDE............... 123-01.5 W
MAPS..................... SKAGGS SPRINGS 1124*000

TOWNSHIP RANGE SECTION
ION 11W 25NW OF NE Mt. DIABLO

GENERAL INFORMATION
WARING FIGURE............... 8
WARING NUMBER................ 71
ELEVATION (M)................ 98
SURFACE ACTIVITY................. HOT SPRINGS
NO. OF SPRINGS............... 3
SPRING TEMPERATURES (C)......... 49 TO 57
DISCHARGE (L/Min)............... 57
ROCK TYPES: FRANCISCAN SEDIMENTARY ROCKS

CHEMISTRY
SAMPLE SOURCE........ BERKSTRESSER, 1968
FLOW (L/Min)........ 15

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>124</td>
<td>14</td>
<td>4.5</td>
<td>945</td>
<td>29</td>
<td>2470</td>
<td></td>
<td>5</td>
<td>54</td>
</tr>
</tbody>
</table>

PH 7.2

DEL 0(10) S04  DEL 0(10) H2O  DEL D H2O
GEOHEMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>152</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>194</td>
</tr>
<tr>
<td>NA-K</td>
<td>78</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>143</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>150</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>124</td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>99</td>
</tr>
<tr>
<td>OPAL</td>
<td>28</td>
</tr>
</tbody>
</table>

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>95 (J)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAXIMUM</td>
<td>150 (A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOST LIKELY</td>
<td>95 (J)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEAN</td>
<td>113</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM²)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD. DEV.</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| VOLUME (KM³)          | 3.3     | STD. DEV. = 0.9 |
| THERMAL ENERGY (J)    | 0.88    | STD. DEV. = 0.28 |

COMMENTS: GEOTHERMOMETRY MAY BE INACCURATE DUE TO LOW FLOW RATE.

REFERENCES: WARING, 1965; BERKSTRESSER, 1968

COMPILED BY: BROOK, C.

SKAGGS HOT SPRINGS, CALIFORNIA
FIELD NAME................ CALISTOGA HOT SPRINGS
KGRA OR OTHER NAME........ GEYSERS-CALISTOGA KGRA
CIRCULAR REFERENCE........ 050

GEOGRAPHIC LOCALITY
STATE..................... CALIFORNIA
COUNTY.................... NAPA
LATITUDE............... 38°34.9' N
LONGITUDE............ 122°34.4' W
MAPS...................... CALISTOGA 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
09N 06W 31 NW OF SW MT. DIABLO

GENERAL INFORMATION
WARNIG FIGURE...................... B
WARNING NUMBER...................... 81
ELEVATION (M)...................... 107
SURFACE ACTIVITY................ HOT SPRINGS
ASSOCIATED DEPOSITS........... SILICA DEPOSITS IN WELL PIPES
NO. OF SPRINGS............... 4
SPRING TEMPERATURES (C)........ 52 TO 78
DISCHARGE (L/MIN).............. 30
NO. OF WELS.................... SEVERAL
WELL DEPTHS (M).................... 46(?) TO 610
MAXIMUM WELL TEMP (C)......... 137 AT DEPTH (M) 610(?)
ROCK TYPES: FAULTED TUFF (PLIOCENE?)

CHEMISTRY
SAMPLE SOURCE.... THOMPSON AND OTHERS, 1978
FLOW (L/MIN)............ 80
COLLECTION DATE: 1976/09/25

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>106</td>
<td>150</td>
<td>25</td>
<td>193</td>
<td>8.7</td>
<td>184</td>
<td>13</td>
<td>206</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F 8 PH
8.4

DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3)............. 141
- NA-K-CA (4/3)............. 97
- NA-K.................. 107

**SILICA**
- ADIABATIC................ 153
- CONDUCTIVE............... 161
- CHALCEDONY............... 137
- CRISTOBALITE............ 111
- OPAL.................... 39

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>137 (M+D)</td>
<td>153 (C)</td>
<td>141 (I)</td>
<td>144</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**
- MINIMUM | 0.6
- MAXIMUM | 1.5

**THICKNESS (KM)**
- MINIMUM | 1.0
- MAXIMUM | 2.5

**SUBSURFACE AREA (KM**2)**
- MINIMUM | 2
- MAXIMUM | 6

**VOLUME (KM**3)**
- 6.9

**THERMAL ENERGY (10**18 J)**
- 2.41

**COMMENTS:**
- 3 WELLS DRILLED BY CALISTOGA POWER CO., DEEPEST ABOUT 610 M; NOW ABANDONED. OTHER WELLS USED FOR BATHING AND HEALTH RESORTS. CHEMICAL ANALYSIS FROM GEYSERING WELL 3 KM NORTHWEST OF MAIN DEVELOPED AREA WHERE WATER CHEMISTRY AND ESTIMATED SUBSURFACE TEMPERATURES ARE SIMILAR.

**REFERENCES:**
- WARING, 1965
- MCNITT, 1963
- KOENIG, 1970
- RENNER AND OTHERS, 1976
- THOMPSON AND OTHERS, 1978

**COMPILED BY:** BROOK, C.

CALISTOGA HOT SPRINGS, CALIFORNIA
FIELD NAME.................. GROVERS HOT SPRINGS
CIRCULAR REFERENCE........ 051

GEOGRAPHIC LOCALITY
STATE......................... CALIFORNIA
COUNTY....................... ALPINE
LATITUDE.................... 38-41.9 N
LONGITUDE................... 119-51.6 W
MAPS.......................... MARKLEEVILLE 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
10N 19E 24 SW MT. DIABLO

GENERAL INFORMATION
WARNING FIGURE................... 8
WARNING NUMBER.................... 113
AREA OF SURFACE EXPRESSION (KM²)......... 0.1
ELEVATION (M).......................... 1800
SURFACE ACTIVITY.................... HOT SPRINGS
NO. OF SPRINGS..................... 2 MAIN SPRINGS AND SEVERAL SEEPS
SPRING TEMPERATURES (C).............. 53 TO 64
DISCHARGE (L/MIN)................... 400
ROCK TYPES: FAULT CONTACT BETWEEN PLIOCENE ANDESITE FLOODS AND MESOZOIC GRANITE

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1977

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>100</td>
<td>31</td>
<td>1.9</td>
<td>440</td>
<td>13</td>
<td>776</td>
<td>160</td>
<td>190</td>
<td></td>
</tr>
</tbody>
</table>

F  4.2  B  3.1  PH  6.79  DEL 0(18) SO4  DEL 0(18) H2O  DEL D H2O  -15.62  -115.4
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) .......... 133
- NA-K-CA (4/3) .......... 117
- NA-K .................... 75

SILICA
- ADIABATIC ............... 133
- CONDUCTIVE ............. 137
- CHALCEDONY .............. 110
- CRISTOBALITE .......... 87
- OPAL ..................... 17

RESERVOIR PROPERTIES
SUBSURFACE TEMP (°C)
- MINIMUM .................. 110 (D)
- MAXIMUM ................... 137 (A)
- MOST LIKELY .............. 130 (J)
- MEAN ....................... 126
- STD. DEV. .................. 6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
- MINIMUM .................. 0.5
- MAXIMUM ................... 2.0
- MOST LIKELY .............. 1.5
- MEAN ....................... 1.7
- STD. DEV. .................. 0.3

THICKNESS (KM)
- MINIMUM .................. 1.0
- MAXIMUM ................... 2.5
- MOST LIKELY .............. 1.5
- MEAN ....................... 2.0
- STD. DEV. .................. 0.4

SUBSURFACE AREA (KM²)
- MINIMUM .................. 1
- MAXIMUM ................... 3
- MOST LIKELY .............. 2
- BASED ON STANDARD ESTIMATE

VOLUME (KM³)
- MINIMUM .................. 3.3
- STD. DEV. = 0.9

THERMAL ENERGY (10¹⁸ J)
- MINIMUM .................. 1.00
- STD. DEV. = 0.28

COMMENTS: STATE PARK. WATER USED FOR BATHING.
REFERENCES: MARINER AND OTHERS, 1977; FETH AND OTHERS, 1964; CURTIS, 1951

COMPILRED BY: BROOK, C.

GROVERS HOT SPRINGS, CALIFORNIA
FIELD NAME: FALES HOT SPRINGS
CIRCULAR REFERENCE: 052

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: MONO
LATITUDE: 38°20'0" N
LONGITUDE: 119°24'0" W
MAPS: FALES HOT SPRINGS 1124000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
06N 23E 24 SE MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 114
AREA OF SURFACE EXPRESSION (KM²): 0.1
ELEVATION (M): 2236
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 20
SPRING TEMPERATURES (°C): 36 TO 61
DISCHARGE (L/MIN): MORE THAN 1000
NO. OF WELLS: 1
WELL DEPTHS (M): 126
ROCK TYPES: PLIOCENE ANDESITE OVERLYING GRANITIC ROCKS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>114</td>
<td>41</td>
<td>10</td>
<td>560</td>
<td>37</td>
<td>1130</td>
<td>260</td>
<td>160</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7</td>
<td>8.2</td>
<td>6.55</td>
</tr>
</tbody>
</table>

DEL 0(18) SO₄ | DEL 0(18) H₂O | DEL 0 H₂O
-4.29 | -17.46 | -132.8
### GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3) .......... 173
- NA-K-CA (4/3) .......... 159
- NA-K ................. 140

**SILICA**
- ADIABATIC .......... 139
- CONDUCTIVE .......... 145
- CHALCEDONY .......... 119
- CRISTOBALITE .......... 94
- OPAL .......... 24

**SULFATE**
- CONDUCTIVE .......... 134
- ONE-STEP STEAM LOSS .. 125
- CONTINUOUS STEAM LOSS . 126

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>MINIMUM</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>MAXIMUM</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>MOST LIKELY</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

**COMMENTS:** CO₂-CHARGED WATER. TRAVERTINE MAY BE PRECIPITATING. GEOTHERMOMETRY MAY BE INACCURATE.

**REFERENCES:** Waring, 1965; Mariner and Others, 1977

**COMPILED BY:** HROOK, C.

FALES HOT SPRINGS, CALIFORNIA
FIELD NAME: BUCKEYE HOT SPRING
CIRCULAR REFERENCE: 053

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: MONO
LATITUDE: 38-14.3 N
LONGITUDE: 119-19.6 W
MAPS: MATTERHORN PEAK, 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
04N 24E 04 NE MT, DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 115
ELEVATION (M): 2100
SURFACE ACTIVITY: HOT SPRING
ASSOCIATED DEPOSITS: TRAVERTINE
SPRING TEMPERATURES (C): 60 TO 64
DISCHARGE (L/MIN): 400
ROCK TYPES: TILL OVERLYING QUARTZ MONZONITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>75</td>
<td>22</td>
<td>4.2</td>
<td>310</td>
<td>10</td>
<td>429</td>
<td></td>
<td>340</td>
<td>28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>pH</th>
<th>DEL 0(18) SiO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1</td>
<td>1.1</td>
<td>7.33</td>
<td>-17.66</td>
<td>-137.9</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>134</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A)ADIABATIC</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C) CONDUCTIVE</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D) CHALCEDONY</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E) CRISTOBALITE</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I) OPAL</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>87 (J)</td>
<td>122 (A)</td>
<td>93 (D)</td>
<td>101</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

| A) QUARTZ CONDUCTIVE | F) CRISTOBALITE |
| B) QUARTZ CONDUCTIVE; PH-CORRECTED | G) AMORPHOUS SILICA |
| C) QUARTZ ADIABATIC | H) NA-K |
| D) CHALCEDONY | I) NA-K-CA |
| E) CHALCEDONY; PH-CORRECTED | J) NA-K-CA; MG-CORRECTED |
| K) SULFATE GEOTHERMOMETER |
| L) SURFACE TEMPERATURE |
| M) WELL TEMPERATURE |
| N) MIXING MODEL |
| O) RENNER AND OTHERS, 1976 |

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY(10**18 J),</td>
<td>0.77</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STD. DEV. = 0.23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES: WARING, 1965; CHESTERMAN, 1975; MARINER AND OTHERS, 1977B

COMPILLED BY BROOK, C.

RUCKEYE HOT SPRING, CALIFORNIA
FIELD NAME: TRAVERTINE HOT SPRINGS AREA
CIRCULAR REFERENCE: 054

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: MONO
LATITUDE: 38°14'8" N
LONGITUDE: 119°12'1" W
MAPS: BODIE 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05N 25E 34 SW MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 116, 117
AREA OF SURFACE EXPRESSION (Km**2): 0.2
ELEVATION (M): 2059
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: ABOUT 25 IN 2 GROUPS 2.5 KM APART
SPRING TEMPERATURES (°C): 40 TO 69
DISCHARGE (L/MIN): 135
NO. OF WELLS: 1
WELL DEPTHS (M): 300
ROCK TYPES: PLIOCENE ANDESITE AND BASALT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>100</td>
<td>64</td>
<td>18</td>
<td>1100</td>
<td>55</td>
<td>1800</td>
<td>920</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

F    | 8    | PH  | DEL D (18) | S04 | DEL D (18) | H2O | DEL D H2O
4.5  | 9.9  | 6.73| -17.46     | -139.3 |
GEOTHERMOMETERS (C)

CAIION

- NA-K-CA (1/3).............. 167
- NA-K-CA (4/3).............. 176
- NA-K...................... 115

SILICA

- ADIABATIC................. 133
- CONDUCTIVE................. 137
- CHALCEDONY................ 110
- CHRISTOBALITE.............. 87
- OPAL...................... 17

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>87 (J)</td>
<td>137 (A)</td>
<td>110 (D)</td>
<td>111</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) | MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>2.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (KM**3).............. 3.3
THERMAL ENERGY(10**18 J)........ 0.87

COMMENTS: AREA INCLUDES THE HOT SPRINGS ABOUT 2.5 KM SOUTH. CHEMISTRY OF BOTH SPRINGS IS SIMILAR SUGGESTING A SINGLE SYSTEM.

REFERENCES: MARINER AND OTHERS, 1977B

COMPILED BY: BROOK, C.

TRAVERTINE HOT SPRINGS AREA, CALIFORNIA
**FIELD NAME**................. NORTH SHORE MONO LAKE (BLACK ROCK POINT HOT SPRING)
**KGRA OR OTHER NAME**........ MONO-LONG VALLEY KGRA
**CIRCULAR REFERENCE**......... 055

### GEOGRAPHIC LOCALITY

- **STATE**..................... CALIFORNIA
- **COUNTY**..................... MONO
- **LATITUDE**.................. 38-02.4 N
- **LONGITUDE**............... 119-04.8 W
- **MAPS**...................... BOOIE 1162,500

#### TOWNSHIP RANGE SECTION BASE & MERIDIAN
- 02N 26E 11 MT, DIABLO

### GENERAL INFORMATION

- **ELEVATION (M)**.............. 1964
- **SURFACE ACTIVITY**......... HOT SPRINGS
- **ASSOCIATED DEPOSITS**....... TRAVERTINE
- **SPRING TEMPERATURES (C)**.... 66
- **DISCHARGE (L/MIN)**......... 150
- **NO. OF WELLS**.............. 1 ABOUT 3 KM SOUTH
- **WELL DEPTHS (M)**........... 743
- **MAXIMUM WELL TEMP (C)**..... 57 AT DEPTH (M) 743

#### ROCK TYPES
- Quaternary Lake Deposits and Pyroclastics

### CHEMISTRY

**SAMPLE SOURCE**.... MARINER AND OTHERS, 1977

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>76</td>
<td>13</td>
<td>2.9</td>
<td>.430</td>
<td>8.8</td>
<td>454</td>
<td>100</td>
<td>350</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>pH</th>
<th>DEL O(18)</th>
<th>DEL O(18)</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>7.7</td>
<td>7.68</td>
<td>DEL O(18)</td>
<td>DEL O(18)</td>
<td>DEL D H2O</td>
</tr>
</tbody>
</table>
## Geothermometers (C)

**Cation**
- Na-K-CA (1/3)........... 123
- Na-K-CA (4/3)........... 125
- Na-K................... 52

**Silica**
- Adiabatic.............. 120
- Conductive............. 122
- Chalcedony............. 94
- Cristobalite........... 72
- Opal................... 4

## Reservoir Properties

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>85 (J)</td>
<td>122 (A)</td>
<td>94 (D)</td>
<td>100</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Subsurface Area (km^2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

Based on standard estimate

| Volume (km^3) | 3.3 | STD. DEV. = 0.3 |
| Thermal Energy (10^18 J) | 0.77 | STD. DEV. = 0.23 |

**Comments:** Springs are covered and inaccessible! Sample from outflow pipe 150 m from source.

**References:** Marinier and Others, 1977; Axtell, 1972

**Compiled by:** Brook, C.

North Shore Mono Lake (Black Rock Point Hot Spring, California)
FIELD NAME: LONG VALLEY CALDERA
KGRA OR OTHER NAME: MONO-LONG VALLEY KGRA
CIRCULAR REFERENCE: 056

GEOPHYSICAL LOCALITY
STATE: CALIFORNIA
COUNTY: MONO
LATITUDE: 37-40.0 N
LONGITUDE: 118-52.0 W
MAPS: MT. MORRISON 1162,500

TOWNSHIP RANGE SECTION BASE & MerIDIAN
035 2BE 32 MT, DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 122-125
AREA OF SURFACE EXPRESSION (Km^2): 10
ELEVATION (M): 2165
SURFACE ACTIVITY: HOT SPRINGS, FUMAROLES
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: 40
SPRING TEMPERATURES (C): 60 TO 94
DISCHARGE (L/MIN): GREATER THAN 1300
NO. OF WELLS: 12
WELL DEPTHS (M): 103 TO 2109
MAXIMUM WELL TEMP (C): 181 AT DEPTH (M) 300
ROCK TYPES: RHYOLITIC TUFFS, FLOWS, AND DOMES
GEOPHYSICS: GRAVITY, MAGNETIC, HEAT FLOW, RESISTIVITY, AMT, MICROEARTHQUAKE, SEISMIC NOISE, P-WAVE DELAY

CHEMISTRY
SAMPLE SOURCE: MARINER AND WILLEY, 1976

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>340</td>
<td>0.9</td>
<td>0.1</td>
<td>390</td>
<td>45</td>
<td>416</td>
<td>16.6</td>
<td>130</td>
<td>280</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>15</td>
<td>9.2</td>
<td>-7.59</td>
<td>-14.16</td>
<td>-115.8</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

**CATION**
- NA-K-CA (1/3) .......... 238
- NA-K-CA (4/3) .......... 344
- NA-K* .................. 201

**SILICA**
- Adiabatic............... 200
- Conductive.............. 219
- Chalcedony.............. 205
- Cristobalite............ 172
- Opal.................... 94

**SULFATE**
- Conductive.............. 245
- One-Step Steam Loss.... 216
- Continuous Steam Loss.. 223

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>200</td>
<td>250</td>
<td>230</td>
<td>227</td>
<td>10</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive  
B) Quartz Conductive, pH-Corrected  
C) Quartz Adiabatic  
D) Chalcedony  
E) Chalcedony, pH-Corrected  
F) Cristobalite  
G) Amorphous Silica  
H) Na-K  
I) Na-K-CA  
J) Na-K-CA, Mg-Corrected  
K) Sulfate Geothermometer  
L) Surface Temperature  
M) Well Temperature  
N) Mixing Model  
O) Renner and Others, 1976

### Depth to Top (KM)

- Minimum: 0.3  
- Maximum: 2.5  
- Most Likely: 1.5  
- Mean: 1.7  
- Std. Dev.: 0.3

### Thickness (KM)

- Minimum: 1.0  
- Maximum: 2.5  
- Most Likely: 1.5  
- Mean: 81.7  
- Std. Dev.: 15.3

### Subsurface Area (KM²)

- Minimum: 45  
- Maximum: 120  
- Most Likely: 80  
- Mean: 81.7  
- Std. Dev.: 15.3

### Volume (KM³)

- Minimum: 136.1  
- Std. Dev.: 36.4

### Thermal Energy (10¹⁸ J)

- Minimum: 77.79  
- Std. Dev.: 21.15

### Comments

A deep (2109 m) test well in the eastern part of the caldera had a maximum temperature of 72 °C.

High-temperature system probably confined to the western part of the caldera west of the Hilton Creek fault. Enthalpy-chloride relationships indicate a possible maximum temperature of 282 °C.

### References

Bailey and Others, 1976  
Mariner and Willey, 1976  
Hoover and Others, 1976  
Kane and Others, 1976  
Williams and Others, 1977  
Smith and Rex, 1977  
Fournier, Sorey, and Others, 1978  
Stanley and Others, 1976

Compiled by: Brook, C.

Long Valley Caldera, California
FIELD NAME.................. COSO AREA
KGRA OR OTHER NAME........ COSO HOT SPRINGS KGRA
CIRCULAR REFERENCE........ 057

GEOPHYSICAL LOCALITY
STATE...................... CALIFORNIA
COUNTY..................... INYO
LATITUDE.................. 36-03.0 N
LONGITUDE................. 117-47.0 W
MAPS........................ HAIWEE RESERVOIR 1162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
22S 38E 04 MT, DIABLO

GENERAL INFORMATION
WARING FIGURE...................... 8
WARING NUMBER...................... 141A, 142
AREA OF SURFACE EXPRESSION (KM^2).................. 0.5
ELEVATION (M)...................... 1098
SURFACE ACTIVITY.................. HOT SPRINGS, FUMAROLES
ASSOCIATED DEPOSITS................ SINTER
NO. OF SPRINGS..................... 10
SPRING TEMPERATURES (C)............ 60 TO 97
DISCHARGE (L/MIN).................. SMALL
NO. OF WELLS....................... 2
WELL DEPTHS (M).................... 114 TO 1477
MAXIMUM WELL TEMP (C)............. 189 AT DEPTH (M) 628

ROCK TYPES: RHYOLITE AND BASALT OVERLYING GRANITIC AND METAMORPHIC ROCKS
GEOPHYSICS: HEAT FLOW, MAGNETIC, GRAVITY, RESISTIVITY, AMT, MICROEARTHQUAKE, SEISMIC GROUND NOISE

CHEMISTRY
SAMPLE SOURCE.... AUSTIN AND PRINGLE, 1970
COLLECTION DATE.. 1968/03/00

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>142</td>
<td>154</td>
<td>74.4</td>
<td>1.0</td>
<td>1632</td>
<td>244</td>
<td>52.8</td>
<td>3042</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>71.6</td>
<td>8.5</td>
</tr>
</tbody>
</table>

DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)........ 238
NA-K-CA (4/3)........ 275
NA-K................ 236

SILICA
ADIABATIC............ 154
CONDUCTION........... 163
CHALCEDONY........... 139
CRISTOBALITE.......... 113
opal.................. 40

SULFATE
CONDUCTION............ 324
ONE-STEP STEAM LOSS... 285
CONTINUOUS STEAM LOSS. 296

RESERVOIR PROPERTIES

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE TEMP (C) 190 240 230 220 11

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) 0.1 2.0 0.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM^2) 17 40 25 27.3 4.8

BASED ON: RESISTIVITY, HEAT FLOW, MAGNETIC SURVEYS

VOLUME (KM^3).......... 45.6
THERMAL ENERGY(10^18 J) 25.21

STD. DEV. = 11.7
STD. DEV. = 6.64

COMMENTS: AREA INCLUDES COSO HOT SPRINGS AND DEVIL'S KITCHEN FUMAROLIC AREA. CHEMICAL ANALYSIS FOR COSO WELL NO. II WATER BOILED DURING SAMPLING. FOURNIER AND OTHERS (1978) CALCULATE SUBSURFACE TEMPERATURES OF 240 TO 275 C USING ENTHALPY-CHLORIDE RELATIONS.


COMPILED BY: BROOK, C.

COSO AREA, CALIFORNIA
FIELD NAME................ RANDBURG AREA
KGRA OR OTHER NAME........ RANDBURG KGRA
CIRCULAR REFERENCE........ 058

GEOGRAPHIC LOCALITY
STATE......................... CALIFORNIA
COUNTY......................... SAN BERNARDINO
LATITUDE...................... 35-23.0 N
LONGITUDE..................... 117-32.2 W
MAPS.......................... KLINDER MOUNTAIN 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
295 41E 25 SE OF NW MT. DIABLO

GENERAL INFORMATION
ELEVATION (M)...................... 990
SURFACE ACTIVITY................... NONE, FOUND BY DRILLING
NO. OF WELLS......................... 1
WELL DEPTHS (M)...................... 235
MAXIMUM WELL TEMP (C).............. 115 AT DEPTH (M) 235
ROCK TYPES: ANDESITE OVERLYING QUARTZ MONZONITE AND SCHIST
GEOPHYSICS: HEAT FLOW (J. SASS, UNPUB.)

CHEMISTRY
SAMPLE SOURCE.... R. MARINER, UNPUB. DATA
COLLECTION DATE.. 1977/01/31

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOILING</td>
<td>LT 1</td>
<td>LT 0.5</td>
<td>LT 0.5</td>
<td>LT 0.5</td>
<td>LT 0.1</td>
<td>47</td>
<td></td>
<td>20</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>HT</td>
<td>PH</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H20</td>
<td>DEL 0 H20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LT 0.1</td>
<td>LT 0.02</td>
<td>6.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESERVOIR PROPERTIES</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MOST LIKELY</td>
<td>MEAN</td>
<td>STD. DEV.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>---------</td>
<td>---------</td>
<td>-------------</td>
<td>------</td>
<td>-----------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>115 (M)</td>
<td>250</td>
<td>150</td>
<td>172</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2</td>
<td>2.0</td>
<td>1.0</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Thermal energy (10^18 J)

- 9.4
- 3.99

Based on heat flow survey

- Thermal energy (10^18 J) = 9.4
  - Std. Dev. = 2.3
  - Mean = 1.7
  - Std. Dev. = 0.3

Comments: Maximum and most likely temperatures are estimates. Hot water flashes in borehole. Chemical analysis of steam condensate, geothermometry not applicable. Isotopes unreliable because of repeated flashing. 15 mg/l NH3 as (N).

References: Koenig, 1970; Moyle, 1974

Compiled by: Brook, C.

Randsburg Area, California
FIELD NAME: TECOPA HOT SPRINGS
CIRCULAR REFERENCE: 059

GEOPHYSICAL LOCALITY
STATE: CALIFORNIA
COUNTY: INYO
LATITUDE: 35-53.2 N
LONGITUDE: 116-14.2 W
MAPS: TECOPA 1162-500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
21N 07E 28t 33 SAN BERNARDINO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 146
ELEVATION (M): 415
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2 OR MORE
SPRING TEMPERATURES (C): 42 TO 48
DISCHARGE (L/MIN): 15
ROCK TYPES: TUFFACEOUS LACUSTRINE DEPOSITS

CHEMISTRY
SAMPLE SOURCE: R.H. MARINER, UNPUB. DATA
FLOW (L/MIN): GT 100
COLLECTION DATE: 1977/01/31

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>100</td>
<td>2</td>
<td>0.22</td>
<td>885</td>
<td>17</td>
<td>686</td>
<td>13</td>
<td>580</td>
<td>545</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL (18) SO4</th>
<th>DEL (18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>9.2</td>
<td>8.45</td>
<td>DEL (18) SO4</td>
<td>DEL (18) H2O</td>
<td>DEL D H2O</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) .......... 145
NA-K-CA (4/3) .......... 241
NA-K .......... 48

SILICA
ADIABATIC .......... 133
CONDUCTIVE .......... 137
CHALCEDONY .......... 110
CRISTOBALITE .......... 87
OPAL .......... 17

RESERVOIR PROPERTIES
SUBSURFACE TEMP (C)  MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
97 (E)  145 (I)  137 (A)  126  10

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.
0.5  2.0  1.5  1.7  0.3
1.0  2.5  1.5
1  3  2

BASED ON STANDARD ESTIMATE

VOLUME (KM**3) .......... 3.3  STD. DEV. = 0.9
THERMAL ENERGY(10**18 J)  1.00  STD. DEV. = 0.30

COMMENTS: GEOTHERMOMETERS MAY BE UNRELIABLE BECAUSE OF LIKELIHOOD OF WATER REACTIONS WITH TUFFACEOUS LACUSTRINE DEPOSITS.
REFERENCES: WARING, 1965

COMPILED BY: BROOK, C.

TECOPA HOT SPRINGS, CALIFORNIA
FIELD NAME.................. SCOVERN HOT SPRING
KURHA OR OTHER NAME........ NEILLS HOT SPRING (AGUA CALIENTE)
CIRCULAR REFERENCE......... 060

GEOGRAPHIC LOCALITY
STATE....................... CALIFORNIA
COUNTY...................... KERN
LATITUDE.................... 35-37.1 N
LONGITUDE................... 118-28.4 W
MAPS......................... LAKE ISABELLA SOUTH :124,000

GENERAL INFORMATION
WARING FIGURE...................... 8
WARING NUMBER...................... 149
ELEVATION (M).................... 762
SURFACE ACTIVITY................... HOT SPRING
NO. OF SPRINGS..................... 17
SPRING TEMPERATURES (°C)............. 53.5
DISCHARGE (L/MIN)............... 435
ROCK TYPES: GRANITIC ROCKS

CHEMISTRY
SAMPLE SOURCE.... R. MARINERI, UNPUB. DATA
COLLECTION DATE.. 1977/01/03

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>53.5</td>
<td>64</td>
<td>2.8</td>
<td>0.18</td>
<td>145</td>
<td>3.0</td>
<td>288</td>
<td>8.1</td>
<td>8</td>
<td>38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>DEL 0(18)</th>
<th>DEL 0(18)</th>
<th>DEL D</th>
<th>DEL D</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2</td>
<td>7.49</td>
<td>SO4</td>
<td>H20</td>
<td>H20</td>
<td>H20</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3) ............. 119
- NA-K-CA (4/3) ............. 108
- NA-K ..................... 53

**SILICA**
- ADIABATIC .................. 113
- CONDUCTIVE ................. 114
- CHALCEDONY ................. 85
- CRISTOBALITE ............... 63
- OPAL .................... -4

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85 (D)</td>
<td>119 (I)</td>
<td>114 (A)</td>
<td>106</td>
<td>7</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

BETWEEN ON UNITED STANDARD ESTIMATE

VOLUME (KM**3) ............... 3.3
THERMAL ENERGY(10**18 J) ........ 0.02

STD. DEV. = 0.9
STD. DEV. = 0.02

COMMENTS:
- SPRING ISSUES FROM IRON STAND PIPE.

REFERENCES:
- WARING, 1965

COMPILED BY: BUCK, C.

SCOVERN HOT SPRING, CALIFORNIA
FIELD NAME ................ SESPE HOT SPRINGS
KGRA OR OTHER NAME ........ SESPE HOT SPRINGS KGRA
CIRCULAR REFERENCE ....... 061

GEOGRAPHIC LOCALITY
STATE ....................... CALIFORNIA
COUNTY ...................... VENTURA
LATITUDE .................... 34°35.7' N
LONGITUDE .................. 118°59.9' W
MAPS ......................... DEVILS HEART PEAK 1124,000

TOWNSHIP   RANGE   SECTION   BASE & MERIDIAN
06N       20W      21      SE OF SE   SAN BERNARDINO

GENERAL INFORMATION
WARING FIGURE .................. 8
WARING NUMBER ................... 111
AREA OF SURFACE EXPRESSION (KM²) .......................... 0.2
ELEVATION (M) .................. 869
SURFACE ACTIVITY ................... HOT SPRINGS
NO. OF SPRINGS .................. 4
SPRING TEMPERATURES (C) .......... 36 TO 90
DISCHARGE (L/MIN) ............... 470
ROCK TYPES: FAULTED GRANITE

CHEMISTRY
SAMPLE SOURCE ....... R. MARINER, UNPUBL. DATA
COLLECTION DATE ........ 1977/01/31

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>98</td>
<td>22</td>
<td>0.11</td>
<td>330</td>
<td>14</td>
<td>70</td>
<td>LT 1</td>
<td>290</td>
<td>290</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL O(18) SO₄</th>
<th>DEL O(18) H₂O</th>
<th>DEL O H₂O</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>13</td>
<td>7.74</td>
<td>+5.72</td>
<td>-9.62</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CAIION**
- NA-K-CA (1/3).......... 148
- NA-K-CA (4/3).......... 126
- NA-K................... 102

**SILICA**
- ADIABATIC.............. 132
- CONDUCTIVE............. 136
- CHALCEDONY............. 109
- CRISTOBALITE........... 85
- OPAL................... 16

**SULFATE**
- CONDUCTIVE............. 111
- ONE-STEP STEAM LOSS... 109
- CONTINUOUS STEAM LOSS.. 109

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>109 (D)</td>
<td>148 (I)</td>
<td>136 (A)</td>
<td>131</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**
- 0.5

**THICKNESS (KM)**
- 1.0

**SUBSURFACE AREA (KM²)**
- 1

Based on: Standard Estimate

**VOLUME (KM³)**
- 3.3

**THERMAL ENERGY (10¹¹J)**
- 1.04

STD. DEV. = 0.9
STD. DEV. = 0.30

REFERENCES: WARING, 1965; MOYLE, 1974

COMPiled BY: BROWN, C.

SESPE HOT SPRINGS, CALIFORNIA
FIELD NAME................ ARROWHEAD HOT SPRINGS
CIRCULAR REFERENCE......... 062

GEOGRAPHIC LOCALITY
STATE....................... CALIFORNIA
COUNTY..................... SAN BERNARDINO
LATITUDE.................. 34-11.2 N
LONGITUDE................. 117-15.9 W
MAPS........................ SAN BERNARDINO NORTH 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
01N 04W 11 NE SAN BERNARDINO

GENERAL INFORMATION
WARING FIGURE...................... a
WARING NUMBER...................... 162
AREA OF SURFACE EXPRESSION (KM²)........ 0.1
ELEVATION (M)..................... 610
SURFACE ACTIVITY...................... HOT SPRINGS
NO. OF SPRINGS................. SEVERAL IN 2 GROUPS
SPRING TEMPERATURES (C)........... 43 TO 86
DISCHARGE (L/MIN)............. 200
ROCK TYPES; FRACTURED GRANITE AND GNEISS

CHEMISTRY
SAMPLE SOURCE.... R, MARINER, UNPUB. DATA
COLLECTION DATE........ 1977/01/31

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.5</td>
<td>106</td>
<td>27</td>
<td>0.14</td>
<td>295</td>
<td>14</td>
<td>74</td>
<td>LT 1</td>
<td>520</td>
<td>76</td>
</tr>
</tbody>
</table>

DEL 0(18) SO₄  DEL 0(18) H₂O  DEL 0  H₂O
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>150</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>119</td>
</tr>
<tr>
<td>NA-K</td>
<td>111</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>133</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>137</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>110</td>
</tr>
<tr>
<td>CHISTOBALITE</td>
<td>87</td>
</tr>
<tr>
<td>OPAL</td>
<td>17</td>
</tr>
</tbody>
</table>

REFERENCES: WARING, 1965
COMPILED BY: BROOK, C.

ARROWHEAD HOT SPRINGS, CALIFORNIA
FIELD NAME: PILGEN ESTATES HOT SPRINGS
CIRCULAR REFERENCE: 063

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: RIVERSIDE
LATITUDE: 33-26.0 N
LONGITUDE: 115-41.1 W
MAPS: FRINK NW 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
04S 12E 36 SAN BERNARDINO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 176A
ELEVATION (M): 61
SURFACE ACTIVITY: HOT WATER WELL
SPRING TEMPERATURES (C): 79 TO 82
DISCHARGE (L/MIN): MORE THAN 3000
NO. OF WELLS: 1
WELL DEPTHS (M): 92
ROCK TYPES: ALLUVIUM OVERLYING TERTIARY INTRUSIVE ROCKS

CHEMISTRY
SAMPLE SOURCE: MOYLE, 1974
COLLECTION DATE: 1965/04/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>82</td>
<td>79</td>
<td>107</td>
<td>16</td>
<td>888</td>
<td>33</td>
<td>268</td>
<td>225</td>
<td>1360</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>B</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td>DEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H20</td>
</tr>
</tbody>
</table>

7.7
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>145</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>132</td>
</tr>
<tr>
<td>Na-K</td>
<td>92</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>122</td>
</tr>
<tr>
<td>Conductive</td>
<td>124</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>96</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>74</td>
</tr>
<tr>
<td>Opal</td>
<td>6</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>96 (D)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum</td>
<td>124 (A)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most Likely</td>
<td>96 (J)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncoded Temperature indicates subjective judgment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, pH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### THICKNESS (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### VOLUME (KM**3)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td>3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

### THERMAL ENERGY (10**18 J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.81</td>
<td></td>
<td></td>
<td>0.81</td>
<td>0.24</td>
</tr>
</tbody>
</table>

### REFERENCES

- Waring, 1965
- Hoyle, 1974

### COMPILED BY

- Brook, C.

**Pilger Estates Hot Springs, California**
FIELD NAME................ SALTON SEA AREA
KGRA OR OTHER NAME............ SALTON SEA KGRA
CIRCULAR REFERENCE........... 064

GEOGRAPHIC LOCALITY
STATE......................... CALIFORNIA
COUNTY........................ IMPERIAL
LATITUDE..................... 33°12',0 N
LONGITUDE.................... 115°36', W
MAPS........................... NILAND 1124*0001 OBSIDIAN BUTTE 1124*000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
11S 13E 22 SAN BERNARDINO

GENERAL INFORMATION
WARING FIGURE................ 8
WARING NUMBER............... 182A
ELEVATION (M).................. -70
SURFACE ACTIVITY.............. HOT SPRINGS AND FUMAROLES NOW COVERED BY SALTON SEA. AREA IDENTIFIED
BY HEAT FLOW ANOMALY AND FOUND BY DRILLING.
NO. OF SPRINGS............... ORIGINALLY 4
SPRING TEMPERATURES (C)....... 72 TO 101
DISCHARGE (L/MIN)............. SMALL
NO. OF WELS................... ABOUT 21
WELL DEPTHS (M)................ 700 TO 2400
MAXIMUM WELL TEMP (C)........... 360 AT DEPTH (M) 2135
ROCK TYPES: QUATERNARY DELTAIC SEDIMENTS INTRUDED BY RHYOLITE DOMES
GEOPHYSICS: GRAVITY, MAGNETIC, HEAT FLOW
RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>300</td>
<td>340</td>
<td>330</td>
<td>323</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35</td>
<td>1.2</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>2.3</td>
<td>2.0</td>
<td>1.9</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>104</td>
<td>54</td>
<td>60.3</td>
<td>16.7</td>
<td></td>
</tr>
</tbody>
</table>

BASED ON ESTIMATES OF RENNER ET AL (1976) AND MAGNETIC ANOMALY

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>STD. DEV. = 33.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>116.6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10**18 J)</th>
<th>STD. DEV. = 28.33</th>
</tr>
</thead>
<tbody>
<tr>
<td>97.11</td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: HYPERSONAL BRINE GEOTHERMOMETRY QUESTIONABLE. DEPTH ESTIMATES FROM WELL DATA, THICKNESS ESTIMATES FROM RENNER ET AL (1976). RESERVOIR IS SEPARATED INTO AN UPPER, UNALTERED (?) PART AND A LOWER, ALTERED PART BY AN IMPERMEABLE AND CONTINUOUS SHALE LAYER. GEOTHERMAL LOOP EXPERIMENTAL FACILITY IS CURRENTLY BEING TESTED.


COMPILED BY: BROOK, C.

SALTON SEA AREA, CALIFORNIA
FIELD NAME: WESTMORELAND
CIRCULAR REFERENCE: 064A

GEOGRAPHIC LOCALITY
STATE: CALIFORNIA
COUNTY: IMPERIAL
LATITUDE: 33-05.0 N
LONGITUDE: 115-39.0 W
MAPS: CALIPATRIA SW AND WESTMORELAND 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
12S 13E SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M): -61
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
NO. OF WELLS: 6
WELL DEPTHS (M): 458 TO 2592
ROCK TYPES: DELTAIC SEDIMENTS
### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>200</td>
<td>235</td>
<td>215</td>
<td>217</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony, pH-corrected
- E) Chalcedony

### Additional Data

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>1.0</td>
<td>1.5</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.0</td>
<td>1.6</td>
<td>1.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>45</td>
<td>135</td>
<td>60</td>
<td>80.0</td>
<td>19.7</td>
</tr>
</tbody>
</table>

Volume (km³): 122.7
Thermal Energy (10¹⁸ J): 66.79

Comments: Most likely temperature is the weighted average of 5 temperatures at 1920 m depth. System may be an extension of the Salton Sea field.

References: Smith, J.L., Oral Communication, 1978

Compiled by: Brook, C.

Westmorland, California
FIELD NAME.................. BRAWLEY
KGRA OR OTHER NAME........ BRAWLEY KGRA
CIRCULAR REFERENCE........ 065

GEOGRAPHIC LOCALITY
STATE......................... CALIFORNIA
COUNTY....................... IMPERIAL
LATITUDE..................... 33-03.0 N
LONGITUDE.................... 115-32.0 W
MAPS......................... WESTMORLAND 1124400

TOWNSHIP RANGE SECTION BASE & MERIDIAN
13S 14E 15 SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M).................. -46
SURFACE ACTIVITY............... NONE, IDENTIFIED BY HEAT FLOW ANOMALY, FOUND BY DRILLING
NO. OF WELLS................... ABOUT 6
WELL DEPTHS (M)................ 1534 TO 4100
MAXIMUM WELL TEMP (C)......... 262 AT DEPTH (M) 2406
ROCK TYPES: SANDY DELTAIC SEDIMENTS
GEOPHYSICS: RESISTIVITY, HEAT FLOW (TEMPERATURE GRADIENT), GRAVITY
### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>230</td>
<td>280</td>
<td>250</td>
<td>253</td>
<td>10</td>
</tr>
</tbody>
</table>

Unconformity temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>1.5</td>
<td>2.2</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>1.5</td>
<td>1.5</td>
<td>1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>13</td>
<td>40</td>
<td>24</td>
<td>25.7</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Based on temperature gradient contours and D.E. White, oral commun., 1978.

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (km³)</td>
<td>34.2</td>
<td></td>
<td></td>
<td>34.2</td>
<td>8.0</td>
</tr>
<tr>
<td>Thermal Energy (10^18 J)</td>
<td>22.02</td>
<td></td>
<td></td>
<td>22.02</td>
<td>5.25</td>
</tr>
</tbody>
</table>

Comments: Brine fluid containing 59,000 ppm TDS. No chemistry available. Thickness and depth estimates based on limited well data (R. Butler, personal commun., 1978).


Compiled by: Brook, C.

Brawley, California
FIELD NAME: GUAMIS (EAST BRAWLEY)
KGRA OR OTHER NAME: GLAMIS KGRA
CIRCULAR REFERENCE: 066

GEODETIC LOCALITY
STATE: CALIFORNIA
COUNTY: IMPERIAL
LATITUDE: 32-58.0 N
LONGITUDE: 115-11.0 W
MAPS: GLAMIS NW 124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
14 S 17E 02 SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M): 37
SURFACE ACTIVITY: NONE, IDENTIFIED BY HEAT FLOW ANOMALY
ROCK TYPES: SANDY DELTAIC SEDIMENTS
GEOPHYSICS: TEMPERATURE GRADIENT
<table>
<thead>
<tr>
<th>Reservoir Properties</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>105</td>
<td>170</td>
<td>120</td>
<td>132</td>
<td>14</td>
</tr>
</tbody>
</table>

Uncoded Temperature indicates Subjective Judgement

A) Quartz Conductive
F) Cristobalite
B) Quartz Conductive, PH-Corrected
G) Amorphous Silica
C) Quartz Adiabatic
H) Na-K
D) Chalcedony
I) Na-K-CA
E) Chalcedony, PH-Corrected
J) Na-K-CA, Mg-Corrected

K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model

O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km^2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on Temperature Gradient Anomaly

<table>
<thead>
<tr>
<th>Volume (km^3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10^18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: Temperatures assumed to be similar to those estimated for the Dunes area.

References: U.S. Bureau of Reclamation, 1972; Rex and Others, 1971

Compiled By: Brook, C.

Glamis (East Brawley), California
FIELD NAME .................. GLAMIS EAST
KGRA OR OTHER NAME .... GLAMIS KGRA
CIRCULAR REFERENCE ....... 067

GEOGRAPHIC LOCALITY
STATE ...................... CALIFORNIA
COUNTY ...................... IMPERIAL
LATITUDE .................... 33-00.0 N
LONGITUDE .................. 115-02.1 W
MAPS ....................... GLAMIS 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
13S 18E 33 SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M) ................. 107
SURFACE ACTIVITY .......... NONE, IDENTIFIED BY HEAT FLOW ANOMALY
ROCK TYPES .................. SANDY DELTAIC SEDIMENTS
GEOPHYSICS .................. TEMPERATURE GRADIENT
### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>105</td>
<td>170</td>
<td>120</td>
<td>132</td>
<td>14</td>
</tr>
<tr>
<td>Uncoded Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Quartz Conductive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B) Quartz Conductive, PH-Corrected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C) Quartz Adiabatic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D) Chalcedony</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E) Chalcedony, PH-Corrected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K) Sulfate Geothermometer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L) Surface Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M) Well Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N) Mixing Model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O) Renner and Others, 1976</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Additional Data

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.8</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (KM²)</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>3.0</td>
<td>0.8</td>
</tr>
<tr>
<td>Volume (KM³)</td>
<td>5.0</td>
<td></td>
<td></td>
<td>STD. DEV. = 1.7</td>
<td></td>
</tr>
<tr>
<td>Thermal Energy (10² J)</td>
<td>1.57</td>
<td></td>
<td></td>
<td>STD. DEV. = 0.56</td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** Temperatures assumed to be similar to those estimated for the Dunes Area.

**References:** U.S. Bureau of Reclamation, 1972; Rex and Others, 1971; Renner and Others, 1976

**Compiled by:** Brook, C.

GLAMIS EAST, CALIFORNIA
FIELD NAME................ EAST MESA
KGRA OR OTHER NAME........ EAST MESA KGRA
CIRCULAR REFERENCE........ 068

GEOGRAPHIC LOCALITY
STATE................. CALIFORNIA
COUNTY............... IMPERIAL
LATITUDE............... 32-47.0 N
LONGITUDE............ 115-15.0 W
MAPS................ HOLTVILLE EAST 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
16S 17E 06 SE SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M).............. fl
SURFACE ACTIVITY........... NONE. IDENTIFIED BY HEAT FLOW ANOMALY, FOUND BY DRILLING
NO. OF WELLS............... 20 OR MORE, SOME OF WHICH ARE INJECTION WELLS,
WELL DEPTHS (M)............ 915 TO 2772
MAXIMUM WELL TEMP (C)..... 204 AT DEPTH (M) 2355
ROCK TYPES: SANDY DELTAIC SEDIMENTS
GEOPHYSICS: HEAT FLOW, GRAVITY, RESISTIVITY, MICROEARTHQUAKE, SEISMIC NOISE

CHEMISTRY
SAMPLE SOURCE........... U.S. BUREAU OF RECLAMATION, 1977
COLLECTION DATE........ 1976/06/09

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>C03</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>320</td>
<td>1360</td>
<td>17.2</td>
<td>8100</td>
<td>1050</td>
<td>202</td>
<td>0.0</td>
<td>42.8</td>
<td>45</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>DEL 0 (18) S04</th>
<th>DEL 0 (18) H2O</th>
<th>DEL 0 H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3)............. 231
- NA-K-CA (4/3) ............ 279
- NA-K ..................... 216

**SILICA**
- ADIABATIC .............. 196
- CONDUCTIVE ............ 214
- CHALCEDONY ............ 199
- CRISTOBALITE .......... 166
- OPAL ................... 90

**REPOSTIVE PROPERTIES**
- MINIMUM 165
- MAXIMUM 200
- MOST LIKELY 180
- MEAN 182
- STD. DEV. 7

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**
- MINIMUM 1.8
- MAXIMUM 2.0
- MOST LIKELY 1.8
- MEAN 1.1
- STD. DEV. 0.0

**THICKNESS (KM)**
- MINIMUM 1.0
- MAXIMUM 1.2
- MOST LIKELY 1.2
- MEAN 1.1
- STD. DEV. 0.0

**SUBSURFACE AREA (KM**2**)**
- MINIMUM 16
- MAXIMUM 40
- MOST LIKELY 32.0
- MEAN 32.0
- STD. DEV. 5.7

**VOLUME (KM**3**)**
- MINIMUM 36.3
- STD. DEV. = 6.6

**THERMAL ENERGY (10**18** J)**
- MINIMUM 16.32
- STD. DEV. = 3.05

**COMMENTS**
- BRINE FLUIDS, GEOTHERMOMETRY QUESTIONABLE. CHEMICAL ANALYSIS FOR UNFLASHED FLUID FROM WELLHEAD MESA 6-1. THICKNESS AND DEPTH ESTIMATES FROM WELL DATA. A 10 MW POWER PLANT IS UNDER CONSTRUCTION.

**REFERENCES**
- U.S. BUREAU OF RECLAMATION, 1972, 1974, 1977
- SWANBERG, 1976
- BIEHLER, 1971
- BARKMAN AND OTHERS, 1976
- NARASIMHAN AND OTHERS, 1977
- COMBS AND JARZABEK, 1978

**COMPILED BY** BROOK, C.

**EAST MESA, CALIFORNIA**
FIELD NAME................ DUNES KGRA OR OTHER NAME..,,.,., DUNES KGRA CIRCULAR REFERENCE........ 069

GEOGRAPHIC LOCALITY
STATE...................... CALIFORNIA COUNTY.................... IMPERIAL LATITUDE................... 32-48.2 N LONGITUDE.................... 115-00.8 W MAPS......................... GLAMIS SE 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
15S 19E 28 SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M).................... 75 SURFACE ACTIVITY.................... NONE, IDENTIFIED BY ANOMALOUS HEAT FLOW. NO. OF WELLS......................... 1 WELL DEPTHS (M).................... 612 MAXIMUM WELL TEMP (C).............. 103 AT DEPTH (M) ABOUT 280 ROCK TYPES: SANDY DELTAIC SEDIMENTS

GFOPHYSICS: TEMPERATURE GRADIENT, GRAVITY, TELLURIC

CHEMISTRY
SAMPLE SOURCE..... COPLEN AND KOLESAR, 1974

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SO2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>118</td>
<td>136</td>
<td>1.7</td>
<td>1262</td>
<td>103</td>
<td>76</td>
<td>0.04</td>
<td>178</td>
<td>2021</td>
</tr>
</tbody>
</table>

F     B    PH
6.58   

DEL 0(18) SO4   DEL 0(18) H2O   DEL D H2O
-10.77 -94
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>189</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>185</td>
</tr>
<tr>
<td>NA-K</td>
<td>161</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>141</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>147</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>121</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>96</td>
</tr>
<tr>
<td>OPAL</td>
<td>25</td>
</tr>
</tbody>
</table>

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>105</td>
<td>170</td>
<td>120</td>
<td>132</td>
<td>14</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>Depth to Top (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2</td>
<td>1.5</td>
<td>0.2</td>
<td>1</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Thickness (KM)    | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |
|                  | 3       | 8       | 5           | 5.3  | 1.0       |

**BASED ON TEMPERATURE GRADIENT CONTOURS**

<table>
<thead>
<tr>
<th>Volume (KM**3)</th>
<th>0.9</th>
<th>STD. DEV. = 2.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10**18 J)</td>
<td>2.80</td>
<td>STD. DEV. = 0.83</td>
</tr>
</tbody>
</table>

**REFERENCES**

- Rex and Others, 1971
- U.S. BUREAU OF RECLAMATION, 1972
- Coplen, 1973
- Coplen and Kolesar, 1974
- Comus and WILT, 1976

**COMPILED BY:** Brook, C.,

DUNES, CALIFORNIA
FIELD NAME.................. BORDER
KGRA OR OTHER NAME........ EAST MESA KGRA
CIRCULAR REFERENCE........ 070

GEOMETRIC LOCALITY
STATE............................ CALIFORNIA
COUNTY..................... IMPERIAL
LATITUDE.................. 32-44.0 N
LONGITUDE............... 115-07.0 W
MAPS..................... MIDWAY WELL 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
16S 16E 28 NW SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M)..................... 37
SURFACE ACTIVITY.................. NONE, IDENTIFIED BY HEAT FLOW ANOMALY
ROCK TYPES: SANDY DELTAIC SEDIMENTS
GEOPHYSICS: HEAT FLOW, RESISTIVITY, GRAVITY, MICROEARTHQUAKE, SEISMIC NOISE
<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>150 (0)</td>
<td>170 (0)</td>
<td>160 (0)</td>
<td>160</td>
<td>4</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

| DEPTH TO TOP (KM) | 1.8 | 2.0 | 1.8 | 1.8 | 0.0 |
| THICKNESS (KM)    | 1.0 | 1.2 | 1.2 | 1.1 | 0.0 |
| SUBSURFACE AREA (KM**2) | 2.6 | 5   | 3   | 3.5 | 0.5 |

**BASED ON: ESTIMATES OF RENNER ET AL (1976), TEMPERATURE GRADIENT DATA**

| VOLUME (KM**3) | 4.0 | STD. DEV. = 0.6 |
| THERMAL ENERGY(10**18 J) | 1.57 | STD. DEV. = 0.25 |

**COMMENTS:** DEPTH TO RESERVOIR AND THICKNESS ESTIMATES ARE ASSUMED USING ANALOGY TO EAST MESA TEST SITE.

**REFERENCES:** DUTCHER AND OTHERS, 1972; U.S. BUREAU OF RECLAMATION, 1972, 1974; RENNER AND OTHERS, 1976

**COMPILED BY:** BROOK, C.

**BORDER, CALIFORNIA**
FIELD NAME................... HEBER
KGRA OR OTHER NAME........ HEBER KGRA
CIRCULAR REFERENCE......... 071

GEOGRAPHIC LOCALITY
STATE......................... CALIFORNIA
LATITUDE..................... 32°43.0' N
LONGITUDE.................... 115°31.7' W
MAPS......................... HEBER 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
16S 14E 29 SAN BERNARDINO

GENERAL INFORMATION
ELEVATION (M).................. -1.5
SURFACE ACTIVITY.............. NONE. IDENTIFIED BY HEAT FLOW ANOMALY, FOUND BY DRILLING.
NO. OF WELLS.................. 11
WELL DEPTHS (M)................ 916 TO 3360
ROCK TYPES: SANDY DELTAIC SEDIMENTS
GEOPHYSICS: HEAT FLOW, RESISTIVITY, GRAVITY

CHEMISTRY
SAMPLE SOURCE........ GEONOMICS, INC., 1976

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>268</td>
<td>781</td>
<td>3.8</td>
<td>4563</td>
<td>197</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>B</td>
<td>PH</td>
<td>DEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL D H20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>NA-K-CA (1/3)</th>
<th>NA-K-CA (4/3)</th>
<th>NA-K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>162</td>
<td>180</td>
<td>103</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>A) ADIABATIC,</th>
<th>CONDUCTIVE,</th>
<th>CHALCEDONY,</th>
<th>CRISTOBALITE,</th>
<th>OPAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>185</td>
<td>201</td>
<td>183</td>
<td>152</td>
<td>76</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>160</td>
<td>185</td>
<td>180</td>
<td>175</td>
<td>5</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Adiabatic
- C) Quartz Conductive, pH-Corrected
- D) Chalcedony
- E) Chalcedony, pH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.6</td>
<td>1.8</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Thickness (km)          | 1.2     | 2.4     | 1.5         | 1.7   | 0.3       |
|                        | 30      | 55      | 40          | 41.7  | 5.1       |

Based on Tansey and Wasserman (1976) and temperature gradient contours.

| Volume (km³)            | 70.8    | Std. Dev. = 13.8 |
|                        | 30.60   | Std. Dev. = 6.06  |

| Thermal Energy (10^18 J)| 30.60   | Std. Dev. = 6.06  |

Comments: Chemical analysis for Well J.D. Jackson #1. Average bottom hole temperature of producing wells is 179-181 °C. Maximum temperature reported for the field is 191 °C (Tansey and Wasserman, 1977).


Compiled by Brooker, C. Heuer, California.
Colorado
FIELD NAME: ROUTT HOT SPRINGS
CIRCULAR REFERENCE: 072

GEOGRAPHIC LOCALITY
STATE: COLORADO
COUNTY: ROUTT
LATITUDE: 40-33.6 N
LONGITUDE: 106-51.0 W
MAPS: ROCKY REAK 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
07N 84W 18 SW OF SE 6TH PRINCIPAL MERIDIAN

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 2
ELEVATION (M): 2266
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 5
SPRING TEMPERATURES (°C): 51 TO 64
DISCHARGE (L/MIN): 200-300
ROCK TYPES: PRECAMBRIAN GNEISS AND GRANITE

CHEMISTRY
SAMPLE SOURCE: BARRETT AND PEARL, 1976
FLOW (L/MIN): 133
COLLECTION DATE: 1976/04/00

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>89</td>
<td>7.7</td>
<td>0.1</td>
<td>160</td>
<td>8.8</td>
<td>139</td>
<td>45</td>
<td>130</td>
<td></td>
</tr>
</tbody>
</table>

F PH DEL 0(18) S04 DEL 0(18) H2O DEL D H2O

17 0.28 7.8
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>157</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>126</td>
</tr>
<tr>
<td>NA-K</td>
<td>123</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>127</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>131</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>103</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>80</td>
</tr>
<tr>
<td>OPAL</td>
<td>11</td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBSURFACE TEMP (°C)</strong></td>
<td>103 (D)</td>
<td>157 (I)</td>
<td>131 (A)</td>
<td>130</td>
<td>11</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement

A) Quartz conductive F) Cristobalite K) Sulfate geothermometer
B) Quartz conductive, pH-corrected G) Amorphous silica L) Surface temperature
C) Quartz adiabatic H) Na-K M) Well temperature
D) Chalcedony I) Na-K-CA N) Mixing model

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 2.0  | 0.4       |

| SUBSURFACE AREA (KM²) | 1       | 3       | 2         |

Based on standard estimate

<table>
<thead>
<tr>
<th>VOLUME (KM³)</th>
<th>3.3</th>
<th></th>
<th>STD. DEV.</th>
<th>0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL ENERGY(10¹⁸ J)</td>
<td>1.04</td>
<td></td>
<td>STD. DEV.</td>
<td>0.31</td>
</tr>
</tbody>
</table>

**REFERENCES:** Barrftt and Pearl, 1976, 1978

Compiled by: Mariner, R. and Brook, C.

Routt Hot Springs, Colorado
FIELD NAME: PENNY (AVALANCHE) HOT SPRINGS
CIRCULAR REFERENCE: 073

GEOGRAPHIC LOCALITY
STATE: COLORADO
COUNTY: PITKIN
LATITUDE: 39-13.6 N
LONGITUDE: 107-13.5 W
MAPS: REDSTONE 1124000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
10S 88W 04 NE OF NW 6TH PRINCIPAL MERIDIAN

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 8
ELEVATION (M): 2110
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL FOR 0.8 KM ALONG RIVER
SPRING TEMPERATURES (C): 40 TO 56
DISCHARGE (L/MIN): 750
ROCK TYPES: TERTIARY GRANODIORITE INTRUDING PALEOZOIC SEDIMENTARY ROCKS

CHEMISTRY
SAMPLE SOURCE: BARRETT AND PEARL, 1976 (GRANGES SPRING)
FLOW (L/MIN): 45
COLLECTION DATE: 1975/09/00

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>81</td>
<td>440</td>
<td>55</td>
<td>400</td>
<td>38</td>
<td>565</td>
<td>1400</td>
<td>260</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>0.65</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td>DEL O(18)</td>
<td>S04</td>
<td>DEL O(18)</td>
<td>H2O</td>
</tr>
<tr>
<td>2.7</td>
<td>0.65</td>
<td>9.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- Na-K-CA (1/3) .............. 166
- Na-K-CA (2/3) .............. 90
- Na-K ....................... 178

SILICA
- Adiabatic .................. 123
- Conductive .................. 126
- Chalcedony ................ 98
- Cristobalite ............... 75
- Opal ......................... 7

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>90 (I)</td>
<td>126 (A)</td>
<td>98 (D)</td>
<td>105</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) Quartz conductive
B) Quartz conductive, PH-Corrected
C) Quartz adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate geothermometer
L) Surface temperature
M) Well temperature
N) Mixing model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Subsurface Area (km^2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

BASING ON A STANDARD ESTIMATE

| VOLUME (km^3) | 3.3 | STD. DEV. = 0.9 |
| THERMAL ENERGY \(10^{18} J\) | 0.81 | STD. DEV. = 0.24 |

COMMENTS: CHEMICAL ANALYSIS FOR GRANGES SPRING; REPORTED PH (9.2) ASSUMED TO BE IN ERROR AS OTHER SPRINGS HAVE A PH OF 6.3.

REFERENCES: BARRETT AND PEARL, 1976; 1978

COMPILED BY R. MARINER AND C. BROOK
FIELD NAME .............. MT. PRINCETON HOT SPRINGS AREA
KGRA OR OTHER NAME .... CHALK CREEK AREA
CIRCULAR REFERENCE .... 074

GEOGRAPHIC LOCALITY
STATE .................... COLORADO
COUNTY .................... CHAFFEE
LATITUDE ................ 38°43.9' N
LONGITUDE ............... 106°10.2' W
MAPS ...................... PONCHA SPRINGS 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
15S 78W 19 6TH PRINCIPAL MERIDIAN

GENERAL INFORMATION
WARING FIGURE .................. 2
WARING NUMBER .................. 20
AREA OF SURFACE EXPRESSION (KM²) .... 5.0
ELEVATION (M) ................. 2486
SURFACE ACTIVITY ............ NUMEROUS THERMAL SPRINGS AND SHALLOW WELLS
ASSOCIATED DEPOSITS .......... ZEOLITIC ALTERATION
NO. OF SPRINGS .................. ABOUT 34
SPRING TEMPERATURES (C) ........ 39 TO 85
DISCHARGE (L/MIN) ............ 675
NO. OF WELLS .................. 5
WELL DEPTHS (M) ............... 12 TO 55
ROCK TYPES: TERTIARY QUARTZ MONZONITE

CHEMISTRY
SAMPLE SOURCE ........... HARRETT AND PEARL, 1976 (HORTENSE HOT SPRING, PRINCETON HOT SPRING)
FLOW (L/MIN) .............. 64
COLLECTION DATE ........... 1976/04/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>83</td>
<td>8.8</td>
<td>4.7</td>
<td>94</td>
<td>3.2</td>
<td>86</td>
<td>98</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18)</th>
<th>S04</th>
<th>DEL O(18)</th>
<th>H2O</th>
<th>DEL O H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>0.04</td>
<td>8.2</td>
<td>-3.75</td>
<td>-16.40</td>
<td>-117.1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**
- \( \text{NA-K-CA} (1/3) \) 131
- \( \text{NA-K-CA} (4/3) \) 93
- \( \text{NA-K} \) 85

**SILICA**
- \( \text{ADIABATIC} \) 127
- \( \text{CONDUCTIVE} \) 130
- \( \text{CHALCEDONY} \) 103
- \( \text{CRISTOBALITE} \) 80
- \( \text{OPAL} \) 11

**SULFATE**
- \( \text{CONDUCTIVE} \) 140
- \( \text{ONE-STEP STEAM LOSS} \) 133
- \( \text{CONTINUOUS STEAM LOSS} \) 134

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>93 (I)</td>
<td>140 (K)</td>
<td>103 (D)</td>
<td>112</td>
<td>10</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, pH-corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

**DEPTH TO TOP (KM)**
- Minimum 0.1
- Maximum 2.0
- Most Likely 1.0

**THICKNESS (KM)**
- Minimum 1.0
- Maximum 2.3
- Most Likely 1.5

**SUBSURFACE AREA (KM²)**
- Minimum 2
- Maximum 6
- Most Likely 4

**VOLUME (KM³)**
- Minimum 6.4
- Maximum 6.4
- Most Likely 6.4

**THERMAL ENERGY (10¹⁸ J)**
- Minimum 1.68
- Maximum 1.68
- Most Likely 1.68

Comments: Chemical analysis for Hortense Hot Spring. Isotopic data from Mt. Princeton Hot Spring. Thermal wells used for space heating, greenhouses, and bathing. Zeolitization is probably not active.

References: Barret and Pearl, 1976; 1978; Olson and Dellechaie, 1976; Sharp, 1970; Waring, 1965

Compiled by: Mariner, R. and Brook, C.

Mt. Princeton Hot Springs Area, Colorado
FIELD NAME: PONCHA HOT SPRINGS
KGRA OR OTHER NAME: PONCHA KGRA
CIRCULAR REFERENCE: 075

GEOGRAPHIC LOCALITY
STATE: COLORADO
COUNTY: CHAFFEE
LATITUDE: 38-29.8 N
LONGITUDE: 106-04.6 W
MAPS: BONANZA 1162+500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
49N 08E 15 NEW MEXICO

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 21
ELEVATION (M): 2428
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 5
SPRING TEMPERATURES (°C): 50 TO 71
DISCHARGE (L/MIN): 895
ROCK TYPES: PRECAMBRIAN GRANITE AND GNEISS

CHEMISTRY
SAMPLE SOURCE: BARRETT AND PEARL, 1976 (SPRING B)
FLOW (L/MIN): 114
COLLECTION DATE: 1975/06/00

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>83</td>
<td>18</td>
<td>0.5</td>
<td>190</td>
<td>7.8</td>
<td>214</td>
<td></td>
<td>190</td>
<td>48</td>
</tr>
</tbody>
</table>

F B PH DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ........... 139
NA-K-CA (4/3) ........... 101
NA-K .................... 99

SILICA
ADIABATIC ................ 124
CONDUCTIVE .............. 127
CHALCEDONY .............. 99
CRISTOBALITE ............ 76
OPAL ..................... 8

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C) MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
MINIMUM 98 (D) 127 (A) 101 (I) 109 7

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
0.5 2.0 1.5 1.7 0.3
THICKNESS (KM) 1.0 2.5 1.5
SUBSURFACE AREA (KM**2) 1.0 3.0 2.0

VOLUME (KM**3) ........... 3.3

THermal ENERGY (10**18 J) 0.84

STD. DEV. = 0.9
STD. DEV. = 0.24

COMMENTS: ANALYSIS FROM SPRING B; OTHER SPRINGS HAVE PH OF 7.5-8.0. TWO GROUPS OF SPRINGS, MOST OF THE WATER IS PIPPED 8 KM TO SALIDA FOR USE IN SWIMMING POOL. ASSOCIATED WITH FLUORITE DEPOSITS.


COMPiled BY: MARINER, R. AND BROOK, C.

PONCHA HOT SPRINGS, COLORADO
FIELD NAME............... WAUNITA HOT SPRINGS
CIRCULAR REFERENCE..... 076

GEOGRAPHIC LOCALITY
STATE...................... COLORADO
COUNTY.................... GUNNISON
LATITUDE.................. 38-30.8 N
LONGITUDE................. 106-30.5 W
MAPS........................ PITKIN 1124,000

TOWNSHIP HANGF. SECTION BASE & MERIDIAN
49W 04E 10-11 NEW MEXICO

GENERAL INFORMATION
WAKING FIGURE............... .......... 2
WARING NUMBER...................... 14
ELEVATION (M)...................... 2727
SURFACE ACTIVITY.............. HOT SPRINGS
NO. OF SPRINGS..................... SEVERAL IN 2 GROUPS
SPRING TEMPERATURES (C)........ 62 TO 80
DISCHARGE (L/MIN)............... MORE THAN 600
ROCK TYPES: MESOZOIC SANDSTONE AND SHALE ON NORTH SIDE OF TERTIARY INTRUSIVE DOME

CHEMISTRY
SAMPLE SOURCE.............. HARRETT AND PEARL, 1976 (UPPER WAUNITA HOT SPRINGS)
FLOW (L/MIN)................. 114
COLLECTION DATE.............. 1975/10/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>110</td>
<td>5.9</td>
<td>Lt 0.2</td>
<td>160</td>
<td>10</td>
<td>119</td>
<td>190</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

F 18 B PH
0.06 8.4

DEL 0(18) 504
DEL 0(18) H20
DEL 0(18) H20
<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>165</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>139</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>116 (D)</td>
<td>165 (I)</td>
<td>143 (A)</td>
<td>141</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) QUARTZ CONDUCTIVE</td>
</tr>
<tr>
<td>B) QUARTZ CONDUCTIVE, PH-CORRECTED</td>
</tr>
<tr>
<td>C) QUARTZ ADIABATIC</td>
</tr>
<tr>
<td>D) CHALCEDONY</td>
</tr>
<tr>
<td>E) CHALCEDONY, PH-CORRECTED</td>
</tr>
<tr>
<td>F) CRISTOBALITE</td>
</tr>
<tr>
<td>G) AMORPHOUS SILICA</td>
</tr>
<tr>
<td>H) NA-K</td>
</tr>
<tr>
<td>I) NA-K-CA</td>
</tr>
<tr>
<td>J) NA-K-CA, MG-CORRECTED</td>
</tr>
<tr>
<td>K) SULFATE GEOTHERMOMETER</td>
</tr>
<tr>
<td>L) SURFACE TEMPERATURE</td>
</tr>
<tr>
<td>M) WELL TEMPERATURE</td>
</tr>
<tr>
<td>N) MIXING MODEL</td>
</tr>
<tr>
<td>O) RENNER AND OTHERS, 1976</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |

| SUBSURFACE AREA (KM**2) | 1.0   | 3.0    | 2.0         | 2.0  | 0.4       |

<table>
<thead>
<tr>
<th>BASED ON: STANDARD ESTIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLUME (KM**3)</td>
</tr>
<tr>
<td>THERMAL ENERGY(10**18 J)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMENTS:</th>
<th>ANALYSIS FOR SPRING C, UPPER WAUNITA HOT SPRINGS. WATER USED FOR SPACE HEATING AND BATHING.</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPILED BY:</td>
<td>MARINER, R, AND BROOK, C.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WAUNITA HOT SPRINGS</th>
<th>COLORADO</th>
</tr>
</thead>
</table>
FIELD NAME: CEBOLLA (POWDERHORN) HOT SPRINGS
CIRCULAR REFERENCE: 077

GEOGRAPHIC LOCALITY
STATE: COLORADO
COUNTY: GUNNISON
LATITUDE: 38-16.4 N
LONGITUDE: 107-05.9 W
MAPS: POWDERHORN 124000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
46N 02W 04 NW OF NE NEW MEXICO

GENERAL INFORMATION
WARNING FIGURE: 2
WAKING NUMBER: 15
ELEVATION (M): 2466
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: FOSSIL TRAVERTINE AND SINTER
NO. OF SPRINGS: 3
SPRING TEMPERATURES (C): 38 TO 41
DISCHARGE (L/MIN): MORE THAN 11
ROCK TYPES: PRECAMBRIAN METAMORPHIC ROCKS, CAMBRIAN AND ORDOVICIAN INTRUSIVE ROCKS AND OLIGOCENE VOLCANICLASTIC ROCKS.

CHEMISTRY
SAMPLE SOURCE: BARRETT AND PEARL, 1976 (SPRING A)
FLOW (L/MIN): 11
COLLECTION DATE: 1976/04/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>92</td>
<td>120</td>
<td>51</td>
<td>310</td>
<td>66</td>
<td>1180</td>
<td>0</td>
<td>120</td>
<td>120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8</td>
<td>1.1</td>
<td>6.4</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

**CATION**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>219</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>293</td>
<td></td>
</tr>
</tbody>
</table>

**SILICA**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>133</td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>105</td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (°C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47 (J)</td>
<td>133 (A)</td>
<td>105 (D)</td>
<td>95</td>
<td>18</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASING ON: STANDARD ESTIMATE AND SPRING DEPOSIT DISTRIBUTION

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>STO. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY(10**18 J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.72</td>
<td>STO. DEV. = 0.26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS**

ANALYSIS FOR SPRING A, CO2-CHARGED WATER GEOTHERMOMETRY MAY BE UNRELIABLE, MOST OF THERMAL ACTIVITY IN AREA PROBABLY OCCURRED DURING THE OLIGOCENE. PRESENT ACTIVITY ASSOCIATED WITH A FAULT.

**REFERENCES**

HARKETI AND PEARL, 1976, 1978
HEDLUND AND OLSON, 1975

COMPILED BY: MARINER, R., AND BROOK, C.

CEHOLLA (POWDERHORN) HOT SPRINGS, COLORADO
FIELD NAME: PARADISE HOT SPRING
CIRCULAR REFERENCE: 078

GEOGRAPHIC LOCALITY
STATE: COLORADO
COUNTY: DOLORES
LATITUDE: 37-45.2 N
LONGITUDE: 108-07.9 W
MAPS: GROUNDHOG MOUNTAIN 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
40N 11W 06 NEW MEXICO

GENERAL INFORMATION
ELEVATION (M): 2745
SURFACE ACTIVITY: HOT SPRINGS
SPRING TEMPERATURES (C): 40 TO 46
DISCHARGE (L/MIN): 114
ROCK TYPES: SANDSTONE, SHALES, AND SiltSTONE

CHEMISTRY
SAMPLE SOURCE: BARRETT AND PEAL, 1976
FLOW (L/MIN): 114
COLLECTION DATE: 1976/04/00

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>150</td>
<td>170</td>
<td>28</td>
<td>1900</td>
<td>370</td>
<td>697</td>
<td>110</td>
<td>3100</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>A</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.7</td>
<td>4.3</td>
<td>6.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEL 0(18) SO4 DEL 0(18) H2O DEL 0 H2O
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) 250
NA-K-CA (4/3) 268
NA-K 278

SILICA
ADIABATIC 153
CONDUCTIVE 161
CHALCEDONY 137
CRISTOBALITE 111
OPAL 39

RESEVOIR PROPERTIES
SUBSURFACE TEMP (C)
MINIMUM 130
MAXIMUM 170 (J)
MOST LIKELY 161 (A)
MEAN 154
STD. DEV. 9

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) MINIMUM 0.5
THICKNESS (KM) 2.0
SUBSURFACE AREA (KM²) 1.0

BASED ON STANDARD ESTIMATE
VOLUME (KM³) 3.3
THERMAL ENERGY (10¹⁸ J) 1.25

STD. DEV. = 0.9
STD. DEV. = 0.36

COMMENTS: SALINE WATER, CHEMICAL GEOTHERMOMETERS UNRELIABLE. REPORTED TEMPERATURES ARE PROBABLY TOO HIGH.


COMPILATED BY: MARINER, R.
PARADISE HOT SPRING, COLORADO
FIELD NAME: WAGON WHEEL GAP HOT SPRINGS
CIRCULAR REFERENCE: 079

GEOGRAPHIC LOCALITY
STATE: COLORADO
COUNTY: MINERAL
LATITUDE: 37°41.1' N
LONGITUDE: 106°49.8' W
MAPS: SPAR CITY 124000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
41N 01E 35 SE OF SE NEW MEXICO

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 31
ELEVATION (M): 2588
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: FOSSIL TRAVERTINE AND SINTER
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 48 TO 57
DISCHARGE (L/MIN): 245
ROCK TYPES: TERTIARY TUFFS AND VOLCANICS

CHEMISTRY
SAMPLE SOURCE: BARRETT AND PEARL, 1976 (4UR RANCH SPRING)
FLOW (L/MIN): 100
COLLECTION DATE: 1976/04/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>57</td>
<td>84</td>
<td>66</td>
<td>15</td>
<td>490</td>
<td>48</td>
<td>1020</td>
<td>200</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.6</td>
<td>2.6</td>
<td></td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEL O(18) SO4, DEL O(18) H2O, DEL D H2O
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Na-K-CA (1/3)</th>
<th>Na-K-CA (4/3)</th>
<th>Na-K</th>
<th>Si</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adiabatic</strong></td>
<td>188</td>
<td>181</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conductive</strong></td>
<td>154</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Adiabatic</strong></td>
<td>154</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Conductive</strong></td>
<td>128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chalcedony</strong></td>
<td>128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Chalcedony</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cristobalite</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Opal</strong></td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>86 (J)</td>
<td>128 (A)</td>
<td>100 (D)</td>
<td>105</td>
<td>9</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km^2)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on 1 Standard Estimate

### Volume (km^3)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td>3.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

### Thermal Energy (10^18 J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.81</td>
<td></td>
<td>0.81</td>
<td>0.24</td>
</tr>
</tbody>
</table>

### Comments

Analysis for 4UR Ranch Spring, associated with fluorite deposits. Geothermometers may be unreliable because of high CO2 content.

### References

Harrett and Pearl, 1976, 1978

Compiled by: Mariner, R. and Brook, C.

Wagon Wheel Gap Hot Springs, Colorado
FIELD NAME: SAND DUNES SWIMMING POOL WELL
CIRCULAR REFERENCE: 080

GEOGRAPHIC LOCALITY

STATE: COLORADO
COUNTY: ALAMOSA
LATITUDE: 37.467 N
LONGITUDE: 105.513 W

MAPS: DEADMAN CAMP 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
41N 10E 27 NE OF NE NEW MEXICO

GENERAL INFORMATION

ELEVATION (M): 2375
SURFACE ACTIVITY: NONE, FOUND BY DRILLING.
WELL DEPTHS (M): 1342
ROCK TYPES: ALLU VIM OF SAN LUIS VALLEY

GEOPHYSICS: REGIONAL GRAVITY, REGIONAL HEAT FLOW

CHEMISTRY

SAMPLE SOURCE: BARRETT AND PEARL, 1976
COLLECTION DATE: 1975/08/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>120</td>
<td>3.2</td>
<td>0.4</td>
<td>81</td>
<td>8.6</td>
<td>176</td>
<td>23</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>H</td>
<td>PH</td>
<td>DEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL D</td>
<td>H20</td>
<td></td>
</tr>
<tr>
<td>4.7</td>
<td>0.51</td>
<td>8.3</td>
<td>DE L</td>
<td>DEL</td>
<td>DEL</td>
<td>DEL</td>
<td>DEL</td>
<td>DEL</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C) 

**CATION**
- Na-K-CA (1/3) .......... 187
- Na-K-CA (4/3) .......... 140
- Na-K ................. 191

**SILICA**
- ADIABATIC ............... 141
- CONDUCTIVE ............. 148
- CHALCEDONY ............ 122
- CRISTOBALITE .......... 97
- OPAL .................. 26

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>122 (D)</td>
<td>152 (J)</td>
<td>148 (A)</td>
<td>141</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive  
B) Quartz Conductive, PH-Corrected  
C) Quartz Adiabatic  
D) Chalcedony  
E) Chalcedony, PH-Corrected  
F) Cristobalite  
G) Amorphous Silica  
H) Na-K  
I) Na-K-CA  
J) Na-K-CA, Mg-Corrected  
K) Sulfate Geothermometer  
L) Surface Temperature  
M) Well Temperature  
N) Mixing Model  
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.5</td>
<td>0.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>0.7</td>
<td>0.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>3.0</td>
<td>2</td>
<td>2.0</td>
<td>0.7</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>Std. Dev. = 0.7</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10**18 J)</th>
<th>Std. Dev. = 0.26</th>
</tr>
</thead>
</table>

**COMMENTS:** Chalcedony temperature compares favorably to bottom hole temperature for Mapco State Well 16 km to the southeast. Thermal waters believed to be fault controlled in area of above-normal heat flow. Area may be larger.

**REFERENCES:** Barrett and Pearl, 1976; 1978; Reiter, 1975

**Compiled by:** Mariner, R. and Brook, C.

Sand Dunes Swimming Pool Well, Colorado
FIELD NAME: MAPCO STATE WELL 1-32
CIRCULAR REFERENCE: 081

GEOPHYSICAL LOCALITY
STATE: COLORADO
COUNTY: ALAMOSA
LATITUDE: 37°40.2' N
LONGITUDE: 105°40.0' W
MAPS: MEDANO RANCH 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
40N 12E 32 NEW MEXICO

GENERAL INFORMATION
ELEVATION (M): 2375
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
NO. OF WELLS: 1
WELL DEPTHS (M): 2890
MAXIMUM WELL TEMP (°C): 128 AT DEPTH (M) 2890
ROCK TYPES: ALLUVIUM OF SAN LUIS VALLEY
GEOPHYSICS: REGIONAL GRAVITY, REGIONAL HEAT FLOW
<table>
<thead>
<tr>
<th>Reservoir Properties</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>90</td>
<td>135</td>
<td>128 (M)</td>
<td>118</td>
<td>10</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz conductive
B) Quartz conductive, pH-corrected
C) Quartz adiabatic
D) Chalcedony
E) Chalcedony, pH-corrected
F) Cristobalite
G) Amorphous silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-corrected
K) Sulfate geothermometer
L) Surface temperature
M) Well temperature
N) Mixing model
O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>2.0</td>
<td>3.0</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Volume (km³)............ 1.7  Std. Dev. = 0.4
Thermal Energy(10¹⁸ J) 0.46  Std. Dev. = 0.12

Comments: Minimum and maximum temperatures calculated for 2 and 3 km depths, respectively, assuming a constant geothermal gradient of 45 °C/km. Area may be larger.

References: Barrett and Pearl, 1978

Compiled by: Mariner, R. and Brook, C.

Mapco State Well 1-32, Colorado
FIELD NAME.................. SPLASHLAND HOT WATER WELL
CIRCULAR REFERENCE........ 082

GEOGRAPHIC LOCALITY
STATE..................... COLORADO
COUNTY.................... ALAMOSA
LATITUDE.................. 37-29.3 N
LONGITUDE................. 105-51.4 W
MAPS...................... ALAMOSA EAST 1124,000

TOWNSHIP          RANGE          SECTION          BASE & MERIDIAN
                  10E             34            SE OF SE    NEW MEXICO

GENERAL INFORMATION
ELEVATION (M)........ 2375
SURFACE ACTIVITY........... NONE, FOUND BY DRILLING.
NO. OF WELLS............... 1
WELL DEPTHS (M).......... 610
ROCK TYPES................. ALLUVIUM OF THE SAN LUIS VALLEY
GEOPHYSICS.............. REGIONAL GRAVITY, REGIONAL HEAT FLOW

CHEMISTRY
SAMPLE SOURCE......... BARRETT AND PEARL, 1976
COLLECTION DATE........ 1975/08/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>110</td>
<td>4.1</td>
<td>0.4</td>
<td>72</td>
<td>9.9</td>
<td>151</td>
<td>29</td>
<td>6.4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H20</th>
<th>DEL 0 H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2</td>
<td>0.34</td>
<td>8.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (1/3)</td>
<td>197</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>224</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Reservoir Properties**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>1.0</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Based on: Standard Estimate

**Volume (km³)**: 3.3, Std. Dev. = 0.9

**Thermal Energy (10¹⁸ J)**: 1.14, Std. Dev. = 0.33

**Comments**: System is probably similar to the one at Sand Dunes Swimming Pool.

**References**: Barrett and Pearl, 1976, 1978

**Compiled By**: Mariner, R. and Brook, C.

**Splashland Hot Water Well, Colorado**
Hawaii
FIELD NAME: STEAMING FLATS (SULPHUR BANK) AREA
CIRCULAR REFERENCE: 083

GEOGRAPHIC LOCALITY
STATE: HAWAII
COUNTY: HAWAII
LATITUDE: 19°26.5' N
LONGITUDE: 155°16.0' W
MAPS: KILAUEA CRATER 1:24,000

GENERAL INFORMATION
WARING FIGURE: 10
WARING NUMBER: 4
AREA OF SURFACE EXPRESSION (KM²): 5
ELEVATION (M): 1208
SURFACE ACTIVITY: FUMAROLES
SPRING TEMPERATURES (°C): 97
ROCK TYPES: BASALT
### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 (0)</td>
<td>240 (0)</td>
<td>150 (0)</td>
<td>163</td>
<td>29</td>
</tr>
</tbody>
</table>

**Uncoded Temperature:** Indicates subjective judgement

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate

- Volume (km³) = 3.3
- Thermal Energy (10¹² J) = 1.33

### Comments:
System may be hotter and more extensive

### References:
Warin, 1965; White and Warin, 1963; Peterson, 1967; Renner and Others, 1976

### Compiled by:
Brook, C.

**Steaming Flats (Sulphur Bank) Area, Hawaii**
FIELD NAME: KAMAILI Homesteads (1955 Eruption) Area
KGRA OR OTHER NAME: East Rift
CIRCULAR REFERENCE: 084

GEOGRAPHIC LOCALITY
STATE: HAWAII
COUNTY: HAWAII
LATITUDE: 19-26.5 N
LONGITUDE: 154-57.0 W
MAPS: PAHOA SOUTH 1124,000

GENERAL INFORMATION
ELEVATION (M): 300
SURFACE ACTIVITY: Area of recent lava eruptions
NO. OF WELLS: 3
WELL DEPTHS (M): 56 to 211
MAXIMUM WELL TEMP (C): 113 at depth (M) 211
ROCK TYPES: BASALT
GEOPHYSICS: RESISTIVITY, GRAVITY, MAGNETIC, MICROEARTHQUAKE, GROUND-NOISE
### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>240</td>
<td>290</td>
<td>290</td>
<td>273</td>
<td>12</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

A) Quartz Conductive  
B) Quartz Conductive, PH-Corrected  
C) Quartz Adiabatic  
D) Chalcedony  
E) Chalcedony, PH-Corrected

- F) Cristobalite  
- G) Amorphous Silica  
- H) Na-K  
- I) Na-K-CA  
- J) Na-K-CA, Mg-Corrected  
- K) Sulfate Geothermometer  
- L) Surface Temperature  
- M) Well Temperature  
- N) Mixing Model  
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.7</td>
<td>1.5</td>
<td>1.0</td>
<td>1.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.4</td>
<td>1.3</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>15</td>
<td>5</td>
<td>7.3</td>
<td>2.8</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>9.5</th>
<th>STD. DEV. = 4.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10¹⁸ J)</td>
<td>6.65</td>
<td>STD. DEV. = 3.05</td>
</tr>
</tbody>
</table>

**Comments:** Located about 6 km southwest of Kapoho Reservoir area, no surface expression, no water chemistry, area identified by geophysical anomalies and may be similar to Kapoho Reservoir. Depth of gravity anomaly occurs at 1 km, zone of low resistivity occurs between 0.7 km and 2.1 km, proposed to be a self-sealed system.

**References:** Furumoto, 1976; Renner and Others, 1976

Compiled by: Brook, C.

Kamaili Homesteads (1955 Eruption) Area, Hawaii
FIELD NAME: KAPOHO RESERVOIR (PUULENA AREA)
KGRA OR OTHER NAME: WELL HGP-A
CIRCULAR REFERENCE: 085

GEOGRAPHIC LOCALITY
STATE: HAWAII
COUNTY: HAWAII
LATITUDE: 19-28.5 N
LONGITUDE: 154-53.8 W
MAPS: PAHOA SOUTH 1:24,000

GENERAL INFORMATION
ELEVATION (M): 185
SURFACE ACTIVITY: AREA OF RECENT LAVA Eruptions
NO. OF WELLS: 2
WELL DEPTHS (M): 200 TO 1967
MAXIMUM WELL TEMP (C): 358 AT DEPTH (M) 1967
ROCK TYPES: BASALT
GEOPHYSICS: RESISTIVITY, GRAVITY, MAGNETIC, MICROEARTHQUAKE, GROUND-NOISE

CHEMISTRY
SAMPLE SOURCE: KIHARA AND OTHERS, 1977

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>146-153</td>
<td>420</td>
<td>40</td>
<td>1</td>
<td>600</td>
<td>123</td>
<td>123</td>
<td>925</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F 0 PH
LT 5

DELT 0(18) SO4
DELT 0(18) H2O
DELT 0 H2O
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3)............. 244
- NA-K-CA (4/3)............. 231
- NA-K.................... 286

SILICA
- ADIABATIC................. 214
- CONDUCTIVE............... 237
- CHALCEDONY............... 226
- CRISTOBALITE............. 191
- OPAL..................... 112

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>244 (I)</td>
<td>290 (M)</td>
<td>290 (M)</td>
<td>275</td>
<td>11</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

VOLUME (KM**3).............. 1.9  STD. DEV. = 0.7
THERMAL ENERGY(10**18 J) 1.31  STD. DEV. = 0.52

COMMENTS: TEMPERATURE CURVE INDICATES THAT THE MAXIMUM TEMPERATURE OF 358 DEG C AT 1967 M (TD) IS IN A ZONE OF CONDUCTIVE HEAT FLOW. THE CURVE IS ISOTHERMAL BETWEEN 1220 M AND 1769 M; THIS INTERVAL IS CONSIDERED AS THE RESERVOIR.


COMPILED BY: BROOKS, C.

KAPoho RESERVOIR (PUULENA AREA), HAWAII
Idaho
FIELD NAME: RED RIVER HOT SPRINGS
CIRCULAR REFERENCE: 086

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: IDAHO
LATITUDE: 45-47.2 N
LONGITUDE: 115-11.9 W
MAPS: SABLE HILL 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
28N 10E 03 SE BOISE

GENERAL INFORMATION
WARING FIGURE: 4
WARING NUMBER: 10
ELEVATION (M): 1585
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER (?)
NO. OF SPRINGS: 9
SPRING TEMPERATURES (°C): 37 to 55
ROCK TYPES: CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 132
COLLECTION DATE: 1972/08/21

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>76</td>
<td>2.7</td>
<td>0</td>
<td>81</td>
<td>1.6</td>
<td>36</td>
<td>36</td>
<td>44</td>
<td>4.4</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td>DEL 0(18)</td>
<td>SO4</td>
<td>DEL 0(18)</td>
<td>H2O</td>
<td>DEL D</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>8.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS (°C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>NA-K-CA (1/3)</th>
<th>NA-K-CA (4/3)</th>
<th>NA-K</th>
<th>SILICA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>110</td>
<td>80</td>
<td>50</td>
<td>120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADIABATIC</th>
<th>CONDUCTIVE</th>
<th>CHALCEDONY</th>
<th>CRISTOBALITE</th>
<th>OPAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>122</td>
<td>94</td>
<td>72</td>
<td>4</td>
</tr>
</tbody>
</table>

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>80 (A)</td>
<td>112 (B)</td>
<td>83 (E)</td>
<td>92</td>
</tr>
</tbody>
</table>

**MINIMUM** | **MAXIMUM** | **MOST LIKELY** | **MEAN** | **STD. DEV.**

| DEPTH TO TOP (KM) | 0.5 | 2.0 | 1.5 | 1.7 | 0.3 |
| THICKNESS (KM) | 1.0 | 2.5 | 1.5 | 2.0 | 0.4 |
| SUBSURFACE AREA (KM²) | 1 | 3 | 2 | 1 | 0.9 |

**VOLUME (KM³)** | **STD. DEV. = 0.9** |
| **THERMAL ENERGY (10¹⁸ J)** | **STD. DEV. = 0.20** |

**COMMENTS:** A very dilute, high PH water.

**REFERENCES:** YOUNG AND MITCHELL, 1973

**COMPILED BY:** MARINER, R.

**RED RIVER HOT SPRINGS, IDAHO**
FIELD NAME: RIGGINS HOT SPRINGS
CIRCULAR REFERENCE: 087

**GEOGRAPHIC LOCALITY**
- **STATE**: IDAHO
- **COUNTY**: IDAHO
- **LATITUDE**: 45°35.0' N
- **LONGITUDE**: 116°10.2' W
- **MAPS**: RIGGINS HOT SPRINGS 1124,000

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**
- 24N 02E 14 SW OF NE OF SE BOISE

**GENERAL INFORMATION**
- **WARING FIGURE**: 4
- **WARING NUMBER**: 13
- **ELEVATION (M)**: 610
- **SURFACE ACTIVITY**: HOT SPRINGS
- **ASSOCIATED DEPOSITS**: TRAVERTINE
- **NO. OF SPRINGS**: 4
- **DISCHARGE (L/MIN)**: 190

**ROCK TYPES**: ALLUVIUM OVERLYING PALEOZOIC AND MESOZOIC GNEISSES

**CHEMISTRY**
- **SAMPLE SOURCE**: YOUNG AND MITCHELL, 1973
- **FLOW (L/MIN)**: 190
- **COLLECTION DATE**: 1972/08/01

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>72</td>
<td>6.2</td>
<td>0.1</td>
<td>160</td>
<td>3.4</td>
<td>11</td>
<td>25</td>
<td>300</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>8.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ........... 116
NA-K-CA (4/3) .......... 95
NA-K ................. 54

SILICA
ADIAHATIC ............... 118
CONDUCTIVE ............ 120
CHALCEDONY .......... 91
CRISTOBALITE ........ 69
OPAL ................ 1

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
MINIMUM 91 (0)
MAXIMUM 120 (A)
MOST LIKELY 95 (1)

REFERENCES: YOUNG AND MITCHELL, 1973; HAMILTON, 1969

COMPILED BY: MARINER, R.

RIGGINS HOT SPRINGS, IDAHO
FIELD NAME: KRIGBAUM HOT SPRINGS
CIRCULAR REFERENCE: 088

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: ADAMS
LATITUDE: 44°58'1" N
LONGITUDE: 116°11'4" W

MAPS: BAKER 11250×000
TOWNSHIP RANGE SECTION BASE & MERIDIAN
19N 02E 22 SW OF NE BOISE

GENERAL INFORMATION
WARING FIGURE: 4
WARING NUMBER: 17
ELEVATION (M): 1433
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 40 to 43
DISCHARGE (L/MIN): 151
ROCK TYPES: CRETACEOUS GRANITE NEAR MIocene BASALT

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 80
COLLECTION DATE: 1972/06/29

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>73</td>
<td>5.3</td>
<td>0.2</td>
<td>140</td>
<td>3.3</td>
<td>81</td>
<td>9</td>
<td>190</td>
<td>26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.8</td>
<td>0.8</td>
<td></td>
</tr>
</tbody>
</table>
**Geothermometers (°C)**

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>120</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>96</td>
</tr>
<tr>
<td>Na-K</td>
<td>61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>118</td>
</tr>
<tr>
<td>Conductive</td>
<td>120</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>92</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>70</td>
</tr>
<tr>
<td>Opal</td>
<td>2</td>
</tr>
</tbody>
</table>

**Reservoir Properties**

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>92 (D)</td>
<td>120 (A)</td>
<td>96 (I)</td>
<td>103</td>
<td>6</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

<table>
<thead>
<tr>
<th>Temperature Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Quartz Conductive</td>
<td></td>
</tr>
<tr>
<td>B) Quartz Conductive, PH-corrected</td>
<td></td>
</tr>
<tr>
<td>C) Quartz Adiabatic</td>
<td></td>
</tr>
<tr>
<td>D) Chalcedony</td>
<td></td>
</tr>
<tr>
<td>E) Chalcedony, PH-corrected</td>
<td></td>
</tr>
<tr>
<td>F) Cristobalite</td>
<td></td>
</tr>
<tr>
<td>G) Amorphous Silica</td>
<td></td>
</tr>
<tr>
<td>H) Na-K</td>
<td></td>
</tr>
<tr>
<td>I) Na-K-CA</td>
<td></td>
</tr>
<tr>
<td>J) Na-K-CA, Mg-corrected</td>
<td></td>
</tr>
<tr>
<td>K) Sulfate Geothermometer</td>
<td></td>
</tr>
<tr>
<td>L) Surface Temperature</td>
<td></td>
</tr>
<tr>
<td>M) Well Temperature</td>
<td></td>
</tr>
<tr>
<td>N) Mixing Model</td>
<td></td>
</tr>
<tr>
<td>O) Renner and Others, 1976</td>
<td></td>
</tr>
</tbody>
</table>

**Depth to Top (km)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**Thickness (km)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Subsurface Area (km**²**)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Based on standard estimate.

**Volume (km**³**)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Thermal Energy (10**¹**8 J)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.79</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**References:** Young and Mitchell, 1973; Waring, 1965

**Compiled by:** Mariner, R.

Krigbaum Hot Springs, Idaho
FIELD NAME: WHITE LICKS HOT SPRINGS
CIRCULAR REFERENCE: 089

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: ADAMS
LATITUDE: 44-40.9 N
LONGITUDE: 116-13.8 W
MAPS: CASCADE U62 t 50o TOWNSHIP RANGE SECTION BASE & MERIDIAN
16N 02E 33 SW OF NW BOISE

GENERAL INFORMATION
WAKING FIGURE: 4
WAKING NUMBER: 19
ELEVATION (M): 1484
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: NUMEROUS
SPRING TEMPERATURES (C): 63 TO 67
DISCHARGE (L/MIN): 115
ROCK TYPES: MIocene BASALT AND CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB, DATA

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>105</td>
<td>39</td>
<td>LT 0.1</td>
<td>390</td>
<td>16</td>
<td>71</td>
<td>630</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

F 8 8
PH 7.82
DEL O(18)  S04  DEL O(18)  H2O  DEL O(18)  Cl
-4.24  -15.25
DEL O H2O

### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>144</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>118</td>
</tr>
<tr>
<td>NA-K</td>
<td>99</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>135</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>140</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>114</td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>89</td>
</tr>
<tr>
<td>OPAL</td>
<td>19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>163</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>148</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>151</td>
</tr>
</tbody>
</table>

### Reservoir Properties

- **Subsurface Temp (C)**
  - Minimum: 114 (D)
  - Maximum: 162 (K)
  - Most Likely: 140 (A)

- **Uncoded temperature indicates subjective judgement**
  - A) Quartz Conductive
  - H) Quartz Conductive, PH-corrected
  - C) Quartz Adiabatic
  - D) Chalcodony
  - E) Chalcodony, PH-corrected
  - F) Cristobalite
  - G) Amorphous Silica
  - I) Na-K
  - J) Na-K-CA
  - K) Sulfate Geothermometer
  - L) Surface Temperature
  - M) Well Temperature
  - N) Mixing Model
  - O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (KM²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

- **Based on standard estimate**

<table>
<thead>
<tr>
<th>Volume (KM³)</th>
<th>3.3</th>
<th>Std. Dev. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10¹¹ J)</td>
<td>1.11</td>
<td>Std. Dev. = 0.32</td>
</tr>
</tbody>
</table>

### References:
- Young and Mitchell, 1973
- Compiled by: Brook, C., Mariner, R.

**White Licks Hot Springs, Idaho**
FIELD NAME: VULCAN HOT SPRINGS
OTHER NAME: VULCAN HOT SPRINGS KGRA
CIRCULAR REFERENCE: 090

STATE: IDAHO
COUNTY: VALLEY
LATITUDE: 44°34.0' N
LONGITUDE: 115°41.5' W
MAPS: WARM LAKE 1162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN:
14N 06E 11 SE OF NW BOISE

GENERAL INFORMATION
WARNING FIGURE: 4
WARNING NUMBER: 32
ELEVATION (M): 1707
SUSTAINABLE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: 13
SPRING TEMPERATURES (°C): 84 (?) TO 87
DISCHARGE (L/MIN): 1900
ROCK TYPES: CRETACEOUS GRANITE WITH PEGMATITE VEINS

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUBL, DATA
COLLECTION DATE: 1978/05/07

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td>105</td>
<td>1.6</td>
<td>99</td>
<td>3.3</td>
<td>123</td>
<td>109</td>
<td>35</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>87</td>
<td>105</td>
<td>1.6</td>
<td>99</td>
<td>3.3</td>
<td>123</td>
<td>109</td>
<td>35</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>8</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>504</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>0.13</td>
<td>0.81</td>
<td>+3.44</td>
<td>-18.79</td>
<td>-18.79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) ............. 138
- NA-K-CA (4/3) ............. 122
- NA-K ................... 84

SILICA
- ADIABATIC ................. 135
- CONDUCTIVE ............... 140
- CHALCEDONY ............... 114
- CRISTOBALITE ............. 89
- OPAL .................... 19

SULFATE
- CONDUCTIVE ............... 56
- ONE-STEP STEAM LOSS ..... 58
- CONTINUOUS STEAM LOSS .. 59

RESERVOIR PROPERTIES

SUHSSURFACE TEMP (C)
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
- 87 (L) 140 (A) 138 (I) 122 12

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNTER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
- DEPTH TO TOP (KM) 0.5 2.0 1.5
- THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
- SUBSURFACE AREA (KM²) 1
- BASED ON: STANDARD ESTIMATE
- VOLUME (KM³) ............. 3.3 STD. DEV. = 0.9
- THERMAL ENERGY (10¹¹ J) 0.96 STD. DEV. = 0.29

COMMENTS: PH-CORRECTED CHALCEDONY INDICATES 86 C, PH-CORRECTED QUARTZ 114 C, ESTIMATED AQUIFER TEMPERATURES ARE PROBABLY TOO HIGH. SO₄-ISOTOPE GEOTHERMOMETER INDICATES LESS THAN THE SPRING TEMPERATURE. LOSS OF ONLY 1.6 MG/L CA WOULD HAVE INCREASED THE NA-K-CA GEOTHERMOMETER FROM 100 TO 138 C, IMPLYING POSSIBLE CALCITE PRECIPITATION IN THE SUBSURFACE.

REFERENCES: WARING, 1965; YOUNG AND MITCHELL, 1973

COMPILED BY: MARINER, R.

VULCAN HOT SPRINGS, IDAHO
FIELD NAME: CABARTON HOT SPRINGS
CIRCULAR REFERENCE: 091

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: VALLEY
LATITUDE: 44°25'0" N
LONGITUDE: 116°01'.7" W
MAPS: SMITHS FERRY 1162,500

TOWNSHIP RANGE SECTION
17N 04E 31 NE OF SW BOISE

GENERAL INFORMATION
ELEVATION (M): 1438
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: NUMEROUS
SPRING TEMPERATURES (C): 56 TO 70.5
DISCHARGE (L/MIN): 265
ROCK TYPES: CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
COLLECTION DATE: 1972/08/03

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.5</td>
<td>78</td>
<td>1.7</td>
<td>0</td>
<td>100</td>
<td>1.9</td>
<td>70</td>
<td>26</td>
<td>46</td>
<td>49</td>
</tr>
<tr>
<td>F</td>
<td>11</td>
<td>PH</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H20</td>
<td>DEL D H20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)............. 114
NA-K-CA (4/3)............. 99
NA-K..................... 48

SILICA
ADIAHATIC............... 121
CONDUCTIVE............. 124
CHALCEDONY............. 96
CRISTOBALITE........... 73
OPAL..................... 5

RESERVOIR PROPERTIES
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE Temp (C) 96 (D) 124 (A) 99 (I) 106 6

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPTb TO Top (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM^2) 1 3 2 2.0 0.4

VOLUME (KM^3)......... 3.3 STD. DEV. = 0.9
THERMAL ENERGY (10^18 J) 0.82 STD. DEV. = 0.24

COMMENTS: A very dilute water. Loss of several mg/l calcium could be increasing the temperature estimated from the NA-K-CA geothermometer.

REFERENCES: YOUNG AND MITCHELL, 1973

COMPilED BY: MARINER, R.

CABARION HOT SPRINGS, IDAHO
FIELD NAME................ BOILING SPRINGS
CIRCULAR REFERENCE........ 092

GEOGRAPHIC LOCALITY
STATE....................... IDAHO
COUNTY..................... VALLEY
LATITUDE.................. 44°21.9' N
LONGITUDE................ 115°51.4' W
MAPS....................... BOILING SPRINGS 1162,500
TOWNSHIP RANGE SECTION BASE & MERIDIAN
12N 05E 22 NW OF NW BOISE

GENERAL INFORMATION
WARING FIGURE...................... 4
WARING NUMBER...................... 38
ELEVATION (M)..................... 1234
SURFACE ACTIVITY............... HOT SPRINGS
ASSOCIATED DEPOSITS.............. SINTER, MINOR CARBONATE
NO. OF SPRINGS................. SEVERAL IN 3 MAIN GROUPS
SPRING TEMPERATURES (°C)....... 80 TO 86
DISCHARGE (L/MIN)............... 624
ROCK TYPE: CRETACEOUS GRANITE WITH PEGMATITE VEINS

CHEMISTRY
SAMPLE SOURCE........ MARINER, R., UNPUB. DATA
COLLECTION DATE........ 1978/05/08

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
<td>86</td>
<td>1.4</td>
<td>74</td>
<td>1.9</td>
<td>126</td>
<td>110</td>
<td>14</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL O(18)</th>
<th>DEL O(18)</th>
<th>DEL D</th>
<th>DEL D</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>0.09</td>
<td>8.70</td>
<td>+0.30</td>
<td>-17.76</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CA(ION)</th>
<th>NA-K-CA (1/3)</th>
<th>124</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NA-K-CA (4/3)</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>NA-K</td>
<td>66</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>126</td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

| SULFATE             |               |             |
| CONDUCTIVE          | 86            |             |
| ONE-STEP STEAM LOSS | 86            |             |
| CONTINUOUS STEAM LOSS | 86         |             |

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3.3</td>
</tr>
</tbody>
</table>

**COMMENTS:** CHALCEDONY WITH PH-CORRECTION INDICATES 83 C, REPORTED DEPOSITION OF ZEOLITES, CALCITE, AND MERCURY MINERALS.

**REFERENCES:** WARING, 1965; DICKSON AND TUNELL, 1968; YOUNG AND MITCHELL, 1973

**COMPILED BY:** MARINER, R. BROOK, C.

**BOILING SPRINGS, IDAHO**
FIELD NAME: CRANE CREEK - COVE CREEK AREA
KGRA OR OTHER NAME: CRANE CREEK KGRA
CIRCULAR REFERENCE: 093

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: WASHINGTON
LATITUDE: 44°18.3' N
LONGITUDE: 116°44.7' W
MAPS: CRANE CREEK RESERVOIR 1162560

TOWNSHIP RANGE SECTION BASE & MERIDIAN
11N 03W 07 BOISE

GENERAL INFORMATION
ELEVATION (M): 732
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER AND TRAVERTINE
NO. OF SPRINGS: ABOUT 4 IN 2 GROUPS 11 KM APART
SPRING TEMPERATURES (°C): 57 TO 92
DISCHARGE (L/MIN): 220
NO. OF WELLS: 2
WELL DEPTHS (M): 550 TO 610
ROCK TYPES: TERTIARY BASALT AND FLUVIAL DEPOSITS
GEOPHYSICS: GRAVITY, MAGNETIC, AMT

CHEMISTRY
SAMPLE SOURCE: YOUNG AND WHITEHEAD, 1975
FLOW (L/MIN): 17
COLLECTION DATE: 1973/08/02

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>180</td>
<td>29</td>
<td>0.5</td>
<td>280</td>
<td>18</td>
<td>201</td>
<td>250</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) SiO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0(18) H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8</td>
<td>-</td>
<td>7.99</td>
<td>-14.39</td>
<td>-150</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>163</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>126</td>
</tr>
<tr>
<td>NA-K</td>
<td>137</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>162</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>173</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>151</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>123</td>
</tr>
<tr>
<td>UPAL</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>249</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>218</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>226</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>151 (D)</td>
<td>200</td>
<td>163 (I)</td>
<td>171</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

| QUARTZ CONDUCTIVE | CRISTOBALITE | SULFATE GEOTHERMOMETER |
| QUARTZ CONDUCTIVE, PH-CORRECTED | AMORPHOUS SILICA | |
| QUARTZ ADIABATIC | NA-K | |
| CHALCEDONY | NA-K-CA | |
| CHALCEDONY, PH-CORRECTED | NA-K-CA, MG-CORRECTED | |
| CRISTOBALITE | |
| AMORPHOUS SILICA | |
| NA-K | |
| NA-K-CA | |
| SULFATE | |
| SURFACE TEMPERATURE | |
| WELL TEMPERATURE | |
| MIXING MODEL | |
| RENNER AND OTHERS, 1976 | |

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.3</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUHSSURFACE AREA (KM^2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>50</td>
<td>15</td>
<td></td>
<td>23.3</td>
<td>9.6</td>
</tr>
</tbody>
</table>

BASED ON SPRING DISTRIBUTION, AREA OF ALTERATION, AMT SURVEY

<table>
<thead>
<tr>
<th>VOLUME (KM^3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.9</td>
<td></td>
<td></td>
<td></td>
<td>23.3</td>
<td>9.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10^18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.4</td>
<td></td>
<td></td>
<td></td>
<td>16.4</td>
<td>7.65</td>
</tr>
</tbody>
</table>

COMMENTS: SPRINGS AT CRANE CREEK AND COVE CREEK HAVE SIMILAR CHEMISTRY AND ARE IN A ZONE OF ALTERATION AND MERCURY MINERALIZATION. SPRINGS ARE ABOUT 11 KM APART AND MAY BE SEPARATE SYSTEMS AS REFLECTED BY MINIMUM AREA ESTIMATE.

REFERENCES: YOUNG AND WHITEHEAD, 1975; RIGHMIRE AND OTHERS, 1976

COMPILED BY: MARINER, R., BROOK, C.

CRANE CREEK - COVE CREEK AREA, IDAHO
FIELD NAME................ WEISER AREA
CIRCULAR REFERENCE........ 094

GEOGRAPHIC LOCALITY
STATE.................... IDAHO
COUNTY................... WASHINGTON
LATITUDE................ 44-17.9 N
LONGITUDE.............. 117-02.9 W
MAPS...................... OLDS FERRY SE 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
11N 06W 10 BOISE

GENERAL INFORMATION
WAKING FIGURE............... 4
WAKING NUMBER............... 21
ELEVATION (M).............. 671
SURFACE ACTIVITY........... HOT SPRINGS
NO. OF SPRINGS............. SEVERAL
SPRING TEMPERATURES (C)..... 25 TO 77
DISCHARGE (L/MIN)......... 20
NO. OF WELLS............... 6 SHALLOW WELLS
WELL DEPTHS (M)........... 28 TO 183
MAXIMUM WELL TEMP (C).... 77 AT DEPTH (M) 3
ROCK TYPES: PLEISTOCENE AND PLIOCENE FLUVIAL AND LAKE DEPOSITS
GEOPHYSICS: GRAVITY, MAGNETIC, AMT, GROUND TEMPERATURE

CHEMISTRY
SAMPLE SOURCE............. YOUNG AND WHITEHEAD, 1975
COLLECTION DATE........... 1972/08/02

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>70.5</td>
<td>140</td>
<td>2.9</td>
<td>140</td>
<td>5.0</td>
<td>35</td>
<td>38</td>
<td>150</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>R</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>9.3</td>
<td></td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H20</td>
<td>DEL D H20</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3).............. 142
- NA-K-CA (4/3)............. 127
- NA-K...................... 89

SILICA
- ADIABATIC.................. 149
- CONDUCTIVE................ 157
- CHALCEDONY................ 133
- CRISTOBALITE.............. 107
- OPAL....................... 35

RESEVOIR PROPERTIES

SUBSURFACE TEMP (C)
- MINIMUM: 90 (E)
- MAXIMUM: 157 (A)
- MOST LIKELY: 142 (I)
- MEAN: 130
- STD. DEV.: 14

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
- MINIMUM: 0.5
- MAXIMUM: 2.0
- MOST LIKELY: 1.5
- MEAN: 1.7
- STD. DEV.: 0.3

THICKNESS (KM)
- MINIMUM: 1.0
- MAXIMUM: 2.5
- MOST LIKELY: 1.5
- MEAN: 2.7
- STD. DEV.: 0.8

SUBSURFACE AREA (KM**2)
- MINIMUM: 1
- MAXIMUM: 5
- MOST LIKELY: 2

RASED ON SPHING AND WELL DISTRIBUTION, GROUND TEMPERATURE ANOMALY

VOLUME (KM**3)............. 4.4
- STD. DEV. = 1.7

THERMAL ENERGY (10**18 J)... 1.38
- STD. DEV. = 0.55

COMMENTS: SULFATE ISOTOPE GEOTHERMOMETER ON SEVERAL SAMPLES RANGE FROM 219 TO 235 C. ISOTOPIC DATA FROM HIGHTMIRE AND OTHERS (1976).

REFERENCES: YOUNG AND WHITEHEAD, 1975; HIGHTMIRE AND OTHERS, 1976

COMPILLED BY: MARINER, R.; BROOK, C.

WEISER AREA, IDAHO
FIELD NAME: ROYSTONE HOT SPRINGS
CIRCULAR REFERENCE: 095

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: GEM
LATITUDE: 43°57.2' N
LONGITUDE: 116°21.2' W
MAPS: MONTOUR H62 t 500

TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
07N  01E  08 NE OF SE OF SE BOISE

GENERAL INFORMATION
WAKING FIGURE: 4
WAKING NUMBER: 66
ELEVATION (M): 768
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 5
SPRING TEMPERATURES (C): 45 TO 55
DISCHARGE (L/MIN): 76

ROCK TYPES: ALLUVIUM NEAR MIocene BASALT, OVERLYING CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 76
COLLECTION DATE: 1972/11/24

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SJ02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>120</td>
<td>8.7</td>
<td>0.6</td>
<td>160</td>
<td>7.7</td>
<td>107</td>
<td>107</td>
<td>110</td>
<td>62</td>
</tr>
</tbody>
</table>

F 8 PH DEL 0(18) SO4  DEL 0(18) H2O  DEL 0 H2O
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>150</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>117</td>
</tr>
<tr>
<td>NA-K</td>
<td>112</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>141</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>140</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>122</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>97</td>
</tr>
<tr>
<td>OPAL</td>
<td>26</td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>122 (D)</td>
<td>148 (A)</td>
<td>135 (J)</td>
<td>135</td>
<td>5</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**THICKNESS (KM)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**SUBSURFACE AREA (KM**2**)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**VOLUME (KM**3**)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THERMAL ENERGY (10**18 J)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.08</td>
<td>STD. DEV. = 0.31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REFERENCES:** YOUNG AND MITCHELL, 1973

**COMPILED BY:** MARINER, R.

**ROYSTONE HOT SPRINGS, IDAHO**
FIELD NAME: BONNEVILLE HOT SPRINGS
CIRCULAR REFERENCE: 096

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: BOISE
LATITUDE: 44°09.5' N
LONGITUDE: 115°18.4' W
MAPS: CHALLIS 1:250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
10N 10E 31 SW BOISE

GENERAL INFORMATION
WARING FIGURE: 4
WARING NUMBER: 80
ELEVATION (M): 1585
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER, TRAVERTINE
NO. OF SPRINGS: 8
SPRING TEMPERATURES (°C): 68 TO 85
DISCHARGE (L/MIN): 1370
ROCK TYPES: CRETAEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. DATA
COLLECTION DATE: 1978/05/05

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>99</td>
<td>1.9</td>
<td>0.4</td>
<td>2.8</td>
<td>1.0</td>
<td>110</td>
<td>101</td>
<td>46</td>
<td>7.6</td>
</tr>
</tbody>
</table>

F  B  PH  DEL 0(18) SO4  DEL 0(18) H2O  DEL 0 H2O
17  0.06  9.32  -1.01  -18.46
## Geothermometers (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>136</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>108</td>
</tr>
<tr>
<td>Na-K</td>
<td>86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>132</td>
</tr>
<tr>
<td>Conductive</td>
<td>137</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>110</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>86</td>
</tr>
<tr>
<td>Opal</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>91</td>
</tr>
<tr>
<td>One-step steam loss</td>
<td>90</td>
</tr>
<tr>
<td>Continuous steam loss</td>
<td>90</td>
</tr>
</tbody>
</table>

## Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>87 (B)</td>
<td>136 (A+I)</td>
<td>91 (K)</td>
<td>105</td>
<td>11</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Thickness (km)          | 1.0     | 2.5     | 1.5         |      |           |

| Subsurface Area (km²)   | 1       | 3       | 2           | 2.0  | 0.4       |

Volume (km³): 3.3, Std. Dev. = 0.9

Thermal Energy (10⁻¹⁸ J): 0.81, Std. Dev. = 0.25

Comments: Calcite may be precipitating in the subsurface; if the calcium concentration is doubled, the Na-K-CA geothermometer would give 91 °C.

References: Young and Mitchell, 1973; Waring, 1965

Compiled by: Mariner, R.

Bonneville Hot Springs, Idaho
FIELD NAME: PAYETTE RIVER AREA NEAR BANKS
CIRCULAR REFERENCE: 097

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: BOISE
LATITUDE: 44°05.1' N
LONGITUDE: 116°03.0' W
MAPS: BANKS 1162,500

TOWNship RANGE SECTION BASE & MERIDIAN
9N 03E 25 NE OF NW BOISE

GENERAL INFORMATION
ELEVATION (M): 1158
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 1
SPRING TEMPERATURES (°C): 78.5
DISCHARGE (L/MIN): 76
ROCK TYPES: CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. DATA
COLLECTION DATE: 1978/05/08

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>78.5</td>
<td>101</td>
<td>4.5</td>
<td>0.01</td>
<td>130</td>
<td>5.2</td>
<td>167</td>
<td>77</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F 10(18) SO4  DEL 0(18) H2O  DEL 0 H2O
### Geothermometers (C)

- **CATION**
  - Na-K-CA (1/3) ........... 143
  - Na-K-CA (4/3) ........... 116
  - Na-K ................ 97

- **SILICA**
  - Adiabatic ............. 133
  - Conductive ........... 138
  - Chalcedony .......... 111
  - Cristobalite ........ 87
  - Opal ................ 17

### Reservoir Properties

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subsurface Temp (C)</strong></td>
<td>111 (D)</td>
<td>143 (I)</td>
<td>138 (A)</td>
<td>131</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depth to Top (km)</strong></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Thickness (km)</strong></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Subsurface Area (km</strong>2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Volume (km**3) .......... 3.3 Std. Dev. = 0.9

### Thermal Energy (10**18 J) 1.04 Std. Dev. = 0.30

#### References:
- Young and Mitchell, 1973

Compiled by: Mariner, R., Brook, C.

Payette River area near Banks, Idaho
FIELD NAME: NEINMEYER HOT SPRINGS

CIRCULAR REFERENCE: 098

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: ELMORE
LATITUDE: 43°45.5' N
LONGITUDE: 115°34.7' W

MAPS: BARBER FLAT 1162,500

TOWNSHIP: 15N
RANGE: 07E
SECTION: 24
BASE & MERIDIAN: BOISE

GENERAL INFORMATION
WARING FIGURE: A
WARING NUMBER: 116
ELEVATION (M): 1158
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: 13
SPRING TEMPERATURES (C): 68 TO 76
DISCHARGE (L/MIN): 1320
ROCK TYPES: CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. DATA
COLLECTION DATE: 1978/05/06

<table>
<thead>
<tr>
<th>TEMP (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIO2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1.5</td>
<td>62</td>
<td>1.6</td>
<td>106</td>
<td>106</td>
<td>28</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

F: 8.03  PH: 9.35  DEL O(18) H2O: -1.12  DEL O(18) SO4: -18.35

DEL 0 H2O
GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>121</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| SILICA       |          |          |          |          |
| ADIABATIC    | 133      |          |          |          |
| CONDUCTIVE   | 137      |          |          |          |
| CHALCEDONY   | 110      |          |          |          |
| CRISTOBALITE | 87       |          |          |          |
| OPAL         | 17       |          |          |          |

| SULFATE      |          |          |          |          |
| CONDUCTIVE   | 93       |          |          |          |
| ONE-STEP STEAM LOSS | 91 |          |          |          |
| CONTINUOUS STEAM LOSS | 91 |          |          |          |

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>90 (I)</td>
<td>100</td>
<td>93 (K)</td>
<td>94</td>
<td>2</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.71</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th></th>
<th>VOLUME (KM³)</th>
<th>THERMAL ENERGY (10¹⁸ J)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>0.71</td>
</tr>
</tbody>
</table>

STD. DEV. = 0.9                      STD. DEV. = 0.20

COMMENTS: PH-CORRECTED QUARTZ = 85°C, PROBABLY A DEEP CIRCULATING WATER WITH AN AQUIFER TEMPERATURE NEAR 90°C.

REFERENCES: YOUNG AND MITCHELL, 1973; WARING, 1965

COMPILED BY: MARINER, R.

NEINMEYER HOT SPRINGS, IDAHO
FIELD NAME................ LATTY HOT SPRINGS
CIRCULAR REFERENCE........ 099

GEOGRAPHIC LOCALITY
STATE.......................... IDAHO
COUNTY......................... ELMORE
LATITUDE........................ 43°07.0' N
LONGITUDE...................... 115°18.3' W
MAPS............................ BENNETT MTN, 1162+500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03S 10E 31 NW OF SE OF SE BOISE

GENERAL INFORMATION
ELEVATION (M)...................... 1189
SURFACE ACTIVITY.................. HOT SPRINGS
NO. OF SPRINGS..................... 1
SPRING TEMPERATURES (C)............ 55
ROCK TYPE(S): PLEISTOCENE BASALTS, VITRIC TUFFS

CHEMISTRY
SAMPLE SOURCE.. YOUNG AND MITCHELL, 1973
COLLECTION DATE.. 1972/07/05

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>100</td>
<td>0.4</td>
<td>1.7</td>
<td>90</td>
<td>33</td>
<td>10</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F : 8 PH DEL 0(18) SO4 DEL 0(18) H20 DEL D H20

7 : 8.4
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>NA-K-CA (1/3)</th>
<th>NA-K-CA (4/3)</th>
<th>NA-K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>137</td>
<td>124</td>
<td>80</td>
</tr>
</tbody>
</table>

SILICA

<table>
<thead>
<tr>
<th></th>
<th>ADIABATIC</th>
<th>CONDUCTIVE</th>
<th>CRISTOBALITE</th>
<th>OPAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>133</td>
<td>137</td>
<td>110</td>
<td>17</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110 (D)</td>
<td>137 (A, I)</td>
<td>125</td>
<td>124</td>
<td>6</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE

B) QUARTZ CONDUCTIVE, PH-CORRECTED

C) QUARTZ ADIABATIC

D) CHALCEDONY

E) CHALCEDONY, PH-CORRECTED

F) CRISTOBALITE

G) AMORPHOUS SILICA

H) NA-K

I) NA-K-CA

J) NA-K-CA, MG-CORRECTED

K) SULFATE GEOTHERMOMETER

L) SURFACE TEMPERATURE

M) WEIL TEMPERATURE

N) MIXING MODEL

O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

THICKNESS (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (KM**3)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THERMAL ENERGY (10**18 J)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.98</td>
<td>0.98</td>
<td>STD. DEV. = 0.28</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: PH-CORRECTION ON THE SILICA WOULD REDUCE THESE ESTIMATES B C. A VERY DILUTE WATER IN WHICH THE CHEMICAL GEOTHERMOMETERS MAY NOT BE VALID.

REFERENCES: YOUNG AND MITCHELL, 1973; MALDE AND OTHERS, 1963

COMPILED BY: MARINER, R.

LATTY HOT SPRINGS, IDAHO
**FIELD NAME**.................. RADIO TOWERS AREA  
**CIRCULAR REFERENCE**......... 100

**GEOGRAPHIC LOCALITY**

<table>
<thead>
<tr>
<th>STATE</th>
<th>ELMORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNTY</td>
<td>ELMORE</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>43-02.2 N</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>115-27.4 W</td>
</tr>
<tr>
<td>MAPS</td>
<td>BENNETT Mtn, 1162-500</td>
</tr>
</tbody>
</table>

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**

<table>
<thead>
<tr>
<th>TOWNSHIP</th>
<th>RANGE</th>
<th>SECTION</th>
<th>BASE &amp; MERIDIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>045</td>
<td>08E</td>
<td>36</td>
<td>NE OF NW OF NW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BOISE</td>
</tr>
</tbody>
</table>

**GENERAL INFORMATION**

<table>
<thead>
<tr>
<th>ELEVATION (M)</th>
<th>968</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE ACTIVITY</td>
<td>NONE, FOUND BY DRILLING</td>
</tr>
<tr>
<td>DISCHARGE (L/MIN)</td>
<td>30</td>
</tr>
<tr>
<td>NO. OF WELLS</td>
<td>1</td>
</tr>
<tr>
<td>WELL DEPTHS (M)</td>
<td>580</td>
</tr>
<tr>
<td>ROCK TYPES: PLIOCENE AND PLEISTOCENE SEDIMENTS</td>
<td></td>
</tr>
</tbody>
</table>

**CHEMISTRY**

| SAMPLE SOURCE | YOUNG AND MITCHELL, 1973 |
| FLOW (L/MIN) | 30 |
| COLLECTION DATE | 1972/06/06 |

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>86</td>
<td>3.2</td>
<td>0.2</td>
<td>160</td>
<td>3.7</td>
<td>447</td>
<td>5.4</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>PH</th>
<th>DEL O(18) SiO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>7.8</td>
<td>DEL O(18) SiO4</td>
<td>DEL O(18) H2O</td>
<td>DEL D H2O</td>
</tr>
</tbody>
</table>
# Geothermometers (C)

**CATION**
- Na-K-CA (1/3) ............. 124
- Na-K-CA (4/3) ............. 114
- Na-K .................. 59

**SILICA**
- Adiabatic ............... 126
- Conductive ............. 129
- Chalcedony ............. 101
- Cristobalite ........... 78
- Opal ................... 10

## Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>101 (D)</td>
<td>150</td>
<td>124 (I)</td>
<td>125</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km**2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>Volume (km**3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Std. Dev. = 0.9

<table>
<thead>
<tr>
<th>Thermal Energy (10**18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.99</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.29</td>
</tr>
</tbody>
</table>

Std. Dev. = 0.29

Comments: A very dilute water geothermometers may be unreliable. Geothermal test well about 0.5 km north had a maximum temperature of 189 °C at 2.7 km.

References: Young and Mitchell, 1973; Ralston and Chapman, 1968

Compiled by: Mariner, R., and Brook, C.

Radio Towers Area, Idaho
FIELD NAME: GRAVEL PITS AREA
CIRCULAR REFERENCE: 101

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: ELMORE
LATITUDE: 42°56.3' N
LONGITUDE: 115°29.6' W
MAPS: HAMMETT 1:24,000; GLENNS FERRY 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05S 08E 34 SE BOISE

GENERAL INFORMATION
ELEVATION (M): 762
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
ASSOCIATED DEPOSITS: TRAVERTINE
SPRING TEMPERATURES (C): 34
DISCHARGE (L/MIN): 7.6
NO. OF WELLS: 1
WELL DEPTHS (M): 403
ROCK TYPES: Plio-Pleistocene sediments

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 8
COLLECTION DATE: 1972/07/05

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>58</td>
<td>9.1</td>
<td>1</td>
<td>320</td>
<td>11</td>
<td>797</td>
<td>6.5</td>
<td>59</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>7.7</td>
<td></td>
</tr>
</tbody>
</table>

DEL 0(18) S04 DEL 0(18) H2O DEL D H2O
### Geothermometers (C)

**Cation**
- **NA-K-CA** (1/3): 144
- **NA-K-CA** (4/3): 141
- **NA-K**: 86

**Silica**
- **Adiabatic**: 109
- **Conductive**: 109
- **Chalcedony**: 79
- **Cristobalite**: 58
- **Opal**: -8

### Reservoir Properties

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subsurface Temp (°C)</strong></td>
<td>79 (D)</td>
<td>120 (J)</td>
<td>109 (A)</td>
<td>103</td>
<td>9</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

### Uncoded Temperature Indications

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depth to Top (km)</strong></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Thickness (km)</strong></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subsurface Area (km²)</strong></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on standard estimate

### Volume (km³)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume (km³)</strong></td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

### Thermal Energy (10⁻¹⁸ J)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermal Energy (10⁻¹⁸ J)</strong></td>
<td>0.79</td>
<td>0.79</td>
<td>0.79</td>
<td>0.79</td>
<td>0.23</td>
</tr>
</tbody>
</table>

### Comments:

Chemical geothermometers questionable because of the low flow-rate.

### References:

Young and Mitchell, 1973

Compiled by: Mariner, R.

Gravel Pits Area, Idaho
FIELD NAME .................. BRUNEAU-GRAND VIEW AREA
KGRA OR OTHER NAME .......... BRUNEAU KGRA, CASTLE CREEK KGRA
CIRCULAR REFERENCE ......... 102

GEOGRAPHIC LOCALITY
STATE ....................... IDAHO
COUNTY ..................... OWYHEE
LATITUDE ................... 42°56.0' N
LONGITUDE .................. 115°56.0' W
MAPS ....................... HOT SPRINGS, JACKASS BUTTE, LITTLE VALLEY, SUGAR VALLEY, BRUNEAU, GRANDVIEW
1:24,000 BRUNEAU, GRAND VIEW, BIG FOOT BUTTE, INDIAN COVE 1:62,500
TOWNSHIP RANGE SECTION BASE & MERIDIAN
06S 04E

GENERAL INFORMATION
WAKING FIGURE .................. 4
WAKING NUMBER .................. 160-169
ELEVATION (M) .................. 808
SURFACE ACTIVITY .............. HOT SPRINGS AND WELLS
NO. OF SPRINGS ................. SEVERAL
SPRING TEMPERATURES (C) ........ 11° TO 41°
DISCHARGE (L/MIN) ................ 10,000 (COMBINED SPRING AND WELL DISCHARGE)
NO. OF WELLS .................... MORE THAN 80
WELL DEPTHS (M) .................. 46° TO 3000
MAXIMUM WELL TEMP (C) ............ 83° AT DEPTH (M) WELL HEAD
ROCK TYPES: LACUSTINE AND FLUVIAL TUFFACEOUS SEDIMENTS, SILICIC AND BASALTIC VOLCANIC ROCKS
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, AMT

CHEMISTRY
SAMPLE SOURCE ............ YOUNG AND WHITEHEAD, 1975
COLLECTION DATE ........... 1973/06/07

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>83</td>
<td>110</td>
<td>2.1</td>
<td>0</td>
<td>110</td>
<td>1.7</td>
<td>22</td>
<td>64</td>
<td>62</td>
<td>15</td>
</tr>
<tr>
<td>F</td>
<td>15</td>
<td>9.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PH DEL 0(18) S04 DEL 0(18) H20 DEL 0 H20
-17.5 -146
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Na-K-CA ) (1/3)</td>
<td>106</td>
</tr>
<tr>
<td>( Na-K-CA ) (4/3)</td>
<td>91</td>
</tr>
<tr>
<td>( Na-K )</td>
<td>36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>137</td>
</tr>
<tr>
<td>Conductive</td>
<td>143</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>116</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>92</td>
</tr>
<tr>
<td>Opal</td>
<td>22</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>90 (1σ)</td>
<td>120</td>
<td>110</td>
<td>107</td>
<td>6</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgment.

- A) Quartz Conductive
- B) Quartz Adiabatic, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (KM)

- Minimum: 0.9
- Maximum: 2.0
- Most Likely: 2.0
- Mean: 1.2
- Std. Dev.: 0.2

### Thickness (KM)

- Minimum: 1.0
- Maximum: 1.7
- Most Likely: 1.0
- Mean: 1.4
- Std. Dev.: 0.3

### Subsurface Area (KM²)

- Minimum: 1000
- Maximum: 2250
- Most Likely: 1200
- Mean: 1483.3
- Std. Dev.: 274.1

Rased on well distribution, estimate of Renner et al. (1976), and AMT survey.

### Volume (KM³)

- Minimum: 1829.4
- Maximum: 419.8
- Most Likely: 108.6

### Thermal Energy (10^18 J)

- Minimum: 452.79
- Maximum: 419.8
- Most Likely: 108.6

### Comments:

Several water wells 300 to 1000 m deep used for irrigation. Two deep test wells to 3 km, may be a stacked system. Sulfate-isotope geothermometer for 6 samples gives 95 to 131°C.

### References:

- Young and Whitehead, 1975
- Rightmire and Others, 1976
- Renner and Others, 1976

Compiled by R. Martin, R., and Brook, C.

Brunefaut-Grand View Area, Idaho
FIELD NAME............... MURPHY HOT SPRINGS
KGRA OR OTHER NAME....... KITTY'S HOT HOLE
CIRCULAR REFERENCE...... 103

GEOGRAPHIC LOCALITY
STATE...................... IDAHO
COUNTY...................... OWYHEE
LATITUDE.................... 42°01'8" N
LONGITUDE................... 115°22'0" W
MAPS...................... TWIN FALLS 1:250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
16S 09E 24 NW OF NW BOISE

GENERAL INFORMATION
WARING FIGURE............ 4
WARING NUMBER............. 169B
ELEVATION (M).............. 1554
SURFACE ACTIVITY.......... HOT SPRINGS
NO. OF SPRINGS............... 2
ROCK TYPES: PLIOCENE SILICIC VOLCANIC ROCKS

CHEMISTRY
SAMPLE SOURCE.... YOUNG AND MITCHELL, 1973
FLOW (L/MIN)....... 265
COLLECTION DATE.. 1972/05/23

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>83</td>
<td>0.6</td>
<td>0.0</td>
<td>30</td>
<td>2</td>
<td>67</td>
<td>1</td>
<td>4.7</td>
<td>2.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.6</td>
<td>7.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>112</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>141</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>127</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>76</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>51 (L)</td>
<td>160 (I)</td>
<td>99 (D)</td>
<td>103</td>
<td>22</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement

A) QUARTZ CONDUCTIVE
B) QUARTZ ADIABATIC
C) QUARTZ ADIABATIC, PH-CORRECTED
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate

### Volume (km³)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thermal Energy (10¹⁸ J)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.79</td>
<td>STD. DEV. = 0.30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** A very dilute water; chemical geothermometers may be unreliable.

**References:**
- Young and Mitchell, 1973
- Compiled by: Mariné, R., and Brook, C.
- Murphy Hot Springs, Idaho
FIELD NAME: OWL CREEK HOT SPRINGS
CIRCULAR REFERENCE: 104

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: LEMHI
LATITUDE: 45-20.5 N
LONGITUDE: 114-27.0 W
MAPS: SHOUP 1162.500

GENERAL INFORMATION
ELEVATION (M): 1158
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2
ROCK TYPES: CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. DATA
COLLECTION DATE: 1978/05/04

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>0.89</td>
<td>4.44</td>
<td>0.04</td>
<td>120</td>
<td>5</td>
<td>203</td>
<td>53</td>
<td>6.4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>0.1</td>
<td>8.47</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOTHERMOMETERS (C)</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MOST LIKELY</td>
<td>MEAN</td>
<td>STD. DEV.</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>-------------</td>
<td>------</td>
<td>-----------</td>
</tr>
<tr>
<td>CATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (1/3)</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>127</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>131</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>103</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>103 (D)</td>
<td>144 (I)</td>
<td>131 (A)</td>
<td>126</td>
<td>9</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ ADIABATIC
- C) CHALCEDONY
- D) CHALCEDONY, PH-CORRECTED
- E) QUARTZ CONDUCTIVE, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA; MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SUHSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

| VOLUME (KM**3)       | 3.3     | STD. DEV. = 0.9 |
| THERMAL ENERGY(10**18 J) | 1.00   | STD. DEV. = 0.29 |

COMMENTS: PH-CORR. QUARTZ COND. = 122 DEG. C.

REFERENCES: USGS, UNPUB. DATA

COMPILED BY: MARINER, R.

OWL CRFEB HOT SPRINGS, IDAHO
FIELD NAME..................  BIG CREEK HOT SPRINGS
CIRCULAR REFERENCE........  105

GEOGRAPHIC LOCALITY
STATE......................... IDAHO
COUNTY......................... LEMHI
LATITUDE........................ 45-18.8 N
LONGITUDE....................... 114-19.2 W
MAPS............................ SHOUP 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
23N 18E 22 SW BOISE

GENERAL INFORMATION
WARNING FIGURE...................... 4
WAKING NUMBER........................ 52
ELEVATION (M)........................ 1698
SURFACE ACTIVITY..................... HOT SPRINGS
ASSOCIATED DEPOSITS................... SINTER AND TRAVERTINE
NO. OF SPRINGS........................ 15
SPRING TEMPERATURES (C).............. 82 TO 93
DISCHARGE (L/MIN).................... 284
ROCK TYPES: CRUSTACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE........................ MARINER, R., UNPUB, DATA
COLLECTION DATE....................... 1978/05/04

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>93</td>
<td>140</td>
<td>5.0</td>
<td>0.2</td>
<td>230</td>
<td>16</td>
<td>478</td>
<td>47</td>
<td>47</td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>Na</th>
<th>PH</th>
<th>DEL O(18) SiO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>0.5</td>
<td>7.45</td>
<td>-4.19</td>
<td>-19.94</td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>179</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>173</td>
</tr>
<tr>
<td>Na-K</td>
<td>145</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>149</td>
</tr>
<tr>
<td>Conductive</td>
<td>157</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>133</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>107</td>
</tr>
<tr>
<td>Opal</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sulfate</th>
<th>Value (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>106</td>
</tr>
<tr>
<td>One-step steam loss</td>
<td>105</td>
</tr>
<tr>
<td>Continuous steam loss</td>
<td>105</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>149 (C)</td>
<td>179 (I)</td>
<td>157 (A)</td>
<td>162</td>
<td>6</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, pH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Hased on standard estimate.

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>3.3</th>
<th>Std. Dev. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10⁶² J)</td>
<td>1.32</td>
<td>Std. Dev. = 0.37</td>
</tr>
</tbody>
</table>

### Comments
- Sulfate-isotope geothermometer indicates 105 deg. C perhaps due to oxidation of sulfide to sulfate prior to sample collection.

### References
- Young and Mitchell, 1973; USGS, Unpub. Data
- Compiled by: Brook, C., and Mariner, R.
- Rig Creek Hot Springs, Idaho
FIELD NAME................ SHARKEY HOT SPRINGS
CIRCULAR REFERENCE........ 106

GEOGRAPHIC LOCALITY
STATE......................... IDAHO
COUNTY....................... LEMHI
LATITUDE.................... 45-00.8 N
LONGITUDE................... 113-36.3 W
MAPS....................... GOLDSTONE Mtn., 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
20N 24E 34

GENERAL INFORMATION
WARING FIGURE.................. 7
WARING NUMBER.................. 60
ELEVATION (M).................. 1692
SURFACE ACTIVITY............... HOT SPRINGS
ASSOCIATED DEPOSITS.............. TRAVERTINE
SPRING TEMPERATURES (C)......... 63
DISCHARGE (L/Min)................ 30
ROCK TYPES: OLIGOCENE SILICIC VOLCANIC ROCKS

CHEMISTRY
SAMPLE SOURCE... MARINER, R., UNPUBL. DATA
COLLECTION DATE.. 1978/05/05

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>94</td>
<td>5.7</td>
<td>0.36</td>
<td>290</td>
<td>16</td>
<td>472</td>
<td>155</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>1.6</td>
<td>8.16</td>
<td>-3.59</td>
<td>-19.79</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>170</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>172</td>
</tr>
<tr>
<td>NA-K</td>
<td>124</td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>130</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>134</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>107</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>83</td>
</tr>
<tr>
<td>OPAL</td>
<td>14</td>
</tr>
<tr>
<td>SULFATE</td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>102</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>98</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>98</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>102 (K)</td>
<td>134 (A)</td>
<td>107 (D)</td>
<td>114</td>
<td>7</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>1.0</th>
<th>2.5</th>
<th>1.5</th>
<th></th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASIS ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>3.3</th>
<th>STD. DEV. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL ENERGY (10**18 J)</td>
<td>0.89</td>
<td>STD. DEV. = 0.26</td>
</tr>
</tbody>
</table>

COMMENTS: MG-CORRECTED NA-K-CA GEOTHERMOMETER GIVES 160 C. SPRING APPEARS TO BE DEPOSITING TRAVERTINE! NA-K-CA GEOTHERMOMETER PROBABLY UNRELIABLE.

REFERENCES: YOUNG AND MITCHELL, 1973

COMPiled BY: BROOK, C. AND MARINER, R.

SHARKFY HOT SPRINGS, IDAHO.
FIELD NAME: SUNBEAM HOT SPRINGS
CIRCULAR REFERENCE: 107

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: CUSTER
LATITUDE: 44°16.1' N
LONGITUDE: 114°44.9' W
MAPS: SUNBEAM 1162+500

TOWNSHIP: 11N
RANGE: 15E
SECTION: 19 SW
BASE & MERIDIAN: BOISE

GENERAL INFORMATION
WARING FIGURE: 4
WARING NUMBER: 93
ELEVATION (M): 1823
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE AND SINTER
NO. OF SPRINGS: NUMEROUS
SPRING TEMPERATURES (°C): 65 TO 76
DISCHARGE (L/MIN): 1678
ROCK TYPES: CRETAČOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. DATA
COLLECTION DATE: 1978/05/05

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>S</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>88</td>
<td>1.5</td>
<td>89</td>
<td>2.2</td>
<td>130</td>
<td></td>
<td></td>
<td>35</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>0.19</td>
<td>8.75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F 8  PH
15 0.19 8.75

FE 0(18) S04  FE 0(18) H2O  FE D H2O
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3) ......... 124
- NA-K-CA (4/3) .......... 106
- NA-K ................... 64

**SILICA**
- ADIABATIC .............. 127
- CONDUCTIVE ............. 130
- CHALCEDONY ............. 103
- CRISTOBALITE ........... 80
- OPAL .................... 11

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINIMUM</td>
<td>81 (E)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAXIMUM</td>
<td>130 (A)</td>
<td></td>
<td>124 (I)</td>
<td>112</td>
<td>11</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT**

A) QUARTZ CONDUCTIVE  F) CRISTOBALITE
B) QUARTZ CONDUCTIVE, PH-CORRECTED  G) AMORPHOUS SILICA
C) QUARTZ ADIABATIC  H) NA-K
D) CHALCEDONY  I) NA-K-CA
E) CHALCEDONY, PH-CORRECTED  J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

**DEPTH TO TOP (KM)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THICKNESS (KM)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>3.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**SUBSURFACE AREA (KM**2)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**VOLUME (KM**3)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

**THERMAL ENERGY**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.87</td>
<td></td>
<td></td>
<td></td>
<td>0.26</td>
</tr>
</tbody>
</table>

**COMMENTS**

PH CORR, QUARTZ = 110 DEG. C, IF 1.5 MG/L CA LOST THEN NA-K-CA REDUCED TO 89 DEG C, SUGGESTING THAT CALCITE MAY BE PRECIPITATING IN THE SUBSURFACE.

**REFERENCES**

YOUNG AND MITCHELL, 1973; CHOATE, 1962

**COMPILED BY**

MARINER, R.

**SUNBEAM HOT SPRINGS, IDAHO**
FIELD NAME: SLATE CREEK HOT SPRINGS
CIRCULAR REFERENCE: 108

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: CUSTER
LATITUDE: 44°10.1' N
LONGITUDE: 114°37.4' W
MAPS: LIVINGSTON CREEK 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
ION 16E 30 NE BOISE

GENERAL INFORMATION
WARING FIGURE: 4
WARING NUMBER: 99
ELEVATION (M): 2146
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 8
SPRING TEMPERATURES (C): 32 TO 50
DISCHARGE (L/MIN): 700
ROCK TYPES: PALEOZOIC ARGILLITE

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
COLLECTION DATE: 1972/07/11

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>86</td>
<td>8.1</td>
<td>0.1</td>
<td>83</td>
<td>4.5</td>
<td>110</td>
<td>110</td>
<td>110</td>
<td>7</td>
</tr>
<tr>
<td>F</td>
<td>H</td>
<td>PH</td>
<td>DEL O(18) S04</td>
<td>DEL O(18) H2O</td>
<td>DEL D H2O</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.7</td>
<td>8.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>( \text{HA-K-CA (1/1)} )</th>
<th>145</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{NA-K-CA (4/3)} )</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>( \text{NA-K} )</td>
<td>122</td>
<td></td>
</tr>
</tbody>
</table>

SILICA

| \( \text{ADIABATIC} \) | 126 |
| \( \text{CONDUCTIVE} \) | 129 |
| \( \text{CHALCEDONY} \) | 101 |
| \( \text{CRISTOBALITE} \) | 78  |
| \( \text{OPAL} \) | 10  |

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUHSURFACE TEMP (C)</td>
<td>90 (I)</td>
<td>129 (A)</td>
<td>101 (D)</td>
<td>107</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODDED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (Km)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (Km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (Km**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (Km**3) | 3.3 | STD. DEV. = 0.9
THERMAL ENERGY (10**18 J) | 0.82 | STD. DEV. = 0.24

REFERENCES: YOUNG AND MITCHELL, 1973

COMPILED BY: MARINER, R.

SLATE CREEK HOT SPRINGS, IDAHO
FIELD NAME................ MAGIC RESERVOIR AREA
KGRA OR OTHER NAME......... LAVA CREEK HOT SPRING
CIRCULAR REFERENCE........ 109

GEOGRAPHIC LOCALITY
STATE..................... IDAHO
COUNTY..................... BLAINE
LATITUDE.................. 43°19.7' N
LONGITUDE............... 114°23.9' W
MAPS...................... BELLEVUE 1162500

TOWNSHIP RANGE SECTION
015 17E 23 NE OF NE

BASE & MERIDIAN
BOISE

GENERAL INFORMATION
WARING FIGURE...................... 4
WARING NUMBER...................... 146
ELEVATION (M)...................... 1465
SURFACE ACTIVITY................. FLOWING WELL
ASSOCIATED DEPOSITS............... TRAVERTINE
NO. OF SPRINGS..................... NONE
DISCHARGE (L/Min)............... 20
NO. OF WELLS....................... 1
WELL DEPTHS (M)................... 79
ROCK TYPES; TERTIARY RHYOLITIC TUFFS

CHEMISTRY
SAMPLE SOURCE........ Mitchell, 1976
FLOW (L/Min)..... 20

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>105</td>
<td>20</td>
<td>0.1</td>
<td>321</td>
<td>23</td>
<td>735</td>
<td>0</td>
<td>52</td>
<td>85</td>
</tr>
</tbody>
</table>

DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O
### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>114 (D)</td>
<td>192 (K)</td>
<td>140 (A)</td>
<td>149</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>STD. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (km³)          | Minimum | Maximum | Most Likely | Mean | STD. Dev. = 0.9 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THERMAL ENERGY (10¹⁷ J) | Minimum | Maximum | Most Likely | Mean | STD. Dev. = 0.37 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Comments
- ISOTOPES FROM R. MARINER, UNPUB. DATA
- REFERENCES: MITCHELL, 1976; YOUNG AND MITCHELL, 1973
- COMPILED BY: MARINER, R., AND BROOK, C.

MAGIC RESERVOIR AREA, IDAHO
FIELD NAME: WORSWICK (WASEWICK) HOT SPRINGS
CIRCULAR REFERENCE: 110

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: CAMAS
LATITUDE: 43°33.5' N
LONGITUDE: 114°47.2' W
MAPS: SYDNEY BUTTE 1124000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03N 14E 28 NE OF SW BOISE

GENERAL INFORMATION
WARING FIGURE: 4
WARING NUMBER: 136
ELEVATION (M): 1814
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER, TRAVERTINE
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (C): 50 TO 81
DISCHARGE (L/MIN): 1764
ROCK TYPES: CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 1764
COLLECTION DATE: 1972/07/10

<table>
<thead>
<tr>
<th>TEMP</th>
<th>S1O2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>MC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>96</td>
<td>1.8</td>
<td>0</td>
<td>69</td>
<td>1.9</td>
<td>51</td>
<td>28</td>
<td>35</td>
<td>5</td>
</tr>
</tbody>
</table>

F 8 PH
15 7.3

DELOT 0(18) SO4 DELOT 0(18) H2O DELOT 0 H2O
GEOTHERMOMETERS (C)
CATION
NA-K-CA (1/3) ............ 124
NA-K-CA (4/3) ............ 93
NA-K ....................... 71
SILICA
ADIABATIC .................. 131
CONDUCTIVE .................. 135
CHALCEDONY ................. 108
CRISTOBALITE ............... 84
OPAL ......................... 15

RESERVOIR PROPERTIES
SUBSURFACE TEMP (C)
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV. 
81 (L) 107 (D) 93 (I) 94 5

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5
SUBSURFACE AREA (KM*2) 1 3 2

VOLUME (KM**3) ............ 3.3
THERMAL ENERGY(10**18 J) 0.71

REFERENCES: WARING, 1965; YOUNG AND MITCHELL, 1973
COMPILED BY: BROOK, C. AND MARINER, R.
WORSWICK (WASEWICK) HOT SPRINGS; IDAHO
FIELD NAME................ WARDROP HOT SPRINGS
KGRA OR OTHER NAME.......... HOT SPRINGS RANCH
CIRCULAR REFERENCE........... 111

GEOGRAPHIC LOCALITY
STATE......................... IDAHO
COUNTY........................ CAMAS
LATITUDE...................... 43-23.0 N
LONGITUDE..................... 114-55.9 W
MAPS.......................... FAIRFIELD 162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
01N 13E 32 NW OF SW 0015E

GENERAL INFORMATION
WARING FIGURE...................... 4
WARING NUMBER...................... 137
ELEVATION (M)...................... 1573
SURFACE ACTIVITY................... HOT SPRINGS
NO. OF SPRINGS..................... SEVERAL
DISCHARGE (L/MIN)............... 730
ROCK TYPES: ALLUVIUM OVERLYING CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE........ MITCHELL, 1976
FLOW (L/MIN)...... 95

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>78</td>
<td>1</td>
<td>0</td>
<td>56</td>
<td>2</td>
<td>58</td>
<td>30</td>
<td>12</td>
<td>5.7</td>
</tr>
</tbody>
</table>

F     B     PH
9.2

DEL 0(18) SI04  DEL 0(18) H20  DEL D H20
GEOTHERMOMETERS (C)

CATION
- Na-K-CA (1/3) .......... 136
- Na-K-CA (4/3) .......... 107
- Na-K .......................... 89

SILICA
- Adiabatic .......................... 121
- Conductive .......................... 124
- Chalcedony ......................... 96
- Cristobalite ....................... 73
- Opal ................................. 5

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE TEMP (°C)</td>
<td>67 (L)</td>
<td>136 (I)</td>
<td>89 (B)</td>
<td>97</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive
B) Quartz Adiabatic
C) Quartz Adiabatic, Ph-Corrected
D) Chalcedony
E) Chalcedony, Ph-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

DEPTH TO TOP (KM)
- Minimum 0.5
- Maximum 2.0
- Most Likely 1.5
- Mean 1.7
- STD. DEV. 0.3

THICKNESS (KM)
- Minimum 1.0
- Maximum 2.5
- Most Likely 1.5
- Mean 2.0
- STD. DEV. 0.4

SUBSURFACE AREA (KM²)
- Minimum 1
- Maximum 3
- Most Likely 2
- Mean 2.0
- STD. DEV. 0.4

VOLUME (KM³) ................... 3.3

THERMAL ENERGY (10³² J) ........ 0.74

COMMENTS: A VERY DILUTE WATER IN WHICH SMALL CHANGES IN CA OR K COULD HAVE A PRONOUNCED EFFECT ON THE NA-K-CA GEOTHERMOMETER.

REFERENCES: MITCHELL, 1976; YOUNG AND MITCHELL, 1973

COMPILED BY: MARINER, R. AND BROOK, C.

WADROP HOT SPRINGS, IDAHO
FIELD NAME: Barron's Hot Springs
CIRCULAR REFERENCE: 112

GEOGRAPHIC LOCALITY
STATE: Idaho
COUNTY: Camas
LATITUDE: 43°17.5' N
LONGITUDE: 114°54.4' W
MAPS: Fairfield 1162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
01S 13E 34 NE OF NW Boise

GENERAL INFORMATION
ELEVATION (M): 1541
SURFACE ACTIVITY: Hot Springs
ASSOCIATED DEPOSITS: Travertine
NO. OF SPRINGS: Several
SPRING TEMPERATURES (°C): 62 to 73
DISCHARGE (L/Min): 117
NO. OF WELLS: 1
ROCK TYPES: Alluvium overlying Quaternary Basalt

CHEMISTRY
SAMPLE SOURCE: Mitchell, 1976
FLOW (L/Min): 40

<table>
<thead>
<tr>
<th>TFMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>77</td>
<td>3.6</td>
<td>0.1</td>
<td>99</td>
<td>2.5</td>
<td>226</td>
<td>0</td>
<td>13</td>
<td>15</td>
</tr>
</tbody>
</table>

PH: 7.3

DEL 0(18) S04
DEL 0(18) H2O
DEL D H2O
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3)...... 121
- NA-K-CA (4/3)..... 91
- NA-K.............. 65

SILICA
- ADIABATIC......... 121
- CONDUCTIVE.... 123
- CHALCEDONY..... 95
- CHALCITALITE..... 72
- OPAL............... 4

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>90 (I)</td>
<td>123 (A)</td>
<td>95 (O)</td>
<td>103</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
- MINIMUM 0.5
- MAXIMUM 2.0
- MOST LIKELY 1.5
- MEAN 1.7
- STD. DEV. 0.3

THICKNESS (KM)
- MINIMUM 1.0
- MAXIMUM 2.5
- MOST LIKELY 1.5
- MEAN 2.0
- STD. DEV. 0.4

SUBSURFACE AREA (KM**2)
- MINIMUM 3.0
- MAXIMUM 5.0
- MOST LIKELY 4.0
- MEAN 4.0
- STD. DEV. 0.5

VOLUME (KM**3)
- MINIMUM 3.3
- MAXIMUM 3.7
- MOST LIKELY 3.5
- MEAN 3.5
- STD. DEV. 0.6

THERMAL ENERGY (10**18 J)
- MINIMUM 0.79
- MAXIMUM 0.89
- MOST LIKELY 0.84
- MEAN 0.84
- STD. DEV. 0.08

REFERENCES:
- MITCHELL, 1976
- YOUNG AND MITCHELL, 1973

COMPILED BY: BROOK, C. AND MARINER, R.

BARRON'S HOT SPRINGS, IDAHO
FIELD NAME: WHITE ARROW HOT SPRINGS
CIRCULAR REFERENCE: 113

**GEOGRAPHIC LOCALITY**

STATE: IDAHO
COUNTY: GOODING
LATITUDE: 43-02.9 N
LONGITUDE: 114-57.2 W

MAPS: DAVIS MNT. 1162;500

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**

04S 13E 30 SE OF NE BOISE

**GENERAL INFORMATION**

WARMING FIGURE: 4
WARMING NUMBER: 170, 172
ELEVATION (M): 1013
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE

NO. OF SPRINGS: 4
SPRING TEMPERATURES (C): 65
DISCHARGE (L/MIN): 3122
NO. OF WELLS: 1
WELL DEPTHS (M): 49
ROCK TYPES: ALLUVIUM NEAR PLIOCENE BASALT

**CHEMISTRY**

SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 3126
COLLECTION DATE: 1972/05/26

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>97</td>
<td>1.2</td>
<td>0</td>
<td>91</td>
<td>1.6</td>
<td>141</td>
<td>22</td>
<td>15</td>
<td>6.6</td>
</tr>
</tbody>
</table>

F 4 PH
12 7.5

DEL 0(18) S04 DEL 0(18) H2O DEL D H2O
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>NA-K-CA (1/3)</th>
<th>112</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NA-K-CA (4/3)</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>NA-K</td>
<td>43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>ADIABATIC</th>
<th>131</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONDUCTIVE</td>
<td>136</td>
</tr>
<tr>
<td></td>
<td>CHALCEDONY</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>CRISTOBALITE</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>OPAL</td>
<td>15</td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 (I)</td>
<td>109 (D)</td>
<td>100 (I)</td>
<td>103</td>
<td>2</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz conductive
B) Quartz conductive, pH-corrected
C) Quartz adiabatic
D) Chalcedony
E) Chalcedony, pH-corrected
F) Cristobalite
G) Amorphous silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-corrected
K) Sulfate geothermometer
L) Surface temperature
M) Well temperature
N) Mixing model
O) Renner and others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 3.5  | 0.5       |

| SUBSURFACE AREA (KM**2) | 2.5     | 5       | 3         | 3.5  | 0.5       |

**VOLUME (KM**3**) | 5.8     | STD. DEV. = 0.4 |

**THERMAL ENERGY 10**18 J | 1.39    | STD. DEV. = 0.34 |

**COMMENTS:** Area includes 49 m deep well at chalk mine about 2 km to the east. Other thermal springs and wells are in the vicinity.

**REFERENCES:** Young and Mitchell, 1973; Waring, 1965; Stearns and others, 1938

**COMPILED BY:** Brook, C.

**WHITE ARROW HOT SPRINGS, IDAHO**
**FIELD NAME**................. BANBUHY AREA
**CIRCULAR REFERENCE**......... 114

**GEOGRAPHIC LOCALITY**
- **STATE**................. IDAHO
- **COUNTY**................. TWIN FALLS
- **LATITUDE**.............. 42-41.4 N
- **LONGITUDE**............ 114-50.0 W
- **MAPS**.................. THOUSAND SPRINGS 1124,000

**TOWNSHIP RANGF SECTION BASE & MERIDIAN**
- OHS 14E 30-33 BOISE

**GENERAL INFORMATION**
- **WARING FIGURE**......... 4
- **WARING NUMBER**.......... 173-175
- **ELEVATION (M)**......... 890
- **SURFACE ACTIVITY**..... HOT SPRINGS
- **ASSOCIATED DEPOSITS**.. TRAVERTINE
- **NO. OF SPRINGS**........ SEVERAL
- **SPRING TEMPERATURES (C)**.. 52 TO 59
- **DISCHARGE (L/MIN)**.... 1550
- **ROCK TYPES**........... Pleistocene and Pliocene sediments overlying Pliocene and older silicic and basaltic volcanics

**CHEMISTRY**
- **SAMPLE SOURCE**........ YOUNG AND MITCHELL, 1973
- **COLLECTION DATE**...... 1972/05/24

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>59</td>
<td>97</td>
<td>1.1</td>
<td>0</td>
<td>100</td>
<td>1.5</td>
<td>88</td>
<td>38</td>
<td>26</td>
<td>27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

**CATION**
- **Na-K-CA (1/3)**: 108
- **Na-K-CA (4/3)**: 101
- **Na-K-**: 35

**SILICA**
- **Adiabatic**: 131
- **Conductive**: 136
- **Chalcedony**: 109
- **Cristobalite**: 65
- **Opal**: 15

### Reservoir Properties

**Subsurface Temp (C)**
- **Minimum**: 108 (I:D)
- **Maximum**: 136 (A)
- **Most Likely**: 108 (I)
- **Mean**: 117
- **Std. Dev.**: 7

**Uncoded Temperature Indicates Subjective Judgement**
- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

**Depth to Top (km)**: 0.5 2.0 1.5
**Thickness (km)**: 1.0 2.5 1.5
**Subsurface Area (km²)**: 7 25 16

**Volume (km³)**: 26.7
**Thermal Energy (10¹⁸ J)**: 7.37

**Comment**: A very dilute, high pH water. Area includes Banbury and Miracle Hot Springs, and Deep Creek and Salmon Falls Creek areas. Analysis for Miracle Hot Springs.

**References**: Young and Mitchell, 1973; Stearns and Others, 1938

**Compiled By**: Marinek, R. and Brook, C.

**Hanbury Area, Idaho**
FIELD NAME................ RAFT RIVER AREA
KGRA OR OTHER NAME........ RAFT RIVER KGRA
CIRCULAR REFERENCE......... 115

GEOGRAPHIC LOCALITY
STATE..................... IDAHO
COUNTY.................... CASSIA
LATITUDE.................. 42°06.1 N
LONGITUDE................. 113°22.8 W
MAPS...................... CHOCKECHERRY 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
15S 26E 23-25 BOISE

GENERAL INFORMATION
WARING FIGURE...................... 4
WARING NUMBER..................... 184
ELEVATION (M)...................... 1478
SURFACE ACTIVITY................... HOT WELLS, WARM SEEPS
ASSOCIATED DEPOSITS................ TRAVERTINE
NO. OF WELLS....................... 4 DEEP TEST WELLS
WELL DEPTHS (M)..................... 866 TO 1996
MAXIMUM WELL TEMP (C)............. 147 AT DEPTH (M) 785

ROCK TYPES: ALLUVIUM OVERLYING TERTIARY TUFFACEOUS SEDIMENTS AND SILICIC VOLCANIC ROCKS
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, AMT, SP, SEISMIC REFRACTION

CHEMISTRY
SAMPLE SOURCE.... STOKER, R., PERSONAL COMMUNICATION, 1978 KUNZE, 1977, P.30

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>158</td>
<td>193</td>
<td>0.6</td>
<td>1185</td>
<td>97.2</td>
<td>54</td>
<td>53.3</td>
<td>2170</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.34</td>
<td>-17.42</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) .......... 184
- NA-K-CA (4/3) .......... 169
- NA-K .................. 162

SILICA
- ADIABATIC .............. 155
- CONDUCTIVE .......... 164
- CHALCEDONY .......... 141
- CRISTOBALITE ......... 114
- UPAI .................. 42

SULFATE
- CONDUCTIVE .......... 135
- ONE-STEP STEAM LOSS.. 131
- CONTINUOUS STEAM LOSS 131

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)

<table>
<thead>
<tr>
<th>_minimum</th>
<th>maximum</th>
<th>most likely</th>
<th>mean</th>
<th>std. dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>135 (K)</td>
<td>164 (A)</td>
<td>147 (M)</td>
<td>149</td>
<td>6</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

K) SULFATE GEOTHERMOMETER

L) SURFACE TEMPERATURE

M) WELL TEMPERATURE

N) MIXING MODEL

O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) 1.1 1.3 1.3
THICKNESS (KM) 1.0 1.7 1.0
SUBSURFACE AREA (KM*2) 5 30 15

BASING ON WELL DISTRIBUTION, GEOLOGY AND GEOPHYSICS

VOLUME (KM*3) .......... 20.6

THERMAL ENERGY(10**18 J) . 7.42

STD. DEV. = 7.0

STD. DEV. = 2.54

COMMENTS: CHEMICAL ANALYSIS IS THE MEAN OF SEVERAL SAMPLES FROM WELL RRGE-31. ISOTOPIC DATA FROM WELL RRGE-2.

TWO SHALLOW WELLS (126 AND 165 M) HAVE SURFACE TEMPERATURES OF 93 AND 90 C, RESPECTIVELY. PRODUCING ZONES FOR DEEP TEST WELLS OCCUR BETWEEN 1144 AND 1830 M WITH AVERAGE EFFECTIVE PERMEABLE PRODUCING THICKNESS OF ABOUT 183 M. STABILIZED RESERVOIR TEMPERATURE 147-149 C.


COMPILED BY: BROOK, C. AND MARINER, R.

RAFT RIVER AREA, IDAHO
FIELD NAME: ASHTON WARM SPRINGS
CIRCULAR REFERENCE: 116

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTRY: FREMONT
LATITUDE: 44-05.7 N
LONGITUDE: 111-27.5 W
MAPS: ASHTON 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
09N 42E 23 NW OF NE OF SE BOISE

GENERAL INFORMATION
ELEVATION (M): 1502
SURFACE ACTIVITY: HOT SPRINGS
ROCK TYPES: PLEISTOCENE BASALT

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 8
COLLECTION DATE: 1972/08/28

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>110</td>
<td>1.1</td>
<td>0.1</td>
<td>36</td>
<td>1.6</td>
<td>92</td>
<td></td>
<td>4.7</td>
<td>2.9</td>
</tr>
<tr>
<td>F</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>pH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>139</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>91</td>
</tr>
<tr>
<td>Na-K</td>
<td>105</td>
</tr>
</tbody>
</table>

**SILICA**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>137</td>
</tr>
<tr>
<td>Conductive</td>
<td>143</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>116</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>92</td>
</tr>
<tr>
<td>Opal</td>
<td>22</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBSURFACE TEMP (C)</strong></td>
<td>41 (L)</td>
<td>143 (A)</td>
<td>91 (I)</td>
<td>92</td>
<td>21</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, pH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

**DEPT TO TOP (KM)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**THICKNESS (KM)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**VOLUME (KM**3)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

**THERMAL ENERGY (10**18 J)**

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.69</td>
<td></td>
<td>0.69</td>
<td>0.27</td>
</tr>
</tbody>
</table>

COMMENTS: LOW FLOW RATE! VERY DILUTE WATER! CHEMICAL GEOTHERMOMETERS MAY BE UNRELIABLE.

REFERENCES: Young and Mitchell, 1973; Stearns and Others, 1939

COMPILED BY: Mariner, R.

ASHTON WARM SPRINGS, IDAHO
FIELD NAME: NEWDALE AREA
CIRCULAR REFERENCE: 117

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: FREMONT
LATITUDE: 43°53.2' N
LONGITUDE: 111°35.4' W
MAPS: NEWDALE U24tQ00

TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
07N  41E  35  SE OF SE OF SW  BCISE

GENERAL INFORMATION
ELEVATION (M): 1564
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
NO. OF WELLS: SEVERAL
ROCK TYPES: TERTIARY SILICIC VOLCANIC ROCKS(?)

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
COLLECTION DATE: 1972/08/09

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>75</td>
<td>20</td>
<td>6.3</td>
<td>78</td>
<td>8.6</td>
<td>240</td>
<td></td>
<td>33</td>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>S04</th>
<th>DEL 0(18)</th>
<th>H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4</td>
<td>7.9</td>
<td></td>
<td>DEL 0(18)</td>
<td></td>
<td>DEL 0(18)</td>
<td></td>
<td>DEL D H20</td>
</tr>
<tr>
<td>GEOTHERMOMETERS (C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------</td>
<td>----------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (1/3)</td>
<td>169</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>84</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>195</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>93</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESEVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>84 (I)</td>
<td>122 (A)</td>
<td>93 (D)</td>
<td>100</td>
<td>8</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 53.3 | 18.4      |

| Subsurface Area (KM**2) | 10 | 100 | 50 |

Based on: Blackwell, D., Unpub. Data and Well Distribution

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>88.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10**18 J)</td>
<td>20.32</td>
</tr>
</tbody>
</table>

References: Young and Mitchell, 1973

Compiled By: Mariner, R.

Newdale Area, Idaho
FIELD NAME: MAPLE GROVE HOT SPRINGS
CIRCULAR REFERENCE: 118

GEOGRAPHIC LOCALITY
STATE: IDAH0
COUNTY: FRANKLIN
LATITUDE: 42°18'.2' N
LONGITUDE: 111°42'.2' W
MAPS: ONEIDA NARROW RESERVOIR

TOWNSHIP RANGE SECTION BASE & MERIDIAN
13S 41E 07 SW OF NE BOISE

GENERAL INFORMATION
ELEVATION (M): 1525
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: SEVERAL
ROCK TYPES: PALEOZOIC QUARTZITE(?)

CHEMISTRY
SAMPLE SOURCE: YOUNG AND MITCHELL, 1973
FLOW (L/MIN): 1325
COLLECTION DATE: 1972/05/10

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>55</td>
<td>89</td>
<td>24</td>
<td>490</td>
<td>110</td>
<td>491</td>
<td>0</td>
<td>260</td>
<td>630</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>PH</td>
<td>DEL 0(18)</td>
<td>504</td>
<td>DEL 0(18)</td>
<td>H2O</td>
<td>DEL D</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>7.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>236</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>187</td>
</tr>
<tr>
<td>NA-K</td>
<td>303</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>106</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>106</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>77</td>
</tr>
<tr>
<td>CRISTOHALITE</td>
<td>56</td>
</tr>
<tr>
<td>OPAL</td>
<td>-10</td>
</tr>
</tbody>
</table>

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>77 (D.L)</td>
<td>106 (A)</td>
<td>95 (J)</td>
<td>93</td>
<td>6</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOHALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 2.0  | 0.4       |

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD, DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>3.3</th>
<th>STD, DEV. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL ENERGY (10**18 J)</td>
<td>0.70</td>
<td>STD, DEV. = 0.20</td>
</tr>
</tbody>
</table>

COMMENTS: HIGH FLOW RATE SUGGESTS THAT SUBSURFACE TEMPERATURE IS PROBABLY NEAR SURFACE TEMPERATURE.

REFERENCES: YOUNG AND MITCHELL, 1973

COMPILLED BY: BROOK, C.

MAPLE GROVE HOT SPRINGS, IDAHO
**FIELD NAME**................. RIVERDALE AREA (BFN MEEK WELL)
**CIRCULAR REFERENCE**......... 119

**GEOGRAPHIC LOCALITY**

<table>
<thead>
<tr>
<th>STATE</th>
<th>IDAHO</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNTY</td>
<td>FRANKLIN</td>
</tr>
<tr>
<td>LATITUDE</td>
<td>42°09.9' N</td>
</tr>
<tr>
<td>LONGITUDE</td>
<td>111°50.4' W</td>
</tr>
<tr>
<td>MAPS</td>
<td>RIVERDALE 1:24,000</td>
</tr>
</tbody>
</table>

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**

<table>
<thead>
<tr>
<th>TOWNSHIP</th>
<th>RANGE</th>
<th>SECTION</th>
<th>BASE &amp; MERIDIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>14S</td>
<td>39E</td>
<td>36</td>
<td>SE OF NE BOISE</td>
</tr>
</tbody>
</table>

**GENERAL INFORMATION**

- ELEVATION (M).............. 1448
- SURFACE ACTIVITY........... NONE, FOUND BY DRILLING
- NO. OF WELLS............... 1
- WELL DEPTHS (M)............... 12
- ROCK TYPES: ALLUVIUM OVERLYING TERTIARY TUFFACEOUS SEDIMENTS (?)

**CHEMISTRY**

<table>
<thead>
<tr>
<th>SAMPLE SOURCE</th>
<th>YOUNG AND MITCHELL, 1973</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLLECTION DATE</td>
<td>1972/05/11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>44.5</td>
<td>80</td>
<td>25</td>
<td>7.1</td>
<td>360</td>
<td>24</td>
<td>524</td>
<td>15</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEL 0(18) SiO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEL 0(18)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>147</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>141</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>122</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>75 (J)</td>
<td>125 (A)</td>
<td>97 (D)</td>
<td>99</td>
<td>10</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE     F) CHALCEDONY       K) SULFATE GEOTHERMOMETER
B) QUARTZ CONDUCTIVE, PH-CORRECTED G) AMORPHOUS SILICA L) SURFACE TEMPERATURE
C) QUARTZ ADIABATIC       H) NA-K             M) WELL TEMPERATURE
D) CHALCEDONY             I) NA-K-CA          N) MIXING MODEL
E) CHALCEDONY, PH-CORRECTED J) NA-K-CA, MG-CORRECTED O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (Km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THICKNESS (Km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (Km²)</td>
<td>1 3</td>
<td>2</td>
<td></td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>BASED ON STANDARD ESTIMATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOLUME (Km³)</td>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY (10¹⁸ J)</td>
<td>0.76</td>
<td>STD. DEV. = 0.23</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES: MITCHELL, 1976B; YOUNG AND MITCHELL, 1973

COMPILED BY: MARINET, R. AND BROOK, C.

RIVERDALE AREA (HEN MEEK WELL), IDAHO
FIELD NAME: WAYLAND (BATTLE CREEK) HOT SPRINGS
CIRCULAR REFERENCE: 120

GEOGRAPHIC LOCALITY
STATE: IDAHO
COUNTY: FRANKLIN
LATITUDE: 42-08.0 N
LONGITUDE: 111-55.6 W
MAPS: BANIDA 1124,000

TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
155  39E  08 SE OF NW  BOISE

GENERAL INFORMATION
ELEVATION (M): 1396
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 4
SPRING TEMPERATURES (C): 43 TO 84
DISCHARGE (L/MIN): 2215
ROCK TYPES: ALLUVIUM OVERLYING PALEOZOIC LIMESTONE (?)

CHEMISTRY
SAMPLE SOURCE: MITCHELL, 1976
FLOW (L/MIN): 50

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>C03</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>109</td>
<td>174</td>
<td>19</td>
<td>3161</td>
<td>552</td>
<td>696</td>
<td>35</td>
<td>5141</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F  H  PH  DEL 0(18) SO4  DEL 0(18) H2O  DEL D H2O
### GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>254</th>
<th>315</th>
<th>260</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SILICA

<table>
<thead>
<tr>
<th></th>
<th>137</th>
<th>142</th>
<th>116</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>82 (L)</td>
<td>142 (A)</td>
<td>116</td>
<td>(D) 113</td>
</tr>
</tbody>
</table>

Uncoded temperatures indicate subjective judgment.

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

### DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### THICKNESS (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### VOLUME (KM**3)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
</tr>
</tbody>
</table>

### THERMAL ENERGY (10**18 J)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
<td>0.08</td>
</tr>
</tbody>
</table>

### COMMENTS

A saline water/ geothermometry, especially Na-K-CA, may not be reliable.

### REFERENCES

- MITCHELL, 1976
- YOUNG AND MITCHELL, 1973

### COMPILED BY

BROOK, C., AND MARINER, R.

WAYLAND (HATTLE CREEK) HOT SPRINGS, IDAHO
FIELD NAME................ SQUAW HOT SPRINGS AREA
CIRCULAR REFERENCE........ 121

GEOGRAPHIC LOCALITY
STATE..................... IDAHO
COUNTY.................... FRANKLIN
LATITUDE............... 42°07.1' N
LONGITUDE.............. 111°55.7' W
MAPS..................... WESTON 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
155 39E 17 SW OF NW BOISE

GENERAL INFORMATION
ELEVATION (M)............... 1366
SURFACE ACTIVITY............ HOT SPRINGS
ASSOCIATED DEPOSITS......... TRAVERTINE
NO. OF SPRINGS............... 4
SPRING TEMPERATURES (C)..... 69 TO 73
DISCHARGE (L/MIN)......... 590
NO. OF WELLS............... 1
WELL DEPTHS (M)............ 6.7
ROCK TYPES: ALLUVIUM OVERLYING TUFFACEOUS SEDIMENTARY ROCKS (?)

CHEMISTRY
SAMPLE SOURCE........ MITCHELL, 1976 (WELL-WATER SAMPLE)
FLOW (L/MIN)............. 115

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>84</td>
<td>124</td>
<td>279</td>
<td>24</td>
<td>4368</td>
<td>782</td>
<td>791</td>
<td>35</td>
<td>7398</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3</td>
<td>6.5</td>
<td>SI04</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### GEOTHERMOMETERS (C)

**CATION**
- **NA-K-CA (1/3)**: 258
- **NA-K-CA (4/3)**: 328
- **NA-K**: 264

**SILICA**
- **ADIABATIC**: 143
- **CONDUCTIVE**: 150
- **CHALCEDONY**: 124
- **CRISTOBALITE**: 99
- **OPAL**: 28

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>84 (L)</td>
<td>150 (A)</td>
<td>124 (D)</td>
<td>119</td>
<td>14</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- **A)** Quartz Conductive
- **B)** Quartz Conductive, pH-Corrected
- **C)** Quartz Adiabatic
- **D)** Chalcedony
- **E)** Chalcedony, pH-Corrected
- **F)** Cristobalite
- **G)** Amorphous Silica
- **H)** NA-K
- **I)** NA-K-CA
- **J)** NA-K-CA, Mg-Corrected
- **K)** Sulfate Geothermometer
- **L)** Surface Temperature
- **M)** Well Temperature
- **N)** Mixing Model
- **O)** Renner and Others, 1976

### DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### THICKNESS (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### SUBSURFACE AREA (KM**2**)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**BASED ON: STANDARD ESTIMATE**

- **VOLUME (KM**3**)**: 3.3
- **THERMAL ENERGY (10**18** J)**: 0.94

**COMMENTS:** MG-Corrected NA-K-CA greater than 200 CI saline water in which the chemical geothermometers may not be accurate; available data does not demonstrate mixing.

**REFERENCES:** Mitchell, 1976

**COMPILED BY:** Marinell, R.

**SQUAW HOT SPRINGS AREA, IDAHO**
FIELD NAME................ MARYSVILLE TEST WELL
KGRA OR OTHER NAME........ MARYSVILLE KGRA
CIRCULAR REFERENCE........ 122

GEOGRAPHIC LOCALITY
STATE..................... MONTANA
COUNTY.................... LEWIS AND CLARK
LATITUDE.................. 46-45.2 N
LONGITUDE................ 112-22.6 W
MAPS...................... GRANITE BUTTE 1124000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
12N 06W 32 5W OF NE MONTANA

GENERAL INFORMATION
SURFACE ACTIVITY............... NONE, FOUND BY DRILLING
NO. OF WELLS..................... 1
WELL DEPTHS (M) .................. 2071
MAXIMUM WELL TEMP (C) .......... 103 AT DEPTH (M) 915
ROCK TYPES: SHALE
GEOPHYSICS: HEAT FLOW, GRAVITY, MAGNETIC, ELECTRICAL RESISTIVITY

CHEMISTRY
SAMPLE SOURCE........... LEONARD AND OTHERS, 1978
COLLECTION DATE........... 1975/08/29

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>96.5</td>
<td>69</td>
<td>7.7</td>
<td>0.5</td>
<td>210</td>
<td>10</td>
<td>260</td>
<td>0</td>
<td>180</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.1</td>
<td>7.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOTHERMOMETERS (C)</td>
<td>CATION</td>
<td>SILICA</td>
<td>ADIABATIC</td>
<td>CONDUCTIVE</td>
<td>CHALCEDONY</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------</td>
<td>--------</td>
<td>-----------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>NA-K-CA (1/3)</td>
<td>154</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>103 (M)</td>
<td>145 (J)</td>
<td>117 (A)</td>
<td>122</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td>1.5</td>
<td>0.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM^2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>10</td>
<td>6</td>
<td></td>
<td>10.0</td>
<td>2.8</td>
</tr>
</tbody>
</table>

**BASED ON:** HEAT FLOW SURVEY AND USGS FILE DATA

<table>
<thead>
<tr>
<th>VOLUME (KM^3)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10^18 J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.42</td>
</tr>
</tbody>
</table>

**COMMENTS:** AREA IDENTIFIED BY HIGH HEAT FLOW AND CORRESPONDING GRAVITY AND MAGNETIC LOWS. MAGMA CHAMBER POSTULATED TO BE AT 5-6 KM DEPTH.

**REFERENCES:** BLACKWELL, 1969, 1970; BLACKWELL AND BAAG, 1973; BLACKWELL AND OTHERS, 1974; LEONARD AND OTHERS, 1970

**COMPILED BY:** BROOK, C.

MARYSVILLE TEST WELL, MONTANA
FIELD NAME: BROADWATER (HELENA) HOT SPRINGS
CIRCULAR REFERENCE: 123

GEOGRAPHIC LOCALITY
STATE: MONTANA
COUNTY: LEWIS AND CLARK
LATITUDE: 46-35.7 N
LONGITUDE: 112-06.7 W
MAPS: HELENA 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
10N 04W 28 NE MONTANA

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 7
ELEVATION (M): 1190
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 59 TO 66.4
DISCHARGE (L/MIN): 110
NO. OF WELLS: 4
WELL DEPTHS (M): 61 TO 73.2
MAXIMUM WELL TEMP (C): 68 AT DEPTH (M) 36.6
ROCK TYPES: QUARTZ MONZONITE INTRUDED INTO DOLOMITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1976
FLOW (L/MIN): LT 50
COLLECTION DATE: 1974/08/24

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>9H</td>
<td>11</td>
<td>0.9</td>
<td>165</td>
<td>5.8</td>
<td>218</td>
<td>170</td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>S04</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.4</td>
<td>0.40</td>
<td>8.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-147.6</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3)........... 134
- NA-K-CA (4/3)........... 100
- NA-K.................. 87

SILICA
- ADIABATIC........... 132
- CONDUCTIVE........ 136
- CHALCEDONY......... 109
- CRISTOBALITE..... 85
- OPAL............... 16

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>97 (E)</td>
<td>136 (A)</td>
<td>120 (J)</td>
<td>118</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (km³) ............... 3.3  
THERMAL ENERGY (10³*18 J) 0.92


COMPILED BY: BROOK, C.

BROADWATER (HELENA) HOT SPRINGS, MONTANA
FIELD NAME: ALHAMBRA HOT SPRINGS

CIRCULAR REFERENCE: 124

GEOGRAPHIC LOCALITY:
STATE: MONTANA
COUNTY: JEFFERSON
LATITUDE: 46-26.8 N
LONGITUDE: 111-59.0 W
MAPS: CLANCY 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03N 03W 16 NE MONTANA

GENERAL INFORMATION:
WARING FIGURE: 2
WARING NUMBER: 18
ELEVATION (M): 1305
SURFACE ACTIVITY: HOT SPRINGS AND SEEPS
ASSOCIATED DEPOSITS: ANCIENT TRAVERTINE DEPOSIT
NO. OF SPRINGS: 4 MAIN SPRINGS
SPRING TEMPERATURES (C): 50 TO 59.4
DISCHARGE (L/MIN): 385
NO. OF WELLS: 7
WELL DEPTHS (M): 20 TO 95
MAXIMUM WELL TEMP (C): 54.8 AT DEPTH (M) 25.0

ROCK TYPES: QUARTZ MONZONITE, ALASKITE

CHEMISTRY:
SAMPLE SOURCE: MARINER AND OTHERS, 1976
FLOW (L/MIN): 40
COLLECTION DATE: 1974/08/23

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>56.5</td>
<td>66</td>
<td>18</td>
<td>3.5</td>
<td>220</td>
<td>9.5</td>
<td>484</td>
<td>89</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>pH</th>
<th>DEL O(18) Si04</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.4</td>
<td>0.24</td>
<td>7.23</td>
<td>-3.49</td>
<td>-19.23</td>
<td>-146.5</td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS (°C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>144</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>110</td>
</tr>
<tr>
<td>NA-K</td>
<td>103</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>114</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>115</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>86</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>65</td>
</tr>
<tr>
<td>OPAL</td>
<td>-2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>99</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>95</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>95</td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>86</td>
<td>115</td>
<td>86 (D+J)</td>
<td>96</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement:

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.1</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate:

- Volume (km³) = 3.3
- Thermal Energy (10⁻²⁸ J) = 0.73

**Comments:** Waring (1965) reports 22 springs with temperatures of 32-57 deg C.

**References:** Waring, 1965; Chadwick and Kaczmarek, 1975; Mariner and Others, 1976; Leonard and Others, 1978

**Compiled by:** Rook, C.

**Almahrra Hot Springs, Montana**
FIELD NAME.................. BOULDER HOT SPRINGS
KGRA OR OTHER NAME........ BOULDER HOT SPRINGS KGRA
CIRCULAR REFERENCE....... 125

GEOGRAPHIC LOCALITY
STATE..................... MONTANA
COUNTY.................... JEFFERSON
LATITUDE.................. 46-12.0 N
LONGITUDE................. 112-05.6 W
MAPS...................... BOULDER, 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05N 04W 10 NE OF SW MONTANA

GENERAL INFORMATION
WARING FIGURE...................... 2
WARING NUMBER...................... 19
ELEVATION (M)............... 1476
SURFACE ACTIVITY.............. HOT SPRINGS
ASSOCIATED DEPOSITS.......... SINTER
NO. OF SPRINGS.................. SEVERAL IN 2 GROUPS
SPRING TEMPERATURES (C)........... 62 TO 76
DISCHARGE (L/MIN)............. LARGE
ROCK TYPES: GRANITE

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1976
FLOW (L/MIN).... LARGE
COLLECTION DATE.. 1974/08/22

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>106</td>
<td>2.2</td>
<td>LT 0.1</td>
<td>120</td>
<td>3.8</td>
<td>168</td>
<td>74</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18) S04</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0.56</td>
<td>8.50</td>
<td>-5.45</td>
<td>-18.91</td>
<td>-146.5</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)............ 136
NA-K-CA (4/3)............ 122
NA-K........................ 80

SILICA
ADIABATIC............... 136
CONDUCTIVE.............. 142
CHALCEDONY............... 115
CRISTOBALITE............. 91
OPAL................................ 21

SULFATE
CONDUCTIVE............... 130
ONE-STEP STEAM LOSS... 124
CONTINUOUS STEAM LOSS.. 125

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C) MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
MINIMUM 130 (K) 142 (A) 136 (I) 136 2

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) 0.5 Minimum 2.0 Maximum 1.5 Most Likely 1.7 Mean 1.7
THICKNESS (KM) 1.0 Minimum 2.5 Maximum 1.5 Most Likely 2.0 Mean 2.0
SUBSURFACE AREA (KM**2) 1 Based on standard estimate
VOLUME (KM**3)............ 3.3 Std. Dev. = 0.9
THERMAL ENERGY(10**18 J) 1.09 Std. Dev. = 0.31

COMMENTS: WARING (1965) REPORTS SURFACE TEMPERATURES AS HIGH AS 86 DEG C.


COMPILED BY: BROOK, C.

BOULDER HOT SPRINGS, MONTANA
FIELD NAME: GREGSON (FAIRMONT) HOT SPRINGS
CIRCULAR REFERENCE: 126

GEOGRAPHIC LOCALITY
STATE: MONTANA
COUNTY: DEER LODGE
LATITUDE: 46-02.6 N
LONGITUDE: 112-48.6 W
MAPS: ANACONDA 1162

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03N 10W 02 SE OF NW MONTANA

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 17
ELEVATION (M): 1568
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (C): 68 TO 73
DISCHARGE (L/MIN): 1150
ROCK TYPES: TERTIARY RHYOLITE OVERLYING QUARTZ MONZONITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1976
COLLECTION DATE: 1974/08/19

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>85</td>
<td>3.9</td>
<td>LT 0.1</td>
<td>165</td>
<td>3.9</td>
<td>166</td>
<td>180</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>S04</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1H</td>
<td>0.30</td>
<td>8.41</td>
<td></td>
<td>-18.60</td>
<td></td>
<td>-149.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEOTHERMOMETERS (C)</td>
<td>CATION</td>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------</td>
<td>-----------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NA-K-CA (1/3)</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NA-K-CA (4/3)</td>
<td>112</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NA-K</td>
<td>61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ADIABATIC</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CONDUCTIVE</td>
<td>128</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHALCEDONY</td>
<td>101</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRISTOBALITE</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OPAL</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESEVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>101 (D)</td>
<td>128 (A)</td>
<td>124 (I)</td>
<td>118</td>
<td>6</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

<table>
<thead>
<tr>
<th>A) QUARTZ CONDUCTIVE</th>
<th>F) CRISTOBALITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B) QUARTZ CONDUCTIVE, PH-CORRECTED</td>
<td>G) AMORPHOUS SILICA</td>
</tr>
<tr>
<td>C) QUARTZ ADIABATIC</td>
<td>H) NA-K</td>
</tr>
<tr>
<td>D) CHALCEDONY</td>
<td>I) NA-K-CA</td>
</tr>
<tr>
<td>E) CHALCEDONY, PH-CORRECTED</td>
<td>J) NA-K-CA, MG-CORRECTED</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| THICKNESS (KM)            | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |

| SUBSURFACE AREA (KM**2)   | 1       | 3       | 2           | 2.0  | 0.4       |

**BASED ON: STANDARD ESTIMATE**

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>3.3</th>
<th>STD. DEV. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL ENERGY(10**18 J)</td>
<td>0.92</td>
<td>STD. DEV. = 0.26</td>
</tr>
</tbody>
</table>

**COMMENTS:** WATER USED TO HEAT GREENHOUSE.

**REFERENCES:** KONZESKI AND OTHERS, 1962; WARING, 1965; MARINER AND OTHERS, 1976A

**COMPILED BY:** BROOK, C.

**GREGSON (FAIRMONT) HOT SPRINGS, MONTANA**
FIELD NAME: NORRIS (HAPGOOD, BEARTRAP) HOT SPRINGS
CIRCULAR REFERENCE: 127

GEOGRAPHIC LOCALITY
STATE: MONTANA
COUNTY: MADISON
LATITUDE: 45-34.5 N
LONGITUDE: 111-41.0 W
MAPS: NORRIS 1"62"500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
03S 01W 14 NE OF SE MONTANA

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 32
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (C): 41.0 TO 52.5
DISCHARGE (L/MIN): 425
NO. OF WELLS: 1
ROCK TYPES: GNEISS (SYENITE?)

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1976
COLLECTION DATE: 1974/08/21

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.5</td>
<td>88</td>
<td>17</td>
<td>3.2</td>
<td>180</td>
<td>10</td>
<td>380</td>
<td>130</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

F 8 PH: 7.4 DEL 0(18) SO4 DEL 0(18) H2O DEL D H2O -148.4
GEOTHERMOMETERS (C)

CATION
- Na-K-CA (1/3) = 153
- Na-K-CA (4/3) = 111
- Na-K = 124

SILICA
- Adiabatic = 127
- Conductive = 130
- Chalcedony = 103
- Cristobalite = 80
- Opal = 11

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUN/SURFACE TEMP (C)</td>
<td>87 (J)</td>
<td>130 (A)</td>
<td>103 (D)</td>
<td>107</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) Quartz Conductive
- B) Quartz Conductive, Ph-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, Ph-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

DEPTH TO TOP (KM) | 0.5 | 2.0 | 1.5 | 1.7 | 0.3 |
THICKNESS (KM) | 1.0 | 2.5 | 1.5 | 2.0 | 0.4 |
SUN/SURFACE AREA (KM**2) | 1 | 3 | 2 | 3.3 | STD. DEV. = 0.9 |

VOLUME (KM**3) | 3.3 | STD. DEV. = 0.9 |

THERMAL ENERGY (10**18 J) | 0.82 | STD. DEV. = 0.25 |

REFERENCES:
- Peale, 1896
- Waring, 1965
- Mariner and Others, 1976
- Leonard and Others, 1978
- Chadwick and Kaczmarek, 1975
- Chadwick, 1978

Compiled by Brook, C.

Norris (Hapgood, Hearttrap) Hot Springs, Montana
FIELD NAME: SILVER STAR (BARKEL'S) HOT SPRINGS
CIRCULAR REFERENCE: 128

GEOGRAPHIC LOCALITY
STATE: MONTANA
COUNTY: MADISON
LATITUDE: 45°41.5' N
LONGITUDE: 112°17.2' W
MAPS: TWIN BRIDGES, 1162, 500

TOWNSHIP: 02S
RANGE: 06W
SECTION: 01 SW
BASE & MERIDIAN: MONTANA

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 30
ELEVATION (M): 1400
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 4
SPRING TEMPERATURES (C): 67 TO 73
DISCHARGE (L/MIN): 150-200
ROCK TYPES: TERTIARY LAKE BEDS OVERLYING GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1976
COLLECTION DATE: 1974/08/18

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>71.5</td>
<td>110</td>
<td>9.3</td>
<td>0.3</td>
<td>170</td>
<td>6.4</td>
<td>170</td>
<td>190</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>pH</th>
<th>DEL O(18) SiO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.7</td>
<td>0.25</td>
<td>8.17</td>
<td>-5.46</td>
<td>-18.48</td>
<td>-145.4</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3).......... 139
NA-K-CA (4/3)........... 109
NA-K................... 93

SILICA
ADIABATIC............. 137
CONDUCTIVE............. 143
CHALCEDONY............. 116
CHRISTOBALITE......... 92
UPAL................... 22

SULFATE
CONDUCTIVE............. 135
ONE-STEP STEAM LOSS.... 128
CONTINUOUS STEAM LOSS.. 129

RESEVOIR PROPERTIES
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE TEMP (C) 116 (D) 143 (A) 135 (K, I) 131 6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPTH TO TOP (KM) 0.5 2.0 1.5 1.7 0.3
THICKNESS (KM) 1.0 2.5 1.5 2.0 0.4
SUBSURFACE AREA (KM**2) 1 3 2

VOLUME (KM**3)........... 3.3 STD. DEV. = 0.9

THERMAL ENERGY (10**18 J) 1.05 STD. DEV. = 0.30


COMPILED BY: BROOK, C.

SILVER STAR (BARKEL'S) HOT SPRINGS, MONTANA
FIELD NAME.................. ENNIS (THEXTON) HOT SPRINGS
CIRCULAR REFERENCE......... 129

GEOGRAPHIC LOCALITY
STATE......................... MONTANA
COUNTY....................... MADISON
LATITUDE.................... 45-22.0 N
LONGITUDE................... 111-44.8 W
MAPS........................ ENNIS 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
05S 01W 28 SW OF SE MONTANA

GENERAL INFORMATION
SURFACE ACTIVITY............... HOT SPRING
NO. OF SPRINGS.................. 1
SPRING TEMPERATURES (C)........ 83
DISCHARGE (L/MIN)................ 115
NO. OF WELLS..................... 2
WELL DEPTHS (M).................. 100
MAXIMUM WELL TEMP (C)........... 89 AT DEPTH (M) 30

ROCK TYPES: ALLUVIUM OVERLYING GNEISS

CHEMISTRY
SAMPLE SOURCE....... LEONARD AND OTHERS, 1978
FLOW (L/MIN)...... LT 75
COLLECTION DATE... 1976/04/01

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>83</td>
<td>9.6</td>
<td>5.8</td>
<td>0.6</td>
<td>340</td>
<td>17</td>
<td>442</td>
<td>0</td>
<td>220</td>
<td>120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>pH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL O H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>0.61</td>
<td>7.7</td>
<td>-1.80</td>
<td>-19.09</td>
<td></td>
</tr>
</tbody>
</table>
GEOETHERMOMETERS (C)

CAIION
NA-K-CA (1/3)............. 167
NA-K-CA (4/3)............. 178
NA-K.................. 115

SILICA
ADIABATIC................ 131
CONDUCTIVE............. 135
CHALCEDONY........... 108
CHRISTOBALITE......... 84
OPAL.................. 15

SULFATE
CONDUCTIVE............. 92
ONE-STEP STEAM LOSS.... 91
CONTINUOUS STEAM LOSS.. 91

RESEVOIR PROPERTIES

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE TEMP (C) 108 (D) 145 (J) 135 (A) 129 8

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPTH TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM**2) 1 3 2 2.0 0.4

VOLUME (KM**3)............. 3.3 STD. DEV. = 0.9
THERMAL ENERGY (10**18 J) 1.03 STD. DEV. = 0.30

REFERENCES: LEONARD AND OTHERS, 1978; CHADWICK, 1978

COMPILY BY: BROOK, C.

FNNIS (TheEXTON) HOT SPRINGS, MONTANA
Nevada
FIELD NAME: BALTAZOR HOT SPRINGS
KGRA OR OTHER NAME: BALTAZOR HOT SPRINGS KGRA
CIRCULAR REFERENCE: 130

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: HUMHOLDT
LATITUDE: 41°55.3' N
LONGITUDE: 118°42.6' W
MAPS: DENI 1162500

TOWNSHIP: 46N
RANGE: 28E
SECTION: 13 NW
BASE & MERIDIAN: MT. DIABLO

GENERAL INFORMATION
ELEVATION (M): 1284
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: SINTER, TRAVERTINE
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 80
DISCHARGE (L/MIN): 100
NO. OF WELLS: 1
WELL DEPTHS (M): SHALLOW

ROCK TYPES: QUATERNARY ALLUVIUM, TERTIARY VOLCANIC ROCKS, CRETACEOUS TO TERTIARY GRANODIORITE

GEOPHYSICS: GRAVITY, MAGNETIC, AMT

SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975
FLOW (L/MIN): 100

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>160</td>
<td>8.4</td>
<td>LT 0.1</td>
<td>180</td>
<td>8.7</td>
<td>139</td>
<td>220</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

F  H  PH  DEL 0(18)  S04  DEL 0(18)  H2O  DEL 0D  H2O
7.1 2.9 8.00  -1.98  -15.26  -125.3
**GFOTHERMOMETERS (°C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>152</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>124</td>
</tr>
<tr>
<td>NA-K</td>
<td>112</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>156</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>165</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>142</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>115</td>
</tr>
<tr>
<td>OPAL</td>
<td>42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>158</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>148</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>150</td>
</tr>
</tbody>
</table>

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>152 (I)</td>
<td>165 (A)</td>
<td>158 (K)</td>
<td>158</td>
<td>3</td>
</tr>
</tbody>
</table>

*UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT*  
A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>3.7</td>
<td>1.0</td>
</tr>
<tr>
<td>VOLUME (KM**3)</td>
<td>6.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY (10**16 J)</td>
<td>2.36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*BASED ON AMT SURVEY*  

**COMMENTS:** AREA OF HIGH HEAT FLOW NEARBY. ONE SHALLOW WELL FLOWS 90°C WATER AT 25 LPM.

**REFERENCES:** MARINER AND OTHERS, 1974; 1975; WILDEMAN, 1964; USGS FILE DATA; RENNER AND OTHERS, 1976

**COMPILRED BY:** MARINER, R.; BROOK, C.

NEVADA HOT SPRINGS, NEVADA
FIELD NAME: Dyke Hot Springs
CIRCULAR REFERENCE: 131

GEOGRAPHIC LOCALITY
STATE: Nevada
COUNTY: Humboldt
LATITUDE: 41°34.0' N
LONGITUDE: 118°33.7' W
MAPS: Duffer Peak 1162.500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
43N 30E 25 SE OF SE Mt. Diablo

GENERAL INFORMATION
ELEVATION (M): 1256
SURFACE ACTIVITY: Hot Springs
DISCHARGE (L/MIN): 100

ROCK TYPES: Quaternary Alluvium; Triassic and Jurassic Metamorphic Rocks

CHEMISTRY
SAMPLE SOURCE: Mariner and Others, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>66</td>
<td>85</td>
<td>1.8</td>
<td>LT 0.1</td>
<td>150</td>
<td>4.3</td>
<td>243</td>
<td>82</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

F 8.0 1.0 PH DEL 0(18) S04 DEL 0(18) H20 DEL D H20
0.0 1.0 8.9 -16.29 -128.0
### GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CAIION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>137</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>136</td>
</tr>
<tr>
<td>NA-K</td>
<td>73</td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>125</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>128</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>101</td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>78</td>
</tr>
<tr>
<td>OPAL</td>
<td>9</td>
</tr>
</tbody>
</table>

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>76 (E)</td>
<td>137 (I)</td>
<td>106 (B)</td>
<td>106</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**BASED ON STANDARD ESTIMATE**

VOLUME (KM**3), ............ 3.3
THERMAL ENERGY(10**10 J), 0.82

**REFERENCES:** MARINER AND OTHERS, 1974A; 1975; WILLDEN, 1964; SMITH, 1973

**COMPILED BY:** MARINER, R.

**DYKE HOT SPRINGS, NEVADA**
FIELD NAME................ PINTO HOT SPRINGS (EAST AND WEST)
KGRA OR OTHER NAME........ PINTO HOT SPRINGS KGRA
CIRCULAR REFERENCE....... 132

GEOGRAPHIC LOCALITY
STATE...................... NEVADA
COUNTY................... HUMBOLDT
LATITUDE................ 41-21.0 N
LONGITUDE.............. 118-47.0 W
MAPS...................... VYA 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
40N 28E 19 SE OF NE MT, DIABLO

GENERAL INFORMATION
WARRING FIGURE.............. 8
WARRING NUMBER.............. 9
ELEVATION (M)............... 1372
SURFACE ACTIVITY........... HOT SPRINGS
ASSOCIATED DEPOSITS......... SINTER AND TRAVERTINE
NO. OF SPRINGS............... SEVERAL
SPRING TEMPERATURES (C)...... 92
NO. OF WELLS............. ONE (WEST)
ROCK TYPES: CRETACEOUS OR TERTIARY GRANODIORITE
GEOPHYSICS: GRAVITY, MAGNETIC, AMT, TELLURIC CURRENT

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>MCO3</th>
<th>C03</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>93</td>
<td>150</td>
<td>14</td>
<td>0.4</td>
<td>330</td>
<td>23</td>
<td>495</td>
<td>1</td>
<td>120</td>
<td>160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0 H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>7.5</td>
<td>7.14</td>
<td>-7.09</td>
<td>-14.20</td>
<td>-129.2</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

**CATION**
- NA-K-CA (1/3) .......... 176
- NA-K-CA (4/3) .......... 163
- NA-K ................... US

**Silica**
- Adiabatic .............. 153
- Conductive .......... 161
- Chalcedony .......... 137
- Cristobalite .......... 111
- Opal ................. 39

**Sulfate**
- Conductive .......... 232
- One-Step Steam Loss.. 207
- Continuous Steam Loss. 213

### Reservoir Properties

<table>
<thead>
<tr>
<th>Surface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>153 (C)</td>
<td>190</td>
<td>176 (I)</td>
<td>173</td>
<td>8</td>
</tr>
</tbody>
</table>

Uncoded Temperature Indicates Subjective Judgement

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Thickness (km)          | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |
|                        | 3       | 10      | 5           | 6.0  | 1.5       |

| Subsurface Area (km²)   | 3       | 10      | 5           | 6.0  | 1.5       |

Based on: Spring Distribution, AMT, Gravity

| Volume (km³)            | 10.0    | Std. Dev. = 3.1 |
|                        |         |                |
| Thermal Energy (10¹¹*18 J) | 4.27   | Std. Dev. = 1.35 |

References: Mariner and Others, 1974; 1975; Warren, 1965; Willden, 1964; Hoover and Batzle, 1977

Compiled by: Mariner, R.

Pinto Hot Springs (East and West), Nevada
### Field Name
Double Hot Springs Area

### KGRA or Other Name
Double Hot Springs KGRA

### Circular Reference
133

### Geographic Locality

<table>
<thead>
<tr>
<th>State</th>
<th>Nevada</th>
</tr>
</thead>
<tbody>
<tr>
<td>County</td>
<td>Humboldt</td>
</tr>
<tr>
<td>Latitude</td>
<td>41°02.9' N</td>
</tr>
<tr>
<td>Longitude</td>
<td>119°01.7' W</td>
</tr>
<tr>
<td>Maps</td>
<td>VYA H2SO4000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Township</th>
<th>Range</th>
<th>Section</th>
<th>Base &amp; Meridian</th>
</tr>
</thead>
<tbody>
<tr>
<td>J6N</td>
<td>26E</td>
<td>04</td>
<td>MT, Diablo</td>
</tr>
</tbody>
</table>

### General Information

<table>
<thead>
<tr>
<th>Warning Figure</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning Number</td>
<td>12</td>
</tr>
<tr>
<td>Elevation (m)</td>
<td>1290</td>
</tr>
<tr>
<td>Surface Activity</td>
<td>Hot Springs</td>
</tr>
<tr>
<td>No. of Springs</td>
<td>Several</td>
</tr>
<tr>
<td>Discharge (L/min)</td>
<td>175</td>
</tr>
</tbody>
</table>

### Rock Types
Quaternary Alluvium, Tertiary Basalt and Ash-Flow Hylolite

### Chemistry

| Sample Source | Mariner and Others, 1974, 1975 |

#### Chemical Analysis (ppm)

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>105</td>
<td>4.8</td>
<td>0.1</td>
<td>180</td>
<td>4.5</td>
<td>261</td>
<td>2</td>
<td>120</td>
<td>59</td>
</tr>
</tbody>
</table>

#### pH and Redox Potential

<table>
<thead>
<tr>
<th>pH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0 H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1.8</td>
<td>-15.93</td>
<td>-128.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

\begin{align*}
\text{NA-K-CA (1/3)} & : 114 \\
\text{NA-K-CA (4/3)} & : 113 \\
\text{NA-K} & : 64
\end{align*}

SILICA

\begin{align*}
\text{ADiABATIC} & : 135 \\
\text{CONDUCTIVE} & : 140 \\
\text{CHALCEDONY} & : 114 \\
\text{CRISTOBALITE} & : 89 \\
\text{OPAL} & : 19
\end{align*}

RESERVOIR PROPERTIES

\begin{align*}
\text{MINIMUM} & : 114 (D) \\
\text{MAXIMUM} & : 140 (A) \\
\text{MOST LIKELY} & : 127 (I)
\end{align*}

SUBSURFACE TEMP (C)

\begin{align*}
\text{MINIMUM} & : 114 (D) \\
\text{MAXIMUM} & : 140 (A) \\
\text{MOST LIKELY} & : 127 (I) \\
\text{MEAN} & : 127 \\
\text{STD. DEV.} & : 5
\end{align*}

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADiABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)

\begin{align*}
\text{MINIMUM} & : 0.5 \\
\text{MAXIMUM} & : 2.0 \\
\text{MOST LIKELY} & : 1.5 \\
\text{MEAN} & : 1.7 \\
\text{STD. DEV.} & : 0.3
\end{align*}

THICKNESS (KM)

\begin{align*}
\text{MINIMUM} & : 1.0 \\
\text{MAXIMUM} & : 2.5 \\
\text{MOST LIKELY} & : 1.5 \\
\text{MEAN} & : 1.7 \\
\text{STD. DEV.} & : 2.1
\end{align*}

SUBSURFACE AREA (KM**2)

\begin{align*}
\text{MINIMUM} & : 2 \\
\text{MAXIMUM} & : 12 \\
\text{MOST LIKELY} & : 8 \\
\text{MEAN} & : 7.3 \\
\text{STD. DEV.} & : 4.2
\end{align*}

BASED ON THERMAL SPRINGS AND HIGH GROUND TEMPERATURES ALONG LINEAR TREND

VOLUME (KM**3)

\begin{align*}
\text{MINIMUM} & : 1.2 \\
\text{MAXIMUM} & : 2.2 \\
\text{MEAN} & : 1.7 \\
\text{STD. DEV.} & : 4.2
\end{align*}

THERMAL ENERGY (10**18 J)

\begin{align*}
\text{MINIMUM} & : 3.70 \\
\text{MAXIMUM} & : 3.70 \\
\text{MEAN} & : 1.27 \\
\text{STD. DEV.} & : 1.27
\end{align*}

REFERENCES:


COMPILED BY R. MARINER

DOUBLE HOT SPRINGS AREA NEVADA
FIELD NAME................BLACK HOCK POINT AREA
KGRA OR OTHER NAME........DOUBLE HOT SPRINGS KGRA
CIRCULAR REFERENCE........134

GEOGRAPHIC LOCALITY
STATE......................NEVADA
COUNTY.....................PERSHING
LATITUDE..................40-57.0 N
LONGITUDE..................119-00.2 W
MAPS......................LOVELOCK 1:250,000

TOWNSHIP RANGE SECTION
36N 26E 347
BASE & MERIDIAN
MT. DIABLO

GENERAL INFORMATION
WARING FIGURE..............8
WARING NUMBER...............16
ELEVATION (M)...............1220
SURFACE ACTIVITY...............HOT SPRINGS
ROCK TYPES: QUATERNARY PLAYA DEPOSITS! TERTIARY VOLCANIC AND SEDIMENTARY ROCKS

CHEMISTRY
SAMPLE SOURCE...........MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>S (g/l)</th>
<th>Ca (mg/l)</th>
<th>Mg (mg/l)</th>
<th>Na (mg/l)</th>
<th>K (mg/l)</th>
<th>HCO3 (mg/l)</th>
<th>CO3 (mg/l)</th>
<th>SO4 (mg/l)</th>
<th>Cl (mg/l)</th>
<th>F (ppm)</th>
<th>H (ppm)</th>
<th>pH</th>
<th>DEL 0(18)</th>
<th>S04</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>120</td>
<td>35</td>
<td>4</td>
<td>1500</td>
<td>20</td>
<td>932</td>
<td>290</td>
<td>787</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F HD DEL 0(18) S04 DEL 0(18) H2O DEL D H2O
### GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>116</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>151</td>
</tr>
<tr>
<td>NA-K</td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>141</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>148</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>122</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>97</td>
</tr>
<tr>
<td>OPAL</td>
<td>26</td>
</tr>
</tbody>
</table>

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>116(1)</td>
<td>148 (A)</td>
<td>122 (D)</td>
<td>129</td>
<td>7</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, Mg-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM^2)</th>
<th>1</th>
<th>3</th>
<th>2</th>
<th>2.0</th>
<th>0.4</th>
</tr>
</thead>
</table>

**BASED ON STANDARD ESTIMATE**

<table>
<thead>
<tr>
<th>VOLUME (KM^3)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY(10^8 J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
<td>1.02</td>
<td>0.29</td>
</tr>
</tbody>
</table>

**REFERENCES:** MARINER AND OTHERS, 1974; TATLOCK, 1965; OLMSTED AND OTHERS, 1975; RENNER AND OTHERS, 1976

**COMPILED BY:** MARINER, R.

**BLACK ROCK POINT AREA, NEVADA**
FIELD NAME: BUTTE SPRINGS (TREGO)
KGRA OR OTHER NAME: TREGO KGRA
REFERENCES: 135

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: PERSHING
LATITUDE: 40°46.0 N
LONGITUDE: 119°07.0 W
MAPS: LOVELOCK 1|250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
JAN 26E 31 NE MI. DIABLO

GENERAL INFORMATION
WARNING FIGURE: 8
WARNING NUMBER: 63
ELEVATION (M): 1219
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPINGS: SEVERAL
ROCK TYPES: QUATERNARY DUNE SANDS CRETACEOUS GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINEH AND OTHERS, 1976
COLLECTION DATE: 1975/08/21

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>84.5</td>
<td>19</td>
<td>11</td>
<td>0.2</td>
<td>430</td>
<td>8.6</td>
<td>162</td>
<td>180</td>
<td>500</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>5.0</td>
<td>7.93</td>
<td></td>
<td>-14.87</td>
<td>-127.6</td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA+K+CA (1/3)</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA+K+CA (4/3)</td>
<td>129</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA+K</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHISTOBALITE</td>
<td>74</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>96 (D)</td>
<td></td>
<td>124 (A+I)</td>
<td>124 (A+I)</td>
<td>115</td>
<td>7</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIABATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA+K+CA  
J) NA+K+CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.0</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM*2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

**VOLUME (KM*3).......... 3.3  STD. DEV. = 0.9**

**THERMAL ENERGY(10**18 J) 0.90  STD. DEV. = 0.26**

**REFERENCES:**  
MARINER AND OTHERS, 1976  
WARING, 1965  
TATLOCK, 1969  
OLMSTED AND OTHERS, 1975  
RENNER AND OTHERS, 1976

**COMPILED BY:** MARINER, R.  
HUTTE SPRINGS (TREGO), NEVADA
FIELD NAME ............... FLY RANCH (WARDS) HOT SPRINGS
KGRA OR OTHER NAME ....... FLY RANCH KGRA
CIRCULAR REFERENCE .... 136

GEOGRAPHIC LOCALITY
STATE ..................... NEVADA
COUNTY ..................... WASHOE
LATITUDE .................. 40-52.0 N
LONGITUDE ................. 119-20.9 W
MAPS ...................... LOVELOCK 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
34N 23E 01 MT. DIABLO

GENERAL INFORMATION
WARING FIGURE ...................... 8
WARING NUMBER ...................... 37
ELEVATION (M) ...................... 1234
SURFACE ACTIVITY ..................... ARTESIAN WELLS
ASSOCIATED DEPOSITS ................ TRAVERTINE
DISCHARGE (L/MIN) .................. 500
NO. OF WELLS ...................... 2
WELL DEPTHS (M) .................... 244 TO 305
MAXIMUM WELL TEMP (C) .............. 108
ROCK TYPES: QUATERNARY ALLUVIUM, UPPER TERTIARY BASALT, TUFFS, AND SEDIMENTARY ROCK
GEOPHYSICS: MAGNETIC, MICROEARTHQUAKE, SEISMIC GROUNDNOISE, RESISTIVITY, SP

CHEMISTRY
SAMPLE SOURCE .... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>82</td>
<td>31</td>
<td>4.2</td>
<td>340</td>
<td>17</td>
<td>458</td>
<td>4</td>
<td>46</td>
<td>240</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td>-14.72</td>
<td>DEL 0(18)</td>
<td>504</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL 0</td>
<td>H20</td>
</tr>
<tr>
<td>7.91</td>
<td>1.9</td>
<td></td>
<td>120.7</td>
<td>DEL 0(18)</td>
<td>504</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL 0</td>
<td>H20</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- Na-K-CA (1/3)............. 153
- Na-K-CA (4/3)............. 125
- Na-K..................... 115

SILICA
- ADIABATIC.................. 124
- CONDUCTIVE.................. 126
- CHALCEDONY.................. 99
- CRISTOBALITE............... 76
- OPAL........................ 7

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>99 (D)</td>
<td>126 (A)</td>
<td>100 (J)</td>
<td>108</td>
<td>6</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THICKNESS (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

HASHD ON: G. KELLER, UNPUB. TEMPERATURE GRADIENT DATA

VOLUME (KM**3)............. 4.4

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>STD. DEV. = 1.3</th>
</tr>
</thead>
</table>

THERMAL ENERGY (10**18 J)

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10**18 J)</th>
<th>STD. DEV. = 0.35</th>
</tr>
</thead>
</table>

REFERENCES: MARINER AND OTHERS, 1974A, 1975A USGS FILE DATA

COMPILED BY: MARINER, R.

FLY RANCH (WARDS) HOT SPRINGS, NEVADA
FIELD NAME: GREAT BOILING SPRINGS (GERLACH)
KGRA OR OTHER NAME: GERLACH KGRA
CIRCULAR REFERENCE: 137

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: WASHOE
LATITUDE: 40-39.7 N
LONGITUDE: 119-21.7 W
MAPS: GERLACH 1162,500

TOWNSHIP RANGE SECTION
3?N 23E 15 NW

BASE & MERIDIAN
MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 38
AREA OF SURFACE EXPRESSION (KM²): 0.6
ELEVATION (M): 1207
SURFACE ACTIVITY: HOT SPRINGS AND POOLS
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: APPROX. 70
SPRING TEMPERATURES (C): 20 TO 90
DISCHARGE (L/MIN): 1000
NO. OF WELLS: 1
WELL DEPTHS (M): 150
MAXIMUM WELL TEMP (C): 110
AT DEPTH (M): 150

ROCK TYPES: QUATERNARY ALLUVIUM AND LAKE SEDIMENTS, CRETACEOUS TO TERTIARY GRANODIORITE

GEOPHYSICS: GRAVITY, MAGNETIC, AMT, RESISTIVITY, MICROEARTHQUAKE, TEMPERATURE GRADIENT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
<td>165</td>
<td>66</td>
<td>1.2</td>
<td>1400</td>
<td>130</td>
<td>83</td>
<td>1</td>
<td>400</td>
<td>2200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>PH</th>
<th></th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>9.9</td>
<td>7.20</td>
<td></td>
<td>+6.53</td>
<td>-10.83</td>
<td>-100.5</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

CATION
NA-K-CA (1/3) ........... 205
NA-K-CA (4/3) ........... 230
NA-K ................... 175

SILICA
ADIABATIC ............... 158
CONDUCTIVE ............. 167
CHALCEDONY ............. 144
CRISTOBALITE ........... 117
UPAL ....................... 44

SULFATE
CONDUCTIVE ............. 93
ONE-STEP STEAM LOSS.... 92
CONTINUOUS STEAM LOSS.. 92

Reservoir Properties

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>158 (C)</td>
<td>205 (I)</td>
<td>170</td>
<td>178</td>
<td>10</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>1.0</th>
<th>2.5</th>
<th>1.5</th>
<th>1.7</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>VOLUME (KM**3)</th>
<th>3.3</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL ENERGY(10**18 J)</td>
<td>1.46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

COMMENTS: THE SULFATE-ISOTOPE GEOTHERMOMETER INDICATES A TEMPERATURE NEAR BOILING; DISSOLUTION OF SALINE DEPOSITS POSSIBLE.

REFERENCES: MARINER AND OTHERS, 1974A; 1975A; OLMS TED AND OTHERS, 1975A; WARING, 1965A; RENNER AND OTHERS, 1976A

SGS FILE DATA

COMPILED BY: MARINER, R.

GREAT BOILING SPRINGS (GERLACH), NEVADA
FIELD NAME: SAN EMEDIO DESERT AREA
KGRA OR OTHER NAME: SAN EMEDIO DESERT KGRA
CIRCULAR REFERENCE: 138

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: WASHOE
LATITUDE: 40°24' N
LONGITUDE: 119°25' W
MAPS: KUMIVA PEAK 1162,500

TOWNSHIP RANGE SECTION
29N 23E MT. DIABLO

GENERAL INFORMATION
ELEVATION (M): 1231
SURFACE ACTIVITY: HOT SEEP SPRINGS
ASSOCIATED DEPOSITS: SINTER AND TRAVERTINE
NO. OF SPRINGS: THREE GROUPS
ROCK TYPES: ALLUVIUM OVERLATING TERTIARY BASALT, ANDESITE, AND TUFFACEOUS SEDIMENTS
GEOPHYSICS: GRAVITY, MAGNETIC, AMT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1976
FLOW (L/MIN): LT 1
COLLECTION DATE: 1975/08/20

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>215</td>
<td>160</td>
<td>2.3</td>
<td>1500</td>
<td>120</td>
<td>129</td>
<td></td>
<td>240</td>
<td>2300</td>
</tr>
<tr>
<td>F</td>
<td>O</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.7</td>
<td>7.2</td>
<td>6.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DELTAS (°): 504 DEL 0(18), H₂O DEL 0(18) H₂O DEL D H₂O -11.61 -106.4
GEOTHERMOMETERS (C)

CATION
NA-K-Ca (1/3).......... 189
NA-K-Ca (4/3).......... 191
NA-K................... 159

SILICA
ADHIBATIC.............. 172
CONDUCTIVE............ 185
CHALCEDONY............ 165
CRISTOBALITE.......... 135
opal.................. 61

RESERVOIR PROPERTIES

MINIMUM            MAXIMUM            MOST LIKELY            MEAN      STD. DEV.
SUBSURFACE TEMP (C) 125                  189 (I)                  185 (A)      166      15

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM            MAXIMUM            MOST LIKELY            MEAN      STD. DEV.
DEPTH TO TOP (KM)   0.5                  2.0                    1.5
THICKNESS (KM)      1.0                  2.5                    1.5
SUBSURFACE AREA (KM**2) 1                  3                      2
BASFRD ON: STANDARD ESTIMATE

VOLUME (KM**3)........... 3.3          STD. DEV. = 0.9
THERMAL ENERGY(10**18 J) 1,36           STD. DEV. = 0.40

COMMENTS: NEGIGIBLE FLOW RATES MAKE QUANTITATIVE INTERPRETATION OF THE GEOTHERMOMETERS IMPOSSIBLE. NEAR SURFACE REACTIONS PROBABLE. MINIMUM TEMPERATURE ESTIMATED ASSUMING CONDUCTIVE COOLING. TEMPERATURES MAY BE 200°C OR HIGHER.

REFERENCES: MARINER AND OTHERS, 1976C

COMPILED BY: MARINER, R.

SAN EMEDIO DESERT AREA, NEVADA
FIELD NAME: THE NEEDLES (NEEDLE ROCKS, PYRAMID LAKE)
CIRCULAR REFERENCE: 139

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: WASHOE
LATITUDE: 40°08.8' N
LONGITUDE: 119°40.5' W
MAPS: THE NEEDLE ROCKS U2<1000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
26N 21E 06 SW OF SW MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 49
ELEVATION (M): 1158
SURFACE ACTIVITY: HOTSPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: SEVERAL
NO. OF WELLS: 3
WELL DEPTHS (M): 1219 (?) TO 1795
MAXIMUM WELL TEMP (C): 116
ROCK TYPES: QUATERNARY ALLUVIUM AND TUFA OLIVINE BASALT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>110</td>
<td>260</td>
<td>0.1</td>
<td>1100</td>
<td>160</td>
<td>24</td>
<td>1</td>
<td>340</td>
<td>1900</td>
</tr>
<tr>
<td>F</td>
<td>R</td>
<td>PH</td>
<td></td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H2O</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>6.1</td>
<td>8.43</td>
<td></td>
<td>-6.33</td>
<td>-106.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>RESERVOIR PROPERTIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>MINIMUM</td>
</tr>
<tr>
<td>214</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>183</td>
</tr>
<tr>
<td>NA-K</td>
<td>232</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAI</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM^2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>3.0</td>
<td>2.0</td>
<td></td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

**BASED ON STANDARD ESTIMATE**

- VOLUME (KM^3) | MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

- THERMAL ENERGY (10^18 J) | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.97</td>
<td>0.27</td>
</tr>
</tbody>
</table>

**COMMENTS**: SAMPLE FROM LEAKING STEAM WELL (FLASHING AT THE SURFACE)

**REFERENCES**: MARINER AND OTHERS, 1974A; 1975; WARING, 1965; BONHAM, 1969; RENNER AND OTHERS, 1976

**COMPILED BY**: MARINER, R.

THE NEEDLES (NEEDLE ROCKS, PYRAMID LAKE), NEVADA
FIELD NAME: MOANA AREA
KGRA OR OTHER NAME: MOANA SPRINGS KGRA
CIRCULAR REFERENCE: 140

GEOPHYSICAL LOCALITY
STATE: NEVADA
COUNTY: WASHOE
LATITUDE: 39°29.7' N
LONGITUDE: 119°48.9' W
MAPS: RENO 1124,0000 MT, ROSE 1162,5001 MT, ROSE NE 1124,000

TOWNSHIP
19N
RANGE
19E
SECTION
26 NE
BASE & MERIDIAN
MT. DIABLO

GENERAL INFORMATION
WARNING FIGURE: 55A
WARNING NUMBER: 55A
ELEVATION (M): 1384
SURFACE ACTIVITY: INACTIVE SPRINGS
NO. OF SPRINGS: NONE
NO. OF WELLS: MORE THAN 20
WELL DEPTHS (M): 20 TO 307
MAXIMUM WELL TEMP (C): 96 AT DEPTH (M) 94
ROCK TYPES: MIOCENE TO LATE PLEISTOCENE DIATOMITE, SANDSTONE, AND CONglomerate; TERTIARY VOLCANIC FLOWS; GRANITE AND METAMORPHICS OF PRE-TERTIARY AGE

CHEMISTRY
SAMPLE SOURCE: RAYTEN AND SCHEIBACH, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>135</td>
<td>29</td>
<td>0.8</td>
<td>203</td>
<td>7.4</td>
<td>146</td>
<td>340</td>
<td>42</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>1.8</td>
<td>7.65</td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS** (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>132</th>
<th>89</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>147</th>
<th>155</th>
<th>104</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>96 (H)</td>
<td>155 (A)</td>
<td>96 (H)</td>
<td>116</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TDP (KM)</td>
<td>0.1</td>
<td>1.0</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>2.0</td>
<td>2.5</td>
<td>2.1</td>
<td>2.2</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>4.0</td>
</tr>
</tbody>
</table>

**COMMENTS:**

- NA-K-CA GEOTHERMOMETER AGREES WITH THE OBSERVED WELL TEMPERATURE
- CONTACT WITH DIATOMITE POSSIBLE
- MAY CAUSE THE LARGE SILICA CONCENTRATION

**REFERENCES:**

- RATERMAN AND SCHEIBACH, 1975
- ATKINSON, 1978

**COMPILED BY:** MARONER, R.

**MOANA AREA, NEVADA**
FIELD NAME: STEAMBOAT SPRINGS
KGRA OR OTHER NAME: STEAMBOAT SPRINGS KGRA
CIRCULAR REFERENCE: 141

GEOGRAPHIC LOCALITY

STATE: NEVADA
COUNTY: WASHOE
LATITUDE: 39-23.0 N
LONGITUDE: 119-45.0 W
MAPS: MT. ROSE 1162,5001 VIRGINIA CITY 1162,5001 RENO 11250,0001 STEAMBOAT 1124,000

TOWNSHIP RANGE SECTION
1AN 20L 33
BASE & MERIDIAN
MT. DIABLO

GENERAL INFORMATION

WARNING FIGURE: 8
WARNING NUMBER: 56.55 E/F
AREA OF SURFACE EXPRESSION (KM**2): 5.7
ELEVATION (M): 1420
SURFACE ACTIVITY: HOT SPRINGS, FUMAROLE, GEYSER(S)
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: MANY (74)
SPRING TEMPERATURES (C): 45 TO 96
DISCHARGE (L/MIN): 250
NO. OF WELLS: 6 DEEP EXPLORATION WELLS
WELL DEPTHS (M): 218 TO 558
MAXIMUM WELL TEMP (C): 186 AT DEPTH (M) 221
ROCK TYPES: PLEISTOCENE VOLCANICS, PRE-TERTIARY GRANITE, METAMORPHICS
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, SP, AMT, TELLURIC CURRENT

CHEMISTRY

SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975
FLOW (L/MIN): 10

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>270</td>
<td>16</td>
<td>0.7</td>
<td>680</td>
<td>66</td>
<td>364</td>
<td>2</td>
<td>73</td>
<td>837</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>PH</td>
<td>DEL O(18)</td>
<td>504</td>
<td>DEL O(18)</td>
<td>H2O</td>
<td>DEL D H2O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>47</td>
<td>7.19</td>
<td>-3.28</td>
<td>-10.64</td>
<td>-116.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/1).............. 207
- NA-K-CA (4/3)............. 233
- NA-K....................... 180

**SILICA**
- ADIABATIC.................. 185
- CONDUCTIVE.................. 201
- CHALCEDONY.................. 184
- CRISTOBALITE................. 153
- OPAL.......................... 77

**SULFATE**
- CONDUCTIVE.................. 231
- ONE-STEP STEAM LOSS........ 207
- CONTINUOUS STEAM LOSS..... 213

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.3</td>
<td>1.0</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>2.0</td>
<td>2.7</td>
<td>2.7</td>
<td>2.5</td>
<td>0.2</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM×2)</td>
<td>4</td>
<td>25</td>
<td>6</td>
<td>11.7</td>
<td>4.7</td>
</tr>
<tr>
<td>VOLUME (KM×3)</td>
<td>28.8</td>
<td></td>
<td></td>
<td>14.37</td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY (10×18 J)</td>
<td>14.37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

**COMMENTS:**
- SULFATE ISOTOPE GEOTHERMOMETER BASED ON SAMPLE COLLECTED BY N. NEHRING. EXTENSIVE SINTER DEPOSITS.
- ABOUT 35 WELLS USED MOSTLY FOR SPA SUPPLY.

**REFERENCES:**
- MARINER AND OTHERS, 1974A, 1975
- RENNER AND OTHERS, 1976
- WHITE, 1968
- WHITE AND OTHERS, 1964
- THOMPSON AND WHITE, 1964

**COMPILED BY:**
- H.O. MARINER, R.

**STEAMBOAT SPRINGS, NEVADA**
FIELD NAME................ WABUSKA HOT SPRINGS
KGRA OR OTHER NAME........ WAHUSKA KGRA
CIRCULAR REFERENCE........ 142

GEOGRAPHIC LOCALITY
STATE........................ NEVADA
COUNTY........................ LYON
LATITUDE..................... 39-09.7 N
LONGITUDE.................... 119-11.0 W
MAPS.......................... WABUSKA 1162 500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
15N 25E 16 SE MT. DIABLO

GENERAL INFORMATION
WARING FIGURE................... 8
WARING NUMBER.................... 62
ELEVATION (M)..................... 1310
SURFACE ACTIVITY................ HOT SPRINGS
ASSOCIATED DEPOSITS............... TRAVERTINE
NO. OF SPRINGS................... SEVERAL
SHIVING TEMPERATURES (C)........ 59 TO 97
NO. OF WELLS.................... AT LEAST 3
WELL DEPTHS (M).................. 149 TO 678
MAXIMUM WELL TEMP (C)............ 106
ROCK TYPES: ALLUVIUM MIocene-PLEISTOCENE BASALT & ANDESITE MesoZOIC METAMORPHICS
GEOPHYSICS: GRAVITY, MAGNETIC, AMT

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>110</td>
<td>39</td>
<td>0.1</td>
<td>300</td>
<td>14</td>
<td>74</td>
<td>620</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.2</td>
<td>10</td>
<td>8.06</td>
<td>-3.22</td>
<td>-15.38</td>
<td>-129.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)............. 146
NA-K-CA (4/3)............. 109
NA-K...................... 109

SILICA
ADIABATIC.................. 137
CONDUCTIVE................ 143
CHALCEDONY................. 116
CRISTOBALITE.............. 92
OPAL....................... 22

SULFATE
CONDUCTIVE................. 146
ONE-STEP STEAM LOSS........ 140
CONTINUOUS STEAM LOSS..... 141

RESERVOIR PROPERTIES
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE TEMP (C) 106 (M) 146 (I) 140 (K) 131 9

UNCORRECTED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
0.5 2.0 1.5 1.7 0.3

THICKNESS (KM) 1.0 2.5 1.5

SUBSURFACE AREA (KM*2) 1 30 2

VOLUME (KM*3)......... 18.3 STD. DEV. = 11.9

THERMAL ENERGY(10**18 J) 5.73 STD. DEV. = 3.75

REFERENCES: MARINER AND OTHERS, 1974A, 19751 MOORF, 19691 WARING, 1965

COMPILED BY RY MARINER, R.

WAHUSSA HOT SPRINGS, NEVADA
FIELD NAME: LEE HOT SPRINGS
CIRCULAR REFERENCE: 143

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: CHURCHILL
LATITUDE: 39-12.6 N
LONGITUDE: 118-43.4 W
MAPS: ALLEN SPRINGS U62, so 1162, 500

TOWNSHIP
RANGE
SECTION
16N
29E
34

BASE & MERIDIAN
NW OF NE
MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 74A
ELEVATION (M): 4020
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (°C): 78 TO 88
DISCHARGE (L/Min): 130
ROCK TYPES: MIocene TO PLIOCENE VOLCANIC ROCKS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975
FLOW (L/Min): 130

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SO4</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>180</td>
<td>44</td>
<td>0.6</td>
<td>450</td>
<td>26</td>
<td>114</td>
<td></td>
<td>470</td>
<td>380</td>
</tr>
<tr>
<td>F</td>
<td>2.4</td>
<td>7.40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEL 0(18) SO4 = -8.03
DEL 0(18) H2O = -13.21
DEL D H2O = -125.8
## GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>162</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>137</td>
</tr>
<tr>
<td>NA-K</td>
<td>128</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>162</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>173</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>151</td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>123</td>
</tr>
<tr>
<td>OPAL</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>282</td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>239</td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>251</td>
</tr>
</tbody>
</table>

## RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>162 (C+I)</td>
<td>173 (A)</td>
<td>162 (C+I)</td>
<td>166</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM*2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**BASED ON STANDARD ESTIMATE**

- VOLUME (KM*3): 3.3 (STD. DEV. = 0.9)
- THERMAL ENERGY (10**10 J): 1.36 (STD. DEV. = 0.38)

**COMMENTS**: THE SULFATE ISOTOPE GEOTHERMOMETER INDICATES A VERY HIGH TEMPERATURE (239 TO 282 °C). THE PRESENCE OF TRAVERTINE RATHER THAN SINTER FAVORS THE LOWER TEMPERATURE.

**REFERENCES**: MARINER AND OTHERS, 1974, 1975; WILLODEN AND SPEED, 1974

**COMPILED BY**: MARINER, R.

LEE HOT SPRINGS, NEVADA
FIELD NAME ................ SODA LAKE AREA
KGRA OR OTHER NAME .......... STILLWATER-SODA LAKE KGRA
CIRCULAR REFERENCE ......... 144

GEOGRAPHIC LOCALITY
STATE ...................... NEVADA
COUNTY ..................... CHURCHILL
LATITUDE ................... 39-34, 0 N
LONGITUDE ................... 118-51, 1 W
MAPS ....................... SODA LAKE IT621500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
20N 28E 28 M1, DIABLO

GENERAL INFORMATION
ELEVATION (M) .................... 1200
SURFACE ACTIVITY .............. FUMAROLE AND WARM GROUND
NO. OF WELLS ................... 2
WELL DEPTHS (M) ................ 152 TO 1313
MAXIMUM WELL TEMP (C) ........ 152 AT DEPTH (M) 152
ROCK TYPES: PLEISTOCENE LAKE DEPOSITS AND BASALTIC TUFF
GEOPHYSICS: GRAVITY, MAGNETIC, AHT, TEMPERATURE SURVEY

CHEMISTRY
SAMPLE SOURCE .......... MARINER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>144</td>
<td>160</td>
<td>82</td>
<td>2.1</td>
<td>1000</td>
<td>48</td>
<td>144</td>
<td></td>
<td>360</td>
<td>1500</td>
</tr>
</tbody>
</table>

F  0.6  B  5.7  PH  7.86  DEL O(18) SI04  DEL O(18) H20  DEL D H20
 DEL 0.28  -13.48  -109.3
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3)............ 161
- NA-K-CA (4/3)............ 159
- NA-K..................... 112

SILICA
- DIAPHRAGMATIC............. 156
- CONDUCTIVE.............. 165
- CHALCEDONY.............. 142
- CHROMALITE.............. 115
- OPALE.................... 42

SULFATE
- CONDUCTIVE............. 127
- ONE-STEP STEAM LOSS.... 129
- CONTINUOUS STEAM LOSS.. 129

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>144 (M)</td>
<td>165 (A)</td>
<td>161 (I)</td>
<td>157</td>
<td>5</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>0.3</th>
<th>2.0</th>
<th>1.0</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.7</td>
<td>1.5</td>
<td>1.7</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1</td>
<td>28</td>
<td>5</td>
<td>11.3</td>
<td>5.9</td>
</tr>
</tbody>
</table>

BASING ON SHALLOW TEMPERATURE SURVEY

| VOLUME (KM³)              | 19.6    |       |             | 11.3  |           |
| THERMAL ENERGY (10¹³ J)   | 7.51    |       |             | 4.32  |           |

COMMENTS: CHALCEDONY GEOTHERMOMETER INDICATES 142 DEG C; PERMEABILITY OF AQUIFER IS VERY LOW; ONLY TOTAL DEPTH AVAILABLE ON THE DEEPER WELL.

REFERENCES: MORRISON, 1964; MARINER AND OTHERS, 1975; OLMSTED AND OTHERS, 1975

COMPILED BY: MARINER, R.

SODA LAKE AREA, NEVADA
FIELD NAME.................. STILLWATER AREA
KGRA OR OTHER NAME........... STILLWATER-SODA LAKE KGRA
CIRCULAR REFERENCE.......... 145

GEOGRAPHIC LOCALITY
STATE...................... NEVADA
COUNTY.................... CHURCHILL
LATITUDE.................. 39-31,3 N
LONGITUDE.................. 118-33,1 W
MAPS........................ STILLWATER 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
19N 31E 07 SW MT. DIABLO

GENERAL INFORMATION
ELEVATION (M).................. 1189
SURFACE ACTIVITY................... NONE. FOUND BY DRILLING
WELL DEPTHS (M)................... 1292
MAXIMUM WELL TEMP (C).............. 156 AT DEPTH (M) 430
ROCK TYPES: ALLUVIUM AND TERTIARY BASALT
GEOPHYSICS: GRAVITY, MAGNETIC, AMT, TEMPERATURE SURVEY

CHEMISTRY
SAMPLE SOURCE............. MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>S102</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>170</td>
<td>108</td>
<td>1.7</td>
<td>1480</td>
<td>42</td>
<td>90</td>
<td></td>
<td>190</td>
<td>2200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.0</td>
<td>15</td>
<td>7.57</td>
<td>~3.14</td>
<td>~12.36</td>
<td>~110.2</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Minimum (I)</th>
<th>Maximum (K)</th>
<th>Most Likely (C)</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>73</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adiabatic</td>
<td>159</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>169</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>146</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>119</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td>46</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>191</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Step Steam Loss</td>
<td>177</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Steam Loss</td>
<td>179</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum (I)</th>
<th>Maximum (K)</th>
<th>Most Likely (C)</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>140 (I)</td>
<td>177 (K)</td>
<td>159 (C)</td>
<td>159</td>
<td>8</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgment on temperature.

- A) Quartz Conductive
- B) Quartz Conductive, PH-corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K-CA
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (Km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4</td>
<td>2.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thickness (Km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Subsurface Area (Km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>66</td>
<td>26</td>
<td>35.3</td>
<td>11.1</td>
</tr>
</tbody>
</table>

Based on shallow temperature survey.

### Volumetric (Km³)

<table>
<thead>
<tr>
<th>Volumetric (Km³)</th>
<th>58.9</th>
<th>Std. Dev. = 21.8</th>
</tr>
</thead>
</table>

### Thermal Energy (10²⁴ J)

<table>
<thead>
<tr>
<th>Thermal Energy (10²⁴ J)</th>
<th>22.84</th>
<th>Std. Dev. = 8.56</th>
</tr>
</thead>
</table>

Comments: Well data from the O'Neill-Oliphant Reynolds #1 geothermal test well.

References: Mariner and Others, 1974; 1975; Willden and Speed, 1974; Morrison, 1964; Olmsted and Others, 1975; Renner and Others, 1976

Compiled by: Mariner, R.

Stillwater Area, Nevada
FIELD NAME................. FERNLEY AREA
KGRA OR OTHER NAME........ BRADY-HAZEN KGRA
CIRCULAR REFERENCE........ 146

GEOGRAPHIC LOCALITY
STATE..................... NEVADA
COUNTY.................... LYON
LATITUDE.................. 39-35.9 N
LONGITUDE................. 119-06.4 W
MAPS...................... TWO TIPS 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
20N 26E 18 SE MT. DIABLO

GENERAL INFORMATION
ELEVATION (M).................. 1241
NO. OF WELLS.................... 3
WELL DEPTHS (M).................. 91 TO 229
MAXIMUM WELL TEMP (C)............ 132
ROCK TYPES: ALLUVIUM OVERLYING TERTIARY BASALT, ANDESITE, AND TUFFACEOUS SEDIMENTARY ROCKS

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1975

TEMP(C) SI02 CA MG NA K HC03 CO3 SO4 CL
86 150 70 1.5 620 38 100 400 820

F 0 PH DEL O (18) SO4 DEL O (18) H20 DEL D H20
4.2 5.6 7.05 -5.61 -13.30 -121.5
**GEOTHERMOMETERS (C)**

**CATION**

- NA-K-CA (1/3) .......... 166
- NA-K-CA (4/3) .......... 145
- NA-K- ................. 133

**SILICA**

- ADIABATIC .............. 153
- CONDUCTIVE ............ 161
- CHALCEDONY ............ 137
- CRISTOBALITE .......... 111
- UPSAL ................. 39

**SULFATE**

- CONDUCTIVE ............ 220
- ONE-STEP STEAM LOSS ... 196
- CONTINUOUS STEAM LOSS . 202

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>161 (A)</td>
<td>220 (K)</td>
<td>166 (I)</td>
<td>182</td>
<td>13</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

**DEPTH TO TOP (KM)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

**THICKNESS (KM)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**SUBSURFACE AREA (KM**^2**)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate.

**VOLUME (KM**^3**)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>STD, DEV, = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THERMAL ENERGY (10**^18** J)**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,51</td>
<td>STD, DEV. = 0.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REFERENCES:** Mariner and Others, 1975

Compiled by: Mariner, R.

Fernley Area, Nevada
FIELD NAME................ BRADY HOT SPRINGS
KGRA OR OTHER NAME........ BRADY-HAZEN KGRA
CIRCULAR REFERENCE........ 147

GEOGRAPHIC LOCALITY
STATE..................... NEVADA
COUNTY.................... CHURCHILL
LATITUDE.................. 39-47.2 N
LONGITUDE............... 119-00.0 W
MAPS..................... FIRE BALL RIDGE 162, 500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
22N 26E 12 Sw MT, DIABLO

GENERAL INFORMATION
WARING FIGURE...................... 8
WARING NUMBER...................... 72
ELEVATION (M)...................... 1256
SURFACE ACTIVITY.................... FUMAROLE
ASSOCIATED DEPOSITS................. SINTER, TRAVERTINE
NO. OF WELLS....................... MORE THAN 13
WELL DEPTHS (M).................... 73 TO 2219
MAXIMUM WELL TEMP (C)............. 214
ROCK TYPES: PLEISTOCENE BASALT QUATERNARY ALLUVIUM
GEOPHYSICS: HEAT FLOW, GRAVITY, MAGNETICS

CHEMISTRY
SAMPLE SOURCE.... USGS FILE DATA

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SO4</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>52</td>
<td>0.4</td>
<td>100</td>
<td>40</td>
<td>102</td>
<td>270</td>
<td>1400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F  4.7  8  PH  6.99 AT 16 DEG C
DEL 0(18) SO4  DEL 0(18) H20  DEL 0 H20
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3).......... 246
NA-K-CA (4/3).......... 129
NA-K.................. 434

SILICA
ADIABATIC............ 153
CONDUCTIVE........... 161
CHALCEDONY.......... 117
CHRISTOBALITE...... 111
OPAL.................. 39

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
MINIMUM 140
MAXIMUM 170
MOST LIKELY 155
MEAN 155
STD. DEV. 6

SUBSURFACE AREA (KM²)
MINIMUM 0.3
MAXIMUM 1.5
MOST LIKELY 1.0
MEAN 1.7
STD. DEV. 0.3

VOLUME (KM³)........... 21.7
STD. DEV. = 11.1

THERMAL ENERGY (10⁸ J) 8.19
STD. DEV. = 4.22

COMMENTS: HOT SPRINGS BECAME INACTIVE AFTER SEVERAL GEOTHERMAL WELLS WERE DRILLED IN THE EARLY 1960'S.

REFERENCES: OLMSTEAD AND OTHERS, 1975; GARSIDE, 1974

COMPILER: MARINEH, R. AND BROOK, C.

HEAVY HOT SPRINGS, NEVADA
FIELD NAME: DESERT PEAK AREA
KGRA OR OTHER NAME: BRADY-HAZEN KGRA
CIRCULAR REFERENCE: 148

GEORGE LOCALITY
STATE: NEVADA
COUNTY: CHURCHILL
LATITUDE: 39-45.7 N
LONGITUDE: 118-57.0 W
MAPS: DESERT PEAK 1:62,500

TOWNSHIP RANGE SECTION
22N 27E 21 NE OF NE
BASE & MERIDIAN
MT. DIABLO

GENERAL INFORMATION
ELEVATION (M): 1403
SURFACE ACTIVITY: NONE, FOUND BY DRILLING
NO. OF WELLS: 3
WELL DEPTHS (M): 10 TO 2337
ROCK TYPES: TERTIARY ANDESITE, BASALT, SILICEOUS ASH FLOW TUFFS, AND JURASSIC METAVOLCANICS

CHEMISTRY
SAMPLE SOURCE: BENoit, 1978

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>440</td>
<td>90</td>
<td>1.0</td>
<td>2000</td>
<td>240</td>
<td>43</td>
<td></td>
<td>90</td>
<td>3600</td>
</tr>
</tbody>
</table>

F B PH DEL 0(18) S04 DEL 0(18) H20 DEL 0 H2O
-5.26 -12.52
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>225</th>
<th>269</th>
<th>206</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>217</th>
<th>241</th>
<th>231</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>229</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>195</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>116</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th>206</th>
<th>211</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-step steam loss</td>
<td>206</td>
<td></td>
</tr>
<tr>
<td>Continuous steam loss</td>
<td>211</td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>208 (M)</td>
<td>229 (K)</td>
<td>225 (I)</td>
<td>221</td>
<td>5</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Thickness (km)          | 1.0     | 2.7     | 1.5         | 1.7  | 0.4       |

| Subsurface Area (km²)   | 10      | 50      | 30          | 30.0 | 8.2       |

Based on: Geologic Inference

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>52.0</th>
<th>Std. Dev. = 10.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10³ J)</td>
<td>28.88</td>
<td>Std. Dev. = 10.01</td>
</tr>
</tbody>
</table>

Comments: Wells B 21-2 (200 C) and B 21-1 (208 C) are both capable of total flow of over 204,300 kg/hr.

Chemically very different from Huddy Hot Springs! Reservoir developer thinks the heat comes from deep circulation. Thickness estimates based on well data.

References: Henoit, 1978

Compiled by: Marinem, R.

Desert Peak Area, Nevada
FIELD NAME................ DIXIE HOT SPRINGS
KGRA OR OTHER NAME........ DIXIE VALLEY KGRA
CIRCULAR REFERENCE........ 149

GEOGRAPHIC LOCALITY
STATE..................... NEVADA
COUNTY.................... CHURCHILL
LATITUDE.................. 39-47.9 N
LONGITUDE............... 118-04.0 W
MAPS...................... DIXIE HOT SPRINGS 1:62,500

TOWNSHIP   RANGE   SECTION   BASE & MERIDIAN
22N       35E       05 SE   MT. DIABLO

GENERAL INFORMATION
WARING FIGURE................... 8
WARING NUMBER.................... 71A
ELEVATION (M).................... 1045
SURFACE ACTIVITY............... HOT SPRINGS AND SEEPS
DISCHARGE (L/MIN)... SEVERAL 100
ROCK TYPES: QUATERNARY ALLUVIUM! TERTIARY VOLCANIC ROCKS! MESOZOIC INTRUSIVE
GEOPHYSICS: GRAVITY, MAGNETIC, AMT, SEISMIC REFRACTION

CHEMISTRY
SAMPLE SOURCE,..., MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SIO2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>115</td>
<td>3.6</td>
<td>0.02</td>
<td>190</td>
<td>6.5</td>
<td>111</td>
<td>11</td>
<td>111</td>
<td>126</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>S04</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1</td>
<td>0.89</td>
<td>8.60</td>
<td>-2.09</td>
<td>-15.89</td>
<td>-126.1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>Component</th>
<th>Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
<td>Adiabatic</td>
<td>139</td>
</tr>
<tr>
<td></td>
<td>Conductive</td>
<td>145</td>
</tr>
<tr>
<td></td>
<td>Chalcedony</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td>Cristobalite</td>
<td>95</td>
</tr>
<tr>
<td></td>
<td>Opal</td>
<td>24</td>
</tr>
<tr>
<td>Sulfate</td>
<td>Conductive</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>One-Step Steam Loss</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Continuous Steam Loss</td>
<td>121</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>127 (K)</td>
<td>145 (A)</td>
<td>145 (A)</td>
<td>139</td>
<td>4</td>
</tr>
<tr>
<td>Uncoded Temperature indicates subjective judgement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz conductive A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz conductive, PH-corrected B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz adiabatic C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony D)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony, PH-corrected E)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quartz, PH-corrected F)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K G)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K, Ca (1/3)</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K, Ca (4/3)</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### References

- Mariner and Others, 1974a, 19751 Pag, 19651 Waring, 19651 RENNER AND OTHERS, 19761 THOMPSON AND OTHERS, 19671 USGS File Data

Compiled by: Mariner, R.

Dixie Hot Springs, Nevada
FIELD NAME: COLADO AREA
CIRCULAR REFERENCE: 150

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: PERSHING
LATITUDE: 40°14.9' N
LONGITUDE: 118°24.7' W
MAPS: CREAN 1162500; LOVELock 1162500

TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
28N  32E  33 SE  MT. DIABLO

GENERAL INFORMATION
ELEVATION (M): 1231
SURFACE ACTIVITY: NONE
NO. OF SPRINGS: NONE
NO. OF WELLS: 2
ROCK TYPES: PLAYA DEPOSITS OVERLYING TERTIARY RHYOLITE AND MESOZOIC SEDIMENTS
GEOPHYSICS: GRAVITY, MAGNETIC

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. USGS FILE DATA
COLLECTION DATE: 1976/07/27

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>S102</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>85</td>
<td>110</td>
<td>6.5</td>
<td>1450</td>
<td>120</td>
<td>199</td>
<td>120</td>
<td>2400</td>
<td></td>
</tr>
</tbody>
</table>

F  pH  PH DEL 0(18)  S04  DEL 0(18) H2O  DEL 0 H2O
4.6 8.7 7.56 AT 38 DEG C
### Geothermometers (°C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>194</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>205</td>
</tr>
<tr>
<td>Na-K</td>
<td>163</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>125</td>
</tr>
<tr>
<td>Conductive</td>
<td>128</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>101</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>78</td>
</tr>
<tr>
<td>Opal</td>
<td>9</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>61 (M)</td>
<td>128 (A)</td>
<td>101 (D)</td>
<td>97</td>
<td>14</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz conductive  
B) Quartz conductive, pH-corrected  
C) Quartz adiabatic  
D) Chalcedony  
E) Chalcedony, pH-corrected  
F) Cristobalite  
G) Amorphous silica  
H) Na-K  
I) Na-K-CA  
J) Na-K-CA, Mg-corrected  
K) Sulfate geothermometer  
L) Surface temperature  
M) Well temperature  
N) Mixing model  
O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>Thickness (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (KM**2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Volume (KM**3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10**18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.24</td>
</tr>
</tbody>
</table>

Comments: Magnesium corrected Na-K-CA geothermometer indicates 160 deg C1 mixing possible! Wells are adjacent to the Colado Kgra and have pumped discharge rates of several thousand L/m.

References: Stewart and Carlson, 1974.
FIELD NAME: HUMBOLDT HOUSE
CIRCULAR REFERENCE: 151

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: PERSHING
LATITUDE: 40-32.1 N
LONGITUDE: 118-16.1 W
MAPS: LOVELOCK 1:250,000

TOWNSHIP 31N
RANGE 33E
SECTION 21 SE OF NE MT. DIABLO

GENERAL INFORMATION
ELEVATION (M): 1375
SURFACE ACTIVITY: THERMAL WATER DISCHARGING FROM A SULPHUR EXPLORATION WELL
ASSOCIATED DEPOSITS: SULFUR, TRAVERTINE, AND SINTER(?)
NO. OF WELLS: 3
ROCK TYPES: PLAYA DEPOSITS OVERLYING TRIASSIC CARBONATES(?)
GEOPHYSICS: GRAVITY, MAGNETIC

CHEMISTRY
SAMPLE SOURCE: PHILLIPS-CAMPBELL E-1, USGS FILE DATA
COLLECTION DATE: 1978/06/22

<table>
<thead>
<tr>
<th></th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiling</td>
<td>340</td>
<td>43</td>
<td>3.6</td>
<td>1350</td>
<td>230</td>
<td>202</td>
<td>18</td>
<td>2230</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th>DEL 0(18)</th>
<th>S04</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL 0 H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>6.2</td>
<td></td>
<td></td>
<td>-4.57</td>
<td>-14.89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

| CATION | NA-K-CA (1/1) | 249 |
|        | NA-K-CA (4/3) | 295 |
|        | NA-K          | 256 |

| SILICA | ADOABATIC         | 200 |
|        | CONDUCTIVE        | 219 |
|        | CHALCEDONY        | 205 |
|        | CHALCEDONY, PH-CORRECTED | 172 |
|        | CRISTOBALITE      | 172 |
|        | OPAL              | 94  |

| SULFATE | CONDUCTIVE        | 172 |
|         | ONE-STEP STEAM LOSS | 162 |
|         | CONTINUOUS STEAM LOSS | 164 |

RESERVOIR PROPERTIES

- SUBSURFACE TEMP (C)
  - MINIMUM: 172 (K)
  - MAXIMUM: 249 (I)
  - MOST LIKELY: 230 (J)
  - MEAN: 217
  - STD. DEV.: 16

- UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
  - A) QUARTZ CONDUCTIVE
  - B) QUARTZ CONDUCTIVE, PH-CORRECTED
  - C) QUARTZ ADIABATIC
  - D) CHALCEDONY
  - E) CHALCEDONY, PH-CORRECTED
  - F) CRISTOBALITE
  - G) AMORPHOUS SILICA
  - H) NA-K
  - I) NA-K-CA
  - J) NA-K-CA, MG-CORRECTED
  - K) SULFATE GEOTHERMOMETER
  - L) SURFACE TEMPERATURE
  - M) WELL TEMPERATURE
  - N) MIXING MODEL
  - O) RENNER AND OTHERS, 1976

- DEPTH TO TOP (KM)
  - MINIMUM: 0.5
  - MAXIMUM: 2
  - MOST LIKELY: 1.5
  - MEAN: 1.7
  - STD. DEV.: 0.3

- THICKNESS (KM)
  - MINIMUM: 1.0
  - MAXIMUM: 2.5
  - MOST LIKELY: 1.5
  - MEAN: 2.0
  - STD. DEV.: 0.4

- SUBSURFACE AREA (KM**2)
  - MINIMUM: 3
  - MAXIMUM: 2
  - MOST LIKELY: 2
  - MEAN: 2.0
  - STD. DEV.: 0.4

- VOLUME (KM**3)
  - MINIMUM: 3.3
  - MAXIMUM: 3.3
  - MOST LIKELY: 3.3
  - MEAN: 3.3
  - STD. DEV.: 0.9

- THERMAL ENERGY (10**18 J)
  - MINIMUM: 1.62
  - MAXIMUM: 1.62
  - MOST LIKELY: 1.62
  - MEAN: 1.62
  - STD. DEV.: 0.53

COMMENTS: CHEMICAL ANALYSIS FROM TOTAL-FLOW SAMPLE. THE OTHER DEEP EXPLORATION WELL WAS DRILLED BY UNION OIL CO. IN NE NE SEC. 3, T.31N., R. 33E.

REFERENCES: USGS, UNPUBL. DATA

COMPILED BY: BROOK, C. AND MARINER, R.

HUMBOLDT HOUSE, NEVADA
FIELD NAME................ KYLE HOT SPRINGS
KGRA OR OTHER NAME........ KYLE HOT SPRINGS KGRA
CIRCULAR REFERENCE....... 152

GEOGRAPHIC LOCALITY
STATE..................... NEVADA
COUNTY.................... PERSHING
LATITUDE.................. 40-24.4 N
LONGITUDE................ 117-52.9 W
MAPS...................... KYLE HOT SPRINGS 1162.500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
29N 36E 01 SW MT. DIABLO

GENERAL INFORMATION
WARING FIGURE...................... e
WARING NUMBER...................... 66
ELEVATION (M)..................... 1390
SURFACE ACTIVITY.............. HOT SPRING AND SEEPS
ASSOCIATED DEPOSITS.. SINTER
NO. OF SPRINGS............... SEVERAL
SPRING TEMPERATURES (C)..... 38 TO 77
DISCHARGE (L/MIN).............. 20
ROCK TYPES: QUATERNARY ALLUVIUM AND PALEOZOIC METAMORPHIC ROCKS
GEOPHYSICS: GRAVITY, MAGNETIC, HEAT FLOW, RESISTIVITY, SP, TELLURIC

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>S102</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>77</td>
<td>150</td>
<td>95</td>
<td>25.5</td>
<td>540</td>
<td>80</td>
<td>544</td>
<td>51</td>
<td>770</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>R</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H20</th>
<th>DEL 0 H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7</td>
<td>3.8</td>
<td>6.50</td>
<td>-3.93</td>
<td>-15.50</td>
<td>-130.0</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA</td>
<td>211</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>169</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>235</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SILICA

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>153</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>161</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPAL</td>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SULFATE

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td>154</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td>146</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SURFACE TEMP (C)</td>
<td>154 (K)</td>
<td>161 (A)</td>
<td>161 (A)</td>
<td>159</td>
<td>2</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CHRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>2</td>
<td>16</td>
<td>5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

VOLUME (KM³)........... 12.8  STD. DEV. = 5.6
THERMAL ENERGY(10¹ºJ) | 4,96 | STD. DEV. = 2.19

COMMENTS: MG-CORRECTED NA-K-CA GEOTHERMOMETER INDICATES 75 CI LOW FLOW RATE MAY HAVE PERMITTED EXTENSIVE NEAR-SURFACE REACTION WITH THE COUNTRY ROCK.


COMPILED BY: MARINEK, R.

KYLE HOT SPRINGS, NEVADA
FIELD NAME................ SOU (GILBERT'S) HOT SPRINGS
KGRA OR OTHER NAME........ DIXIE VALLEY KGRA
CIRCULAR REFERENCE........ 153

GEOGRAPHIC LOCALITY
STATE..................... NEVADA
COUNTY.................... PERSHING
LATITUDE.................. 40.054 N
LONGITUDE................ 117.435 W
MAPS...................... CAIN MNT, 1162,500

GENERAL INFORMATION
WARING FIGURE...................... 8
WARING NUMBER...................... 68
ELEVATION (M)..................... 1122
SURFACE ACTIVITY................... HOT SPRINGS
ASSOCIATED DEPOSITS................ TRAVERTINE
NO. OF SPRINGS..................... SEVERAL
ROCK TYPES: QUATERNARY ALLUVIUM, TERTIARY FLOWS AND VOLCANIC RELATED SEDIMENTS

CHEMISTRY
SAMPLE SOURCE...... MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>65</td>
<td>110</td>
<td>22</td>
<td>165</td>
<td>26</td>
<td>312</td>
<td>370</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

F   PH
8.1 8.1

DEL O(18) SO4  DEL O(18) H2O  DEL D H2O
GEOTHERMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>189</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>244</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>113</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>64</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>79 (J)</td>
<td>114 (A)</td>
<td>86 (D)</td>
<td>93</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>1.5</td>
<td>1.5</td>
<td>1.7</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.5</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM*2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (KM*3)............ 3.3

THERMAL ENERGY (10^18 J) 0.70

REFERENCES:
- Mariner and Others, 1974
- Waring, 1965
- Tatlock, 1969
- RENNER AND OTHERS, 1976

COMPILED BY: Mariner, R.

504 (GILBERT'S) HOT SPRINGS, NEVADA.
FIELD NAME................. LEACH HOT SPRINGS
KGRA OR OTHER NAME........ LEACH HOT SPRINGS KGRA
CIRCULAR REFERENCE.......... 154

GEOGRAPHIC LOCALITY
STATE..................... NEVADA
COUNTY.................... PERSHING
LATITUDE.................. 40-36.2 N
LONGITUDE.................. 117-38.7 W
MAPS...................... LEACH HOT SPRINGS 1/62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
32N 33W 36 SE MT. DIABLO

GENERAL INFORMATION
WARING FIGURE.............. B
WARING NUMBER................ 64
ELEVATION (M).............. 1421
SURFACE ACTIVITY........... HOT SPRINGS
ASSOCIATED DEPOSITS........ SINTER AND TUFA
NO. OF SPRINGS............ 30
SPRING TEMPERATURES (C)..... 34 TO 95
DISCHARGE (L/MIN).......... 690

ROCK TYPES: QUaternary alluvium, Tertiary sedimentary rocks, basalt of unknown age, Paleozoic rock

GEOPHYSICS: HEAT FLOW

CHEMISTRY
SAMPLE SOURCE..... MARINER AND OTHERS, 1974, 1975
COLLECTION DATE.... 1972/00/00

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>135</td>
<td>8.8</td>
<td>0.5</td>
<td>160</td>
<td>16</td>
<td>366</td>
<td>1</td>
<td>53</td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>pH</th>
<th>DEL O(18)</th>
<th>SO4</th>
<th>DEL O(18)</th>
<th>H2O</th>
<th>DEL O H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.0</td>
<td>1.2</td>
<td>7.40</td>
<td>-5.22</td>
<td>-15.70</td>
<td>-120.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) .......... 176
- NA-K-CA (4/3) .......... 139
- NA-K .......... 161

SILICA
- ADIABATIC .......... 147
- CONDUCTIVE .......... 155
- CHALCEDONY .......... 130
- CRISTOBALITE .......... 104
- OPAL .......... 33

SULFATE
- CONDUCTIVE .......... 170
- ONE-STEP STEAM LOSS... 159
- CONTINUOUS STEAM LOSS.. 161

RESEVOIR PROPERTIES

SUBSURFACE TEMP (C)

| MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV.
|---------|---------|-------------|------|-----------
| 155 (A) | 170 (K) | 160 (J)     | 162  | 3         |

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM) 0.5
THICKNESS (KM) 1.0
SUBSURFACE AREA (KM**2) 3.5

VOLUME (KM**3) .......... 9.7
THERMAL ENERGY (10**18 J) 3.85

COMMENTS: DIFFERENCES IN SURFACE TEMPERATURES ARE APPARENTLY RELATED TO THE FLOW RATES.

REFERENCES: MARINER AND OTHERS, 1974; 1975; OLSTED AND OTHERS, 1975; WARING, 1965; SASS AND OTHERS, 1977

COMPILED BY: MARINER, R.

LEACH HOT SPRINGS, NEVADA
FIELD NAME................ GOLCONDA HOT SPRINGS
CIRCULAR REFERENCE........ 195

GEOGRAPHIC LOCALITY
STATE...................... NEVADA
COUNTY..................... HUMBOLDT
LATITUDE.................. 40°57'7" N
LONGITUDE................. 117°29'6" W
MAPS....................... GOLCONDA 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J6N 40E 29 SE MT. OIAHLO

GENERAL INFORMATION
WAKING FIGURE................. 8
WAKING NUMBER.................. 19
ELEVATION (M).................. 1329
SURFACE ACTIVITY............... HOT SPRINGS
ASSOCIATED DEPOSITS............. TRAVERTINE
NO. OF SPRINGS................ 12
SPRING TEMPERATURES (°C)........ 49° TO 74
DISCHARGE (L/MIN)............. 750

ROCK TYPES: QUATERNARY ALLUVIUM CAMBRIAN QUARTZITE TERTIARY VOLCANIC ROCKS

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>66</td>
<td>33</td>
<td>6.8</td>
<td>130</td>
<td>22</td>
<td>429</td>
<td></td>
<td>56</td>
<td>18</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>1.1</td>
<td>6.53</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| F         | 8    | PH  |     |     |    |      |     |     |     |
| 1.8       | 1.1  | 6.53|     |     |    |      |     |     |     |
| F         |      |     |     |     |    |      |     |     |     |
| 1.8       | 1.1  | 6.53|     |     |    |      |     |     |     |
GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td></td>
<td></td>
<td>201</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td></td>
<td></td>
<td>121</td>
</tr>
<tr>
<td>Na-K</td>
<td></td>
<td></td>
<td>255</td>
</tr>
</tbody>
</table>

SILICA

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td></td>
<td></td>
<td>114</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td></td>
<td></td>
<td>115</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td></td>
<td></td>
<td>86</td>
</tr>
<tr>
<td>CHISTOADAL</td>
<td></td>
<td></td>
<td>65</td>
</tr>
<tr>
<td>OPAL</td>
<td></td>
<td></td>
<td>-2</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>86 (D+I)</td>
<td></td>
<td></td>
<td>115 (A)</td>
<td>86 (D+I)</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE  F) CRISTOBALITE  K) SULFATE GEOTHERMOMETER
B) QUARTZ/CONDUCTIVE, PH-CORRECTED  G) AMORPHOUS SILICA  L) SURFACE TEMPERATURE
C) QUARTZ ADIABATIC  H) NA-K  M) WELL TEMPERATURE
D) CHALCEDONY  I) NA-K-CA  N) MIXING MODEL
E) CHALCEDONY, PH-CORRECTED  J) NA-K-CA, MG-CORRECTED  O) RENNER AND OTHERS, 1976

MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV. |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BETA: STANDARD ESTIMATE

VOLUME (KM^3)........... 3.3  STD. DEV. = 0.9
THERMAL ENERGY (10^8J) 0.73  STD. DEV. = 0.21

REFERENCES: MARINER AND OTHERS, 1974; 1975; WARING, 1965; WILLDEN, 1964; ERICKSON AND MARSH, 1974; RENNER AND OTHERS, 1976

COMPILLED BY: MARINER, R,
GOLCONDA HOT SPRINGS, NEVADA
FIELD NAME................ HOT POT (BLOSSUM HOT SPRINGS)
CIRCULAR REFERENCE........ 156

GEOGRAPHIC LOCALITY
STATE........................ NEVADA
COUNTY....................... HUMBOLDT
LATITUDE.................... 40-55.3 N
LONGITUDE................... 117-06.5 W
MAPS......................... HOT POT 1124+000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J3N 43E 11 SW MT. DIABLO

GENERAL INFORMATION
WAKING FIGURE............... 8
WAKING NUMBER............... 19
ELEVATION (M)............... 1353
SURFACE ACTIVITY............. HOT SPRING
NO. OF SPRINGS............... 1
DISCHARGE (L/MIN)............ 265
ROCK TYPES: QUATERNARY ALLUVIUM, TERTIARY BASALT(?), AND CAMBRIAN QUARTZITE

CHEMISTRY
SAMPLE SOURCE.............. MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>58</td>
<td>80</td>
<td>29</td>
<td>5</td>
<td>288</td>
<td>33</td>
<td>823</td>
<td></td>
<td>60</td>
<td>28</td>
</tr>
</tbody>
</table>

F 3 PH 8.0 DEL 0(18) S04 DEL 0(18) H2O DEL D H2O
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3) .......... 194
- NA-K-CA (4/3) .......... 154
- NA-K ...................... 200

**SILICA**
- ADIAHATIC .................. 122
- CONDUCTIVE ................ 125
- CHALCEDONY ................ 97
- CHRISTOBALITE .............. 74
- OPAL ......................... 6

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>97 (D)</td>
<td>125 (A)</td>
<td>114 (J)</td>
<td>112</td>
<td>6</td>
</tr>
</tbody>
</table>

**Unconed temperature indicates subjective judgement**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIAHATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

**Based on standard estimate**

| VOLUME (KM³) | 3.3      | STD. DEV. = 0.9 |
| THERMAL ENERGY(10**18 J) | 0.87  | STD. DEV. = 0.25 |

**REFERENCES:** MARINER AND OTHERS, 1974A; 1975; WILDEIN, 1964; HOSE AND TAYLOR, 1974

**Compiled by:** MARINER, R.

HOT POT (BLOSSOM HOT SPRINGS) ; NEVADA
FIELD NAME.................. HOT SPRINGS RANCH
CIRCULAR REFERENCE........ 157

GEOGRAPHIC LOCALITY
STATE...................... NEVADA
COUNTY..................... HUMBOLDT
LATITUDE................... 40°45.7' N
LONGITUDE................... 117°29.5' W
MAPS........................ EONA MTN. 1162+500

TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
J3N  40E  05  SE  MT. DIABLO

GENERAL INFORMATION
ELEVATION (M)...................... 1475
SURFACE ACTIVITY................... HOT SPRINGS
ASSOCIATED DEPOSITS................ MINOR TRAVERTINE
NO. OF WELLS....................... 1
WELL DEPTHS (M).................... 937
ROCK TYPES: CAMBRIAN PHYLITIC SHALE

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS: 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>125</td>
<td>16</td>
<td>0.9</td>
<td>200</td>
<td>18</td>
<td>385</td>
<td>140</td>
<td>41</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.40</td>
<td></td>
<td>-15.74</td>
<td>-131.4</td>
<td></td>
</tr>
</tbody>
</table>
### GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3) .......... 180
- NA-K-CA (4/3) .......... 139
- NA-K .......... 172

**SILICA**
- ADIABATIC .......... 143
- CONDUCTIVE .......... 150
- CHALCEDONY .......... 125
- CRISTOBALITE .......... 100
- UPAL .......... 29

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>125 (D)</td>
<td>160 (J)</td>
<td>150 (A)</td>
<td>145</td>
<td>7</td>
</tr>
</tbody>
</table>

### UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT
- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

### PHYSICAL PROPERTIES

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |

| SUBSURFACE AREA (KM²) | 1  | 3  | 2  | 2.0 | 0.4 |

### VOLUME (KM³)

| VOLUME (KM³) | 3.3 |

### THERMAL ENERGY (10¹⁸ J)

| THERMAL ENERGY | 1.17 | STD. DEV. = 0.33 |

**COMMENTS:** SPRING WATER SUPERSATURATED WITH RESPECT TO CALCITE.

**REFERENCES:** MARINER AND OTHERS, 1974A; 1975I; WILDDEN, 1964

**COMPiled by:** MARINER, R.

**HOT SPRINGS RANCH, NEVADA**
FIELD NAME: BUFFALO VALLEY HOT SPRINGS

CIRCULAR REFERENCE: 158

GEOPHYSICAL LOCALITY
STATE: NEVADA
COUNTY: LANDER
LATITUDE: 40°22'1" N
LONGITUDE: 117°19'1" W
MAPS: BUFFALO SPRINGS 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
29N 41E 23 SE MT. OIABLO

GENERAL INFORMATION
WADING FIGURE: 6
WADING NUMBER: 78
ELEVATION (M): 1405
SURFACE ACTIVITY: HOT SPRINGS AND SEEPS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 100 TO 200
SPRING TEMPERATURES (C): AMBIENT TO 79
DISCHARGE (L/MIN): 36

ROCK TYPES: QUATERNARY ALLUVIUM QUATERNARY BASALT TERTIARY TUFF

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>Si02</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>80</td>
<td>45</td>
<td>4.9</td>
<td>250</td>
<td>34</td>
<td>811</td>
<td>110</td>
<td>29</td>
<td></td>
</tr>
</tbody>
</table>

F: 4.8
PH: 2.3
C: 6.53
DEL C(18): 504
DEL C(18) H2O: -15.85
DEL C H2O: -131.6
### GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>197</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>140</td>
</tr>
<tr>
<td>Na-K</td>
<td>223</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>122</td>
</tr>
<tr>
<td>Conductive</td>
<td>125</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>97</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>74</td>
</tr>
<tr>
<td>Opal</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>140</td>
</tr>
<tr>
<td>One-step steam loss</td>
<td>128</td>
</tr>
<tr>
<td>Continuous steam loss</td>
<td>130</td>
</tr>
</tbody>
</table>

### RESERVOIR PROPERTIES

#### Subsurface Temp (°C)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>97 (D)</td>
<td>140 (K)</td>
<td>135 (J)</td>
<td>124</td>
<td>10</td>
</tr>
</tbody>
</table>

*Uncoded temperature indicates subjective judgement*

#### Temperature Indicators

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>3.4</td>
<td>1.0</td>
</tr>
</tbody>
</table>

### Subsurface Area (km^2)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>6</td>
<td>3</td>
<td>5.7</td>
<td>2.0</td>
</tr>
</tbody>
</table>

### Thermal Energy (10^18 J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.67</td>
<td>1.0</td>
<td>0.60</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Comments

- Low flow rate!
- Geothermometers are semi-quantitative at best, Na-K-CA geothermometer relatively insensitive to loss of calcium.

### References

- Mariner and Others, 1974a, 1975b
- Olmsted and Others, 1975
- Waring, 1965
- Stewart and McKee, 1970

Compiled by: Mariner, R.

Buffalo Valley Hot Springs, Nevada
FIELD NAME: SMITH CREEK VALLEY AREA
CIRCULAR REFERENCE: 159

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: LANDER
LATITUDE: 39°18.7' N
LONGITUDE: 117°32.5' W
MAPS: MILLETT 1:250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
17N 39E 11 MT, DIABLO

GENERAL INFORMATION
WAKING FIGURE: 8
WAKING NUMBER: 84?
ELEVATION (M): 1859
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: SEVERAL
DISCHARGE (L/MIN): 75
ROCK TYPES: QUATERNARY ALLUVIUM, TERTIARY (OLIGOCENE-MIOCENE) ASH-FLOW RHYOLITE

CHEMISTRY
FLOW (L/MIN): 25

TEMP(C)  SI02  CA   MG   NA   K   HC03  C03   S04  CL
86     110  4.8  0.06 170  8.4 246   5  102  22

F   B   PH   DEL 0(18) S04  DEL 0(18) H20  DEL D H20
8.9  0.66 7.12  -4.06  -16.48  -130.4
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td></td>
<td></td>
<td></td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td></td>
<td></td>
<td></td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
<td>114</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td></td>
<td></td>
<td></td>
<td>137</td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td></td>
<td></td>
<td></td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td></td>
<td></td>
<td></td>
<td>116</td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td></td>
<td></td>
<td></td>
<td>92</td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDUCTIVE</td>
<td></td>
<td></td>
<td></td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>UNSTEP STEAM LOSS</td>
<td></td>
<td></td>
<td></td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS</td>
<td></td>
<td></td>
<td></td>
<td>137</td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>116 (0)</td>
<td>156 (1)</td>
<td>143 (A-K)</td>
<td>138</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON: STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>VOLUME (KM³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10⁸*18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.32</td>
</tr>
</tbody>
</table>


COMPILED BY: MARINER, R.

SMITH CREEK VALLEY AREA, NEVADA
FIELD NAME: SPENCER HOT SPRINGS
CIRCULAR REFERENCE: 160

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: LANDER
LATITUDE: 39°19.5' N
LONGITUDE: 116°51.5' W
MAPS: SPENCER HOT SPRINGS 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: B3
ELEVATION (M): 1731
SURFACE ACTIVITY: HOT SPRINGS AND ARTESIAN WELLS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: SEVERAL
DISCHARGE (L/MIN): 50
ROCK TYPES: QUATERNARY ALLUVIUM, TERTIARY ASH-FLOW TUFF, JURASSIC GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>72</td>
<td>77</td>
<td>4.3</td>
<td>9.4</td>
<td>200</td>
<td>36</td>
<td>672</td>
<td>51</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>H</td>
<td>PH</td>
<td></td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H2O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.7</td>
<td>2.6</td>
<td>6.50</td>
<td></td>
<td>-16.01</td>
<td>-135.8</td>
<td>-16.01</td>
<td>-135.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>210</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>265</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SILICA

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>121</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>123</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>95</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>72</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

MINIMUM | MAXIMUM | MOST LIKELY | MEAN | STD. DEV.
---|---|---|---|---|
SUBLABORACE TEMP (C) | 68 (J) | 123 (A) | 95 (D) | 102 | 8

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A) QUARTZ CONDUCTIVE</td>
<td>F) CRISTOBALITE</td>
<td>K) SULFATE GEOTHERMOMETER</td>
<td>L) SURFACE TEMPERATURE</td>
<td>M) WELL TEMPERATURE</td>
<td>N) MIXING MODEL</td>
</tr>
<tr>
<td>B) QUARTZ CONDUCTIVE, PH-CORRECTED</td>
<td>G) AMORPHOUS SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C) QUARTZ ADIABATIC</td>
<td>H) NA-K-CA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D) CHALCEDONY</td>
<td>I) NA-K-CA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E) CHALCEDONY, PH-CORRECTED</td>
<td>J) NA-K-CA, MG-CORRECTED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DEPTH TO TOP (KM) |_minimum_ | _maximum_ | _most likely_ | _mean_ | _STD. DEV._
---|---|---|---|---|---|
0.5 | 2.0 | 1.5 | 1.7 | 0.3 |
THICKNESS (KM) | 1.0 | 2.5 | 1.5 |
SUBSURFACE AREA (KM**2) | 3 | 2 |

VOLUME (KM**3) | 3.3 | STD. DEV. = 0.9 |
THERMAL ENERGY (10**18 J) | 0.78 | STD. DEV. = 0.23 |


COMPILED BY: MARINER, R.

SPENCER HOT SPRINGS, NEVADA
FIELD NAME: DAROUGH HOT SPRINGS
KGRA OR OTHER NAME: DAROUGH HOT SPRINGS KGRA
CIRCULAR REFERENCE: 161

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: NYE
LATITUDE: 38-49.3 N
LONGITUDE: 117-10.8 W
MAPS: TONOPAH 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
11N 43E 8 MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 118
ELEVATION (M): 1707
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: MINOR TRAVERTINE
NO. OF SPRINGS: SEVERAL
DISCHARGE (L/MIN): SEVERAL 100
NO. OF WELLS: 1
WELL DEPTHS (M): 278
MAXIMUM WELL TEMP (C): 129 AT DEPTH (M) 278(?)
RACK TYPES: QUATERNARY ALLUVIUM, PALEozoic RHYOLITE
GEOPHYSICS: GRAVITY, MAGNETIC, AMT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>C03</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td>98</td>
<td>1.3</td>
<td>0.1</td>
<td>110</td>
<td>2.6</td>
<td>146</td>
<td>3</td>
<td>53</td>
<td>12</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>0.22</td>
<td>8.30</td>
<td>DEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL 0</td>
<td>H20</td>
</tr>
<tr>
<td>14</td>
<td>-15.50</td>
<td>-122.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C) 
CAFION 
NA-K-CA (1/3) ............ 126 
NA-K-CA (4/3) ............ 119 
NA-K ..................... 61 
SILICA 
ADIAVATIC ............... 132 
CONDUCTIVE ............ 136 
CHALCEDONY ............. 109 
CRISTOHALITE .......... 85 
OPAL ................... 16

RESERVOIR PROPERTIES 
MINIMUM 129 (M) 
MAXIMUM 136 (A) 
MOST LIKELY 132 (C) 
MEAN 132 
STD. DEV. 1

RECODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE 
B) QUARTZ CONDUCTIVE, PH-CORRECTED 
C) QUARTZ ADIABATIC 
D) CHALCEDONY 
E) CHALCEDONY, PH-CORRECTED 
F) CRISTOHALITE 
G) AMORPHOUS SILICA 
H) NA-K 
I) NA-K-CA 
J) NA-K-CA, Mg-CORRECTED 
K) SULFATE GEOTHERMOMETER 
L) SURFACE TEMPERATURE 
M) WELL TEMPERATURE 
N) MIXING MODEL 
O) RENNER AND OTHERS, 1976

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE 
B) QUARTZ CONDUCTIVE, PH-CORRECTED 
C) QUARTZ ADIABATIC 
D) CHALCEDONY 
E) CHALCEDONY, PH-CORRECTED 
F) CRISTOHALITE 
G) AMORPHOUS SILICA 
H) NA-K 
I) NA-K-CA 
J) NA-K-CA, Mg-CORRECTED 
K) SULFATE GEOTHERMOMETER 
L) SURFACE TEMPERATURE 
M) WELL TEMPERATURE 
N) MIXING MODEL 
O) RENNER AND OTHERS, 1976

DEPTII TO TOP (KM) 
MINIMUM 0.3 
MAXIMUM 2.0 
MOST LIKELY 1.5 
MEAN 1.7 
STD. DEV. 0.4

THICKNESS (KM) 
MINIMUM 1.0 
MAXIMUM 2.7 
MOST LIKELY 1.5 
MEAN 1.7 
STD. DEV. 0.4

SUHSSURFACE AREA (KM**2) 
MINIMUM 2 
MAXIMUM 20 
MOST LIKELY 3 
MEAN 6.3 
STD. DEV. 4.1

VOLUME (KM**3) .......... 14.4 
STD. DEV. = 7.9

THERMAL ENERGY (10**18 J) 4.58 
STD. DEV. = 2.50

COMMENTS: BOILING WELI FLOWS AT 4300 L/MIN.

REFERENCES: MARINER AND OTHERS, 1974A; 1975; WARING, 1965; KLEINHAMPL AND ZIONY, 1967; GARSDIE, 1974; USGS FILE DATA

COMPILED BY: MARINER, R.

DARROUGH HOT SPRINGS, NEVADA
FIELD NAME: BEOWAWE HOT SPRINGS (ABANDONED STEAM WELL)
KGRA OR OTHER NAME: BEOWAWE KGRA
CIRCULAR REFERENCE: 162

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: EUREKA
LATITUDE: 40-34.2 N
LONGITUDE: 116-34.8 W
MAPS: DUNPHY 1612,500
TOWNSHIP: 31N
RANGE: 48E
SECTION: 17 NW
BASE & MERIDIAN: MOUNT DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 38
ELEVATION (M): 1524
ASSOCIATED DEPOSITS: SINTER, HOT SPRINGS, GEYSER, FUMAROLE
NO. OF WELLS: 12
WELL DEPTHS (M): 72 TO 2917
MAXIMUM WELL TEMP (C): 211 AT DEPTH (M) 2917
ROCK TYPES: QUATERNARY ALLUVIUM, MIocene BASALT AND ANDESITE
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, SP, SEISMIC GROUND NOISE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOILING</td>
<td>500</td>
<td>1.3</td>
<td>0.2</td>
<td>250</td>
<td>30</td>
<td>505</td>
<td>81</td>
<td>64</td>
<td>70</td>
</tr>
<tr>
<td>F</td>
<td>18</td>
<td>2.5</td>
<td>9.38</td>
<td>-10.01</td>
<td>-14.76</td>
<td>-130.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

- NA-K-CA (1/3)............. 242
- NA-K-CA (4/3)............. 292
- NA-K..................... 239

SILICA

- ADIABATIC................. 226
- CONDUCTIVE............... 252
- CHALCEDONY............... 245
- CRISTOBALITE.............. 207
- OPAL...................... 128

SULFATE

- CONDUCTIVE............... 295

ONE-STEP STEAM LOSS.... 251
CONTINUOUS STEAM LOSS.. 264

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.9</td>
<td>1.4</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.1</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>4</td>
<td>8</td>
<td>5.3</td>
<td>0.9</td>
</tr>
<tr>
<td>VOLUME (KM**3)</td>
<td>8.2</td>
<td>STD. DEV. = 1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY(10**18 J)</td>
<td>4.73</td>
<td>STD. DEV. = 1.11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

COMMENTS: MINIMUM TEMPERATURE WAS MEASURED IN A 2917 M WELL (M. LANE, PERSONAL COMMUN., 1978). ANALYSIS FROM STEAM WELL ISOTOPIC DATA FROM SPRING, DEPTH TO RESERVOIR AND THICKNESS BASED ON DRILL DATA.


COMPILED BY: MARINER, R. AND BROOK, C.

REOWAWE HOT SPRINGS (ABANDONED STEAM WELL), NEVADA
FIELD NAME: HOT SPRINGS POINT
KGMA OR OTHER NAME: HOT SPRINGS POINT KGRA
CIRCULAR REFERENCE: 163

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: EUREKA
LATITUDE: 40°24.2' N
LONGITUDE: 116°31.0' W
MAPS: CRESCENT VALLEY 1:62,500

TOWNship RANGE SECTION BASE & MERIDIAN
29N 48E 11 NE MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: a
WARING NUMBER: eaA
ELEVATION (M): 1442
SURFACE ACTIVITY: HOT SPRINGS, POOLS, AND SEEPS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 2
NO. OF WELLS: 1
WELL DEPTHS (M): 125
MAXIMUM WELL TEMP (°C): 74
ROCK TYPES: MIocene AND PIocene BASALTS, ORDOVICIAN CHERTS AND QUARTZITE

GEOPHYSICS: GRAVITY

CHEMISTRY
SAMPLE SOURCE: MARİNER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>S</th>
<th>02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>67</td>
<td>53</td>
<td>35</td>
<td>230</td>
<td>58</td>
<td>913</td>
<td>7.0</td>
<td>1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.6</td>
<td>2.1</td>
<td>6.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DEL 0(18) S04</td>
<td>DEL 0(18) H20</td>
<td>DEL D H20</td>
<td></td>
</tr>
</tbody>
</table>

F: 6.6  PH: 2.1  DEL 0(18) S04: ~15.97  DEL 0(18) H20: ~136.1
GEOTHERMOMETERS (C)

CATION

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>233</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>158</td>
</tr>
<tr>
<td>Na-K</td>
<td>325</td>
</tr>
</tbody>
</table>

SILICA

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>115</td>
</tr>
<tr>
<td>Conductive</td>
<td>158</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>65</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>87</td>
</tr>
<tr>
<td>Opal</td>
<td>-2</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>74 (H)</td>
<td>116 (A)</td>
<td>87 (D)</td>
<td>92</td>
<td>9</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive      F) Cristobalite
B) Quartz Conductive, pH-Corrected G) Amorphous Silica
C) Quartz Adiabatic       H) Na-K
D) Chalcedony             I) Na-K-CA
E) Chalcedony, pH-Corrected J) Na-K-CA, Mg-Corrected

K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

DEPTH TO TOP (KM)        0.5       2.0       1.5
THICKNESS (KM)           1.0       2.5       1.5
SUBSURFACE AREA (KM**2)  1         3         2
Based on Standard Estimate

VOLUME (KM**3)           3.3       STD. DEV. = 0.9
THERMAL ENERGY (10**18 J) 0.70      STD. DEV. = 0.21

COMMENTS: MG-Corrected Na-K-CA Geothermometer indicates a temperature less than the surface temperature. High Mg concentration may result from extensive water-rock reaction at or near the surface.

REFERENCES: Marinier and Others, 1974, 1975; Gilluly and Gates, 1965

Compiled by: Marinier, R.

HOT SPRINGS POINT, NEVADA
FIELD NAME: HOT SULPHUR SPRINGS (TUSSCARORA)
CIRCULAR REFERENCE: 164

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: ELKO
LATITUDE: 41-28'.2 N
LONGITUDE: 116-09'.0 W
MAPS: TUSCARORA 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
41N 52E 08 SE OF NE MT, DIABLO

GENERAL INFORMATION
ELEVATION (M): 1768
SURFACE ACTIVITY: HOT SPRINGS
ROCK TYPES: TERTIARY LACUSTRINE ROCKS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974
COLLECTION DATE: 1972/00/00

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>165</td>
<td>12</td>
<td>0.3</td>
<td>160</td>
<td>16</td>
<td>345</td>
<td>61</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1.2</td>
<td>7.3</td>
<td>DEL 0 (18)</td>
<td>S04</td>
<td>DEL 0 (18)</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.2</td>
<td>7.3</td>
<td>DEL 0</td>
<td>S04</td>
<td>DEL 0</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>165</td>
<td>12</td>
<td>0.3</td>
<td>160</td>
<td>16</td>
<td>345</td>
<td>61</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1.2</td>
<td>7.3</td>
<td>DEL 0 (18)</td>
<td>S04</td>
<td>DEL 0 (18)</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.2</td>
<td>7.3</td>
<td>DEL 0</td>
<td>S04</td>
<td>DEL 0</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td>CATION</td>
<td>MIN</td>
<td>MAX</td>
<td>MOST LIKELY</td>
<td>MEAN</td>
<td>STD. DEV.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------</td>
<td>-----</td>
<td>-----</td>
<td>-------------</td>
<td>------</td>
<td>-----------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-Ca (1/2)</td>
<td>184</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-Ca (1/2)</td>
<td>139</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>184</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>MIN</th>
<th>MAX</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>167</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>144 (D)</td>
<td>167 (A)</td>
<td>184 (I)</td>
<td>165</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Quartz Conductive</td>
</tr>
<tr>
<td>B) Quartz Conductive, PH-Corrected</td>
</tr>
<tr>
<td>C) Quartz Adiabatic</td>
</tr>
<tr>
<td>D) Chalcedony</td>
</tr>
<tr>
<td>E) Chalcedony, PH-Corrected</td>
</tr>
<tr>
<td>F) Cristobalite</td>
</tr>
<tr>
<td>G) Amorphous Silica</td>
</tr>
<tr>
<td>H) Na-K</td>
</tr>
<tr>
<td>I) Na-K-CA</td>
</tr>
<tr>
<td>J) Na-K-CA, MG-Corrected</td>
</tr>
<tr>
<td>K) Sulfate Geothermometer</td>
</tr>
<tr>
<td>L) Surface Temperature</td>
</tr>
<tr>
<td>M) Well Temperature</td>
</tr>
<tr>
<td>N) Mixing Model</td>
</tr>
<tr>
<td>O) Renner and Others, 1976</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 2.0     | 2.5     | 1.5         | 2.0  | 0.4       |

| S UBSURFACE AREA (KM^2) | 3.0 | 2.0 | 2.0 | 0.4 |

| VOLUME (KM^3)        | 3.3 | STD. DEV. = 0.9 |
| THERMAL ENERGY (10^18 J) | 1.35 | STD. DEV. = 0.39 |

REFERENCES: Marinier and Others, 1975; Hose and Taylor, 1974; Granger and Others, 1957; Renner and Others, 1976

Compiled by: Marinier, R.

HOT SULPHUR SPRINGS (TUSCARORA) • NEVADA
FIELD NAME................ CARLIN AREA
CIRCULAR REFERENCE........ 165

GEOGRAPHIC LOCALITY
STATE........................ NEVADA
COUNTY....................... ELKO
LATITUDE.................... 40-42.0 N
LONGITUDE.................... 116-08.0 W
MAPS........................ CARLIN 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J3N 52E 33 MT. DIABLO

GENERAL INFORMATION
ELEVATION (M).................. 1500
SURFACE ACTIVITY.............. HOT SPRINGS
ROCK TYPES: QUATERNARY ALLUVIUM; TERTIARY VOLCANIC ROCKS

CHEMISTRY
SAMPLE SOURCE..... MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP(\degree C)</th>
<th>Si02</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td>70</td>
<td>60</td>
<td>15</td>
<td>45</td>
<td>16</td>
<td>335</td>
<td>52</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.60</td>
<td></td>
<td>-16.64</td>
<td>-132.7</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- Na-K-Ca (1/3)............. 218
- Na-K-Ca (4/3)............. 81
- Na-K..................... 403

SILICA
- Adiabatic.................. 117
- Conductive.................. 118
- Chalcedony............... 90
- Cristobalite............. 68
- Opal........................ 0

RESEVOIR PROPERTIES

SUBSURFACE TEMP (C)
- MINIMUM 81 (I)
- MAXIMUM 118 (A)
- MOST LIKELY 90 (O)

 UNCoded TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-Ca
J) Na-K-Ca, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

VOLUME (KM^3)............. 3.3
THERMAL ENERGY(10^18 J) 0.73

COMMENTS: PH NOT DETERMINED IN THE FIELD.


COMPILED BY: MAHINEH, R.

CARLIN AREA, NEVADA
**FIELD NAME**............. HOT HOLE (ELKO HOT SPRINGS)
**KGRA OR OTHER NAME**........ ELKO HOT SPRINGS KGRA
**CIRCULAR REFERENCE**........ 166

**GEOGRAPHIC LOCALITY**
- **STATE**............. NEVADA
- **COUNTY**............. ELKO
- **LATITUDE**............. 40-49.1 N
- **LONGITUDE**............. 115-46.5 W
- **MAPS**............. ELKO WEST 1124,000

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**
- **J4N**
- **SSE**
- **21 NE**
- **MT. DIABLO**

**GENERAL INFORMATION**
- **WARING FIGURE**.............. 8
- **WARING NUMBER**.............. 32
- **ELEVATION (M)**.............. 1542
- **SURFACE ACTIVITY**........... HOT SPRING
- **ASSOCIATED DEPOSITS**........ TRAVERTINE
- **ROCK TYPES**................. TERTIARY LIMESTONE, VOLCANIC AND LACUSTRINE ROCKS

**CHEMISTRY**
- **SAMPLE SOURCE**........... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>65</td>
<td>60</td>
<td>15.5</td>
<td>120</td>
<td>39</td>
<td>488</td>
<td>1</td>
<td>72</td>
<td>16</td>
</tr>
<tr>
<td>F</td>
<td>H</td>
<td>pH</td>
<td>DEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td>1.9</td>
<td>0.70</td>
<td>7.21</td>
<td>DEL 0(18)</td>
<td>S04</td>
<td>DEL 0(18)</td>
<td>H2O</td>
<td>DEL 0</td>
<td>H2O</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-15.31</td>
<td></td>
<td>-144.7</td>
<td></td>
</tr>
</tbody>
</table>
### GEOTHERMOMETERS (C)

**CATION**
- Na-K-CA (1/3): 234
- Na-K-CA (4/3): 127
- Na-K: 381

**SILICA**
- Adiabatic: 113
- Conductive: 114
- Chalcedony: 86
- Cristobalite: 64
- Opal: 16

### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Temp (°C)</td>
<td>88 (J)</td>
<td>114 (A)</td>
<td>86 (D)</td>
<td>93</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT**

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth To Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3.3</td>
</tr>
</tbody>
</table>

**VOLUME (km³) **: 3.3

**THERMAL ENERGY (10^12 B J)**: 0.70

**REFERENCES:**
1. Marinier and Others, 1974
2. 1975
3. Waring, 1965
4. Granger and Others, 1957
5. Renner and Others, 1976

**COMPILED BY:** Marinier, R.

**HOT HOLE (ELKO HOT SPRINGS) - NEVADA**
FIELD NAME........................ MINERAL (SAN JACINTO) HOT SPRINGS
CIRCULAR REFERENCE............ 167

GEOGRAPHIC LOCALITY
STATE.............................. NEVADA
COUNTY.............................. ELKO
LATITUDE.......................... 41°47.3 N
LONGITUDE......................... 114°43.3 W
MAPS............................... DELEPLAIN 162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
45N 64E 16 MT. DIABLO

GENERAL INFORMATION
WARMING FIGURE...................... 8
WARMING NUMBER..................... 22B
ELEVATION (M)........................ 1615
SURFACE ACTIVITY.................... HOT SPRINGS
NO. OF SPRINGS....................... SEVERAL SPRINGS
SPRING TEMPERATURES (C)............ 25 TO 60
DISCHARGE (L/MIN)................... 4500
NO. OF WELLS........................ SEVERAL SHALLOW WELLS
ROCK TYPES: TEERTIARY LACUSTRINE SEDIMENTS, VOLCANIC FLOWS, AND GRANITE(?)

CHEMISTRY
SAMPLE SOURCE.................... MARINER AND OTHERS, 1974
FLOW (L/MIN)....................... 4500

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>83</td>
<td>1.6</td>
<td>0.01</td>
<td>75</td>
<td>2.2</td>
<td>108</td>
<td>45</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

8.9 0.47 9.1

F
DEL O(18) S04
DEL O(18) H2O
DEL O H2O
### Geothermometers (°C)

**CATION**
- NA-K-CA (1/3).............. 129
- NA-K-CA (4/3).............. 102
- NA-K......................... 75

**SILICA**
- ADIABATIC..................... 124
- CONDUCTIVE..................... 127
- CHALCEDONY..................... 99
- CRISTOBALITE..................... 76
- OPAL........................... 8

### Reservoir Properties

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>100 (A+I)</td>
<td>128 (A+I)</td>
<td>100 (A+I)</td>
<td>109</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz conductive
B) Quartz conductive, pH-corrected
C) Quartz adiabatic
D) Chalcedony
E) Chalcedony, pH-corrected
F) Cristobalite
G) Amorphous silica
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-corrected
K) Sulfate geothermometer
L) Surface temperature
M) Well temperature
N) Mixing model
O) Renner and others, 1976

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Based on standard estimate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Volume (km³)................. 3.3
- Std. Dev. = 0.9
- Thermal energy (10¹⁸ J) | 0.85
- Std. Dev. = 0.25

**References:** Marinier and others, 1974; Granger and others, 1957; Renner and others, 1976

Compiled by: Marinier, R.

**Mineral (San Jacinto) Hot Springs, Nevada**
FIELD NAME: HOT SULPHUR SPRINGS (SULPHUR SPRINGS)
CIRCULAR REFERENCE: 168

GEOGRAPHIC LOCALITY
STATE: NEVADA
COUNTY: ELKO
LATITUDE: 41°09.4' N
LONGITUDE: 114°59.1' W
MAPS: OXLEY PEAK 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
JAN 62E 20 SE OF SE MT. DIABLO

GENERAL INFORMATION
WARING FIGURE: 8
WARING NUMBER: 30
ELEVATION (M): 1743
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: SEVERAL
ROCK TYPES: TERTIARY VOLCANIC ROCKS OVERLYING PALEOZOIC LIMESTONE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974-1975

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>86</td>
<td>48</td>
<td>13</td>
<td>370</td>
<td>46</td>
<td>1230</td>
<td>12</td>
<td>37</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>BE</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.4</td>
<td>0.73</td>
<td>6.60</td>
<td>-16.95</td>
<td>-136.6</td>
<td></td>
</tr>
</tbody>
</table>
## GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>199</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>158</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>211</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## SULFURIC ACID

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>126</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## CONDUCTIVE

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>179</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## CHALCEDONY

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## CRISTOBALITE

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## OPAL

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 (J)</td>
<td>129 (A)</td>
<td>102 (D)</td>
<td>105</td>
<td>9</td>
</tr>
</tbody>
</table>

### UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELT TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

### DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### THICKNESS (KM)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### SUBSURFACE AREA (KM²)

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### BASED ON SPRING DISTRIBUTION

<table>
<thead>
<tr>
<th>VOLUME (KM³)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### THERMAL ENERGY (10¹⁸ J)

<table>
<thead>
<tr>
<th>THERMAL ENERGY</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### COMMENTS:

An analysis with higher silica concentration is not used because it contains twice as much magnesium.

### REFERENCES:

- MARINER AND OTHERS, 1974A, 1975
- WARING, 1965
- GRANGER AND OTHERS, 1957

### COMPILED BY:

- MARINER, R.

## HOT SULPHUR SPRINGS (SULPHUR SPRINGS), NEVADA
FIELD NAME................ SULPHUR HOT SPRINGS (HOT SULPHUR SPRINGS)
KGRA OR OTHER NAME........ RUBY VALLEY KGRA
CIRCULAR REFERENCE........ 169

GEOGRAPHIC LOCALITY
STATE...................... NEVADA
COUNTY...................... ELKO
LATITUDE.................. 40°35.2' N
LONGITUDE................. 115°17.1' W
MAPS......................... LAMOILLE 1162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J1N 59E 11 NW MT. DIABLO

GENERAL INFORMATION
ELEVATION (M)............... 1844
SURFACE ACTIVITY............. HOT SPRINGS
ASSOCIATED DEPOSITS.......... SINTER
NO. OF SPRINGS............... 101
SPRING TEMPERATURES (C)...... 45° TO 95°
DISCHARGE (L/MIN)............ 500
ROCK TYPES: QUATERNARY ALLUVIUM, MESOZOIC GRANITE, OLDER METAMORPHICS
GEOPHYSICS: AMT, GRAVITY, MAGNETIC, TELLURIC, TEMPERATURE SURVEY

CHEMISTRY
SAMPLE SOURCE........ MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>93</td>
<td>210</td>
<td>1.0</td>
<td>0.03</td>
<td>135</td>
<td>8.9</td>
<td>244</td>
<td>15</td>
<td>40</td>
<td>23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>R</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H20</th>
<th>DEL D H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.7</td>
<td>0.20</td>
<td>8.53</td>
<td>-5.05</td>
<td>-16.09</td>
<td>-130.1</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

**CATION**
- NA-K-CA (1/3) ............... 181
- NA-K-CA (4/3) ............... 190
- NA-K .................................. 140

**SILICA**
- ADIABATIC ......................... 171
- CONDUCTIVE ....................... 183
- CHALCEDONY ....................... 163
- CHRISTOBALITE ................... 134
- OPAL .................................. 59

**SULFATE**
- CONDUCTIVE ....................... 161
- ONE-STEP STEAM LOSS .......... 153
- CONTINUOUS STEAM LOSS ....... 154

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>VOLUME (KM**3)</td>
<td>7.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>THERMAL ENERGY(10**18 J)</td>
<td>3.43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

**COMMENTS**

SULFATE-ISOTOPE TEMPERATURE (150 DEG C) MAY BE DUE IN PART TO THE OXIDATION OF SULFIDE TO SULFATE AT THE SURFACE.

**REFERENCES**

MARINER AND OTHERS, 1974, 1975
OLMSTED AND OTHERS, 1975
GRANGER AND OTHERS, 1957
RENNER AND OTHERS, 1976

**COMPILED BY**

MARINER, R.

SULPHUR HOT SPRINGS (HOT SULPHUR SPRINGS) - NEVADA
FIELD NAME: CHERRY CREEK AREA
CIRCULAR REFERENCE: 170

### GEOGRAPHIC LOCALITY
- **STATE**: NEVADA
- **COUNTY**: WHITE PINE
- **LATITUDE**: 39-51.0 N
- **LONGITUDE**: 114-54.3 W
- **MAPS**: ELY 11250 x 000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
- **23N**
- **63E**
- **06**

### GENERAL INFORMATION
- **WARMING FIGURE**: 8
- **WARMING NUMBER**: 957
- **ELEVATION (M)**: 1859
- **SURFACE ACTIVITY**: HOT SPRINGS
- **NO. OF SPRINGS**: SEVERAL
- **ROCK TYPES**: TERTIARY GRANITE

### CHEMISTRY
- **SAMPLE SOURCE**: MARINER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>105</td>
<td>0.3</td>
<td>150</td>
<td>4.8</td>
<td>380</td>
<td>1</td>
<td></td>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>DEL (18) SO4</th>
<th>DEL (18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>7.77</td>
<td>-16.20</td>
<td>-127.8</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Minimum</th>
<th>Maximum (A)</th>
<th>Most Likely (D)</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>128</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>81</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHI STOYHALITE</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UPAL</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Surface Temp (C)</th>
<th>Minimum</th>
<th>Maximum (A)</th>
<th>Most Likely (D)</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMS</td>
<td></td>
<td>90 (1)</td>
<td>140 (A)</td>
<td>114 (D)</td>
<td>115</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>Depth To Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sumsurface Area (km²)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

BASED ON STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10⁻¹⁸ J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:  MARINER AND OTHERS, 1975

COMPILED BY:  MARINER, R.

CHERRY CREEK AREA, NEVADA
New Mexico
FIELD NAME.................. VALLES CALDEMA
KGRA OR OTHER NAME........ BACA LOCATION NO. 1 KGRA
CIRCULAR REFERENCE....... 171

GEOGRAPHIC LOCALITY
STATE....................... NEW MEXICO
COUNTY...................... SANDOVAL
LATITUDE................... 35-54.0 N
LONGITUDE.................. 106-32.0 W
MAPS....................... VALLE SAN ANTONIO 1:24,000; JEMEZ SPRINGS 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
20N 03E 35 NEW MEXICO

GENERAL INFORMATION
WARING FIGURE..................... 2
WARING NUMBER..................... 11, 12
ELEVATION (M)..................... 2650
SURFACF ACTIVITY.................. HOT SPRINGS, FUMAROLES
NO. OF SPRINGS..................... SEVERAL IN 3 GROUPS
SPRING TEMPERATURES (C)............. 25 TO 87
DISCHARGE (L/MIN).................. GT 2080
NO. OF WELLS....................... 17
WELL DEPTHS (M).................... 800 TO 2745
MAXIMUM WELL TEMP (C)............. 332 AT DEPTH (M) 1500
ROCK TYPES: RHYOLITE FLOWS AND TUFFS AND ANDESITE OVERLYING (?) SANDSTONES AND LIMESTONES
GEOPHYSICS: REGIONAL AEROMAGNETIC AND GRAVITY
### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean (°C)</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>250</td>
<td>290</td>
<td>278</td>
<td>273</td>
<td>8</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

- A) Quartz Conductive
- B) Quartz Conductive, Ph-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, Ph-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Additional Data

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean (m)</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.4</td>
<td>1.5</td>
<td>1.0</td>
<td>1.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>25</td>
<td>160</td>
<td>40</td>
<td>75.0</td>
<td>30.2</td>
</tr>
</tbody>
</table>

Based on: Well Distribution, Geology, Aeromagnetic Survey

### Volume (km³)

- Quantity: 125.0
- Std. Dev. = 56.3

### Thermal Energy (10¹⁸ J)

- Quantity: 86.96
- Std. Dev. = 39.29

**Comments:** One group of acid-sulfate springs; extensive hydrothermal alteration, and associated gas seeps in southwest quadrant of Pleistocene Caldera. Vapor-dominated areas of limited extent locally overlie hot-water reservoir; a 50 MW generating plant is planned.

**References:**
- Waring, 1965
- Summers, 1965
- B. Smith and Others, 1970
- Lambert, 1976
- Cordell, 1976
- R. L. Smith, Personal Comm., 1978
- Dondanville, 1978

**Compiled By:** Brook, C.

Valles Caldera, New Mexico
FIELD NAME: JEMEZ SPRINGS (OJOS CALIENTES)
CIRCULAR REFERENCE: 172

GEOGRAPHIC LOCALITY
STATE: NEW MEXICO
COUNTY: SANDOVAL
LATITUDE: 35°46.3' N
LONGITUDE: 106°41.4' W
MAPS: JEMEZ SPRINGS 1:24,000

TOWNSHI NP | RANGE | SECTION | BASE & MERIDIAN
---------- | ------ | -------- | -----------------
1 MN | 02E | 23 | NEW MEXICO

GENERAL INFORMATION
WAKING FIGURE: 2
WAKING NUMBER: 15
ELEVATION (M): 1091
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 10
SPRING TEMPERATURES (C): 34° TO 76° C
DISCHARGE (L/MIN): 756
ROCK TYPES: ALLUVIUM OVERLYING LIMESTONE

CHEMISTRY
SAMPLE SOURCE: TRAINER, 1974 USGS FILE DATA
FLOW (L/MIN): 4.9
COLLECTION DATE: 1972/12/02

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>SI04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td>79</td>
<td>130</td>
<td>4.8</td>
<td>640</td>
<td>82</td>
<td>732</td>
<td>1.5</td>
<td>53</td>
<td>920</td>
</tr>
</tbody>
</table>

F: 4 | PH: 7.4 | DEL 0(18) SI04 | DEL 0(18) H2O |
4.8 | 7.4 | 6.3 | -10.52 | -82.1
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ........ 202
NA-K-CA (4/3) .......... 163
NA-K .................. 215

SILICA
ADIABATIC ............... 122
CONDUCTIVE ............. 124
CHALCEDONY ............. 96
CHISTHOTHALITE ........... 74
OPAL .................... 6

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>96 (D)</td>
<td>124 (A)</td>
<td>96 (D)</td>
<td>105</td>
<td>7</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT
A) QUARTZ CONDUCTIVE  F) CRISTOBALITE  K) SULFATE GEOTHERMOMETER
B) QUARTZ CONDUCTIVE, PH-CORRECTED  G) AMORPHOUS SILICA  L) SURFACE TEMPERATURE
C) QUARTZ ADIAHATIC  H) NA-K  M) WELL TEMPERATURE
D) CHALCEDONY  I) NA-K-CA  N) MIXING MODEL
E) CHALCEDONY, PH-CORRECTED  J) NA-K-CA, MG-CORRECTED  O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)  THICKNESS (KM)  SUBSURFACE AREA (KM²)
MINIMUM  0.5  1.0  1
MAXIMUM  2.0  2.5  2
MOST LIKELY  1.5  1.5  2
MEAN  1.7  1.7  2.0
STD. DEV.  0.3  0.4

VOLUME (KM³)  THERMAL ENERGY (10^18 J)
MINIMUM  1.3  0.81
STD. DEV. = 0.9  STD. DEV. = 0.24

COMMENTS: MAY BE DEPOSITING CALCITE IN THE SUBSURFACE. WARING (1965) REPORTS 50 SPRINGS IN 2 GROUPS. WATER MAY BE DERIVED IN PART FROM RESERVOIR BENEATH VALLES CALDERA.

REFERENCES: WARING, 1965; SUMMERS, 1965A; TRAINER, 1974; SMITH AND OTHERS, 1970

COMPILED BY: BROOK, C.

JEMEZ SPRINGS (OJOS CALIENTES), NEW MEXICO
FIELD NAME: SPENCE SPRING
KGRA OR OTHER NAME: BACA LOCATION NO. 1 KGRA
CIRCULAR REFERENCE: 173

GEOGRAPHIC LOCALITY
STATE: NEW MEXICO
COUNTY: SANDOVAL
LATITUDE: 35-51.0 N
LONGITUDE: 106-37.8 W
MAPS: JEMEZ SPRINGS 1162500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
19N 03E 28 NW NEW MEXICO

GENERAL INFORMATION
ELEVATION (M): 2237
SURFACE ACTIVITY: HOT SPRING
NO. OF SPRINGS: 1
SPRING TEMPERATURES (C): 41
DISCHARGE (L/MIN): 167
ROCK TYPES: RHYOLITE OVERLYING SANDSTONE AND LIMESTONE

CHEMISTRY
SAMPLE SOURCE: TRAINER, 19741 USGS FILE DATA
FLOW (L/MIN): 167
COLLECTION DATE: 1972/12/01

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>100</td>
<td>6.0</td>
<td>1.7</td>
<td>55</td>
<td>1.8</td>
<td>144</td>
<td>1.0</td>
<td>18</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>SO4</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7</td>
<td>0.07</td>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
<td>-11.89</td>
<td></td>
<td>-86.8</td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>120</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>63</td>
</tr>
<tr>
<td>Na-K</td>
<td>82</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>137</td>
</tr>
<tr>
<td>Conductive</td>
<td>137</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>110</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>87</td>
</tr>
<tr>
<td>Opal</td>
<td>17</td>
</tr>
</tbody>
</table>

**Reservoir Properties**

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>63</td>
<td>137 (A)</td>
<td>110 (D)</td>
<td>103</td>
<td>15</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km**2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>Volume (km**3)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>3.3</td>
<td>STD. DEV. = 0.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10**18 J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.79</td>
<td>STD. DEV. = 0.26</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**References:** Smith and others, 1970; Trainer, 1974

Compiled by: Brook, C.

Spence Spring, New Mexico
FIELD NAME: SAN FRANCISCO (LOWER FRISCO) HOT SPRINGS  
KGRA OR OTHER NAME: LOWER FRISCO HOT SPRINGS KGRA  
CIRCULAR REFERENCE: 174

GEOGRAPHIC LOCALITY

STATE: NEW MEXICO  
COUNTY: CATRON  
LATITUDE: 33-14.7 N  
LONGITUDE: 108-52.8 W  
MAPS: WILSON MOUNTAIN 124000

TOWNSHIP: 17S  
RANGE: 20W  
SECTION: 23  
BASE & MERIDIAN: NEW MEXICO

GENERAL INFORMATION

WAKING FIGURE: 2  
WAKING NUMBER: 25  
ELEVATION (M): 1390  
SURFACE ACTIVITY: HOT SPRINGS  
NO. OF SPRINGS: 8  
SPRING TEMPERATURES (C): 37  
DISCHARGE (L/MIN): LT 50  
ROCK TYPES: TERTIARY BASALT  
GEOPHYSICS: GRAVITY

CHEMISTRY

SAMPLE SOURCE: MARINER AND OTHERS, 1977

| TEMP (°C) | S04 | CA | Mg | Na | K | HC03 | C03 | S04 | CL | F | R | pH | DEL O(18) S04 | DEL O(18) H20 | DEL D H20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | 39 | 84 | 46 | 6.2 | 270 | 15 | 121 | 430 | 1.4 | 0.26 | 7.35 | DEL O(18) S04 | -10.44 | -78.6 |
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-Ca (1/3)</td>
<td>151</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-Ca (4/3)</td>
<td>106</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>124</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>128</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>77</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>99 (D,J)</td>
<td>128 (A)</td>
<td>99 (D,J)</td>
<td>109</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz conductive
B) Quartz conductive, ph-corrected
C) Quartz adiabatic
D) Chalcedony
E) Chalcedony, ph-corrected
F) Cristobalite
G) Amorphous silica
H) Na-K
I) Na-K-Ca
J) Na-K-Ca, Mg-corrected
K) Sulfate geothermometer
L) Surface temperature
M) Well temperature
N) Mixing model
O) Renner and Others, 1976

### Subsurface Properties

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
</tr>
</tbody>
</table>

### Volume (km³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

### Thermal Energy

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.04</td>
<td></td>
<td></td>
<td>0.24</td>
</tr>
</tbody>
</table>

### Comments

Small springs and seeps are scattered for 2 km along the San Francisco River.

### References

- Waring, 1965
- Summers, 1965
- Mant AMERIAN AND OTHERS, 1977
- Ramberg AND OTHERS, 1978

Compiled by: Brook, C.

San Francisco (Lower Frisco) Hot Springs, New Mexico
**FIELD NAME:** Radium Hot Springs  
**KURHA ON OTHER NAME:** Radium Springs KGRA  
**CIRCULAR REFERENCE:** 175  

**GEOGRAPHIC LOCALITY**  
STATE: New Mexico  
COUNTY: Dona Ana  
LATITUDE: 37°30.0' N  
LONGITUDE: 106°55.5' W  
MAPS: San Diego Mountain 1162500  

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**  
21S 01W 10 NW OF NE New Mexico  

**GENERAL INFORMATION**  
WARING FIGURE: 2  
WARING NUMBER: 3b  
ELEVATION (M): 1220  
SURFACE ACTIVITY: Extinct Hot Springs  
ASSOCIATED DEPOSITS: Travertine  
NO. OF WELLS: 1  
ROCK TYPES: Sandstone and Limestone  
GEOPHYSICS: Resistivity, Gravity  

**CHEMISTRY**  
SAMPLE SOURCE: Mariner and Others, 1977  

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>52.0</td>
<td>78</td>
<td>120</td>
<td>15</td>
<td>1100</td>
<td>160</td>
<td>414</td>
<td>260</td>
<td>1650</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>DEL 0(18)</th>
<th>DEL 0(18)</th>
<th>DEL D H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>0.68</td>
<td>-9.06</td>
<td>-74.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ............. 222
NA-K-CA (4/3) ............ 213
NA-K .................. 232
SILICA
ADIAHATIC ............ 121
CONDUCTIVE ............. 124
CHALCEDONY ............. 96
CHRISTOHALITE ........... 73
OPAL ................... 5

RESEVOIR PROPERTIES
SUBSURFACE TEMP (C) 74 (M) 124 (A) 96 (D) 98 10

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIAHATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) PENNER AND OTHERS, 1976

DEPTH TO FOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM**2) 1 3 2 2.0 0.4

BETWEEN STANDARD ESTIMATE AND IN PART RESISTIVITY

VOLUME (KM**3) 3.3 STD. DEV. = 0.9
THERMAL ENERGY (10**18 J) 0.75 STD. DEV. = 0.23

COMMENTS: WARING (1965) REPORTS 2 SPRINGS WITH TEMPERATURES OF 74 AND 85 C. MARINER AND OTHERS (1977) REPORT THAT ORIGINAL SPRINGS ARE DRY. TEMPERATURE AND CHEMICAL ANALYSIS FROM PUMPED WELL. SPRING WATER SUPERNATURAL WITH CALCITE NA-K-CA GEOTHERMOMETER UNRELIABLE.


COMPILED BY: BROOK, C.

RADIIUM HOT SPRINGS, NEW MEXICO
FIELD NAME................ LIGHTNING DOCK AREA
KGHA OR OTHER NAME........ LIGHTNING DOCK KGHA
CIRCULAR REFERENCE........ 176

GEOPHYSICAL LOCALITY
STATE...................... NEW MEXICO
COUNTY.................... HIDALGO
LATITUDE.................. 32°08.9' N
LONGITUDE.................. 108°49.9' W
MAPS...................... SWALLOW FORK PEAK 1124:000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
25S 19W 07 NW OF SE NEW MEXICO

GENERAL INFORMATION
ELEVATION (M)............... 1280
SURFACE ACTIVITY............. NONE, FOUND BY DRILLING.
NO. OF WELLS................... 4
WELL DEPTHS (M).............. 27 TO 173
MAXIMUM WELL TEMPERATURE (°C) 107 AT DEPTH (M) 90
ROCK TYPES: ALLUVIUM OVERLYING TERTIARY ANDESITIC TO RHYOLITIC ROCKS
GEOPHYSICS: RESISTIVITY, GRAVITY

CHEMISTRY
SAMPLE SOURCE........ SWANHEIM, 1978

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>14.3</td>
<td>23.2</td>
<td>0.8</td>
<td>318.6</td>
<td>21.1</td>
<td>103.7</td>
<td>500</td>
<td>480</td>
<td>87.6</td>
</tr>
<tr>
<td>F</td>
<td>0.5</td>
<td>8.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>DEL 0(18)</td>
<td>504</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL D</td>
<td>H20</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ........... 168
NA-K-CA (4/3) ........... 142
NA-K .................. 140

SILICA
ADIABATIC ............... 150
CONDUCTIVE ............. 158
CHALCEDONY ............ 134
CHRISTOBALITE ........ 108
UPAL ................... 36

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
107 (M) 168 (I) 158 (A) 144 13

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOThERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
0.09 2.0 1.0 1.7 0.3

THICKNESS (KM)
1.0 2.5 1.5

SUBSURFACE AREA (KM**2)
1 3 2

VOLUME (KM**3) .......... 3.3

THERMAL ENERGY (10**18 J) 1.16

COMMENTS:
CHEMICAL ANALYSIS FROM MCCANT'S WELL I HOT WATER (100 C) OCCURS AT SHALLOW DEPTH (26 M) IN FRACTURED TUFF, 01. TEST WELL (COCKRELL NO-1, FEDERAL) 3 KM NORTH RECORDED 122 C AT 225 M. NEAR-SURFACE WARM AREA OF 3 KM**2 DEFINED BY AREA OF RAPID SNOW MELT AND ANOMALOUS TEMPERATURES AT 1 M DEPTH.

REFERENCES:

COMPILTED BY: BROOK, C.

LIGHTNING DOCK AREA, NEW MEXICO
FIELD NAME: MT. HOOD AREA
KGRA ON OTHER NAME: MT. HOOD KGRA
CIRCULAR REFERENCE: 177

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: WASCO/CLACKAMAS
LATITUDE: 45-22.5 N
LONGITUDE: 121-42.5 W
MAPS: CATHEDRAL RIDGE 1124.0001 TIMBERLINE LODE 1124.000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
02S 09E 29 WILLAMETTE

GENERAL INFORMATION
WAKING FIGURE: 6
WAKING NUMBER: 1
AREA OF SURFACE EXPRESSION (KMQ2): 0.1
ELEVATION (M): 3050
SURFACE ACTIVITY: FUMAROLES AND ACID-SULFATE SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (C): 49 TO 90
ROCK TYPES: QUATERNARY ANDESITIC LAVA AND TUFF
### Reservoir Properties

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>90 (0)</td>
<td>150 (0)</td>
<td>125 (0)</td>
<td>122</td>
<td>12</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgment.

- A) Quartz conductive
- B) Quartz conductive, pH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, pH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (km³)</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>Thermal Energy (10¹⁸ J)</td>
<td>0.96</td>
<td></td>
<td></td>
<td></td>
<td>0.29</td>
</tr>
</tbody>
</table>

Comments: Fumarole gases are more than 97% water vapor with the remainder CO₂ and H₂S. May be a small vapor-dominated system.

References: Ayres and Creswell, 1951; Waring, 1965; Renner and others, 1976

Compiled by: Mariner, R.

Mt. Hood Area, Oregon
FIELD NAME: CAREY (AUSTIN) HOT SPRINGS
KGRA OR OTHER NAME: CAREY HOT SPRINGS KGRA
CIRCULAR REFERENCE: 178

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: CLACKAMAS
LATITUDE: 45-01.2 N
LONGITUDE: 122-00.6 W
MAPS: FISH CREEK MTN. 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
06S 07E 30 NW WILLAMETTE

GENERAL INFORMATION
WATING FIGURE: 6
WAKING NUMBER: 4
AREA OF SURFACE EXPRESSION (KM²): 0.1
ELEVATION (M): 503
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (O): 80 TO 91
DISCHARGE (L/MIN): 950
ROCK TYPES: PLIOCENE TO RECENT BASALTIC FLOW AND PYROCLASTIC ROCKS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS. 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (O)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>86</td>
<td>81</td>
<td>35</td>
<td>0.1</td>
<td>300</td>
<td>7.1</td>
<td>56</td>
<td>140</td>
<td>430</td>
<td></td>
</tr>
</tbody>
</table>

F | H | PH | DEL O(18) | S04 | DEL O(18) | H2O | DEL D | H2O |
| 1.4 | 2.6 | 7.63 | -2.41 | -12.22 | -94.5 |
**Geothermometers (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>118</th>
<th>87</th>
<th>61</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Silica**

<table>
<thead>
<tr>
<th>State</th>
<th>123</th>
<th>126</th>
<th>75</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td></td>
<td>75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td></td>
<td></td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

**Sulfate**

<table>
<thead>
<tr>
<th>Type</th>
<th>181</th>
<th>167</th>
<th>170</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-Step Steam Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Continuous Steam Loss</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Reservoir Properties**

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>87 (I)</th>
<th>126 (A)</th>
<th>98 (D)</th>
<th>104</th>
<th>8</th>
</tr>
</thead>
</table>

Uncoded Temperature Indicates Subjective Judgement

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, MG-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>0.5</th>
<th>2.0</th>
<th>1.5</th>
<th>1.7</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsurface Area (km^2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on Standard Estimate

<table>
<thead>
<tr>
<th>Volume (km^3)</th>
<th>3.3</th>
<th>STD. DEV. = 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Energy (10^3 J)</td>
<td>0.80</td>
<td>STD. DEV. = 0.24</td>
</tr>
</tbody>
</table>

**Comments:** Sulfate - Isotopes Indicate 181 DEG C, May Be Unreliable Due To Oxidation Of HS Or Indicate A Very Deep Reservoir.

**References:** Marinier and Others, 1974; 1975; Peck and Others, 1964; Waring, 1965

**Compiled by:** Marinier, R.

*Cameo (Austin) Hot Springs, Oregon*
FIELD NAME................ BREITENBUSH HOT SPRINGS
KGRA OR OTHER NAME........ BREITENBUSH HOT SPRINGS KGRA
CIRCULAR REFERENCE...... 179

GEOGRAPHIC LOCALITY
STATE.......................... OREGON
COUNTY......................... MARION
LATITUDE....................... 44-46.9 N
LONGITUDE...................... 121-58.5 W
MAPS.......................... BREITENBUSH HOT SPRINGS 1162,500

TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
095  07E  20 NE  WILLAMETTE

GENERAL INFORMATION
WAKING FIGURE.................. 6
WAKING NUMBER.................. 6
AREA OF SURFACE EXPRESSION (KM**2)........ 0.1
ELEVATION (M)................... 683
SURFACE ACTIVITY.............. HOT SPRINGS
NO. OF SPRINGS.................. 40
SPRING TEMPERATURES (C)........... 60 to 92
DISCHARGE (L/MIN).............. 3400
ROCK TYPES: Miocene Basalt, Tuff-Breccia, Tuffs, and Altered Rock
GEOPHYSICS: Gravity, Magnetic, AMT

CHEMISTRY
SAMPLE SOURCE...... MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SO2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>83</td>
<td>100</td>
<td>1.3</td>
<td>720</td>
<td>31</td>
<td>142</td>
<td>140</td>
<td>1300</td>
<td></td>
</tr>
</tbody>
</table>

F          PH
3.4        4.1  7.31

DEL O(18) SO4  DEL O(18) H2O  DEL D H2O
-2.67   -11.66  -97.5
GEOTHERMOMETERS (C)

CAIION
NA-K-CA (1/3)......... 149
NA-K-CA (4/3)......... 128
NA-K.................. 103

SILICA
ADIAIRATIC............ 124
CONDUCTIVE............ 127
CHALCEDONY............ 99
CHRISTOBALITE......... 76
opal................... 8

SULFATE
CONDUCTIVE............ 195
ONE-STEP STEAM LOSS... 179
CONTINUOUS STEAM LOSS.. 182

RESEORV PROPERTIES

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>99 (D)</td>
<td>149 (I)</td>
<td>127 (A)</td>
<td>125</td>
<td>10</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ ADIABATIC
C) QUARTZ CONDUCTIVE, PH-CORRECTED
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>0.5</th>
<th>2.0</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

BEGNED ON: STANDARD ESTIMATE AND AMT

VOLUME (KM^3)........... 3.3 STD. DEV. = 0.9
THERMAL ENERGY (10^8 J) | 0.99 | STD. DEV. = 0.29

COMMENTS: SULFATE-ISOTOPE GEOTHERMOMETER INDICATES 195 DEG C AND MAY INDICATE A DEEP RESERVOIR

REFERENCES: MARINER AND OTHERS, 1974B; 1975; PECK AND OTHERS, 1964; WARING, 1965; USGS FILE DATA

COMPILED BY: MARINER, R.

BREITENBAUGH HOT SPRINGS, OREGON
FIELD NAME: KAHNEETAH HOT SPRINGS
CIRCULAR REFERENCE: 180

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: WASCO
LATITUDE: 44°51.9' N
LONGITUDE: 121°12.9' W
MAPS: EAGLE BUTTE 1240001 BEND 1250000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
00S 13E 20 WILLAMETTE

GENERAL INFORMATION
ELEVATION (M): 448
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (C): 52
DISCHARGE (L/MIN): 200
ROCK TYPES: OLIGOCENE AND MIocene RHOLITES AND TUFFS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>10^4</td>
<td>1.2</td>
<td>0.05</td>
<td>325</td>
<td>3.4</td>
<td>493</td>
<td>9</td>
<td>34</td>
<td>155</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>2.6</td>
<td>8.32</td>
</tr>
</tbody>
</table>

DEL 0(18) S04 DEL 0(18) H2O DEL D H2O
-14.75 -118.9
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)........ 102
NA-K-CA (4/3)........ 120
NA-K.................. 17

SILICA
ADJARATIC............. 135
CONDUCTIVE........... 139
CHALCEDONY............. 113
CRISTOBALITE........... 89
OPAL.................... 19

RESEVOIR PROPERTIES

MINIMUM          MAXIMUM          MOST LIKELY          MEAN          STD. DEV.
SUBSURFACE TEMP (C) 102 (I)          113 (D)          113 (D)          109          3

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE          F) CRISTOBALITE
B) QUARTZ CONDUCTIVE, PH-CORRECTED G) AMORPHOUS SILICA
C) QUARTZ ADIABATIC          H) NA-K
D) CHALCEDONY                I) NA-K-CA
E) CHALCEDONY, PH-CORRECTED J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)         MINIMUM          MAXIMUM          MOST LIKELY          MEAN          STD. DEV.
THICKNESS (KM)            0.5             2.0             1.5
SUBSURFACE AREA (KM**2)   1.0             2.0             1.5

BASSED ON: STANDARD ESTIMATE
VOLUME (KM**3).............. 3.3

STD. DEV. = 0.9

THERMAL ENERGY (10**18 J) 0.85

STD. DEV. = 0.24


COMPILED BY: MARINER, R.

KANNEHELIAH HOT SPRINGS, OREGON
FIELD NAME................ BELKNAP HOT SPRINGS
KGRA OR OTHER NAME ........ BELKNAP-FOLEY HOT SPRINGS KGRA
CIRCULAR REFERENCE........ 181

GEOGRAPHIC LOCALITY
STATE............. OREGON
COUNTY............ LANE
LATITUDE........ 44-11.6 N
LONGITUDE... 122-03.2 W
MAPS................ MCKENZIE BRIDGE 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
16S 06E 11 SE OF NW WILLAMETTE

GENERAL INFORMATION
WAKING FIGURE.................. 6
WAKING NUMBER................... 18
ELEVATION (M).................... 824
SURFACE ACTIVITY................ HOT SPRINGS
NO. OF SPRINGS................... 3
SPRING TEMPERATURES (C)........ 64 TO 71
DISCHARGE (L/MIN)... ........... 300
ROCK TYPES: OLIVINE BASALT

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>96</td>
<td>210</td>
<td>0.2</td>
<td>690</td>
<td>15</td>
<td>17</td>
<td></td>
<td>170</td>
<td>1300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>8</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>SO4</th>
<th>DEL 0(18)</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2</td>
<td>6.4</td>
<td>7.62</td>
<td>+0.35</td>
<td>-11.74</td>
<td>-95.8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

**CATION**
- NA-K-CA (1/3) .......... 113
- NA-K-CA (4/3) .......... 82
- NA-K ................... 56

**SILICA**
- ADIABATIC .............. 131
- CONDUCTIVE ............ 135
- CHALCEDONY .......... 108
- CRISTOHALITE ........... 84
- OPAL .................. 15

**SULFATE**
- CONDUCTIVE .......... 148
- ONE-STEP STEAM LOSS ... 138
- CONTINUOUS STEAM LOSS... 139

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>62 (1)</td>
<td>148 (K)</td>
<td>108 (D)</td>
<td>113</td>
<td>14</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Penner and Others, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (km³)</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
<tr>
<td>Thermal Energy (10¹⁸ J)</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
<td>0.28</td>
</tr>
</tbody>
</table>

**COMMENTS:** May be part of a larger system which includes Foley Hot Springs

**REFERENCES:** Mariner and Others, 1974, 1975; Waring, 1965; Peck and Others, 1964

**COMPILED BY:** Mariner, R.

Helknap Hot Springs, Oregon
**FIELD NAME**................... FOLEY HOT SPRINGS
**KGRA OR OTHER NAME**........ BELKNAP-FOLEY HOT SPRINGS KGRA
**CIRCULAR REFERENCE**......... 182

**GEOGRAPHIC LOCALITY**
- **STATE**........................ OREGON
- **COUNTY**....................... LANE
- **LATITUDE**.................... 44°09.8' N
- **LONGITUDE**................... 122°05.9' W
- **MAPS**.......................... MCKENZIE BRIDGE 1162,500

**TOWNSHIP RANGE SECTION BASE & MERIDIAN**
- 16S 06E 28 NW OF NW WILLAMETTE

**GENERAL INFORMATION**
- **WAKING FIGURE**................... 6
- **WAKING NUMBER**.................... 19
- **ELEVATION (M)**................... 518
- **SURFACE ACTIVITY**................ HOT SPRINGS
- **NO. OF SPRINGS**................... 4
- **SPRING TEMPERATURES (C)**........... 72° to 79°
- **ROCK TYPES**: BASALT

**CHEMISTRY**
- **SAMPLE SOURCE**.............. R. BOWEN, UNPUB. ANALYSIS
- **COLLECTION DATE**............. 1976/03/08

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>60</td>
<td>494</td>
<td>0.8</td>
<td>475</td>
<td>11.2</td>
<td>16</td>
<td>16</td>
<td>550</td>
<td>1304</td>
</tr>
<tr>
<td>F</td>
<td>8</td>
<td>PH</td>
<td></td>
<td></td>
<td></td>
<td>DEL 0(18)</td>
<td>SO4</td>
<td>DEL 0(18)</td>
<td>H2O</td>
</tr>
</tbody>
</table>

**PH**.......................... 8.1
GEOTHERMOMETERS (C)

CA\ION
NA-K-CA (1/3)............ 106
NA-K-CA (4/3)............ 52
NA-K..................... 61

SILICA
ADIABATIC................. 110
CONDUCTIVE............... 111
CHALCEDONY.............. 81
CRISTOBALITE............ 60
OPAL.................... -7

RESEVOIR PROPERTIES
SUBSURFACE TEMP (C)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 (D)</td>
<td>111 (A)</td>
<td>106 (I)</td>
<td>99</td>
<td>7</td>
</tr>
</tbody>
</table>

UNCONED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

THICKNESS (KM)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.3</td>
</tr>
</tbody>
</table>

SUBSURFACE AREA (KM**2)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>2.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (KM**3)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
<td>0.76</td>
<td>0.9</td>
<td>0.76</td>
<td>0.22</td>
</tr>
</tbody>
</table>

COMMENTS: MAY BE PART OF THE SAME SYSTEM AS BELKNAP HOT SPRINGS 6KM NE OF FOLEY H.S.

REFERENCES: WARING, 1965

COMPILED BY: MARINER, R.

FOLEY HOT SPRINGS, OREGON
FIELD NAME: MCCREDIE (WININO) HOT SPRINGS KGRA OR OTHER NAME: MCCREDIE HOT SPRINGS KGRA
CIRCULAR REFERENCE: 183

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: LANE
LATITUDE: 43°42.6' N
LONGITUDE: 122°17.3' W
MAPS: OAKRIDGE H62|500

TOWNSHIP RANGE SECTION
21S 04E 36 NW

BASE & MERIDIAN
WILLAMETTE

GENERAL INFORMATION
WARNING FIGURE: 6
WARNING NUMBER: 22
ELEVATION (M): 634
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 15
DISCHARGE (L/MIN): 76

ROCK TYPES: ANDESITE, DACITE, AND RHYODACITE TUFFS, DOMES, AND FLOWS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>79</td>
<td>460</td>
<td>0.9</td>
<td>1000</td>
<td>22</td>
<td>21</td>
<td>240</td>
<td>2200</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>R</th>
<th>PH</th>
<th>DEL 0(18) Si04</th>
<th>DEL 0(18) H20</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7</td>
<td>18</td>
<td>7.29</td>
<td>DEL 0(18) Si04</td>
<td>DEL 0(18) H20</td>
<td>-94.0</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>114</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>81</td>
</tr>
<tr>
<td>Na-K</td>
<td>56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic.................</td>
<td>122</td>
</tr>
<tr>
<td>Conductive..............</td>
<td>124</td>
</tr>
<tr>
<td>Chalcedony.............</td>
<td>96</td>
</tr>
<tr>
<td>Chalcedony, PH-Corrected</td>
<td>74</td>
</tr>
<tr>
<td>Opal......................</td>
<td>6</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>81 (I)</td>
<td>96 (D)</td>
<td>96 (D)</td>
<td>91</td>
<td>4</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Thickness (km)

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Subsurface Area (km²)

Based on standard estimate.

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thermal Energy (10¹⁸ J)

<table>
<thead>
<tr>
<th>Thermal Energy (10¹⁸ J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.68</td>
<td></td>
<td></td>
<td>0.6</td>
<td>0.19</td>
</tr>
</tbody>
</table>

References: Waring, 1965; Marinier and Others, 1975;
Renner and Others, 1976

Compiled by: Brook, C.

Mckcredie (Winino) Hot Springs, Oregon
FIELD NAME................ NEWBERRY CALDERA
KORA OR OTHER NAME........ NEWBERRY CALDERA KGRA
CIRCULAR REFERENCE........... 184

GEOGRAPHIC LOCALITY
STATE....................... OREGON
COUNTY...................... DESCHUTES
LATITUDE................... 43°43.0' N
LONGITUDE.................. 121°14.0' W
MAPS....................... CRESCENT 11250,0001 PAULINA PEAK 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
21S 13E 29 WILLAMETTE

GENERAL INFORMATION
WARNING FIGURE..................... 6
WARNING NUMBER...................... 32,33
ELEVATION (M)....................... 1950
SURFACE ACTIVITY.................... HOT SPRINGS
NO. OF SPRINGS...................... SEVERAL IN 2 GROUPS
SPRING TEMPERATURES (°C)........... 21 TO 62
DISCHARGE (L/MIN)................... 38

ROCK TYPES: PLEISTOCENE AND HOLOCENE ANDESITE AND BASALT CALDERA STRUCTURE

CHEMISTRY
SAMPLE SOURCE........ MARINER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>36</td>
<td>38</td>
<td>16</td>
<td>32</td>
<td>3.8</td>
<td>184</td>
<td></td>
<td></td>
<td>58</td>
</tr>
<tr>
<td>F</td>
<td>0.2</td>
<td>0.9</td>
<td>6.49</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DEL 0(18)</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO4</td>
<td>-9.42</td>
<td>-76.2</td>
</tr>
<tr>
<td>H2O</td>
<td>-76.2</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>155</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>44</td>
</tr>
<tr>
<td>NA-K</td>
<td>205</td>
</tr>
</tbody>
</table>

SILICA

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>90</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>87</td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>56</td>
</tr>
<tr>
<td>CHERT</td>
<td>37</td>
</tr>
<tr>
<td>OPAL</td>
<td>-26</td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUSSURFACE TEMP (C)</td>
<td>140</td>
<td>280</td>
<td>230</td>
<td>230</td>
<td>20</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

- A) QUARTZ CONDUCTIVE
- H) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- I) NA-K-CA
- J) NA-K-CA, Mg-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

DEPTHS TO TOP (KM)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>28.3</td>
<td>8.2</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>10</td>
<td>50</td>
<td>25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

VOLUME (KM³)

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLUME (KM³)</td>
<td>47.2</td>
</tr>
</tbody>
</table>

THERMAL ENERGY (10²² J)

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>THERMAL ENERGY (10²² J)</td>
<td>27.41</td>
</tr>
</tbody>
</table>

COMMENTS: CHEMICAL ANALYSIS FROM HOT SPRINGS AT EAST LAKE. CHEMICAL COMPOSITION OF HOT SPRINGS AT EAST LAKE AND PAULINA LAKE INDICATES THAT THE WATERS ARE HEATED LAKE WATERS; GEOTHERMOMETRY IS UNRELIABLE. TEMPERATURE ESTIMATES ARE BASED ON COMPARISON WITH OTHER QUATERNARY CALDERAS.

REFERENCES: WARING, 1965; MARINER AND OTHERS, 1975; USGS FILE DATA

COMPILED BY: BROOK, C.

NEWHERDY CALDERA, OREGON
FIELD NAME: Umpqua Hot Springs
CIRCULAR REFERENCE: 185

GEOGRAPHIC LOCALITY
STATE: Oregon
COUNTY: Douglas
LATITUDE: 43°17.5' N
LONGITUDE: 122°22.0' W
MAPS: Toketee Falls 1:62,500
TOWNSHIP  RANGE  SECTION  BASE & MERIDIAN
26S  04E  20  Willamette

GENERAL INFORMATION
WAKING FIGURE: 6
WAKING NUMBER: 24
ELEVATION (M): 799
SURFACE ACTIVITY: Hot Springs
ASSOCIATED DEPOSITS: Travertine
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 41° to 46°
DISCHARGE (L/Min): 19
ROCK TYPES: Quaternary Basalt Overlying Tertiary Andesitic Tuffs

CHEMISTRY
SAMPLE SOURCE: USGS File Data

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>90</td>
<td>340</td>
<td>41</td>
<td>2400</td>
<td>63</td>
<td>1380</td>
<td>190</td>
<td>3500</td>
<td></td>
</tr>
</tbody>
</table>

F  H  PH  DEL 0(18) 5O4  DEL 0(18) H2O  DEL D H2O
1.5 41 6.37
### Geothermometers (C)

**CATION**
- NA-K-CA (1/3) .......... 135
- NA-K-CA (4/3) .......... 141
- NA-K .......... 67

**Silica**
- Adiabatic .......... 128
- Conductive .......... 137
- Chalcedony .......... 104
- Cristobalite .......... 81
- Opal .......... 12

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100 (J)</td>
<td>131 (A)</td>
<td>104 (D)</td>
<td>112</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, pH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>3.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### Based on Standard Estimate

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Thermal Energy (10² J)

<table>
<thead>
<tr>
<th>Thermal Energy (10² J)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.87</td>
<td>0.87</td>
<td>0.87</td>
<td>0.87</td>
<td>0.25</td>
</tr>
</tbody>
</table>

### Comments:
Carbon dioxide charged water GEOTHERMOMETERS MAY NOT BE RELIABLE.

### References:
- Waring, 1965
- USGS File Data
- Compiled by: Mariner, R. and Brook, C.

Umpqua Hot Springs, Oregon
FIELD NAME: Klamath Hills Area
KGRA or Other Name: Klamath Falls KGRA
Circular Reference: 186

Geographic Locality
State: Oregon
County: Klamath
Latitude: 42°03.0' N
Longitude: 121°44.5' W
Maps: Klamath Falls 1:62,500, Merrill 1:62,500

General Information
Elevation (M): 1256
Surface Activity: None, found by drilling
Associated Deposits: Silicified rocks
No. of Wells: Several
Well Depths (M): 47 to 127
Maximum Well Temp (C): 93 at depth (M) 127
Rock Types: Lacustrine and Fluvial Tuffaceous Deposits overlying Basalt
Geophysics: Gravity, Magnetic, Heat Flow

Chemistry
Sample Source: Sample, 1976 (Liskey Well)
Collection Date: 1974/05/09

Temperature (°C) SiO₂ Ca Mg Na K HCO₃ CO₃ SO₄ Cl
93 90 15 0.1 200 4.0 48 2 360 59

F H PH Del O(18) SO₄ Del O(18) H₂O Del D H₂O
8.9 -2.13 -14.95 -116.6

Base & Meridian: Willamette
Township: 40S
Range: 09E
Section: 34 NE
### RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>104 (D)</td>
<td>138 (K)</td>
<td>131 (A)</td>
<td>124</td>
<td>7</td>
</tr>
<tr>
<td>Uncoded Temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicates Subjective Judgement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### MINIMUM MEAN MAXIMUM MOST LIKELY
A) Quartz Conductive       F) Cristobalite     K) Sulfate Geothermometer
B) Quartz Conductive, PH-Corrected G) Amorphous Silica L) Surface Temperature
C) Quartz Adiabatic         H) Na-K             M) Well Temperature
D) Chalcedony               I) Na-K-CA          N) Mixing Model

### DFPTH TO TOP (KM)        THICKNESS (KM)      SUBSURFACE AREA (KM²)
0.05                         1.0                  1
1.5                          2.5                  9
0.5                          1.5                 9
1.7                         0.3                  1.9

### VOLUME (KM³)             THERMAL ENERGY (10¹¹ J)
10.6                         3.12                Std. Dev. = 3.8

**COMMENTS:** Located about 20 km south of Klamath Falls; geology and system characteristics are similar. 9 km² area of silicified rocks, hot water from one well used in greenhouse.

**REFERENCES:** Peterson and McIntyre, 1970; Sammel, 1976

**COMPILED BY:** Mariner, R. and Brook, C.

**KLAMATH HILLS AREA, OREGON**
FIELD NAME: KLAMATH FALLS AREA  
KGRA OR OTHER NAME: KLAMATH FALLS KGKA  
CIRCULAR REFERENCE: 187

**GEOGRAPHIC LOCALITY**  
STATE: OREGON  
COUNTY: KLAMATH  
LATITUDE: 42-14.0 N  
LONGITUDE: 121-46.0 W  
MAPS: KLAMATH FALLS 1162,5001 MERRILL 1162,500

**TOWNSHIP** | **RANGE** | **SECTION** | **BASE & MERIDIAN**  
--- | --- | --- | ---  
JHS | 09E | 21 | WILLAMETTE

**GENERAL INFORMATION**  
WAKING FIGURE: 6  
WAKING NUMBER: 271, 28  
ELEVATION (M): 1525  
SURFACE ACTIVITY: HOT SPRINGS, HOT WATER WELLS  
ASSOCIATED DEPOSITS: SINTER  
NO. OF SPRINGS: SEVERAL AT OLENE GAP  
SPRING TEMPERATURES (C): 74  
DISCHARGE (L/MIN): 30  
NO. OF WELLS: SEVERAL  
WELL DEPTHS (M): 41 TO 551  
MAXIMUM WELL TEMP (C): 99 AT DEPTH (M) 530  
ROCK TYPES: LACUSTRINE AND FLUVIATILE TUFFACEOUS DEPOSITS OVERLYING BASALT  
GEOPHYSICS: GRAVITY, MAGNETIC, HEAT FLOW, AMT

**CHEMISTRY**  
SAMPLE SOURCE: SAMUEL, 1976 (WELL OIT #6)  
COLLECTION DATE: 1975/03/31

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SO2</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>88</td>
<td>90</td>
<td>24.2</td>
<td>0.1</td>
<td>195</td>
<td>3.9</td>
<td>44</td>
<td>400</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL (18)</th>
<th>SO4</th>
<th>DEL (18)</th>
<th>H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2</td>
<td>-4.82</td>
<td>-13.73</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

| Na-K-CA (1/3) | 108 |
| Na-K-CA (4/3) | 71  |
| Na-K          | 51  |

SILICA

| Adiabatic      | 128 |
| Conductive     | 131 |
| Chalcedony     | 104 |
| Cristobalite   | 81  |
| Opal           | 12  |

SULFATE

| Conductive     | 196 |
| One-step Steam Loss | 179 |
| Continuous Steam Loss | 183 |

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>99 (M)</td>
<td>131 (A)</td>
<td>104 (D)</td>
<td>111</td>
<td>7</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGMENT

A) Quartz Conductive
B) Quartz Conductive, Ph-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, Ph-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Penner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.04</td>
<td>0.5</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Thickness (km)   | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |
| Subsurface Area (km**2) | 6      | 150     | 50          | 68.7 | 30.1      |

BASED ON: 60 C ISOTHERM AND AMT SURVEY

| Volume (km**3)   | 114.4   | Std. Dev. = 55.4 |
| Thermal Energy (10**18 J) | 29.77  | Std. Dev. = 14.61 |

COMMENTS: AREA INCLUDES SPRINGS AT OLENE GAP; HOT SPRINGS AT KLAMATH FALLS ARE INACTIVE. ABOUT 8 KM**2 AREA OF SILIFICATION AT KLAMATH FALLS. LUND AND OTHERS (1974) REPORT MAXIMUM WELL TEMPERATURE OF 113°C. OXYGEN ISOTOPE AND SULFATE GEOTHERMOMETER FOR OLENE GAP SPRING. HIGH SULFATE TEMPERATURES PROBABLY INDICATE A VERY DEEP AQUIFER IN A STACKED SYSTEM. LARGE AREA OF WARM WATER. THERMAL WATER PROBABLY ASCENDS ALONG FAULTS AND SPREADS OUT IN NEAR-SURFACE AQUIFERS. STEAM REPORTED IN SOME WELLS.

REFERENCES: SAMUEL, 1970; LUND AND OTHERS, 1974; MARINER AND OTHERS, 1974; PFETZEN AND MCGINTY, 1970; USGS FILE DATA

COMPILED BY: MARINER, R. AND HROOK, C.

KLAMATH FALLS AREA, OREGON
FIELD NAME ........................ SUMMER LAKE HOT SPRINGS
KGRA OR OTHER NAME .......... SUMMER LAKE HOT SPRING KGRA
CIRCULAR REFERENCE ............. 188

GEOGRAPHIC LOCALITY
STATE ........................... OREGON
COUNTY ........................... LAKE
LATITUDE .......................... 42-43.5 N
LONGITUDE ....................... 120-38.7 W
MAPS ............................... SLIDE MTN. 1124,000

TOWNSHIP RANGE SECTION
33S 1/E 12 NE

BASE & MERIDIAN
WILLAMETTE

GENERAL INFORMATION
WARING FIGURE .................. 6
WARING NUMBER .................. 42
ELEVATION (M) .................. 1307
SURFACE ACTIVITY .............. HOT SPRINGS
ASSOCIATED DEPOSITS ........... SINTER
NO. OF SPRINGS ................. 3
SPRING TEMPERATURES (C) ....... 43
DISCHARGE (L/MIN) ............. 75
ROCK TYPES: TERTIARY ANDESITE OVERLAIN BY QUAT., AND TERTIARY SEDIMENTARY ROCKS
GEOPHYSICS: AMT

CHEMISTRY
SAMPLE SOURCE .... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>94</td>
<td>2.1</td>
<td>0.1</td>
<td>390</td>
<td>4.6</td>
<td>406</td>
<td>10</td>
<td>120</td>
<td>280</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL O(18)</th>
<th>DEL O(18)</th>
<th>DEL D</th>
<th>DEL D</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>6.9</td>
<td>0.43</td>
<td>-4.00</td>
<td>-13.32</td>
<td>-115.0</td>
<td></td>
</tr>
</tbody>
</table>
### Geothermometers (°C)

**Cation**
- Na-K-CA (1/3) ............ 112
- Na-K-CA (4/3) ............ 149
- Na-K ...................... 22

**Silica**
- Amorphous ............... 130
- Conductive ............... 134
- Chalcedony ............... 107
- Cristobalite ............. 83
- Opal ...................... 14

**Sulfate**
- Conductive ............... 189
- One-step steam loss ..... 162
- Continuous steam loss ... 169

### Reservoir Properties

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>107 (D)</td>
<td>134 (A)</td>
<td>112 (I)</td>
<td>118</td>
</tr>
<tr>
<td>Uncoded temperature indicates subjective judgement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### A) Quartz Conductive
#### B) Quartz Adiabatic, PH-Corrected
#### C) Quartz Adiabatic
#### D) Chalcedony
#### E) Chalcedony, PH-Corrected

#### F) Cristobalite
#### G) Amorphous Silica
#### H) Na-K

#### K) Sulfate Geothermometer
#### L) Surface Temperature
#### M) Well Temperature
#### N) Mixing Model
#### O) Renner and Others, 1976

### Depth to Top (km)
- Minimum: 0.5
- Maximum: 2.0
- Most Likely: 1.5
- Mean: 1.7
- Std. Dev.: 0.3

### Thickness (km)
- Minimum: 1.0
- Maximum: 2.5
- Most Likely: 1.5

### Subsurface Area (km²)
- Minimum: 1
- Maximum: 8
- Most Likely: 5
- Mean: 4.7
- Std. Dev.: 1.4

### Based on: AMT Survey

#### Volume (km³)
- Minimum: 7.8
- Maximum: 7.8
- Most Likely: 7.8
- Mean: 7.8
- Std. Dev.: 2.8

#### Thermal Energy (10¹² J)
- Minimum: 2.16
- Maximum: 2.16
- Most Likely: 2.16
- Mean: 2.16
- Std. Dev.: 0.80

### Comments:
- Sulfate geothermometer gives 109 °C and may indicate a very deep reservoir in a stacked system.

### References:
- Marinich and Others, 1974B, 1975I
- Walker, 1963J
- Waring, 1965

### Compiled by:
- Marinich, R.

**Summer Lake Hot Springs, Oregon**
FIELD NAME................ LAKEVIEW AREA (HUNTERS AND BARRY RANCH HOT SPRINGS)
KGRA OR OTHER NAME........ LAKEVIEW KGRA
CIRCULAR REFERENCE........ 189

GEOGRAPHIC LOCALITY
STATE....................... OREGON
COUNTY...................... LAKE
LATITUDE.................... 42°12.0' N
LONGITUDE................... 120°21.6' W
MAPS......................... LAKE VIEW NW 1124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
39S 20E 15 WILLAMETTE

GENERAL INFORMATION
WARING FIGURE...................... 6
WARING NUMBER...................... 45,47
AREA OF SURFACE EXPRESSION (KM^2) 5,0
ELEVATION (M)...................... 1464
SURFACE ACTIVITY.................. HOT SPRINGS, GEYSERING WELL
ASSOCIATED DEPOSITS............... TRAVERTINE AND SINTER
NO. OF SPRINGS..................... 16
SPRING TEMPERATURES (C)........... 88 TO 96
DISCHARGE (L/MIN)............... 2500
NO. OF WELLS...................... 2
WELL DEPTHS (M)................... 189 TO 1658
ROCK TYPES: QUATERNARY TO LATE TERTIARY BASALTS AND ANDESITES

CHEMISTRY
SAMPLE SOURCE.... MARINEK AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>140</td>
<td>13</td>
<td>0.1</td>
<td>210</td>
<td>8.5</td>
<td>79</td>
<td></td>
<td>260</td>
<td>120</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>D</th>
<th>PH</th>
<th>DEL O18</th>
<th>SO4</th>
<th>DEL O18</th>
<th>H2O</th>
<th>DEL D</th>
<th>H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4</td>
<td>6.9</td>
<td>7.77</td>
<td>-3.69</td>
<td>-14.32</td>
<td>-119.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**GEOHEATMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>98</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILEX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>149</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>157</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>133</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>107</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SULFATE**

| CONDUCTIVE   | 168      |          |          |          |          |
| ONE-STEP STEAM LOSS | 158      |          |          |          |          |
| CONTINUOUS STEAM LOSS | 160      |          |          |          |          |

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>143 (I)</td>
<td>158 (K)</td>
<td>149 (C)</td>
<td>150</td>
<td>3</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

- A) QUARTZ CONDUCTIVE
- H) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- I) NA-K-CA
- J) NA-K-CA, Mg-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

| DEPTH TO TOP (KM) | 0.5 |          |          |          |          |
| THICKNESS (KM)    | 1.0 | 2.0      | 1.5      |          |          |
| SUBSURFACE AREA (KM^2) | 2   | 2.5      | 2.0      | 1.8    | 0.3      |

**VOLUME (KM^3)........... 15.3  STD. DEV. = 5.6**

**THERMAL ENERGY(10**18 J) | 5.57 | STD. DEV. = 2.04**

**COMMENTS**: WATER COMPOSITION FROM HUNTERS HOT SPRINGS, BARRY RANCH INCLUDED IN THE AREA. SEVERAL SHALLOW WELLS NEAR HUNTERS HOT SPRINGS HAVE BEEN DEVELOPED FOR RESIDENTIAL HEATING.

**REFERENCES**: MARINER AND OTHERS, 1974B; 1975I WALKER; 1963I WARING; 1965I PETERSON AND MCINTYRE, 1970

**COMPILED BY**: MARINER, R.

**LAKEVIEW AREA (HUNTERS AND BARRY RANCH HOT SPRINGS, OREGON)**
FIELD NAME: CRUMPS SPRING
KGRA OR OTHER NAME: CRUMP GEYSER KGRA
CIRCULAR REFERENCE: 190

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: LAKE
LATITUDE: 42°13.8' N
LONGITUDE: 119°53.0' W
MAPS: ADEL 1124,000

TOWNSHIP: 34S
RANGE: 24E
SECTION: 34, SW
BASE & MERIDIAN: WILLAMETTE

GENERAL INFORMATION
WAKING FIGURE: 6
WAKING NUMBER: 49C, 49D
AREA OF SURFACE EXPRESSION (KM$^2$): 1.0
ELEVATION (M): 1525
SURFACE ACTIVITY: HOT SPRINGS AND SEEPS, GEYSERING WELL
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: SEVERAL IN 2 GROUPS
SPRING TEMPERATURES (C): 37 TO 78
DISCHARGE (L/MIN): 0 TO 50
NO. OF WELLS: 1
WELL DEPTHS (M): 50
MAXIMUM WELL TEMP (C): 121 AT DEPTH (M) 201

ROCK TYPES: MIocene TO PLIOcene BASALT OVERLAIN BY QUATERNARY ALLUVIUM

CHEMISTRY
SAMPLE SOURCE: MARIENER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>7H</td>
<td>180</td>
<td>16</td>
<td>0.2</td>
<td>280</td>
<td>11</td>
<td>153</td>
<td>200</td>
<td>240</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>A</th>
<th>PH</th>
<th>DEL 0(18) SiO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.9</td>
<td>13.6</td>
<td>7.26</td>
<td>-4.71</td>
<td>13.28</td>
<td>-115.5</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Material</th>
<th>Conductive</th>
<th>Adiabatic</th>
<th>Chalcedony</th>
<th>Cristobalite</th>
<th>Amorphous Silica</th>
<th>Sulfate Conductive</th>
<th>One-Step Steam Loss</th>
<th>Continuous Steam Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>144</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>122</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adiabatic</td>
<td>162</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>173</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>151</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>123</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAI</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>144 (I)</td>
<td>185 (A)</td>
<td>173 (A)</td>
<td>167</td>
<td>9</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgment.

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

### Depth to Top (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>2.0</td>
<td>1.0</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

### Thickness (km)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>4.3</td>
<td>1.4</td>
</tr>
</tbody>
</table>

### Subsurface Area (km²)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>4</td>
<td>4.3</td>
<td>1.4</td>
</tr>
</tbody>
</table>

### Volume (km³)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.2</td>
<td></td>
<td></td>
<td>2.97</td>
<td>2.8</td>
</tr>
</tbody>
</table>

### Thermal Energy (10¹⁸ J)

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.97</td>
<td></td>
<td></td>
<td></td>
<td>1.16</td>
</tr>
</tbody>
</table>

### Comments:

A shallow well (Crumps Geyser) erupts every few hours.

### References:

Mariner and Others, 1974A; 1975A; Walker and Repenning, 1965A; Peterson, 1959A; Waring, 1965A; USGS File Data

Compiled by: Mariner. R. and Brook, C.

Crumps Spring, Oregon
FIELD NAME: FISHER HOT SPRING
KGRA OR OTHER NAME: CRUMP GEYSER KGRA
CIRCULAR REFERENCE: 191

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: LAKE
LATITUDE: 42-17.9 N
LONGITUDE: 119-46.5 W
MAPS: CRUMP LAKE 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
38S 25E 10 NW OF NW WILLAMETTE

GENERAL INFORMATION
WARMING FIGURE: 6
WARMING NUMBER: 49A
ELEVATION (M): 1385
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 1
SPRING TEMPERATURES (C): 68
DISCHARGE (L/MIN): 75
ROCK TYPES: MIocene TO Pliocene BASALT OVERLAIN BY QUATERNARY ALLUVIUM

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>77</td>
<td>8.4</td>
<td>1.0</td>
<td>92</td>
<td>7.9</td>
<td>105</td>
<td>1</td>
<td>59</td>
<td>56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>R</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0 H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>2.2</td>
<td>7.93</td>
<td>DEL 0(18) SO4</td>
<td>DEL 0(18) H2O</td>
<td>-117.0</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) 169
- NA-K-CA (4/3) 112
- NA-K 167

SILICA
- ADIABATIC 121
- CONDUCTIVE 123
- CHALCEDONY 95
- CRISTOBALITE 72
- OPAL 4

RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
- MINIMUM 95 (D)
- MAXIMUM 123 (A+J)
- MOST LIKELY 123 (A+J)
- MEAN 114
- STD. DEV. 7

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED

F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
- MINIMUM 0.5
- MAXIMUM 2.0
- MOST LIKELY 1.5
- MEAN 1.7
- STD. DEV. 0.3

THICKNESS (KM)
- MINIMUM 1.0
- MAXIMUM 2.5
- MOST LIKELY 1.5
- MEAN 2.0
- STD. DEV. 0.4

SUBSURFACE AREA (KM^2)
- MINIMUM 1
- MAXIMUM 3
- MOST LIKELY 2
- MEAN 2.0
- STD. DEV. 0.4

VOLUME (KM^3)
- MINIMUM 3.3
- MAXIMUM 8.9
- MOST LIKELY 6.9
- MEAN 8.9
- STD. DEV. 0.26

REFERENCES: MARINER AND OTHERS, 1974; 1975; WALKER AND REPENNING, 1965

COMPILED BY: MARINER, R.

FISHER HOT SPRING, OREGON
FIELD NAME: .................. WEHERG HOT SPRINGS
CIRCULAR REFERENCE: ...... 192

GEOGRAPHIC LOCALITY
STATE: ...................... OREGON
COUNTY: ..................... GRANT
LATITUDE: .................. 44-00.0 N
LONGITUDE: ................. 119-38.8 W
MAPS: ...................... BURNS 11250.000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
18S 26E 18 WILLAMETTE

GENERAL INFORMATION
ELEVATION (M)................. 1525
SURFACE ACTIVITY............. HOT SPRINGS
NO. OF SPRINGS............... 1
SPRINGS TEMPERATURES (C)...... 46
DISCHARGE (L/MIN)............. 40
ROCK TYPES: ARKOSIC SANDSTONE AND VOLCANIC ROCKS OF JURASSIC AGE.

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>82</td>
<td>30</td>
<td>7.8</td>
<td>610</td>
<td>36</td>
<td>439</td>
<td>1</td>
<td>204</td>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL 0(18) S04</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0 H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.9</td>
<td>15</td>
<td>6.53</td>
<td>-15.14</td>
<td>-122.1</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>169</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>162</td>
</tr>
<tr>
<td>Na-K</td>
<td>130</td>
</tr>
</tbody>
</table>

SILICA

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>124</td>
</tr>
<tr>
<td>Conductive</td>
<td>126</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>99</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>76</td>
</tr>
<tr>
<td>Opal</td>
<td>7</td>
</tr>
</tbody>
</table>

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>99 (D)</td>
<td>126 (A)</td>
<td>100 (J)</td>
<td>100</td>
<td>6</td>
</tr>
</tbody>
</table>

Uncoded Temperature Indicates Subjective Judgement

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, pH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Volume (km³) = 3.3
Thermal Energy (10¹¹ J) = 0.84

COMMENTS: CO₂ Charged Water, Chemical Geothermometers may be unreliable.

REFERENCES: MARINER AND OTHERS, 1974B; 1975

COMPILED BY: MARINER, R.

WEBERG HOT SPRINGS, OREGON
FIELD NAME .................... HARNEY LAKE AREA
CIRCULAR REFERENCE .......... 193

GEOGRAPHIC LOCALITY
STATE ...................... OREGON
COUNTY ..................... HARNEY
LATITUDE .................. 43-10.9 N
LONGITUDE ................ 119-03.2 W
MAPS ..................... BURNS 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
27S 29E 36 Willamette

GENERAL INFORMATION
WAKING FIGURE .................. 6
WAKING NUMBER .................. 64
ELEVATION (M) .................. 1250
SURFACE ACTIVITY .............. HOT SPRINGS
SPRING TEMPERATURES (C) ......... 68
DISCHARGE (L/MIN) .............. 550
ROCK TYPES: PLIOCENE BASALT, TUFFS AND WELDED TUFFS
GEOPHYSICS: HEAT FLOW

CHEMISTRY
SAMPLE SOURCE .... MARINER AND OTHERS, 1974

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>68</td>
<td>9?</td>
<td>12</td>
<td>1.8</td>
<td>630</td>
<td>13</td>
<td>566</td>
<td>1</td>
<td>140</td>
<td>590</td>
</tr>
</tbody>
</table>

F      | pH   | DEL O(18) SO4 | DEL O(18) H2O | DEL D H2O
3.3    | 11.3 | DEL O(18) | DEL O(18) | -128.5
7.26   |      | DEL O(18) | DEL O(18) | DEL O(18)
GEOTHERMOMETERS (C)

CAFEON
NA-K-CA (1/3) ........ 130
NA-K-CA (4/3) ........ 150
NA-K .................. 53

SILICA
ADIABATIC .......... 129
CONDUCTIVE ......... 133
CHALCEDONY .......... 105
CHISTOUALITE ....... 82
OPAL .................. 13

RESERVOIR PROPERTIES
MINIMUM
MEMAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE TEMP (C) 105 (D,J) 133 (A) 105 (D,J) 114 7

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIAHATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM
DEPTH TO TOP (KM) 0.5
THICKNESS (KM) 1.0
SUBSURFACE AREA (KM**2) 1

MAXIMUM
MOST LIKELY
1.5
1.5
2

SUBSURFACE AREA (KM**2)

STO. DEV. = 0.9

VOLUME (KM**3) .......... 3.3

STD. DEV. = 0.9

THERMAL ENERGY(10**18 J) 0.89

STD. DEV. = 0.26


COMPILRED BY: MARINER, R.

HARNEY LAKE AREA, OREGON
FIELD NAME: CRANE HOT SPRINGS
CIRCULAR REFERENCE: 194

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: HARNEY
LATITUDE: 43°26.4' N
LONGITUDE: 118°38.4' W
MAPS: CRANE 1 162.500

TOWNSHIP RANGE SECTION
245 33E 34 SW OF NE
BASE & MERIDIAN WILLAMETTE

GENERAL INFORMATION
WARING FIGURE: 6
WARING NUMBER: 53
ELEVATION (M): 1254
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 50 TO 78
DISCHARGE (L/MIN): 550

ROCK TYPES: PLIOCENE AND PLEISTOCENE PYROCLASTIC ROCKS
            PLIOCENE BASALT AND ANDESITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>83</td>
<td>3.7</td>
<td>0.1</td>
<td>170</td>
<td>3.9</td>
<td>202</td>
<td>3</td>
<td>86</td>
<td>79</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.0</td>
<td>7.9</td>
<td>8.10</td>
<td>DEL 0(18) SO4</td>
<td>DEL 0(18) H2O</td>
<td>DEL D H2O</td>
</tr>
</tbody>
</table>

-16.17
-133.5
<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/2)</td>
<td>124</td>
<td></td>
<td></td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>113</td>
<td></td>
<td></td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td>59</td>
<td></td>
<td></td>
<td>59</td>
<td></td>
</tr>
</tbody>
</table>

| SILICA                       |         |         |             |      |           |
| A) DIAMATIC                  | 124     |         |             | 124  |           |
| B) CONDUCTIVE                | 127     |         |             | 127  |           |
| C) CHALCEDONY                | 99      |         |             | 99   |           |
| D) CRISTOBALITE              | 76      |         |             | 76   |           |
| E) OPAL                      | 9        |         |             | 9    |           |

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>99 (D)</td>
<td>127 (A)</td>
<td>124 (I)</td>
<td>117</td>
<td>6</td>
</tr>
</tbody>
</table>

| DEPTH TO TOP (KM)            | 0.5     | 2.0     | 1.5         | 1.7  | 0.3       |
| THICKNESS (KM)               | 1.0     | 2.5     | 1.5         | 2.0  | 0.4       |
| SUBSURFACE AREA (KM**2)      | 1       | 3       | 2           | 2    | 0.4       |

| VOLUME (KM**3)               | 3.3     |         | STD. DEV. = 0.9 |
| THERMAL ENERGY (10**10 J/1)  | 0.91    | STD. DEV. = 0.26 |

REFERENCES: LEONARD, 1970; GREENE AND OTHERS, 1972; MARINER AND OTHERS, 1974; 1975

COMPiled BY: MARINER, R.

CRANE HOT SPRINGS, OREGON
FIELD NAME.................. RIVERSIDE AREA
CIRCULAR REFERENCE........ 195

GEOGRAPHIC LOCALITY
STATE........................ OREGON
COUNTY....................... MALHEUR
LATITUDE.................... 43°28.0' N
LONGITUDE................... 118°11.3' W
MAPS........................ BURNS 1:250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
24S 37E 20 WILLAMETTE

GENERAL INFORMATION
WARING FIGURE.................. 6
WARING NUMBER.................. 84
ELEVATION (M)................... 1098
SURFACE ACTIVITY.............. HOT SPRINGS
NO. OF SPRINGS.................. SEVERAL
SPRING TEMPERATURES (°C)........ 41 TO 63
DISCHARGE (L/MIN). ............. 200
ROCK TYPES: MIocene BASALT
GEOPHYSICS: HEAT FLOW

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>110</td>
<td>34</td>
<td>0.5</td>
<td>240</td>
<td>9.7</td>
<td>160</td>
<td>290</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8</td>
<td>6.0</td>
<td>7.43</td>
</tr>
</tbody>
</table>

DEL 0(18) SO4  DEL 0(18) H2O  DEL 0 H2O
-15.15  -134.0
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>137</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>96</td>
</tr>
<tr>
<td>NA-K</td>
<td>98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>137</td>
</tr>
<tr>
<td>Conductive</td>
<td>143</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>116</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>92</td>
</tr>
<tr>
<td>Opal</td>
<td>22</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>96 (I)</td>
<td>143 (A)</td>
<td>116 (D)</td>
<td>118</td>
<td>10</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

- A) Quartz Conductive
- B) Quartz Adiabatic
- C) Quartz Conductive, PH-Corrected
- D) Chalcedony
- E) Chalcedony, PH-Corrected

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### References

- Reference 1: Mariner and Others, 1974b, 1975; Walker and Repenning, 1965; Waring, 1965
- Compiled by: Mariner, R.
- Riverside Area, Oregon
**FIELD NAME**................. MICKEY SPRINGS  
**KGRA OR OTHER NAME**......... ALVORD KGRA  
**CIRCULAR REFERENCE**.......... 196

**GEOGRAPHIC LOCALITY**
- **STATE**..................... OREGON  
- **COUNTY**.................... HARNEY  
- **LATITUDE**.................. 42-40.5 N  
- **LONGITUDE**................. 118-20.7 W  
- **MAPS**..................... ADEL 11250,000

**TOWNSHIP** | **RANGE** | **SECTION** | **BASE & MERIDIAN**
--- | --- | --- | ---
33S | 35E | 13 | WILLAMETTE

**GENERAL INFORMATION**
- **AREA OF SURFACE EXPRESSION (KM$$^2$$)**. 0.1  
- **ELEVATION (M)**.................. 1238  
- **SURFACE ACTIVITY**............... HOT SPRINGS AND MUD POTS  
- **ASSOCIATED DEPOSITS**............. SINTER  
- **NO. OF SPRINGS**.................. 4 TO 6  
- **SPRING TEMPERATURES (C)**........ 73  
- **DISCHARGE (L/MIN)**.............. 100  
- **ROCK TYPES**: MIocene ANDESITIC TUFF-BRECCIA, BASALTS, AND ANDESITE

**CHEMISTRY**
- **SAMPLE SOURCE**.... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>C03</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>200</td>
<td>0.9</td>
<td>0.1</td>
<td>550</td>
<td>35</td>
<td>774</td>
<td>11</td>
<td>230</td>
<td>240</td>
</tr>
</tbody>
</table>

**F** | **H** | **Pm** | **DEL 0(18) S04** | **DEL 0(18) H20** | **DEL 0 H20**
--- | --- | --- | --- | --- | ---
16 | 10.5 | 8.05 | -7.91 | -13.42 | -124.3
### Geothermometers (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-Ca (1/3)</td>
<td>207</td>
</tr>
<tr>
<td>Na-K-Ca (4/3)</td>
<td>330</td>
</tr>
<tr>
<td>Na-K</td>
<td>136</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>168</td>
</tr>
<tr>
<td>Conductive</td>
<td>180</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>159</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>130</td>
</tr>
<tr>
<td>Opal</td>
<td>56</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SULFATE</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>273</td>
</tr>
<tr>
<td>One-Step Steam Loss</td>
<td>227</td>
</tr>
<tr>
<td>Continuous Steam Loss</td>
<td>240</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>180 (A)</td>
<td>227 (K)</td>
<td>207 (I)</td>
<td>205</td>
<td>10</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

**A** Quartz Conductive
**B** Quartz Conductive, PH-Corrected
**C** Quartz Adiabatic
**D** Chalcedony
**E** Chalcedony, PH-Corrected
**F** Cristobalite
**G** Anomorphous Silica
**H** Na-K
**I** Na-K-Ca
**J** Na-K-Ca, Mg-Corrected
**K** Sulfate Geothermometer
**L** Surface Temperature
**M** Well Temperature
**N** Mixing Model
**O** Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thickness (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Subsurface Area (km²)</th>
<th>1</th>
</tr>
</thead>
</table>

Based on AMI Survey.

<table>
<thead>
<tr>
<th>Volume (km³)</th>
<th>12.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD. DEV. = 6.7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10¹⁸ J)</th>
<th>6.54</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD. DEV. = 3.46</td>
<td></td>
</tr>
</tbody>
</table>

### References:
Mariner and Others, 1974; 1975; Walker and Repenning, 1965; USGS File Data.

Compiled by: Mariner, R.

Mickey Springs, Oregon.
FIELD NAME: ALVORD HOT SPRINGS
KURA OR OTHER NAME: ALVORD KGRA
CIRCULAR REFERENCE: 197

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: HARNEY
LATITUDE: 42°32.6' N
LONGITUDE: 118°31.6' W
MAPS: ADEL 1250X000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J4S J4E 33 WILLAMETTE

GENERAL INFORMATION
WARING FIGURE: 6
WARING NUMBER: 68
AREA OF SURFACE EXPRESSION (KM²): 0.5
ELEVATION (M): 1250
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (°C): 76
DISCHARGE (L/MIN): 500
ROCK TYPES: MIocene RHYODACITE, BASALT AND ANDESITE

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>S0₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>120</td>
<td>12</td>
<td>2.2</td>
<td>960</td>
<td>69</td>
<td>1196</td>
<td>1</td>
<td>220</td>
<td>780</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18)</th>
<th>S0₄</th>
<th>DEL 0(18)</th>
<th>H₂0</th>
<th>DEL 0 H₂0</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2</td>
<td>30</td>
<td>6.73</td>
<td>-6.05</td>
<td>-13.23</td>
<td>-123.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) .......... 199
- NA-K-CA (4/3) .......... 257
- NA-K- .......... 148

SILICA
- ADIABATIC .......... 141
- CONDUCTIVE .......... 148
- CHALCEDONY .......... 122
- CHRISTOBALITE .......... 97
- OPAL .......... 26

SULFATE
- CONDUCTIVE .......... 231
- ONE-STEP STEAM LOSS .... 281
- CONTINUOUS STEAM LOSS .. 209

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>148 (A)</td>
<td>231 (K)</td>
<td>164 (J)</td>
<td>181</td>
<td>18</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, PH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, PH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsurface area (km²)</td>
<td>1</td>
<td>6</td>
<td>2</td>
<td>3.0</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Based on A.M.I. survey.

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume (km³)</td>
<td>5.0</td>
<td></td>
<td></td>
<td>STD. DEV. = 2.1</td>
<td></td>
</tr>
<tr>
<td>Thermal energy (10¹¹ J)</td>
<td>2.24</td>
<td></td>
<td></td>
<td>STD. DEV. = 0.96</td>
<td></td>
</tr>
</tbody>
</table>

References: Mariner and others, 1974; 1975; Walker and Repenning, 1965; Waring, 1965; USGS file data

Compiled by: Mariner, R., Alvord Hot Springs, Oregon
FIELD NAME.................. HOT (BORAX) LAKE AREA
KURA OR OTHER NAME........ ALVORO KGPA
CIRCULAR REFERENCE......... 198

GEOGRAPHIC LOCALITY
STATE..................... OREGON
COUNTY.................... HARNEY
LATITUDE.................. 42-20.1 N
LONGITUDE................ 118-36.0 W
MAPS...................... ADEL U250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J/S 33E 15 WILLAMETTE

GENERAL INFORMATION
WARING FIGURE...................... 6
WARING NUMBER...................... 6970
AREA OF SURFACE EXPRESSION (KM^2) 0.1
ELEVATION (M)...................... 1235
SURFACE ACTIVITY.................. HOT SPRINGS
ASSOCIATED DEPOSITS.............. SINTER
NO. OF SPRINGS..................... SEVERAL
SPRING TEMPERATURES (C).......... 36 TO 96
DISCHARGE (L/MIN)................ 3500
ROCK TYPES: QUATERNARY ALLUVIUM AND PLAYA DEPOSITS, MIOCENE TO PLIOCENE BASALTS
GEOFYSICS: GRAVITY, MAGNETIC, HEAT FLOW, AMT

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1974
FLOW (L/MIN)..... 15

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>96</td>
<td>160</td>
<td>14</td>
<td>0.3</td>
<td>450</td>
<td>28</td>
<td>374</td>
<td>4</td>
<td>434</td>
<td>250</td>
</tr>
</tbody>
</table>

F         | 7.2  | 14 | 7.30 | DEL 0(18) S04 | DEL 0(18) H20 | DEL D H20
7.2 | 14 | 7.30 | -0.58 | -14.36 | -125.4 |
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>176</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>178</td>
</tr>
<tr>
<td>Na-K</td>
<td>134</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>156</td>
</tr>
<tr>
<td>Conductive</td>
<td>165</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>142</td>
</tr>
<tr>
<td>Cristobalite</td>
<td>115</td>
</tr>
<tr>
<td>Opal</td>
<td>42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sulfate</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>265</td>
</tr>
<tr>
<td>One-Step Steam Loss</td>
<td>231</td>
</tr>
<tr>
<td>Continuous Steam Loss</td>
<td>240</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (C)</td>
<td>165 (C)</td>
<td>231 (K)</td>
<td>176 (I)</td>
<td>191</td>
<td>14</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz Conductive
- B) Quartz Conductive, PH-Corrected
- C) Quartz Adiabatic
- D) Chalcedony
- E) Chalcedony, PH-Corrected
- F) Cristobalite
- G) Amorphous Silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, MG-Corrected
- K) Sulfate Geothermometer
- L) Surface Temperature
- M) Well Temperature
- N) Mixing Model
- O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>5.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Subsurface Area (km²)</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on AMT Survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volume (km³)</td>
<td>8.3</td>
<td>STD. DEV. = 3.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal energy (10^8 J)</td>
<td>3.95</td>
<td>STD. DEV. = 1.71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: Sampled spring along fracture north of Hot Lake, no evidence of mixing of waters issuing along the fracture.

References: Mariner and others, 1974b, 1975a, Walker and Repenning, 1965a, Waring, 1965a, USGS file data

Compiled by: Mariner, R.

Hot (HORAX) Lake Area, Oregon
FIELD NAME: TROUT CREEK AREA
CIRCULAR REFERENCE: 199

**GEOGRAPHIC LOCALITY**

- **STATE:** OREGON
- **COUNTY:** HARNEY
- **LATITUDE:** 42°11.4' N
- **LONGITUDE:** 118°23.0' W
- **MAPS:** ADEL 11250, 000

<table>
<thead>
<tr>
<th>TOWNSHIP RANGE SECTION</th>
<th>BASE &amp; MERIDIAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>39S 37E 16</td>
<td>WILLAMETTE</td>
</tr>
</tbody>
</table>

**GENERAL INFORMATION**

- **WARING FIGURE:** 6
- **WARING NUMBER:** 72
- **ELEVATION (M):** 1738
- **SURFACE ACTIVITY:** HOT SPRINGS AND SEEPS
- **NO. OF SPRINGS:** SEVERAL
- **SPRING TEMPERATURES (°C):** 52
- **DISCHARGE (L/MIN):** 200
- **ROCK TYPES:** MIocene to Pliocene Basalt, Andesite, and Rhyolite Flows
- **GEOPHYSICS:** HEAT FLOW

**CHEMISTRY**

**SAMPLE SOURCE:** MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>105</td>
<td>18</td>
<td>0.8</td>
<td>270</td>
<td>10.8</td>
<td>439</td>
<td>1</td>
<td>204</td>
<td>24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0 H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.8</td>
<td>6.77</td>
<td>-9.22</td>
<td>-16.17</td>
<td>-127.4</td>
</tr>
<tr>
<td>CATION</td>
<td>NA-K-CA (1/3)</td>
<td>NA-K-CA (4/3)</td>
<td>NA-K</td>
<td>SULFATE</td>
</tr>
<tr>
<td>------------</td>
<td>---------------</td>
<td>---------------</td>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>143</td>
<td>118</td>
<td>97</td>
<td>135</td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIABATIC</td>
<td>135</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>114</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHRISTOBALITE</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>140 (A)</td>
<td>180</td>
<td>143 (I)</td>
<td>154</td>
<td>9</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

- A) Quartz conductive
- B) Quartz conductive, PH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, PH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>0.5</th>
<th>2.0</th>
<th>1.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM^2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Based on standard estimate.

- Volume (KM^3): 3.3, STD. DEV. = 0.9
- Thermal energy (10^18 J): 1.25, STD. DEV. = 0.36

References: Marinier and others, 1974a, 1975b; Walker and Repenning, 1965; Waring, 1965; Bowen and others, 1977

Compiled by R. Marinier, Trout Creek Area, Oregon
FIELD NAME: MCDEMITT AREA
CIRCULAR REFERENCE: 200

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: MALHEUR
LATITUDE: 42°04.7' N
LONGITUDE: 117°45.6' W
MAPS: JORDAN VALLEY 11250,000

TOWNSHIP RANGE SECTION
40S 42E 25
BASE & MERIDIAN
WILLAMETTE

GENERAL INFORMATION
WARMING FIGURE: 6
WARMING NUMBER: 86
ELEVATION (M): 1891
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
SPRING TEMPERATURES (°C): 52
DISCHARGE (L/MIN): 750

ROCK TYPES: TERTIARY AND QUATERNARY PEDIMENT GRAVELS, MIocene BASALT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>72</td>
<td>0.6</td>
<td>0.1</td>
<td>130</td>
<td>1.0</td>
<td>237</td>
<td>13</td>
<td>52</td>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.6</td>
<td>1.1</td>
<td>8.79</td>
<td>-16.95</td>
<td>-134.6</td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
- NA-K-CA (1/3) ....... 90
- NA-K-CA (4/3) ....... 104
- NA-K ............... 3

SILICA
- ADIABATIC .......... 118
- CONDUCTIVE .......... 120
- CHALCEDONY .......... 91
- CHISTOSILICATE ....... 69
- OPAL ............... 1

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Temp (°C)</td>
<td>84 (E)</td>
<td>120 (A)</td>
<td>90 (I)</td>
<td>98</td>
<td>8</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>Property</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Top (km)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Thickness (km)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Subsurface Area (km^2)</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

VOLUME (km^3) .............. 3.3

THERMAL ENERGY (10^18 J) .... 0.75

COMMENTS: RESERVOIR TEMPERATURE MAY BE LESS THAN 90 DEG C.


COMPILED BY: MARINER, R.

MCDERMOTT AREA, OREGON
FIELD NAME: MEDICAL HOT SPRINGS
CIRCULAR REFERENCE: 201

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: UNION
LATITUDE: 45°01.1' N
LONGITUDE: 117°37.5' W

TOWNSHIP RANGE SECTION
96S 41E 25 NE

BASE & MERIDIAN
MEDICAL SPRINGS 1124,000

GENERAL INFORMATION
WADING FIGURE: 6
WADING NUMBER: 12
ELEVATION (M): 1060
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2 GROUPS
SPRING TEMPERATURES (°C): 60
DISCHARGE (L/MIN): 200
ROCK TYPES: MIocene BASALTS AND ANDESITES; PALEOZOIC METAVOLCANIC ROCKS

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS 1974, 1975

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>80</td>
<td>72</td>
<td>0.2</td>
<td>190</td>
<td>7.0</td>
<td>26</td>
<td></td>
<td>400</td>
<td>77</td>
</tr>
</tbody>
</table>

1° | H | PH | DEL O(18) SO₄ | DEL O(18) H₂O | DEL O H₂O |
| 1.2| 2.2| 8.23| -16.99 | -130.2 |
**GEOTHERMOMETERS (°C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>66</td>
<td>125</td>
<td>97 (D)</td>
<td>96</td>
<td>12</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SILICA**

<table>
<thead>
<tr>
<th></th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>60</td>
<td>125</td>
<td>97 (D)</td>
<td>96</td>
<td>12</td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RESEVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1.0</td>
<td>3.0</td>
<td>2.0</td>
<td>0.9</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

**REFERENCES:**
MARINER AND OTHERS, 1974B; 1975; WALKER, 1973; WARING, 1965

**COMPILED BY:** MARINER, R.

**MEDICAL HOT SPRINGS, OREGON**
FIELD NAME: LITTLE VALLEY AREA
CIRCULAR REFERENCE: 202

GEOGRAPHIC LOCALITY
STATE: OREGON
COUNTY: MALHEUR
LATITUDE: 43°53.5'N
LONGITUDE: 117°30.0'W
MAPS: HARPER 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
19S 43E 30 NW WILLAMETTE

GENERAL INFORMATION
WARING FIGURE: 6
WARING NUMBER: 76
ELEVATION (M): 756
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: SEVERAL
DISCHARGE (L/MIN): 550
ROCK TYPES: PLIOCENE BASALTS, VOLCANIC DERIVED SEDIMENTARY ROCK

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TEMPERATURE (°C)</th>
<th>S102</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>115</td>
<td>3.2</td>
<td>160</td>
<td>3.2</td>
<td>127</td>
<td>1</td>
<td>110</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

F | H | pH | DEL 0(18) S04 | DEL 0(18) H2O | DEL 0 H2O
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.8</td>
<td>4.7</td>
<td>8.71</td>
<td>-0.63</td>
<td>-16.52</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3) ............ 118
NA-K-CA (4/3) ............ 109
NA-K ................... 51

SILICA
ADIA BATIC ............. 139
CONDUCTIVE ............ 145
CHALCEDONY .......... 119
CRISTOBALITE ............ 95
OPAL ................... 24

SULFATE
CONDUCTIVE ............ 215
ONE-STEP STEAM LOSS ... 189
CONTINUOUS STEAM LOSS .. 195

RESERVOIR PROPERTIES

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.

SUBSURFACE TEMP (C) 118 (D:1) 145 (A) 118 (D:1) 127 6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUANTZ ADIA BATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.

DEPTH TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM^2) 1 3 2

VOLUME (KM^3) .......... 3.3

THERMAL ENERGY(10^18 J) 1.01

STD. DEV. = 0.9
STD. DEV. = 0.29

COMMENTS: SULFATE ISOTOPE GEOTHERMOMETER INDICATES A HIGHER TEMPERATURE (215 DEG C) AND MAY INDICATE A DEEP SYSTEM.


COMPILLED BY: MARINER, R.

LITTLE VALLEY AREA, OREGON
FIELD NAME .................. NEAL HOT SPRINGS
CIRCULAR REFERENCE ........ 203

GEOGRAPHIC LOCALITY
STATE ...................... OREGON
COUNTY ..................... MALHEUR
LATITUDE .................. 44-01.4 N
LONGITUDE .................. 117-27.6 W
MAPS ...................... JAMIESON 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
11S 43E 09 NW WILLAMETTE

GENERAL INFORMATION
WARING FIGURE ...................... 6
WARING NUMBER ...................... 75
ELEVATION (M) ...................... 793
SURFACE ACTIVITY .................. HOT SPRINGS
ASSOCIATED DEPOSITS ................ SINTER
SPRING TEMPERATURES (C) .......... 87
DISCHARGE (L/MIN) ................. 100
ROCK TYPES: MIocene(?) FLOWS (BASALTIC)

CHEMISTRY
SAMPLE SOURCE .... MARINER AND OTHERS, 1974, 1975

<table>
<thead>
<tr>
<th>TFM (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>87</td>
<td>140</td>
<td>8.8</td>
<td>0.2</td>
<td>190</td>
<td>16</td>
<td>198</td>
<td>120</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>pH</th>
<th>Del 0(18) SO4</th>
<th>Del 0(18) H2O</th>
<th>Del D H2O</th>
</tr>
</thead>
</table>
**GEOTHERMOMETERS (C)**

- **CATION**
  - Na-K-CA (1/3) ............ 181
  - Na-K-CA (4/3) ............ 151
  - Na- ................. 165

- **SILICA**
  - Adiabatic .............. 162
  - Conductive .............. 173
  - Chalcedony ............. 151
  - Cristobalite ............ 123
  - Opal .................. 50

- **SULFATE**
  - Conductive .............. 210
  - One-step steam loss .... 149
  - Continuous steam loss .. 194

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (°C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>173 (A)</td>
<td>210 (K)</td>
<td>181 (I)</td>
<td>188</td>
<td>8</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement:

- A) Quartz conductive
- B) Quartz conductive, PH-corrected
- C) Quartz adiabatic
- D) Chalcedony
- E) Chalcedony, PH-corrected
- F) Cristobalite
- G) Amorphous silica
- H) Na-K
- I) Na-K-CA
- J) Na-K-CA, Mg-corrected
- K) Sulfate geothermometer
- L) Surface temperature
- M) Well temperature
- N) Mixing model
- O) Renner and others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| THICKNESS (KM)    | 1.0     | 2.5     | 1.5         |      |           |
|                   |         |         |             |      |           |

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM²)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on: standard estimate

<table>
<thead>
<tr>
<th>VOLUME (KM³)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THERMAL ENERGY (10¹¹B J)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.56</td>
<td></td>
<td></td>
<td></td>
<td>0.44</td>
</tr>
</tbody>
</table>


Compiled by: Mariner, R.

Neal Hot Springs, Oregon
FIELD NAME................. VALE HOT SPRINGS
KGRA OR OTHER NAME........ VALE HOT SPRINGS KGRA
CIRCULAR REFERENCE........ 204

GEOGRAPHIC LOCALITY
STATE...................... OREGON
COUNTY..................... MALHEUR
LATITUDE.................. 43°59.4' N
LONGITUDE.................. 117°14.0' W
MAPS....................... VALE EAST 1:24,000 BOISE 1:1250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
18S 45E 20 WILLAMETTE

GENERAL INFORMATION
WARING FIGURE...................... 6
WARING NUMBER...................... 77
ELEVATION (M)...................... 671
SURFACE ACTIVITY................... HOT SPRINGS
NO. OF SPRINGS..................... TWO GROUPS
SPRING TEMPERATURES (C)............ 73 TO 97
DISCHARGE (L/Min).................. 76
ROCK TYPES: TUFFACEOUS LACUSTRINE DEPOSITS OVERLYING TERTIARY BASALT AND RHYOLITE
GEOPHYSICS: GRAVITY, HEAT FLOW, AMT, MAGNETIC

CHEMISTRY
SAMPLE SOURCE.... MARINER AND OTHERS, 1975

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>130</td>
<td>19</td>
<td>0.8</td>
<td>310</td>
<td>16</td>
<td>143</td>
<td></td>
<td>100</td>
<td>360</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18) SI02</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>9.4</td>
<td>7.47</td>
<td>-3.91</td>
<td>-15.00</td>
<td>-135.0</td>
</tr>
</tbody>
</table>
### Geothermometers (C)

<table>
<thead>
<tr>
<th>Cation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>157</td>
</tr>
<tr>
<td>Na-K-CA (4/3)</td>
<td>135</td>
</tr>
<tr>
<td>Na-K</td>
<td>118</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Silica</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adiabatic</td>
<td>145</td>
</tr>
<tr>
<td>Conductive</td>
<td>152</td>
</tr>
<tr>
<td>Chalcedony</td>
<td>127</td>
</tr>
<tr>
<td>Chrysoalite</td>
<td>102</td>
</tr>
<tr>
<td>Opal</td>
<td>31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sulfate</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conductive</td>
<td>161</td>
</tr>
<tr>
<td>One-step steam loss</td>
<td>149</td>
</tr>
<tr>
<td>Continuous steam loss</td>
<td>151</td>
</tr>
</tbody>
</table>

### Reservoir Properties

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>152 (A)</td>
<td>161 (K)</td>
<td>157 (I)</td>
<td>157</td>
<td>2</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgment.

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, pH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Thickness (km)                | 1.0     | 2.5     | 1.5         |       |           |

| Subsurface Area (km²)         | 10      | 150     | 50          | 70.0  | 29.4      |

Volume (km³) = 116.7, std. dev. = 54.5

Thermal Energy (10¹⁰ J) = 44.62, std. dev. = 20.85

**Comments:** Sulfate isotopes on a sample collected by H. Young from a 90 deg C spring. Sulfate determination on the sample collected by Mariner and others indicated 201 deg C. Area includes Cow Hollow heat flow anomaly.

**References:** Mariner and Others, 1975; Hoover and Long, 1975; Bowen and Blackwell, 1975

**Compiled By:** Mariner, R. and Brook, C.

Valle Hot Springs, Oregon
Utah
FIELD NAME: ABRAHAM (BAKER, CRATER) HOT SPRINGS
KGRA OR OTHER NAME: CRATER SPRINGS KGRA
CIRCULAR REFERENCE: 205

GEOGRAPHIC LOCALITY
STATE: UTAH
COUNTY: JUAN
LATITUDE: 39°36.8' N
LONGITUDE: 112°43.9' W
MAPS: BAKER HOT SPRINGS 1:24,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
14S 08W 10 SAULT UAKE

GENERAL INFORMATION
WATER FIGURE: 7
WATER NUMBER: 24
ELEVATION (M): 1408
SURFACE ACTIVITY: HOT SPRINGS AND WARM, MOIST VAPORS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPINGS: 4
SPRING TEMPERATURES (°C): 43 TO 84
DISCHARGE (L/MIN): MORE THAN 1000
ROCK TYPES: QUATERNARY BASALT OVERLYING LACUSTRINE DEPOSITS
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, AMT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977
FLOW (L/MIN): 1000
COLLECTION DATE: 1974/12/15

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SiO₂</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO₃</th>
<th>CO₃</th>
<th>SO₄</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>84</td>
<td>69</td>
<td>340</td>
<td>52</td>
<td>830</td>
<td>57</td>
<td>156</td>
<td>LT 1</td>
<td>680</td>
<td>1500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>B</th>
<th>PH</th>
<th>DEL H₂O</th>
<th>DEL H₂O</th>
<th>DEL O₁₈</th>
<th>DEL O₁₈</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>0.66</td>
<td>6.48</td>
<td>+12.77</td>
<td>-16.09</td>
<td>-126.3</td>
<td></td>
</tr>
</tbody>
</table>
GEOThERMOMETERS (C)

CATION
NA-K-CA (1/3).............. 164
NA-K-CA (4/3).............. 121
NA-K........................ 144
SILICA
ADIABATIC.................. 116
CONDUCTIVE.................. 117
CHALCEDONY................. 89
CHRISTOBALITE.............. 67
OPAL........................ -1
SULFATE
CONDUCTIVE.................. 22
UNSTEAD STEAM LOSS........ 25
CONTINUOUS STEAM LOSS..... 26

RESERVOIR PROPERTIES
SUBSURFACE TEMP (°C) 86 (J) 117 (A) 89 (D) MEAN 97 STD. DEV. 7

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOThERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPTH TO TOP (KM) 0.5 2.0 1.5
THICKNESS (KM) 1.0 2.5 1.5 1.7 0.3
SUBSURFACE AREA (KM²) 1 6 4

BASED ON AMT AND GRAVITY SURVEYS
VOLUME (KM³).............. 6.1 STD. DEV. = 2.1
THERMAL ENERGY (10¹⁰ J) 1.36 STD. DEV. = 0.48

COMMENTS: THE VERY LOW TEMPERATURE ESTIMATED FROM THE SO4 GEOThERMOMETER MAY INDICATE A LOW TEMPERATURE SOURCE FOR THE SULFATE ONLY.

REFERENCES: MARINER AND OTHERS, 19771 MUNDOFF, 19701 SMITH, 19741 SHUEY, 19741 JOHNSON, 19741 USGS FILE
DATA; NASH AND OTHERS, 1978
COMPILED BY: MARINER, R. AND BROOK, C.

ADHARAN (DAKER, CRATER) HOT SPRINGS, UTAH
FIELD NAME: MONROE-RED HILL HOT SPRINGS
KGRA OR OTHER NAME: MONROE-JOSEPH KGRA
CIRCULAR REFERENCE: 706

GEOGRAPHIC LOCALITY
STATE: UTAH
COUNTY: SEVIER
LATITUDE: 38-38.2 N
LONGITUDE: 112-06.2 W
MAPS: MONROE 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
25S 03W 10-11 SALT LAKE

GENERAL INFORMATION
WADING FIGURE: 7
WADING NUMBER: 48
AREA OF SURFACE EXPRESSION (KM²): 0.1
ELEVATION (M): 1676
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 3 MAIN SPRINGS
SPRING TEMPERATURES (°C): 41 TO 76
DISCHARGE (L/MIN): MORE THAN 1200
ROCK TYPES: PLIOCENE LATITE, BASALTIC ANDESITE, AND RHYOLITE

PHYSICS: TEMPERATURE GRADIENT (D. CHAPMAN, UNPUB. DATA)

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977
FLOW (L/MIN): 175
COLLECTION DATE: 1974/12/16

<table>
<thead>
<tr>
<th>TEMP(°C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>76.5</td>
<td>58</td>
<td>240</td>
<td>34</td>
<td>590</td>
<td>60</td>
<td>416</td>
<td></td>
<td>890</td>
<td>660</td>
</tr>
</tbody>
</table>

F   B   PH   DEL 0(18) SO4   DEL 0(18) H2O   DEL 0 H2O
2.8 2.8 6.25          +8.21             -16.95        -127.3
**Geothermometers (C)**

**Cation**
- Na-K-CA (1/3).......... 180
- Na-K-CA (4/3).......... 123
- Na-K................... 186

**Silica**
- A) Diabatic............. 109
- B) Conductive.......... 109
- C) Chalcedony.......... 79
- D) Cristobalite........ 58
- E) Opal................... -8

**Sulfate**
- Conductive............. 40
- One-Step Steam Loss... 42
- Continuous Steam Loss.. 42

**Reservoir Properties**

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>79</td>
<td>114</td>
<td>109</td>
<td>101</td>
<td>8</td>
</tr>
</tbody>
</table>

**Uncoded Temperature Indicates Subjective Judgement**

A) Quartz Conductive
B) Quartz Conductive, pH-Corrected
C) Quartz Diabatic
D) Chalcedony
E) Chalcedony, pH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

**Depth to Top (km)**
- Minimum: 0.5
- Maximum: 2.0
- Most Likely: 1.5
- Mean: 1.7
- Std. Dev.: 0.3

**Thickness (km)**
- Minimum: 1.0
- Maximum: 2.5
- Most Likely: 1.5
- Mean: 2.8
- Std. Dev.: 0.8

**Subsurface Area (km²)**
- Minimum: 1.5
- Maximum: 5
- Most Likely: 2
- Mean: 2.8
- Std. Dev.: 0.8

**Volume (km³)**
- Minimum: 4.7
- Maximum: 1.09
- Most Likely: 1.1
- Mean: 1.09
- Std. Dev.: 0.38

**Comments:** Analysis for Red Hill Hot Spring, Monroë and Red Hill Hot Springs have virtually identical chemical and isotopic compositions and are considered to be part of the same system. Gypsum and Jarosite may be interfering with the 504 Geothermometer.

**References:** Mariner and Others, 1977; Mundorff, 1970; Callaghan and Parker, 1961

**Compiled By:** Mariner, R. and Brook, C.

Monroe-RFD Hill Hot Springs, Utah
**FIELD NAME**................. JOSEPH HOT SPRINGS
**KGRA OR OTHER NAME**....... MONROE-JOSEPH KGRA
**CIRCULAR REFERENCE**....... 207

**GEOGRAPHIC LOCALITY**

<table>
<thead>
<tr>
<th>STATE</th>
<th>COUNTY</th>
<th>LATITUDE</th>
<th>LONGITUDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UTAH</td>
<td>SEVIER</td>
<td>38°16.7' N</td>
<td>112°11.2' W</td>
</tr>
</tbody>
</table>

**MAPS**.......................... MONROE 1162,500

<table>
<thead>
<tr>
<th>TOWNSHIP</th>
<th>RANGE</th>
<th>SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>25S</td>
<td>04W</td>
<td>20</td>
</tr>
</tbody>
</table>

**BASE & MERIDIAN**.............. SALT LAKE

**GENERAL INFORMATION**

<table>
<thead>
<tr>
<th>WAKING FIGURE</th>
<th>WAKING NUMBER</th>
<th>ELEVATION (M)</th>
<th>SURFACE ACTIVITY</th>
<th>ASSOCIATED DEPOSITS</th>
<th>NO. OF SPRINGS</th>
<th>SPRING TEMPERATURES (C)</th>
<th>DISCHARGE (L/MIN)</th>
<th>ROCK TYPES</th>
<th>GEOPHYSICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>49</td>
<td>1676</td>
<td>HOT SPRINGS</td>
<td>TRAVERTINE</td>
<td>SEVERAL</td>
<td>60 TO 64</td>
<td>114</td>
<td>PLOIocene LAtite, RHYOLITE, AND BASALTIC ANDESITE</td>
<td>AMT</td>
</tr>
</tbody>
</table>

**CHEMISTRY**

**SAMPLE SOURCE**.............. MARINER AND OTHERS, 1977
**FLOW (L/Min)**.............. LT 20
**COLLECTION DATE**........... 1974/12/17

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI02</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HC03</th>
<th>C03</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>63</td>
<td>90</td>
<td>200</td>
<td>44</td>
<td>1450</td>
<td>50</td>
<td>408</td>
<td>1200</td>
<td>1700</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>pH</th>
<th>DEL O(18) S04</th>
<th>DEL O(18) H20</th>
<th>DEL O H20</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>4.9</td>
<td>6.51</td>
<td>-17.32</td>
<td>-133.4</td>
<td></td>
</tr>
</tbody>
</table>
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>NA-K-CA (1/3)</th>
<th>142</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NA-K-CA (4/3)</td>
<td>131</td>
</tr>
<tr>
<td></td>
<td>NA-K</td>
<td>86</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>ADIABATIC</th>
<th>128</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CONDUCTIVE</td>
<td>131</td>
</tr>
<tr>
<td></td>
<td>CHALCEDONY</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>CRISTOBALITE</td>
<td>81</td>
</tr>
<tr>
<td></td>
<td>OPAL</td>
<td>12</td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>87 (J)</td>
<td></td>
<td>131 (A)</td>
<td>104 (D)</td>
<td>107</td>
<td>9</td>
</tr>
</tbody>
</table>

**SUBSURFACE TEMP (C)**

- UNCONED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
- A) QUARTZ CONDUCTIVE
- B) QUARTZ CONDUCTIVE, PH-CORRECTED
- C) QUARTZ ADIABATIC
- D) CHALCEDONY
- E) CHALCEDONY, PH-CORRECTED
- F) CRISTOBALITE
- G) AMORPHOUS SILICA
- H) NA-K
- I) NA-K-CA
- J) NA-K-CA, MG-CORRECTED
- K) SULFATE GEOTHERMOMETER
- L) SURFACE TEMPERATURE
- M) WELL TEMPERATURE
- N) MIXING MODEL
- O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>2.0</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**VOLUME (KM**3**),............. 3.3**

**THERMAL ENERGY**

| 10**18 J | 0.83 | 0.25 |

**COMMENTS**: ESTIMATED RESERVOIR TEMPERATURES ARE SIMILAR TO MONROE RED HILL SYSTEM 8 KM ENE OF JOSEPH.

**REFERENCES**: MARINER AND OTHERS, 1977; MUNDORFF, 1970; CALLAGHAN AND PARKER, 1961

**COMPILED BY**: MARINEK, R. AND BROOK, C.

JOSEPH HOT SPRINGS, UTAH
FIELD NAME: COVE FORT - SULPHURDALE
KGRA OR OTHER NAME: COVE FORT - SULPHURDALE KGRA
CIRCULAR REFERENCE: 208

GEOGRAPHIC LOCALITY
STATE: UTAH
COUNTY: MILLAR AND BEAVER
LATITUDE: 38°36.4' N
LONGITUDE: 112°33.0' W
MAPS: COVE FORT 1162, 500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
25S 06W 32 SALT LAKE

GENERAL INFORMATION
ELEVATION (M): 1951
SURFACE ACTIVITY: H2S GAS SEEPS
ASSOCIATED DEPOSITS: SULFUR AND SINTER
NO. OF SPRINGS: NONE
NO. OF WELLS: 3
WELL DEPTHS (M): 582 TO 2226
MAXIMUM WELL TEMP (C): 179 AT DEPTH (M) 2226

ROCK TYPES: OLIGOCENE LATITE AND ANDESITE OVERLYING MESOZOIC AND PALEOZOIC SANDSTONE, SHALE, AND CARBONATE ROCKS. PLEISTOCENE (?) BASALT NEARBY
GEOPHYSICAL TEMPERATURE GRADIENT
<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>150</td>
<td>180</td>
<td>170</td>
<td>167</td>
<td>6</td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE  F) CRISTOBALITE  
A) QUARTZ CONDUCTIVE, PH-CORRECTED  G) AMORPHOUS SILICA  
C) QUARTZ ADAMATIC  H) NA-K  
D) CHALCEDONY  I) NA-K-CA  
E) CHALCEDONY, PH-CORRECTED  J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEPTH TO TOP (KM)</td>
<td>0.6</td>
<td>2.0</td>
<td>1.5</td>
<td>1.6</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.4</td>
<td>1.5</td>
<td>24.0</td>
</tr>
<tr>
<td>SUHSSURFACE AREA (KM²)</td>
<td>15</td>
<td>35</td>
<td>22</td>
<td>39.2</td>
</tr>
</tbody>
</table>

B) BASED ON TEMPERATURE GRADIENT SURVEY

VOLUME (KM³)............. 39.2  STD. DEV. = 9.8  
THERMAL ENERGY(10¹³J).... 16.05  STD. DEV. = 4.06

COMMENTS: MINIMUM, MAXIMUM, AND MOST LIKELY TEMPERATURES ARE BASED ON MEASURED TEMPERATURES FROM A SINGLE WELL AT 610, 2226, AND 1830 M RESPECTIVELY. SUBSURFACE TEMPERATURES MAY BE HIGHER IN OTHER LOCATIONS. SULFUR DEPOSITS IN ZONE 9 KM LONG.


COMPILED BY: MARINER, R. AND BROOK, C.

COVE FORT - SULPHURDALE, UTAH
FIELD NAME ................ ROOSEVELT (MCKEANS) HOT SPRINGS
KGRA ON OTHER NAME ......... ROOSEVELT HOT SPRINGS KGRA
CIRCULAR REFERENCE......... 209

GEOGRAPHIC LOCALITY
STATE ...................... UTAH
COUNTY ..................... BEAVER
LATITUDE ................... 38-30.0 N
LONGITUDE ................... 112-50.9 W
MAPS ...................... RICHFIELD 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
27S 09W 03 NW SALT LAKE

GENERAL INFORMATION
WARING FIGURE................ 7
WARING NUMBER................ 51
ELEVATION (M)................ 1185
SURFACE ACTIVITY .............. SEEPS
ASSOCIATED DEPOSITS .......... SINTER
NO. OF SPRINGS ............... SEVERAL SEEPS
NO. OF WELLS ................ 7
WELL DEPTHS (M) .............. 382 TO 2234
MAXIMUM WELL TEMP (C) ....... 269? AT DEPTH (M) 1867?
ROCK TYPES: TERTIARY GRANITE INTRUDED INTO PRECAMBRIAN GNEISS
GEOPHYSICS: GRAVITY, MAGNETIC, HEAT FLOW, RESISTIVITY, GROUND NOISE

CHEMISTRY
SAMPLE SOURCE ............... MUNDOF, 1970
COLLECTION DATE ............ 1957/09/11

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SI 02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>313</td>
<td>22</td>
<td></td>
<td>2500</td>
<td>488</td>
<td>156</td>
<td></td>
<td>73</td>
<td>4240</td>
</tr>
<tr>
<td>F</td>
<td>H</td>
<td>PH</td>
<td></td>
<td>DEL 0(18)</td>
<td>504</td>
<td>DEL 0(18)</td>
<td>H20</td>
<td>DEL D H20</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>38</td>
<td>7.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEO THERMOMETERS (C)

CAIION

NA-K-CA (1/3) .......... 284
NA-K-CA (4/1) .......... 446
NA-K ..................... 278

SILICA

ADIMABATIC ............ 195
CONDUCTIVE ............ 213
CHALCEDONY .......... 197
CHISTOBALITE .......... 165
OPAL .................... 88

RESERVOIR PROPERTIES

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
SUBSURFACE TEMP (C) 24 (M) 284 (I) 269 (M) 265 8

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT
A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIMABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CHISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
DEPTH TO TOP (KM) 0.1 2.0 0.8
THICKNESS (KM) 1.5 2.5 2.0 2.0 0.2
SUBSURFACE AREA (KM²) 6 50 15 23.7 9.5

BASED ON AREA OF KNOWN PRODUCTION AND HEAT FLOW SURVEY (D. CHAPMAN, UNPUB. DATA)

VOLUME (KM³) .......... 47.3 STD. DEV. = 19.7
THERMAL ENERGY (10⁶ BTU) 31.99 STD. DEV. = 13.35

COMMENTS: SPRINGS ARE INACTIVE. SINTER DEPOSITS ALONG 4.8 KM TREND. MINIMUM AND MOST LIKELY TEMPERATURES ARE RECORDERD MAXIMUM TEMPERATURES IN TWO WELLS AT 382 AND 1867 M, RESPECTIVELY. SEVEN WELLS ARE CAPABLE OF PRODUCING OVER 4.5 X 10⁵ KG/HR TOTAL MASS FLOW AT 260 C (CIANCANELLI AND CORMAN, 1978). 55 MW CAPACITY PROJECTED.


COMPILED BY: BROOK, C. AND MARINER, R.

ROOSEVELT (MOYFANS) HOT SPRINGS, UTAH
FIELD NAME: THERMO HOT SPRINGS
KGRA OR OTHER NAME: THERMO HOT SPRINGS KGRA
CIRCULAR REFERENCE: 210

GEOGRAPHIC LOCALITY
STATE: UTAH
COUNTY: WEAVER
LATITUDE: 38°11'.N
LONGITUDE: 113°12.2.W

MAPS: THERMO 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
30S 12W 28 Sw of NE SALT LAKE

GENERAL INFORMATION
WARING FIGURE: 7
WARING NUMBER: 52
AREA OF SURFACE EXPRESSION (KM**2): 1.8
ELEVATION (M): 1535
SURFACE ACTIVITY: HOT SPRINGS
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 20
SPRING TEMPERATURES (C): 78 TO 89.5
DISCHARGE (L/MIN): 500 OR MORE
NO. OF WELLS: 1
ROCK TYPES: ALLUVIUM OVERLYING TERTIARY BASALT AND RHYOLITE FLOWS
GEOPHYSICS: AMT

CHEMISTRY
SAMPLE SOURCE: MARINER AND OTHERS, 1977
FLOW (L/MIN): 30
COLLECTION DATE: 1974/12/17

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>89.5</td>
<td>113</td>
<td>71</td>
<td>10</td>
<td>380</td>
<td>52</td>
<td>356</td>
<td>2</td>
<td>480</td>
<td>225</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>6.6</th>
<th>0.93</th>
<th>7.98</th>
</tr>
</thead>
<tbody>
<tr>
<td>PH</td>
<td></td>
<td>-2.52</td>
<td>-14.32</td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

CAIION
- Na-K-CA (1/3).......... 202
- Na-K-CA (4/3).......... 152
- Na-K. .................. 224

SILICA
- ADIABATIC ............... 139
- CONDUCTIVE ............ 144
- CHALCEDONY .......... 118
- CRISTOBALITE ........ 94
- OPAL .................. 23

SULFATE
- CONDUCTIVE ........... 151
- ONE-STEP STEAM LOSS .. 144
- CONTINUOUS STEAM LOSS 145

RESERVOIR PROPERTIES

SUBSURFACE TEMP (°C)  MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.

A) QUARTZ CONDUCTIVE    F) CRISTOBALITE    K) SULFATE GEOTHERMOMETER
B) QUARTZ CONDUCTIVE, PH-CORRECTED G) AMORPHOUS SILICA    L) SURFACE TEMPERATURE
C) QUARTZ ADIABATIC      H) NA-K          M) WELL TEMPERATURE
D) CHALCEDONY           I) NA-K-CA       N) MIXING MODEL
E) CHALCEDONY, PH-CORRECTED J) NA-K-CA, MG-CORRECTED

DEPTHTO TOP (KM)       MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.

0.5  2.0  1.5

THICKNESS (KM)         MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.

1.0  2.5  1.5

SUBSURFACE AREA (KM²)  MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.

4

VOLUME (KM³) ......... 8.3  STD. DEV. = 3.5

THERMAL ENERGY (10¹¹J) 2.85  STD. DEV. = 1.21


COMPILED BY: MARINER, R. AND BROOK, C.

THERMO HOT SPRINGS, UTAH
FIELD NAME................ NEWCASTLE AREA
KGRA OR OTHER NAME........ NEWCASTLE KGRA
CIRCULAR REFERENCE........ 211

GEOGRAPHIC LOCALITY
STATE...................... UTAH
COUNTY...................... IRON
LATITUDE.................... 37-39.7 N
LONGITUDE................... 113-33.7 W
MAPS......................... CEDAR CITY 11250,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
JAN 15W 20 NE OF NW SALT LAKE

GENERAL INFORMATION
ELEVATION (M).................... 1605
SURFACE ACTIVITY................ NONE, FOUND BY DRILLING
NO. OF WELLS..................... 1 DEEP IRRIGATION WELL
WELL DEPTHS (M)................... 152
MAXIMUM WELL TEMP (C)........... 100 AT DEPTH (M) 85
ROCK TYPES: ALLUVIUM OVERLYING TERTIARY ASH-FLOW TUFTS AND OTHER VOLCANIC ROCKS.
GEOPHYSICS: HEAT FLOW, AMT, MAGNETIC

CHEMISTRY
SAMPLE SOURCE............. RUSH, F., UNPUB. DATA
COLLECTION DATE........ 1975/12/24

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>110</td>
<td>52</td>
<td>1.3</td>
<td>260</td>
<td>14</td>
<td>62</td>
<td>550</td>
<td>53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>H</th>
<th>PH</th>
<th>DEL O(18) SO4</th>
<th>DEL O(18) H2O</th>
<th>DEL D H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.0</td>
<td>0.65</td>
<td>7.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA-K-CA (1/3)</td>
<td>14H</td>
<td>140 (I)</td>
<td>143 (A)</td>
<td>130</td>
<td>11</td>
</tr>
<tr>
<td>NA-K-CA (4/3)</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADIABATIC</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE</td>
<td>143</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE</td>
<td>92</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESEVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (°C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 (I)</td>
<td>140 (I)</td>
<td>143 (A)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-Corrected
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-Corrected
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>OFPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>2.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM**2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>2</td>
<td>3.7</td>
<td>1.5</td>
<td></td>
</tr>
</tbody>
</table>

HASED ON: HEAT FLOW SURVEY

| VOLUME (KM**3) | 6.1 | STD. DEV. = 2.9 |
| THERMAL ENERGY (10**18 J) | 1.90 | STD. DEV. = 0.91 |

COMMENTS: MINIMUM TEMPERATURE FOR 4/3 CA1 MAXIMUM FOR 1/3 CA. SEVERAL SHALLOW WELLS CONTAIN THERMAL WATER.

REFERENCES: RUSH, 19771; SHUEY AND OTHERS, 1973

COMPILED BY: MARINER, H. AND BROOK, C.

NEWCASTLE AREA, UTAH
Washington
FIELD NAME: HAKER HOT SPRING
CIRCULAR REFERENCE: 212

GEOGRAPHIC LOCALITY
STATE: WASHINGTON
COUNTY: WHATCOM
LATITUDE: 48°45.9' N
LONGITUDE: 121°40.2' W
MAPS: MT. SHUKSAN 1:62,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
09E 20 NW OF SW WILLAMETTE

GENERAL INFORMATION
WARMING FIGURE: 2
WARMING NUMBER: 1
ELEVATION (M): 439
SURFACE ACTIVITY: HOT SPRING
ASSOCIATED DEPOSITS: TRAVERTINE
NO. OF SPRINGS: 1
SPRING TEMPERATURES (C): 42 TO 44
DISCHARGE (L/MIN): 26
ROCK TYPES: TERTIARY BASALT OVERLYING GRANITE

CHEMISTRY
SAMPLE SOURCE: MARINER, R., UNPUB. DATA
COLLECTION DATE: 1977/07/21

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>103</td>
<td>5.5</td>
<td>0.10</td>
<td>170</td>
<td>9.6</td>
<td>165</td>
<td>87</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

F: 3.2, PH: 2.7, DEL O(18) S04, DEL O(18) H20, DEL D H20
GEOTHERMOMETERS (°C)

<table>
<thead>
<tr>
<th>CAPTION</th>
<th>MINUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation</td>
<td></td>
<td></td>
<td></td>
<td>162 (E)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>162 (I)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>139 (A)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>134 (A)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12 (A)</td>
<td></td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (°C)</td>
<td>102 (E)</td>
<td>162 (I)</td>
<td>139 (A)</td>
<td>134</td>
<td>12</td>
</tr>
</tbody>
</table>

BASED ON: STANDARD ESTIMATE

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td>1.7</td>
<td>0.1</td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>2.0</td>
<td>0.4</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM²)</td>
<td>1.3</td>
<td>2.0</td>
<td>2.0</td>
<td>0.9</td>
<td></td>
</tr>
</tbody>
</table>

VOLUME (KM³) .......... 3.3
THERMAL ENERGY (10^16 J) 1.07

COMMENTS: May be a mixed water, but mixing models do not solve.

REFERENCES: WARING, 1965; CAMPBELL AND OTHERS, 1970; LIVINGSTON, 1972

COMPILED BY: BROOK, C.

BAKER HOT SPRING, WASHINGTON
FIELD NAME: GAMMA HOT SPRINGS

CIRCULAR REFERENCE: 213

GEOGRAPHIC LOCALITY
STATE: WASHINGTON
COUNTY: SNOHOMISH
LATITUDE: 48-10.0 N
LONGITUDE: 121-02.0 W
MAPS: GLACIER PEAK 1162500

GENERAL INFORMATION
ELEVATION (M): 1220
SURFACE ACTIVITY: HOT SPRINGS
DISCHARGE (L/MIN): 13
ROCK TYPES: DACITE TO RHYODACITE TUFFS

CHEMISTRY
SAMPLE SOURCE: TABOR AND CROWDER, 1969
FLOW (L/MIN): 13
COLLECTION DATE: 1962/08/28

<table>
<thead>
<tr>
<th>TEMP(C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>S04</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>150</td>
<td>47</td>
<td>2.6</td>
<td>491</td>
<td>71</td>
<td>269</td>
<td>4.3</td>
<td>728</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>12</td>
<td></td>
<td>7.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F: DEL 0(18) S04
PH: DEL 0(18) H2O
H: DEL D H2O
GEOTHERMOMETERS (C)

<table>
<thead>
<tr>
<th>CATION</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na-K-CA (1/3)</td>
<td>219</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K-CA (4/7)</td>
<td>191</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na-K</td>
<td>243</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adiabatic</td>
<td>153</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductive</td>
<td>161</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chalcedony</td>
<td>137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cristobalite</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opal</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESERVOIR PROPERTIES

<table>
<thead>
<tr>
<th>SUBSURFACE TEMP (C)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>140</td>
<td>195 (J)</td>
<td>161 (A)</td>
<td>165</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td></td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>THICKNESS (KM)</td>
<td>2.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
<tr>
<td>SUBSURFACE AREA (KM**2)</td>
<td>1</td>
<td>1.35</td>
<td>2.0</td>
<td>2.1</td>
<td>0.4</td>
</tr>
</tbody>
</table>

| VOLUME (KM**3)             | 3.3     | STD. DEV. = 0.9 |
| THERMAL ENERGY (10**18 J) | 1.35    | STD. DEV. = 0.39 |

COMMENTS: RECENT ATTEMPTS TO LOCATE THIS SPRING HAVE NOT BEEN SUCCESSFUL. AREA IS WITHIN THE GLACIER PEAK WILDERNESS AREA.

REFERENCES: Tabor and Crowder, 1969

COMPILED BY: HOOK, C.

GAMMA HOT SPRINGS, WASHINGTON
FIELD NAME. OHANAPECOSH HOT SPRINGS
CIRCULAR REFERENCE. 214

GEOGRAPHIC LOCALITY
STATE. WASHINGTON
COUNTY. LEWIS
LATITUDE. 46-44.2 N
LONGITUDE. 121-33.6 W
MAPS. PACKWOOD

TOWNSHIP RANGE SECTION BASE & MERIDIAN
14N 10E 04 NE OF NW WILLAMETTE

GENERAL INFORMATION
WARING FIGURE. 2
WARING NUMBER. 11
ELEVATION (M). 586
SURFACE ACTIVITY. HOT SPRINGS
ASSOCIATED DEPOSITS. TRAVERTINE
NO. OF SPRINGS. 5
SPRING TEMPERATURES (C). 43 to 49
DISCHARGE (L/Min). 225
ROCK TYPE. BASALT

CHEMISTRY
SAMPLE SOURCE. MARINER. R., UNPUB. DATA
COLLECTION DATE. 1977/07/24

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>100</td>
<td>60</td>
<td>4.9</td>
<td>920</td>
<td>52</td>
<td>1060</td>
<td>170</td>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>PH</th>
<th>DEL 0(18) SO4</th>
<th>DEL 0(18) H2O</th>
<th>DEL 0 H2O</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2</td>
<td>6.8</td>
<td>+0.32</td>
<td>-15.26</td>
<td></td>
</tr>
<tr>
<td>GFOTHERMOMETERS (C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (1/3)......... 170</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K-CA (4/3)......... 172</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NA-K.................. 126</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SILICA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADIAHATIC.............. 133</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE............. 137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHALCEDONY............ 110</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRISTOBALITE.......... 87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPAL.................. 17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SULFATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONDUCTIVE............ 108</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ONE-STEP STEAM LOSS... 101</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTINUOUS STEAM LOSS.. 102</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESERVOIR PROPERTIES</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBSURFACE TEMP (C)</td>
<td>108 (K)</td>
<td>137 (A)</td>
<td>135 (J)</td>
<td>127</td>
<td>7</td>
</tr>
</tbody>
</table>

**UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT**

A) QUARTZ CONDUCTIVE  
B) QUARTZ CONDUCTIVE, PH-CORRECTED  
C) QUARTZ ADIAHATIC  
D) CHALCEDONY  
E) CHALCEDONY, PH-CORRECTED  
F) CRISTOBALITE  
G) AMORPHOUS SILICA  
H) NA-K  
I) NA-K-CA  
J) NA-K-CA, MG-CORRECTED  
K) SULFATE GEOTHERMOMETER  
L) SURFACE TEMPERATURE  
M) WELL TEMPERATURE  
N) MIXING MODEL  
O) RENNER AND OTHERS, 1976

<table>
<thead>
<tr>
<th>DEPTH TO TOP (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>THICKNESS (KM)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.5</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUBSURFACE AREA (KM^2)</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
<th>MOST LIKELY</th>
<th>MEAN</th>
<th>STD. DEV.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

**BASED ON: STANDARD ESTIMATE**

| VOLUME (KM^3)         | 3.3     | STD. DEV. = 0.9 |
|                       |         |                 |
| THERMAL ENERGY (10^18 J) | 1.00 | STD. DEV. = 0.29 |

**COMMENTS:** LOCATED IN MT. RAINIER NATIONAL PARK.

**REFERENCES:** FISKE AND OTHERS, 1963; WARING, 1965; CAMPBELL AND OTHERS, 1970; LIVINGSTON, 1972

**COMPILED BY:** BROOK, C.

OHANAPICOSH HOT SPRINGS, WASHINGTON
Wyoming
FIELD NAME................. YELLOWSTONE CALDERA AREA
KGRA OR OTHER NAME........ YELLOWSTONE NATIONAL PARK
CIRCULAR REFERENCE........ 215

GEOGRAPHIC LOCALITY
STATE.......................... WYOMING
COUNTY......................... YELLOWSTONE
LATITUDE........................ 44°28.0 N
LONGITUDE...................... 110°50. W
MAPS............................. OLD FAITHFUL, WEST THUMB, CANYON VILLAGE, NORRIS JUNCTION, MADISON JUNCTION, AND
MAMMOTH 1162;500

GENERAL INFORMATION
WAITING FIGURE................... 5
WAITING NUMBER................... 1-96
AREA OF SURFACE EXPRESSION (KM²)... 355
ELEVATION (M)..................... 2288
SURFACE ACTIVITY.................. GEYSERS, FUMAROLES; HOT SPRINGS, ACID-SULFATE SPRINGS
ASSOCIATED DEPOSITS.............. SINTER TRAVERTINE
NO. OF SPRINGS.................... SEVERAL THOUSAND
SPRING TEMPERATURES (C)........... 50° TO 96°
DISCHARGE (L/MIN).................. 185,000
NO. OF WELLS....................... 13 RESEARCH WELLS
WELL DEPTHS (M)................... TO 332
MAXIMUM WELL TEMP (°C)............ 237° AT DEPTH (M) 332
ROCK TYPES: Pleistocene Rhyolitic Tuffs, Flows, and Domes
GEOPHYSICS: Gravity, Magnetic, Resistivity, Heat Flow, P-Wave Delay, Seismic Noise, Microearthquake
RESERVOIR PROPERTIES

SUBSURFACE TEMP (C)
MINIMUM  230
MAXIMUM  300
MOST LIKELY  270
MEAN  267
STD. DEV.  14

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

DEPTH TO TOP (KM)
MINIMUM  0.3
MAXIMUM  2.5
MOST LIKELY  2.0
MEAN  1.7
STD. DEV.  0.2

THICKNESS (KM)
MINIMUM  1.0
MAXIMUM  2.0
MOST LIKELY  2.0
MEAN  1.7
STD. DEV.  0.2

SUBSURFACE AREA (KM**2)
MINIMUM  375
MAXIMUM  1900
MOST LIKELY  1000
MEAN  1091.7
STD. DEV.  313.0

BASED ON AREAS OF SURFACE ACTIVITY, CALDERA, CALDERA MINUS AREAS OF RESURGENT DOMES, RESPECTIVELY

VOLUME (KM**3) ............ 1819.4
STD. DEV. = 586.3

THERMAL ENERGY (10**18 J) .... 1236.31
STD. DEV. = 405.20

COMMENTS: RESERVOIR ASSUMED TO BE LATERALLY EXTENSIVE AND INTERCONNECTED. AT LEAST ONE VAPOR-DOMINATED AREA (MUD VOLCANO) OF LIMITED EXTENT HAS DEVELOPED OVER A SMALL PART OF THE HOT-WATER SYSTEM. MIXING MODELS AND SULFATE-ISOTOPE GEOTHERMOMETERS INDICATES POSSIBLE TEMPERATURES OF 360 C IN THE DEEP RESERVOIR AREA. WITHDRAWN FROM COMMERCIAL EXPLORATION BECAUSE OF NATIONAL PARK STATUS.


COMPILED BY: MARINER, R. AND BROOK, C.

YELLOWSTONE CALDERA AREA, WYOMING
FIED: NAME: MUD VOLCANO AREA
KNOWN OR OTHER NAME: YELLOWSTONE NATIONAL PARK
CIRCULAR REFERENCE: 215A

GEOGRAPHIC LOCALITY
STATE: WYOMING
COUNTY: YELLOWSTONE
LATITUDE: 44-37.5 N
LONGITUDE: 110-26.0 W
MAPS: CANYON VILLAGE 1162,500

GENERAL INFORMATION
WARNING FIGURE: 5
WARNING NUMBER: 61A - 61D
AREA OF SURFACE EXPRESSION (KM**2): 5
ELEVATION (M): 2318
SURFACE ACTIVITY: HOT SPRINGS, FUMAROLES
ASSOCIATED DEPOSITS: SINTER
NO. OF SPRINGS: 50
SPRING TEMPERATURES (C): 22 TO 90
DISCHARGE (L/MIN): 100
NO. OF WELLS: 1 RESEARCH HOLE
WELL DEPTHS (M): 106
MAXIMUM WELL TEMP (C): 191 AT DEPTH (M) 105
ROCK TYPES: GLACIAL DEPOSITS OVERLYING PLEISTOCENE HYOLTITE TUFFS AND FLOWS
GEOPHYSICS: GRAVITY, MAGNETIC, RESISTIVITY, MICROEARTHQUAKE, SEISMIC NOISE
<table>
<thead>
<tr>
<th>Reservoir Properties</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsurface Temp (°C)</td>
<td>200 (0)</td>
<td>240 (0)</td>
<td>230 (0)</td>
<td>223</td>
<td>8</td>
</tr>
</tbody>
</table>

Uncoded temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive, PH-Corrected
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, PH-Corrected
F) Cristobalite
G) Amorphous Silica
H) Na-K
I) Na-K-CA
J) Na-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (km)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Thermal Energy (10^18 J)

| Volume (km^3)    | 8.2     | Std. Dev. = 1.7 |

Thermal Energy (10^18 J)

| 4.63             | Std. Dev. = 0.99 |

Comments: Vapor-dominated system of probable limited extent overlying Yellowstone Caldera hot-water system at 1.5 km depth. Well data formed basis of vapor-dominated model proposed by White and Others (1971).

References: White and Others, 1971; Zobdy and Others, 1973; Renner and Others, 1976

Compiled by: Brook, C.

Mud Volcano Area, Wyoming
FIELD NAME: HUCKLEBERRY HOT SPRINGS
CIRCULAR REFERENCE: 216

GEOPHYSIC LOCALITY
STATE: WYOMING
COUNTY: TETON
LATITUDE: 44-07.0 N
LONGITUDE: 110-41.0 W
MAP: HUCKLEBERRY MTN, 1162,500

TOWNSHIP RANGE SECTION BASE & MERIDIAN
43N 115 08 N W 6TH PRINCIPAL MERIDIAN

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 100
ELEVATION (M): 2079
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2 SMALL GROUPS
DISCHARGE (L/MIN): 380
ROCK TYPES: TERTIARY LAVA OVERLAYING CRETACEOUS SHALE

CHEMISTRY
SAMPLE SOURCE: USGS FILE DATA

<table>
<thead>
<tr>
<th>TEMP (°C)</th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HC03</th>
<th>CO3</th>
<th>SO4</th>
<th>CL</th>
</tr>
</thead>
<tbody>
<tr>
<td>71</td>
<td>124</td>
<td>12</td>
<td>201</td>
<td>7.8</td>
<td>772</td>
<td>504</td>
<td>12</td>
<td>102</td>
<td></td>
</tr>
</tbody>
</table>

F  H  PH  DEL 0(18) SI04  DEL 0(18) H2O  DEL D H2O
7.1
GEOTHERMOMETERS (C)

CATION

NA-K-CA (1/3).......... 141
NA-K-CA (4/3).......... 112
NA-K............... 95

SILICA

ADIABATIC............... 143
CONDUCTIVE............... 150
CHALCEDONY............... 124
CRISTOBALITE............... 99
OPAL............... 28

RESERVOIR PROPERTIES

SUBSURFACE TEMP (°C)  MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.

124 (D,j)  150 (A)  124 (D,j)  133  6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) RENNER AND OTHERS, 1976

MINIMUM  MAXIMUM  MOST LIKELY  MEAN  STD. DEV.

VOLUME (KM^3)............ 3.3  STD. DEV. = 0.9

THERMAL ENERGY (10^18 J)  1.06  STD. DEV. = 0.30

REFERENCES: RENNER AND OTHERS, 1976; WARING, 1965; HAGUE AND OTHERS, 1896, 1899

COMPILED BY: MARINEM, R.

HUCKLEFERRY HOT SPRINGS, WYOMING
FIELD NAME: GRANITE HOT SPRINGS
CIRCULAR REFERENCE: 217

GEOPHYSIC LOCALITY
STATE: WYOMING
COUNTY: TETON
LATITUDE: 43°22' N
LONGITUDE: 110°27' W
MAPS: GRANITE FALLS 1:124,000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
39N 111W 06 6TH PRINCIPAL MERIDIAN

GENERAL INFORMATION
WARING FIGURE: 2
WARING NUMBER: 102
ELEVATION (M): 2147
SURFACE ACTIVITY: HOT SPRINGS
NO. OF SPRINGS: 2
SPRING TEMPERATURES (C): 44
DISCHARGE (L/Min): 1200
POCK TYPES: GRANITE

CHEMISTRY
SAMPLE SOURCE: USGS FILE DATA
COLLECTION DATE: 1977/09/13

<table>
<thead>
<tr>
<th>TEMP (C)</th>
<th>SiO2</th>
<th>CA</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>S04</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>62</td>
<td>29</td>
<td>5.6</td>
<td>210</td>
<td>11</td>
<td>198</td>
<td>160</td>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>

F 6.3 R 0.148 PH 7.66
DEL O(18) S04 DEL O(18) H20 DEL O H2O
**GEOTHERMOMETERS (C)**

<table>
<thead>
<tr>
<th>CATION</th>
<th>NA-K-CA (1/3)</th>
<th>148</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NA-K-CA (4/3)</td>
<td>103</td>
</tr>
<tr>
<td></td>
<td>NA-K</td>
<td>119</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SILICA</th>
<th>A) Quartz Conductive</th>
<th>C) Quartz Adiabatic</th>
<th>E) Chalcedony, Ph-Corrected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>111</td>
<td>62</td>
<td>-5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONDUCTIVE</th>
<th>112</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHALCEDONY</td>
<td>83</td>
</tr>
<tr>
<td>CHISTOBALITE</td>
<td>62</td>
</tr>
<tr>
<td>OPAL</td>
<td>-5</td>
</tr>
</tbody>
</table>

**RESERVOIR PROPERTIES**

<table>
<thead>
<tr>
<th>Subsurface Temp (°C)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>83 (D)</td>
<td>112 (A)</td>
<td>83 (D)</td>
<td>93</td>
<td>7</td>
</tr>
</tbody>
</table>

Uncooled temperature indicates subjective judgement.

A) Quartz Conductive
B) Quartz Conductive
C) Quartz Adiabatic
D) Chalcedony
E) Chalcedony, Ph-Corrected
F) Cristobalite
G) Amorphous Silica
H) NA-K
I) NA-K-CA
J) NA-K-CA, Mg-Corrected
K) Sulfate Geothermometer
L) Surface Temperature
M) Well Temperature
N) Mixing Model
O) Renner and Others, 1976

<table>
<thead>
<tr>
<th>Depth to Top (KM)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>2.0</td>
<td>1.5</td>
<td>1.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| Thickness (KM)    | 1.0     | 2.5     | 1.5         | 1.7  | 0.3       |

<table>
<thead>
<tr>
<th>Subsurface Area (KM**2)</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Most Likely</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2.0</td>
<td>0.4</td>
</tr>
</tbody>
</table>

Based on standard estimate.

<table>
<thead>
<tr>
<th>Volume (KM**3)</th>
<th>3.3</th>
<th>Std. Dev. = 0.9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Thermal Energy (10**18 J)</th>
<th>0.70</th>
<th>Std. Dev. = 0.21</th>
</tr>
</thead>
</table>

**Comments:** Thermal water used in swimming pool.

**References:** Waring, 1965

**Compiled by:** Mariner, R.

**Granite Hot Springs, Wyoming**
FIELD NAME: AUBURN HOT SPRINGS  
CIRCULAR REFERENCE: 218

GEOPHYSIC LOCALITY
STATE: WYOMING  
COUNTY: LINCOLN  
LATITUDE: 42-49.5 N  
LONGITUDE: 111-00.0 W  
MAPS: AUBURN 1125000

TOWNSHIP RANGE SECTION BASE & MERIDIAN
J3N 119 23 SW OF NW 6TH PRINCIPAL MERIDIAN

GENERAL INFORMATION
WARING FIGURE: 2  
WARING NUMBER: 103  
ELEVATION (M): 1829  
SURFACE ACTIVITY: HOT SPRINGS  
ASSOCIATED DEPOSITS: TRAVERTINE MOUNDS  
NO. OF SPRINGS: SEVERAL  
SPRING TEMPERATURES (C): 16 TO 59.5  
DISCHARGE (L/MIN): 150  
ROCK TYPES: TRIASSIC OR JURASSIC LIMESTONE

CHEMISTRY
SAMPLE SOURCE: USGS FILE DATA  
COLLECTION DATE: 1977/09/14

<table>
<thead>
<tr>
<th></th>
<th>SI02</th>
<th>CA</th>
<th>MG</th>
<th>NA</th>
<th>K</th>
<th>HCO3</th>
<th>CO3</th>
<th>SO4</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>39.5</td>
<td>50</td>
<td>400</td>
<td>68</td>
<td>1550</td>
<td>160</td>
<td>920</td>
<td>1150</td>
<td>2050</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.0</td>
<td>2.9</td>
<td>6.38</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

F  B  PH  DEL 0(18) 504  DEL 0(18) H2O  DEL 0 H2O
GEOTHERMOMETERS (C)

CATION
NA-K-CA (1/3)............ 196
NA-K-CA (4/3)............ 174
NA-K...................... 188

SILICA
ADIABATIC.................. 103
CONDUCTIVE................ 102
CHALCEDONY................ 72
CRISTOBALITE.............. 51
OPAL....................... -14

RESEVOIR PROPERTIES

MINIMUM MAXIMUM MOST LIKELY MEAN STD. DEV.
72 (D) 102 (A) 96 (J) 90 6

UNCODED TEMPERATURE INDICATES SUBJECTIVE JUDGEMENT

A) QUARTZ CONDUCTIVE
B) QUARTZ CONDUCTIVE, PH-CORRECTED
C) QUARTZ ADIABATIC
D) CHALCEDONY
E) CHALCEDONY, PH-CORRECTED
F) CRISTOBALITE
G) AMORPHOUS SILICA
H) NA-K
I) NA-K-CA
J) NA-K-CA, MG-CORRECTED
K) SULFATE GEOTHERMOMETER
L) SURFACE TEMPERATURE
M) WELL TEMPERATURE
N) MIXING MODEL
O) REMNER AND OTHERS, 1976

DEPTH TO TOP (KM)
0.5 2.0 1.5

THICKNESS (KM)
1.0 2.5 1.5 1.7 0.3

SUBSURFACE AREA (KM**2)
1 3 2 2.0 0.4

BASED ON STANDARD ESTIMATE

VOLUME (KM**3)............. 3.3 STD. DEV. = 0.9
THERMAL ENERGY (10**18 J) 0.67 STD. DEV. = 0.2

COMMENTS: GAS DISCHARGE IS PRINCIPALLY CARBON DIOXIDE! WATERS ARE HIGH IN SULFIDE (25MG/L).
REFERENCES: RUBEY, 1958; WARING, 1965

COMPILED BY: MARINER, R.

AUBURN HOT SPRINGS, WYOMING
REFERENCES


Biehler, S., 1971, Gravity studies in the Imperial Valley, in Cooperative geological-geophysical-geochemical investigations of geothermal resources in the Imperial Valley area of California: University of California, Riverside, Education Research Service, p. 29-41.


Chesterman, C.W., 1975, Geology of the Matterhorn Peak 15-minute quadrangle, Mono and Tuolumne Counties, California: California Division of Mines and Geology Map Sheet 22, scale 1:48,000


Coplen, T.B., 1973, Isotopic composition of calcite and water from the Dunes DWR # 1 geothermal test corehole, Imperial Valley, California (abs.): EOS (American Geophysical Union Transactions), v. 54, p. 448.

Coplen, T.B., and Kolesar, Peter, 1974, Investigations of the Dunes geothermal anomaly, Imperial Valley, California, part 1, geochemistry of geothermal fluids: University of California, Riverside, 21 p.


480


Hodge, E.T., 1941, Geology of the Madras Quadrangle: Oregon State College, Studies in Geology, no. 1, geologic map.


Kintzinger, P.R., 1956, Geothermal survey of hot ground near Lordsburg, New Mexico: Science, v. 124, p. 629.


Quong, Roland, 1976, Scaling characteristics in the Geothermal Loop Experimental Facility at Niland, California: Livermore, California, University of California, Lawrence Livermore Laboratory, 33 p.


Reed, M.J., 1975, Chemistry of thermal water in selected geothermal areas of California: California Division of Oil and Gas Report No. TR15, 31 p.


Schroeder, R.C., 1976, Reservoir engineering report for the Magma-SDG & E geothermal experimental site near the Salton Sea, California: Livermore, California, University of California, Lawrence Livermore Laboratory, 62 p.


