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GEOTHERMAL ELECTRICAL POWER GENERATION POTENTIAL OF NEWBERRY VOLCANO AND THE OREGON CASCADE RANGE

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and

A SUMMARY OF DEEP THERMAL DATA FROM THE CASCADE RANGE AND ANALYSIS OF THE "RAIN CURTAIN" EFFECT

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GEOTHERMAL ELECTRICAL POWER GENERATION POTENTIAL OF NEWBERRY VOLCANO AND THE OREGON CASCADE RANGE

1.0 INTRODUCTION

In July, 1992 the Bonneville Power Administration (BPA) contracted with the Oregon Department of Geology and Mineral Industries (DOGAMI) to "Identify and Characterize Geothermal Resources in the State of Oregon". Task 2 of the contract requires DOGAMI to revise the existing geothermal resource assessments for the Oregon Cascades, including Newberry Volcano. This report meets the requirements of Task 2.

Specific tasks required by the above contract include:

1.) Compilation of temperature and thermal conductivity data for geothermal wells drilled since the last assessment in 1985.

2.) Calculation of heat flow and electrical power generation potential for the study area.

3.) Maps and/or tables indicating the degree to which each area has been assessed for geothermal resources.

1.1 Study Area

The study area is shown in Figure 1. The western boundary is the 100 mW/m^2 heat flow contour (Blackwell and others, 1978; Blackwell and others, 1982; Blackwell and others, 1990). The eastern boundary is the junction between the Cascade Range and the High Lava Plains physiographic province on the north, and the Cascade Range and the Basin and Range physiographic province on the south. At Newberry Volcano, the study area is enclosed by the T_{3km}=150 °C contour (The projected temperature at 3 km is equal to 150 °C, see Figure 2).

The 100 mW/m^2 heat flow contour was chosen as a boundary because, at lower heat flow values, the projected temperature at 3 km (the maximum assumed drilling depth) is less than 150 °C (the assumed minimum temperature for electrical power generation).

2.0 DEGREE OF ASSESSMENT

The degree of assessment for geothermal resources was initially addressed in the 1985 report prepared for BPA by the states of Oregon, Washington, Idaho, and Montana (Bloomquist and others, 1985). In that report the exploration for geothermal resources in a given area was described as proceeding through a series of four exploration phases. The following description of the exploration phases is taken from Bloomquist and others (1985). Phase I includes literature searches, regional spring sampling, heat flow studies, reconnaissance mapping, and regional geophysics. Phase II consists of site specific heat flow studies (including shallow temperature gradient drilling), water and soil chemistry, geologic mapping, and geophysics. Phase III includes hydrologic modeling and intermediate depth drilling to further define and confirm the thermal anomaly identified in Phase II. Phase IV consists of deep drilling, reservoir testing and evaluation, and quantitative estimates of the reservoir. Bloomquist and others (1985) provides cost and time estimates for the various exploration phases and subphases. Those estimates are valid today for time requirements, and will not be reviewed here. Obviously, when applying the 1985 cost estimates to the present, inflation will have to be taken into account.

Table 1 shows the phases of exploration for Newberry Volcano and the Oregon Cascade Range. In Table 1 the Cascade Range is divided into five segments, which are, from north to south: 1.) the Mount Hood area, 2.) the Breitenbush area (latitude 45° 15'-44° 30'N), 3.) the Belknap-Foley area (latitude 44° 30'-44° N), 4.) the McCredie area (latitude 44°-43° 30' N), and 5.) the southern Cascades (latitude 43° 30' N to the California border at 42° N).

As Table 1 shows, Phase I exploration is complete or nearly complete in all areas, but only in the Mount Hood and Newberry Volcano areas has the status of exploration proceeded significantly past Phase II. Table 1 is, of course, subjective, and does not reflect any proprietary data that may exist in individual areas.

3.0 RESOURCE EVALUATION

3.1 Introduction

In conductive heat transfer heat is transmitted through a medium by the transfer of energy from one molecule to another via molecular collision. In convective heat transfer it is the motion of a medium (e.g. hot water) that results in the transfer of heat. Most of the reliable heat flow data from the Cascade Range were measurements made in conductive regimes. It is this resource that will be discussed in this section.

Previous attempts to evaluate the conduction-dominated geothermal resource in the United States were Diment and others (1975) in USGS Circular 726 and Sass and Lachenbruch (1979) in USGS Circular 790. In this report we will be concerned only with the conductive resource in the Cascade Range and at Newberry Volcano.

Muffler and Cataldi (1978) describe four methods of evaluating geothermal potential. Of these, only the volume method is appropriate for evaluating the geothermal potential of a conduction-dominated region. In this method, the amount of heat contained in a volume of rock is calculated. Assumptions are then made regarding the percentage of this heat that can be recovered at the surface, and the efficiency with which it can be converted into electrical energy. The result is an educated guess as to the electrical power generation potential an area.

It should be noted that in this report the final estimates of electrical generation potential do not include national parks, national monuments, and wilderness areas.

3.2 Data Base

The data base consists of temperatures measured in drill holes. This effort began in the early 1970's and continues through the present. Many of the holes were drilled specifically for heat flow evaluation. Others are "holes of opportunity". These are usually dry or nonproductive water wells but occasionally mineral exploration holes are used. Temperatures are measured at regular intervals (usually 5 m) in the well. The resulting temperature gradient multiplied by the thermal conductivity of the rock gives heat flow. Thermal conductivity is measured on lithologic samples from the well or is estimated from known measurements on similar rock types.

Appendix A is the complete heat flow data base for the Cascade Range and Newberry Volcano. Most of this data base was previously published in a variety of DOGAMI and USGS reports. A particularly complete compilation is in Ingebritsen and others (1991). Some data from DOGAMI files and a few holes measured since the publication of Ingebritsen and others (1991) has been added to produce Appendix A.

Tabulated in Appendix A are data for the hole location (both township, range, and section and latitude and longitude), hole depth, bottom hole temperature, the interval over which the best temperature gradient was measured, thermal conductivity, both uncorrected and terrain corrected temperature gradients, and heat flow.

3.3 Temperature Calculations

The volume method of geothermal resource assessment requires the calculation of the amount of heat contained in a discrete volume of rock. This in turn requires the definition of the rock volume and the calculation of temperatures within that volume. Two assumptions are required for this process. The first is that the bottom of the geothermal reservoir is at 3 km. This is a practical limit associated with the economics of drilling deep geothermal production wells (Brook and others, 1979). The second is that the minimum temperature for electric power generation is 150 °C (Renner and others, 1975; Brook and others, 1979). At temperatures less than 150 °C no hot water is flashed to steam at typical steam-water separator operating pressures (Renner and others, 1975). Binary generation schemes allow generation at temperatures less than 150 °C, but those systems are unlikely to be practicable at the deep drilling depths required in the Cascade Range and at Newberry Volcano.

Appendix B shows the temperature calculations for individual wells in the Cascade Range and at Newberry Volcano. Tabulated in Appendix B is the hole name (if applicable), location (township, range, and section), depth, bottom hole temperature, the interval over which the best temperature gradient was measured, thermal conductivity, the corrected temperature gradient, heat flow, the projected temperatures at 1 km, 2 km, and 3 km, and the depths to the 90 °C, 100 °C, and 150 °C isotherms. Only the best quality temperature-depth data from Appendix A was utilized to create Appendix B.

The calculation of temperatures at depth is not a simple extrapolation of the best temperature gradient from the bottom of the hole to a depth of 3 km. Although the heat flow is constant for a given hole in a conductive regime, the thermal conductivity is not. Two effects are seen. The first is an increase in thermal conductivity resulting from alteration effects. The second is a decrease in thermal conductivity as subsurface temperatures increase above about 100 °C. This decrease is proportional to the amount of quartz in the rock (the rock-forming mineral with the highest thermal conductivity) and results from a decrease in the efficiency with which the crystal lattice will transmit energy at higher temperatures. To account for these effects, a simple three-part conductivity model was adopted for the study area.

For the interval from the surface to a depth of 1 km, the thermal conductivity was assumed to be the same as that measured on rocks from the well. The temperature at 1 km was calculated from the equation:

$T_1 = T_{bh} + (dT/dZ)(1-Z)$, where:

T_1 is the temperature (in °C) at 1 km
T_{bh} is the bottom hole temperature
dT/dZ is the temperature gradient
Z is the hole depth

For the interval from 1-2 km the thermal conductivity was assumed to be 2.3 W/m°K. This number reflects the best value for altered rocks from the deep holes drilled in the

Old Maid Flat area west of Mount Hood and the deep hole drilled near Breitenbush Hot Springs (SUNEDCO 58-28). The temperature at 2 km was calculated from the equation:

$T_2 = T_1 + (Q/2.3\ W/m°K)(1\ km)$, where:

T_1 and T_2 are the temperatures at 1 and 2 km, respectively
Q is the heat flow in mW/m^2

For the interval from 2-3 km the thermal conductivity was assumed to be 2.1 W/m°K. This number reflects the effects of temperatures greater than 100 °C on thermal conductivity (D.D. Blackwell, Southern Methodist University, personal communication). The temperature at 3 km was calculated from the equation:

$T_3 = T_2 + (Q/2.1\ W/m°K)(1\ km)$, where:

T_2 and T_3 are the temperatures at 2 and 3 km, respectively
Q is the heat flow in mW/m^2

Note that this thermal conductivity model results in maximum projected temperatures at 3 km that are significantly lower than those predicted by the simple extrapolation of the near-surface temperature gradient to 3 km.

Once the temperatures at 1, 2, and 3 km are calculated, it is a simple matter to calculate the depths to particular isotherms. The depth to the 150 °C isotherm combined with the maximum drilling depth (3 km) gives reservoir thickness.

3.4 Cascade Range Geothermal Potential

The geothermal resource in the Cascade Range can be split into hydrothermal and conductive components. The hydrothermal component is associated with known hot springs systems and volcanos. These are, from north to south, Mount Hood (summit fumaroles and Swim Warm Springs), Austin Hot Springs (on the Clackamas River), Breitenbush Hot Spring (on the Breitenbush River), the Belknap-Foley Springs system (on the McKenzie River), McCredie Hot Springs (on Salt Creek, a major tributary of the Middle Fork of the Willamette River), Crater Lake, and Umpqua Hot Spring (on the North Umpqua River). The geothermal potential of these systems has been discussed in U.S. Geological Survey Circulars 726 and 790. With the exception of Crater Lake, which is not available for geothemal development, and the possible exception of Austin Hot Springs (Steve Ingebritsen, USGS, personal communication), these systems have most likely reservoir temperatures less than 150 °C, the assumed minimum temperature for electrical power generation. As a result, and because the U.S. Geological Survey is in the process of revising their geothermal resource assessments (Pat Muffler, USGS, personal communication), the hydrothermal component of the Cascade Range geothermal resource will not be discussed further in this report. Brook and others (1979) give the best estimate of the hydrothermal resource, but it should be noted that these systems are not expected to add significantly to the electrical generation potential of the Cascade Range.

Appendix C contains the calculations of geothermal potential for the Cascade Range. In Appendix C the study area has been divided into a series of blocks, and the electrical generation potential has been calculated for each block. The procedure used is as follows:

1. The well data from Appendix A and T_3 (the temperature at 3 km) and D_{150} (the depth to the 150 °C isotherm) from Appendix B were plotted on 1:100,000 scale topographic maps (or Bureau of Land Management planimetric maps in the few instances where topographic maps are not yet available).

2. The study area was divided into blocks. Because neither the data density nor quality is adequate for contouring, the blocks selected were individual townships. There is a "Block" entry in Appendix C for each individual township in the study area.

3. The area of each block (in km^2) and the percentage of each block that is accessible (i.e. not contained in a National Park or a Wilderness Area) was determined.

4. A T_3 (the temperature at 3 km) and D_{150} (the depth to the 150 °C isotherm) value was assigned to each block based on the best available data. This step required the extrapolation of a relatively sparse data set over large distances, and is almost certainly the weakest part of the procedure.

5. The reservoir thickness was calculated for each block from the equation:

$d = 3 - D_{150}$ where d is reservoir thickness, 3 km is the maximum practicable drilling depth, and D_{150} is the depth to the 150 °C isotherm for the block.

6. The average reservoir temperature was calculated from the equation:

$t = (150 + T_3)/2$ where t is the reservoir temperature, 150 °C represents the minimum temperature for electrical power generation, and T_3 is the temperature at 3 km.

7. The Accessible Resource Base (q_R) is the amount of thermal energy contained in the reservoir (in joules) referenced to a mean annual surface temperature of 15 °C. The 15 °C value for mean annual surface temperature is a

little high for the Cascade Range (true value closer to 10 °C). It was chosen because it was the value used in USGS Circulars 726 and 790, and the use of 15 °C makes the comparison of values between the various reports simpler. q_R is calculated from the formula:

$$q_R = \rho c \cdot a \cdot d \cdot (t - t_{ref})$$ (Brook and others, 1979)

where:

q_R = reservoir thermal energy in joules (J)
ρc = volumetric specific heat of rock plus water (2.7 $J/cm^3/°C$)
a = reservoir area
d = reservoir thickness
t = average reservoir temperature
t_{ref} = reference temperature (15 °C).

The above calculation assumes that all thermal energy between the average reservoir temperature and 15 °C is available for electrical generation. This is clearly not the case, as it includes temperatures below which geothermal power plants cannot be operated efficiently or economically. The use of 15 °C therefore results in a significant overestimate of geothermal potential. This was done in order to maintain consistency with, and permit comparison to, previous reports.

The value for the volumetric specific heat of rock plus water is taken from Brook and others (1979). It assumes the rock volumetric specific heat to be 2.5 $J/cm^3/°C$ and the reservoir porosity to be 15 percent. This assumed porosity is probably high for most of the Cascade Range. In the Santiam Pass 77-24 hole, a nearly 1 km well drilled near the axis of the Cascade Range, only a few thin highly porous zones had porosities of 15 percent or more. The normal porosity was in the 3 - 5 percent range (Blackwell,1992; Hill, 1992). At greater depths, where alteration effects will be more pronounced, porosity can be expected to decrease. The Circular 790 value for volumetric specific heat of rock plus water was used to make comparisons between reports more meaningful.

8. Available work (W_A) was determined using procedures detailed in Circular 790 (Brook and others, 1979). Available work is the maximum amount of mechanical energy that is available at the surface to produce electrical energy. Determining available work is a two step process. First the portion of the reservoir thermal energy (q_R) that can be recovered at the surface must be determined, then the efficiency with which that surface thermal energy can be converted to mechanical energy must be calculated. Brook and others (1979) provide a graph that plots the ratio W_A/q_R versus reservoir temperature for two depths to the center of

the reservoir (1 km and 3 km). The values in the W_A/q_R column of Appendix C were taken from this graph.

The graph in Brook and others (1979) conveniently takes into account the losses involved in producing thermal energy at the surface and the losses involved in converting thermal to mechanical energy. There is one caveat, however. The geothermal recovery factor (Rg) is the ratio of geothermal energy available at the surface to (q_{WH}) to geothermal energy originally in the reservoir (q_R). In producing the graph of W_A/q_R versus temperature, Brook and others (1979) assume a recovery factor of .25. This value for Rg assumes an effective reservoir porosity of 20 percent, which may be valid for the hydrothermal convection systems for which it was designed, but is certainly not valid for the Cascade Range. As mentioned in the previous section, porosities in the Santiam Pass well were mostly less than 10 percent at depths shallower than 1 km, though a few zones with porosities greater than 20 percent were encountered. At Old Maid Flat, west of Mount Hood, porosities in the lower part of a nearly 2 km drill hole were generally less than 2 percent, and often less than 1 percent (Blackwell and others, 1982). These low porosities will drastically reduce the recovery factor. As pointed out by Muffler and Guffanti (1989), the recovery factor of 25% is much too high for use throughout a large geologic province. They also correctly point out that the previous geothermal estimate reported in Bloomquist and others (1985) is probably two orders of magnitude too high as a result of using this high recovery factor. The last three columns in Appendix C are an attempt to account for the lower recovery factor expected in the Cascade Range.

9. The final step in estimating the electrical generation potential of the Cascade Range is to account for losses in the conversion of mechanical energy to electrical energy. Electrical energy is calculated from the formula:

$E = W_A \cdot \_{U}$ where

E = electrical energy in MW for 30 years
W_A = available work
$\_{U}$ = utilization factor

The utilization factor is a function of generation technology and reservoir temperature. For hot water systems Brook and others (1979) use a constant representative value of 0.4 for the utilization factor. That value is also used in this report.

10. The last five columns in Appendix C are calculations of electrical generation potential for each block. The first column is the potential of the block regardless of land status. The second column removes those lands not available

for geothermal development in national parks, national monuments, and wilderness areas from the calculations. The last three columns (0.1 R_g, .01 R_g, and .001 R_g) are an attempt to take into account the lower recovery factors expected in the Cascade Range. The potential for the Cascade Range as a whole (less National Parks and Wilderness Areas) probably lies between the values listed in the 0.1 R_g and .01 R_g columns, but could be as low as the 0.001 R_g column.

Based on the above discussion the best estimate of electrical generation potential is 6 - 59 MW for the Mount Hood area and 365 - 3655 MW for the remainder of the Cascade Range.

3.5 Newberry Volcano Geothermal Potential

The calculations of geothermal electrical generation potential for Newberry Volcano are contained in Appendix D. With three exceptions, the procedure used for these calculations is identical to that described in the proceeding section. First, the blocks used to calculate potential are sections rather than townships. Second, the data density and quality is significantly better at Newberry Volcano than in the Cascade Range, so an attempt was made to contour the data. Figures 2 and 3 are the contoured values of depth to the 150 °C (D_{150}) isotherm and the temperature at 3 km (T_3), respectively. The values assigned to each individual block were taken from these figures. Third, a fraction of the land area on Newberry Volcano that is not available for development is in Newberry National Monument.

The .01 R_g and 0.1 R_g columns in Appendix D result in an estimate of geothermal electrical generation potential for Newberry Volcano of 20 - 202 MW. There is a difference between Newberry Volcano and the Cascade Range, however, and the true potential at Newberry is probably greater than 202 MW. It is quite likely that a magma chamber underlies Newberry Volcano at relatively shallow depths (Achauer and others, 1989; Fitterman and others, 1989; MacLeod and Sherrod, 1989; and Stauber and others; 1989). In addition there is a known hydrothermal system associated with the volcano (MacLeod and Sammel, 1982; Black and others, 1984; Sammel and others, 1989), as evidenced by holes drilled in the caldera by the U.S. Geological Survey and Sandia National Laboratories. The presence of a magma chamber and a known hydrothermal system indicates that a recovery factor (R_g) of 25% may be valid for portions of the volcano. Accordingly, it is likely that the resource potential for Newberry Volcano lies between 200 - 2000 MW. The hydrothermal system seems to be associated with the summit caldera, so the true potential probably lies closer to the lower than the upper of the two above limits.

3.6 Summary

The geothermal electrical generation potential of the Cascade Range and Newberry Volcano has been estimated using the volume method. Only the conductive heat flow component of the geothermal resource has been evaluated. Results indicate that the electrical generation potential of the Mount Hood area lies between 6 - 59 MW, the Cascade Range south of Mount Hood lies between 365 - 3655 MW, and Newberry Volcano lies between 200 - 2000 MW (probably closer to the lower number).

The drill hole data base in the Cascade Range is sparse, with only the Mount Hood and Newberry Volcano areas having progressed much past Phase II exploration.

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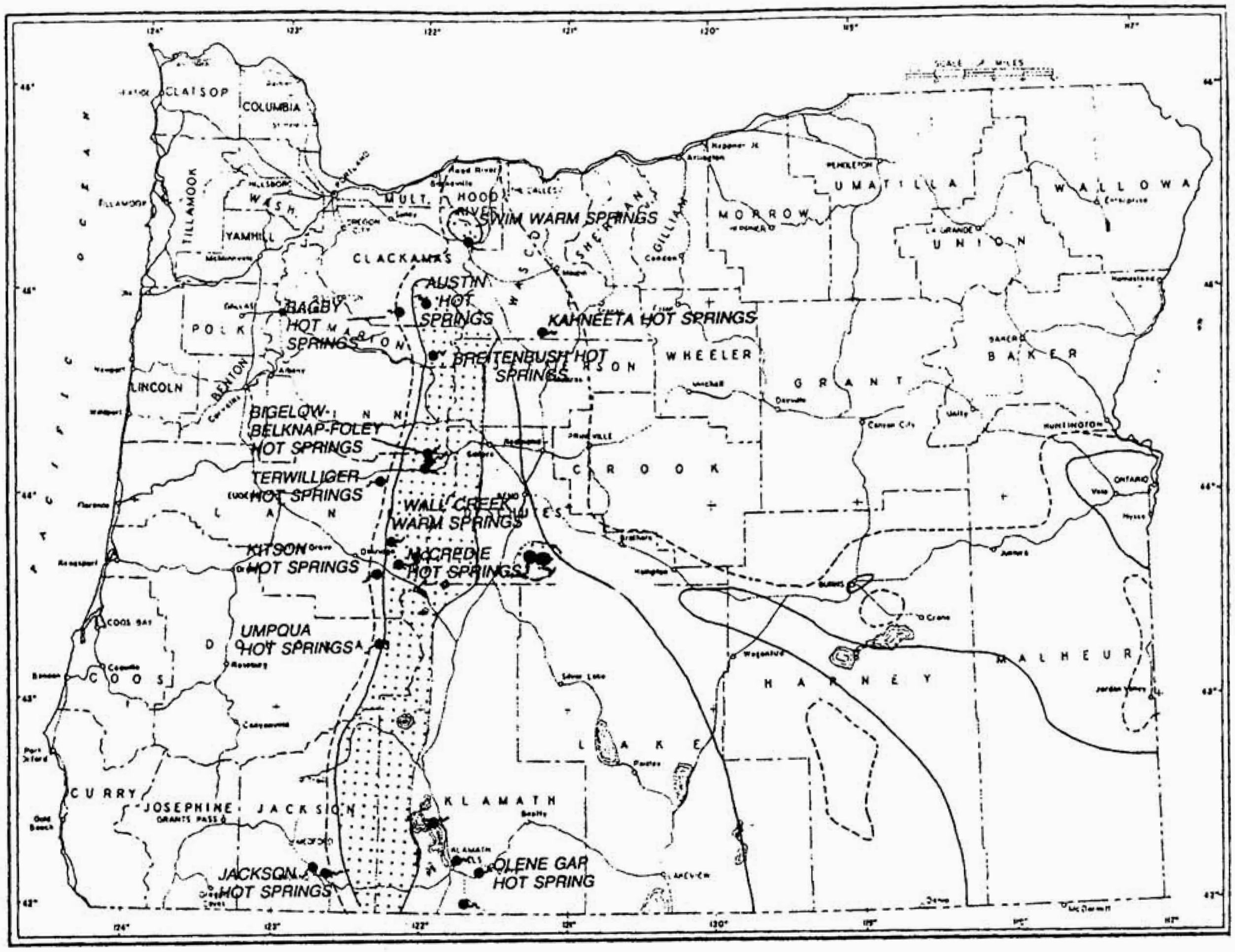

Figure 1. Pattern delineates study area. Spring symbols indicate known hot springs. Heavy line is 100 mW/m^2 contour, dashed line is 80 mW/m^2 contour. Figure modified from Priest (1983).

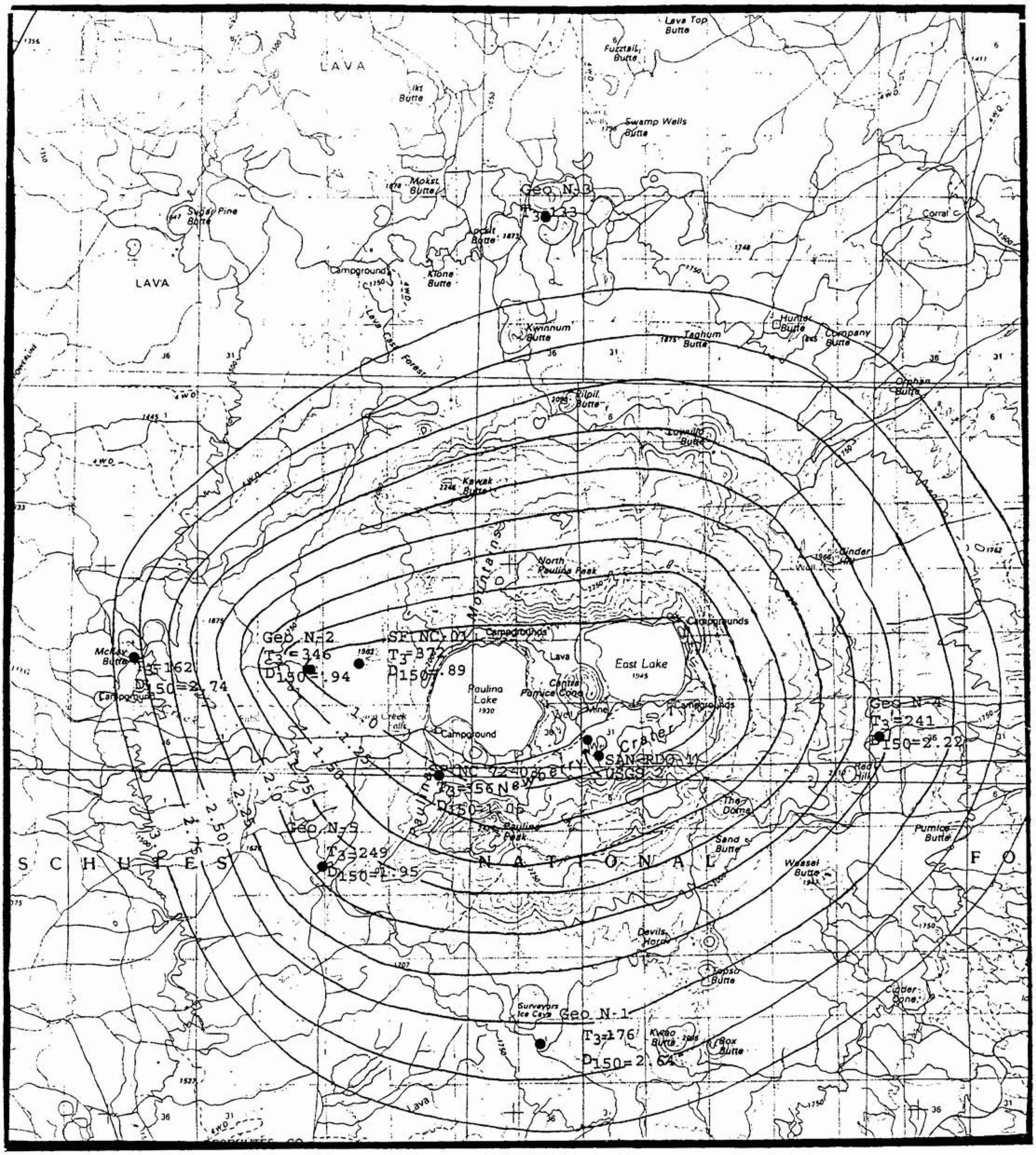

Figure 2. Newberry Volcano. Depth to the 150 °C isotherm. Contour interval is .25 km.

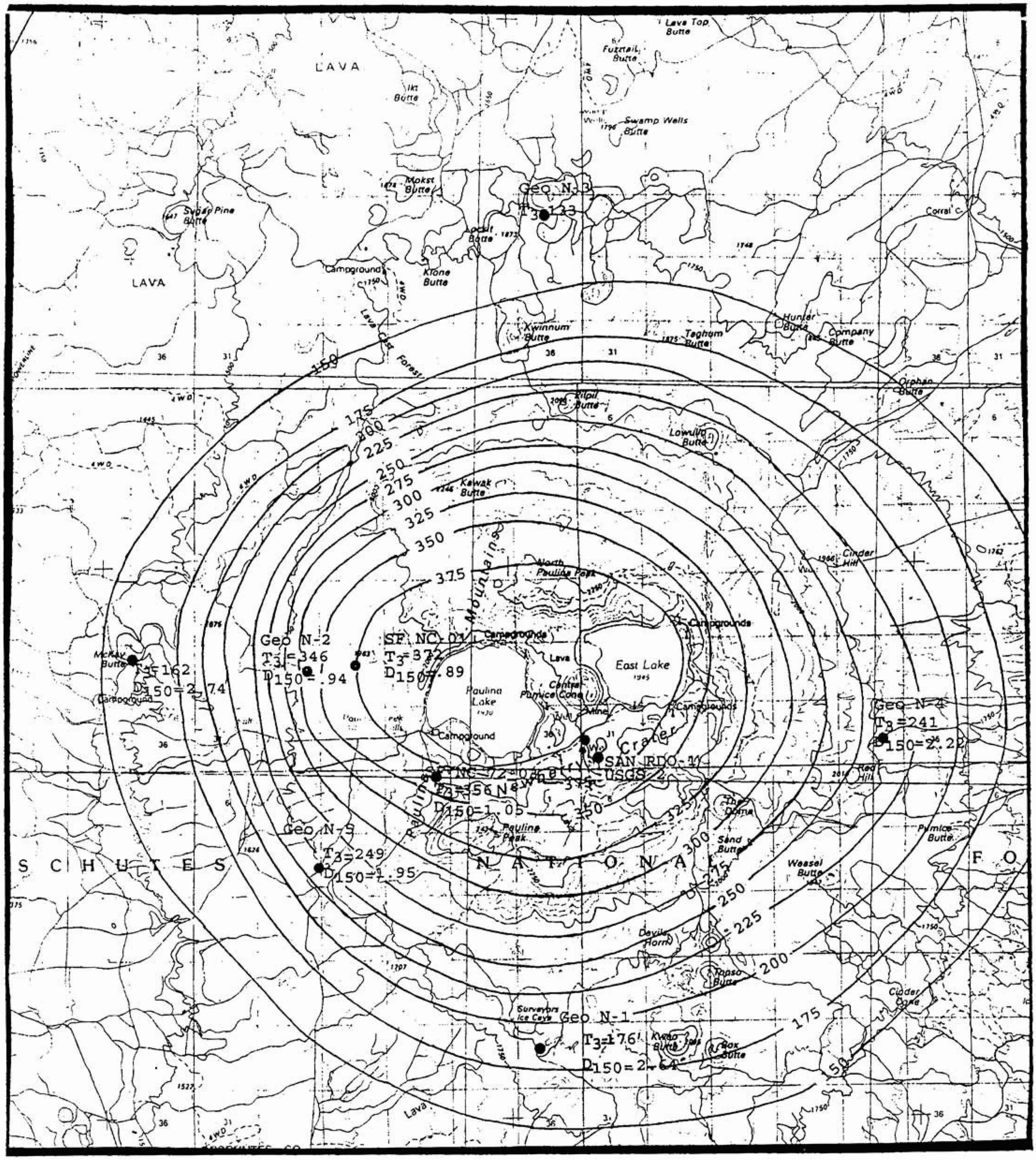

Figure 3. Newberry Volcano. Temperature at 3 km. Contour interval is 25 °C.

TABLE 1
PHASE OF EXPLORATION

	NEWBERRY VOLCANO	SOUTHERN CASCADES	MCCREDIE	BELKNAP-FOLEY	BREITENBUSH	MOUNT HOOD
PASE I - REGIONAL RECONNAISANCE	100	90	90	100	100	100
Literature Search	X	X	X	X	X	X
Temperature Gradient Measurements in Existing Wells: Wide Spacing	X	X	X	X	X	X
Spring, Well Sampling and analyese of Ground Water: Wide Spacing	X	X	X	X	X	X
Broad Reconnaissance Geologic Mapping, 1:1,000,000 or Smaller	X	X	X	X	X	X
Regional Geophysical Studies						
Heat Flow	X	X	X	X	X	X
Gradients	X	X	X	X	X	X
Gravity	X	X	X	X	X	X
Magnetics	X	X	X	X	X	X
Electrical	X			X	X	X
Seismic	X			X	X	X
PHASE II-INITIAL DIRECT EXPLORATION OF IDENTIFIED RESOUR	85	10	30	40	55	80
Temperature Gradient Measurements in all Available Wells	X		X	X	X	X
Sampling of All Availale Wells and Springs						
Thermal Sampling	X			X	X	X
Soil Sampling	25					
Gas Sampling	10					
Cold Water Sampling	X			X	X	25
Qualitative and Quantitative Hydrologic Analysis	75		25	50	50	25
Detailed Geologic Mapping, 1:62,500 Scale or Larger	X		25	50	75	X
Lineament Analysis	X	50	50	50	50	50
Shallow Drilling to Define Heat Flow Anomalies	X	5	50	50	X	X
Detailed Geophysical Exploration						
Heat Flow	X		5	25	50	X
Gradients	X		5	25	50	X
Gravity	X					X
Magnetics	X					X
Electrical	X					X
Seismic	X					X
PHASE III-DIRECT EXPLORATION OF THERMAL ANOMALIES	40					15
Intermediate Depth Drilling to Define Anomalies	75				20	X
Quantitative Hydrologic Modeling of the Geothermal System	25					
PHASE IV-DIRECT TESTING OF GEOTHERMAL RESOURCE AT DE			0	0	5	10
Deep Drilling to Test Aquifer	20				10	25
Reserviir Testing Evaluation (Including Pump Testing)						
Quantitative Reservoir Estimation						

APPENDIX A

HEAT FLOW DATA FROM THE CASCADE RANGE AND NEWBERRY VOLCANO

Hole Name - if assigned. Dashes indicate lack of data (in all columns).

Hole Location - given both as township, range, and section and latitude and longitude. Latitude and longitude in degrees, minutes, and seconds.

Depth - depth in meters (m).

Bottom Hole Temperature - bottom hole temperature in degrees Centigrade (°C).

Interval - interval over which the uncorrected temperature gradient was measured, in meters (m).

Thermal Conductivity - thermal conductivity in Watts per meter degree Kelvin (W/m°K). An "e" following the number indicates that the value is an estimate based on drill hole lithology. Summary statistics for drill hole lithologies are published in Ingebritson and others (1991). Standard deviations are given in parentheses. Square brackets indicate estimated values published prior to Ingebritson and others (1991).

Gradient - uncorrected temperature gradient in degrees Centigrade per kilometer (°C/km). Advectively disturbed profiles are indicated by "adv." Isothermal or near isothermal profiles are indicated by "iso."

Gradient Corrected - terrain corrected temperature gradient in degrees Centigrade per kilometer (°C/km).

Heat Flow - heat flow in milliwatts per square meter (mW/m^2). The product of the terrain corrected temperature gradient and the thermal conductivity.

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
-	3S	4E	03A	122 17 30	45 20 25	92	12.2	75-90	1.35e (0.20)	55.6 (1.52)	>51.0	[>69]
-	3S	4E	18B	122 22 13	45 18 56	65	11.0	-	-	adv.	-	-
-	3S	4E	23D	122 16 46	45 17 22	49	11.8	39-49	1.40e (0.20)	32.8 (4.69)	32.8	[46]
-	3S	4E	27C	122 18 45	45 16 29	50	11.5	38-50	1.40e (0.20)	49.1 (4.16)	52.0	[73]
Short	3S	4E	28B	122 19 48	45 16 53	63	11.7	50-63	1.40e (0.20)	26.8 (2.71)	>25.7	[>36]
-	3S	4E	29B	122 20 31	45 17 08	205	16.5	21-205	1.51e (0.20)	39.9 (1.48)	>36.6	>55
-	3S	4E	33A	122 19 41	45 15 31	114	15.6	-	-	adv.	-	-
-	3S	4E	35C	122 16 58	45 15 34	60	11.5	34-60	1.40e (0.20)	18.7 (0.33)	>20.1	>28
Elliot	3S	5E	20A	122 12 37	45 17 51	61	9.8	15-61	1.40e (0.20)	7.8 (0.43)	8.7	[12]
-	3S	5E	28C	122 12 10	45 16 36	98	13.6	-	-	iso.	-	-
USDA	4S	5E	29A	122 12 55	45 11 45	20	10.2	15-20	1.60e (0.15)	47.4 (8.60)	34.1	[55]
USDA	5S	5E	02D	122 09 05	45 09 43	25	9.3	15-25	1.60e (0.15)	55.3 (2.06)	>42.2	[>68]

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
-	5S	5E	23D	122 09 22	45 07 04	149	15.9	101-149	1.60e	57.1	43.6	70
Roaring R. Campground	5S	6E	06D	122 06 49	45 09 32	40	10.6	23-40	1.60e (0.15)	56.7 (1.50)	>43.6	>70
Oak Grove Work Center	5S	6E	36D	122 00 56	45 05 28	67	7.6	-	-	adv.	-	-
TWW	6S	1E	13D	122 37 11	45 02 51	140	14.9	95-140	1.38	34.8 (0.67)	37.8	44
							(1,2):	35-95	1.59	26.2	28.6	45
								95-140	[1.17]	34.7	37.7	44
MC-WW	6S	1E	35C	122 39 26	45 00 20	195	15.2	110-195	[1.17]	31.4 (0.20)	34.8	41
							(1,2):	95-195	[1.17]	30.9	34.3	40
QWW	6S	2E	18B	122 36 42	45 03 18	92	11.7	55-92	1.30e (0.15)	28.9 (0.41)	28.8	37
						90		55-90	-	29.1	29.0	-
DH-5000	6S	6E	23C	122 02 42	45 01 48	24	8.7	15-24	1.50e (0.25)	69.6 (2.80)	56.1	[84]
						22	-	15-22	-	70.0	-	-
-	6S	6E	23C	122 02 42	45 01 49	27	8.3	22-27	-	adv. 90.5e	-	-
RDHCRCDR	6S	6E	34C	122 03 46	44 59 57	150	20.9	15-150	1.64 (0.04)	81.4 (0.29)	64.7	106
							(1,2,4):	10-150	1.64	81.8	65.0	106
RDHCRLKH	6S	7E	04D	121 57 36	45 04 18	38	7.6	-	-	iso.	-	-
						40	-	0-38	-	-	-	-
L. HARRIET	6S	7E	04D	121 57 25	45 04 21	22	15.9	-	-	adv.	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
CAMPGROUND												
RDH-AHSE	6S	7E	21C	121 57 44	45 01 46	40	17.9	28-40	1.47 (0.07)	155. (6.71)	109.	[160]
							(1,2,4):	10-40	1.47	231.6	162.8	240
RDHCRAHS	6S	7E	30B	122 00 32	45 01 20	135	55.3	95-135	1.65 (0.08)	236. (3.36)	166.	274
						132	-	95-130	1.65	240.7	169.5	279
-	6S	7E	30B	122 00 20	45 01 24	293	82.1	146-293	1.50e (0.25)	83.4 (0.71)	62.7	94
OW W1	7S	1E	11A	122 38 47	44 58 46	2379	-	-	-	-	-	-
							(1,2):	0-2379	[1.59]	26.0	26.0	41
USFS	7S	5E	14D	122 09 51	44 57 47	18	5.5	15-18	-	adv. 70.7e	-	-
CR-BHS	7S	5E	22A	122 10 23	44 57 07	90	13.5	20-90	1.46 (0.05)	84.3 (0.96)	66.8	97
							(1,2,4):	20-90	1.46	84.3	66.8	97
BAGBY H.S. TRAILHEAD	7S	5E	23A	122 09 53	44 57 09	21	5.8	15-22	-	adv. 43.8e	-	-
EWEB-TS	7S	7E	04D	121 57 01	44 58 59	194	5.3	25-194	-	adv. 11.0e	-	-
							-	165-190	1.62	-	-	-
EWEB-PC	7S	8E	05D	121 50 50	44 59 00	187	6.4	-	-	iso.	-	-
EWEB-CC	7S	8E	10A	121 48 26	44 58 32	137	4.5	115-137	-	adv. 9.4e	-	-
						-	-	110-137	1.45	-	-	-
						137	-	110-137	1.45	-	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
H-1-WW	8S	1E	08D	122 42 32	44 53 19	218	15.8	95-215	1.72	27.6	27.6	47
										(0.14)		
WOLFF	8S	1E	09B	122 41 38	44 53 28	103	12.1	30-100	1.60e	38.3	38.3	[61]
									(0.15)	(2.89)		
								30-100	-	34.9		
SM-WM	8S	1E	17D	122 42 18	44 52 18	112	13.3	65-110	1.60e	45.7	45.7	[73]
									(0.15)	(2.03)		
								10-110	[1.59]	28.5	27.0	43
CDR-CK	8S	5E	31C	122 14 47	44 49 52	345	17.2	25-345	1.80	32.3	28.6	51
									(0.33)	(0.10)		
-	8S	6E	01D	122 00 51	44 54 19	62	7.1	-	-	adv.	-	-
EWEB-SB	8S	8E	06D	121 52 53	44 54 21	460	29.8	335-460	1.50e	50.1	44.7	67
									(0.25)	(0.93)		
						460	-	150-460	1.49	71.5	63.3	94
CTGH-1	8S	8E	28D	121 49 54	44 51 02	1465	87.	655-1448	1.50e	72.9	72.9	109
									(0.25)	(0.29)		
					44 51 06	-		500-1465	[1.38]	81.7	79.8	110
RDH-CBCK	8S	8E	31C	121 52 52	44 50 01	98	6.9	85-97	1.47	28.9	26.0	[38]
									(0.08)	(2.44)		
						98	-	70-98	1.47	37.8	34.0	50
-	9S	1E	25D	122 37 19	44 45 11	100e	11.4	73-99	1.60e	20.7	22.8	[37]
									(0.15)	(1.96)		
-	9S	2E	16B	122 34 25	44 47 24	110	14.1	88-107	1.30e	35.4	33.1	43
									(0.15)	(1.42)		
GI-WW	9S	2E	21D	122 33 35	44 46 11	49	10.9	20-48	1.26	51.9	46.3	58
										(2.13)		
								22-48	1.26	53.2	47.5	59

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
-	9S	2E	29B	122 35 08	44 45 40	76	13.6	-	-	adv.	-	-
EV2-WW	9S	3E	11B	122 24 31	44 48 28	85	11.4	60-85	1.34	29.9 (0.99)	26.3	35
								48-85	1.34	27.3	24.0	32
EV1-WW	9S	3E	11C	122 24 49	44 48 06	65	10.5	25-60	1.34	26.5 (0.14)	23.6	31
GR-WW	9S	3E	28C	122 27 06	44 45 24	54	1.25	30-52	1.30e (0.15)	32.9 (1.46)	30.7	[40]
						55	-	25-52	-	30.0	28.0	-
-	9S	3E	36B	122 23 31	44 44 59	73	11.9	30-73	1.30e (0.15)	22.0 (0.97)	20.0	26
WILLAMETTE NATL FOREST	9S	6E	21D	122 04 37	44 46 25	25	8.3	-	-	adv.	-	-
RDH-BHSW	9S	6E	23B	122 02 25	44 46 59	108	14.7	40-105	1.61 (0.11)	68.4 (0.30)	56.4	91
						150	-	30-105	1.61	67.6	55.7	90
SUN-BRA1	9S	7E	03C	121 56 03	44 49 08	138	12.1	40-138	1.50e (0.25)	69.4 (0.53)	65.6	98
							-	30-138	[1.38]	63.5	67.5	92
SUN-BR5	9S	7E	07DDB	121 59 30	44 48 06	149	11.7	35-149	1.50e (0.25)	55.4 (0.23)	53.3e	[80]
								50-150	[1.38]	55.4	61.7	84
BREITENBUS HOT SPRINGS RESORT	9S	7E	20A	121 58 37	44 47 02	482	77.9	-	-	adv.	-	-
BEAMER 2	9S	7E	20A	121 58 15	44 46 48	87	35.2	58-87	1.40e (0.20)	299. (7.78)	253.	355

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
						74	-	6-74	1.27	407.3	339.4	430
-	9S	7E	20A	121 58 20	44 47 04	433	83.7	378-433	1.50e	105.	101.	151
									(0.25)	(2.60)		
BEAMER 3	9S	7E	20A	121 58 22	44 46 55	310	89.2	255-310	1.50e	49.8	44.1	[66]
									(0.25)	(0.31)		
								5-35	1.27	1300	1100	1393
								5-35	1.27	1097	1097	393
								0-310	1.55	<277.2	<261.0	<404
BEAMER 1	9S	7E	20A	121 58 33	44 46 52	150	104.8	-	-	adv.		
								0-150	[1.46]	600.	521.7	763
RDH-BHSE	9S	7E	21A	121 57 07	44 46 44	155	22.5	70-155	1.65	9.19	81.7	135
									(0.15)	(0.91)		
							-	90-150	1.65	92.9	82.6	136
SUN-BR11	9S	7E	28CCD	121 57 50	44 45 30	152	27.2	110-152	1.50e	156.	>142.	>213
									(0.25)	(3.26)		
							-	120-153	[1.38]	146.	130.	180
SUNEDCO 58-28	9S	7E	28D	121 57 26	44 45 32	2457	>141.	1465-1715	2.2	30.7	30.7	68
									(0.20)	(0.35)		
							-	250-856	1.51	148.0	148.0	222
								0-2457	1.88	56.0	56.0	105
SUN-BR10	9S	7E	28DAB	121 57 09	44 45 48	152	19.0	90-152	1.50e	101.	101.	152
									(0.25)	(0.41)		
				121 55 42	44 45 59	-	-	30-153	[1.38]	94.9	67.3	93
SUN-BR2	9S	7E	29CCB	121 59 12	44 45 36	84	7.9	75-84	1.50e	90.5	90.9	[136]
									(0.25)	(0.40)		
								70-84	[1.38]	83.4	78.0	109
SUN-BRA4	9S	7E	34DBB	121 56 06	44 44 53	151	20.1	20-150	1.65e	104.	85.2	141
									(0.15)	(0.20)		
				121 56 12	44 44 57	-	-	20-150	[1.38]	103.6	96.2	130

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
SUN-BR12	9S	7E	36BAD	121 53 48	44 45 16	154	17.6	75-150	1.50e	89.0	79.5	120
									(0.25)	(0.40)		
				121 53 36	44 44 48	-		50-154	[1.38]	86.7	77.3	107
(Olallie L. campground)	9S	8E	12C	121 46 53	44 48 12	70	3.	-	-	iso.	-	-
Ingram	10S	5E	02D	122 09 25	44 43 57	65	9.8	55-65	1.30e	28.1	26.3	[34]
									(0.15)	(1.58)		
FS-DRSWW	10S	5E	03D	122 10 46	44 43 41	180	16.7	-	-	adv.	-	-
							-	10-170	[1.17]	52.0	43.0	51
(Southshore Campground)	10S	5E	15A	122 10 32	44 42 18	29	9.1	24-29	1.30e	53.8	41.7	[54]
									(0.15)	(1.86)		
SUN-BRA5	10S	7E	09BBC	121 57 57	44 43 33	152	13.5	100-152	1.65e	70.4	83.8e	[138]
									(0.15)	(0.68)		
								115-152	[1.38]	68.6	92.6	126
RDH-DVCK	10S	7E	11A	121 54 26	44 43 22	155	16.8	70-155	1.40	83.2	72.3	101
									(0.04)	(0.72)		
								70-150	1.40	83.5	72.6	102
SUN-BRA9	10S	7E	20CBB	121 59 12	44 41 27	154	20.6	75-150	1.50e	112.	90.3	135
									(0.25)	(1.10)		
								75-153	[1.38]	104.3	78.4	108
SUNBRA10	10S	7E	23BCB	121 55 33	44 41 36	152	20.4	80-150	1.65e	115.	83.3	138
									(0.15)	(0.47)		
								85-152	[1.38]	115.6	84.2	117
SUNBRA11	10S	7E	24ACB	121 53 39	44 41 36	147	16.6	45-145	1.65e	87.9	79.2	131
									(0.15)	(0.47)		
						-	-	50-145	[1.38]	87.4	78.9	109
SUNBRA12	10S	73	34ACA	121 55 57	44 39 54	153	18.6	50-150	1.65e	84.8	73.7	122

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
									(0.15)	(0.36)		
								50-150	[1.38]	84.8	71.8	100
RL-WW	11S	1E	07D	122 43 19	44 37 28	58	12.5	40-58	1.34	28.1	26.7	35
										(1.38)		
								40-58	1.34	28.1	26.7	35
-	11S	4E	19D	122 22 19	44 35 20	28	9.6	15-28	1.75e	28.7	19.3	[34]
									(0.20)	(1.13)		
BUCK MTN	11S	6E	22D	122 03 23	44 36 01	77	8.1	65-77	1.21	80.2	72.9e	[88]
									(0.08)	(1.85)		
						152	-	30-50	-	90.8	-	-
						-	-	66-76	1.21	79.0	91.6	111
RDH-MTCK	11S	7E	10D	121 56 07	44 37 35	109	16.1	45-109	1.64	37.3	34.9	57
									(0.13)	(1.79)		
						-	-	33-48	1.64	68.4	64.0	105
						-	-	30-109	1.64	68.4	64.0	105
						-	-	0-108	1.64	68.4	64.0	105
EWEB-TM	12S	7E	09D	121 57 48	44 32 41	587	31.0	270-587	1.36	72.2	70.2	95
									(0.08)	(0.27)		
						-	-	300-600	1.36	71.4	69.4	95
						600	-	300-600	1.36	71.4	69.4	94
MR-WW	13S	1E	20B	122 42 58	44 22 55	130	13.1	90-130	[1.34]	33.6	39.9	53
										(1.76)		
								90-130	[1.34]	33.6	39.9	53
MWW	13S	1E	35A	122 38 58	44 24 08	150	13.8	75-150	[1.34]	31.3	37.2	50
										(0.28)		
								90-150	[1.34]	31.5	37.4	50
-	13S	2E	36C	122 30 46	44 23 40	125	14.9	55-125	1.30e	32.3	27.6	36
									(0.15)	(1.04)		
-	13S	3E	31D	122 29 22	44 23 42	78	12.5	21-78	1.42e	23.1	18.9	27

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
									(0.25)	(0.17)		
-	13S	6E	17B	122 07 17	44 26 30	47	10.1	37-47	1.50e	56.6	42.1	[63]
									(0.25)	(0.86)		
DETRO-FM	13S	7E	09A	121 58 30	44 27 42	55	3.7	-	-	adv.	-	-
				121 58 58	44 27 42	79	-	-	-	-	-	-
SP77-24	13S	7E	24DDB	121 50 27	44 25 30	929	25	718-928	1.66	57.6	-	96
									(0.07)	(6.7)		
EWEB-CL	13S	7E	32C	121 59 40	44 23 24	557	24.9	485-555	1.50e	20.8	37.5*	[56]
									(0.25)	(0.27)		
					44 23 19	"	-	50-205	1.44	112.0	102.8	148
								0-555	1.40	25.6	23.9	33
-	13S	7.5E	23D	121 52 49	44 25 24	121	3.2	-	-	-	-	-
WOLF MDW	14S	6E	32D	122 07 16	44 18 12	154	18.1	40-154	1.46	89.4	74.5	109
									(0.13)	(0.17)		
						-	-	42-155	1.46	87.2	72.7	106
						155	-	42-155	1.46	87.2	72.7	110
RDHCRTBR	15S	6E	11D	122 03 15	44 16 06	50	8.0	-	-	adv.	-	-
						64	-	0-52	-	-	-	-
RDH-CRSM	15S	7E	28A	121 58 24	44 14 48	53	4.4	-	-	adv.	-	-
								0-53	-	-	-	-
OH-2Z	16S	2E	26B	122 32 30	44 09 00	34	10.3	20-34	1.50e	24.7	27.4	[4]
									(0.25)	(0.31)		
						30	-	20-30	-	25.0	-	-
-	16S	2E	26B	-	-	26	10.0	20-26	-	adv.	-	-
										35.5e		

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
BH-3Z	16S	4E	14D	122 17 30	44 10 27	48	10.8	12-48	1.80 (0.33)	37.7 (0.38)	34.9	63
					44 10 03	45	-	12-45	1.80	37.8	35.0	63
-	16S	4E	29B	122 21 34	44 09 16	23	8.7	-	-	iso.	-	-
DDH-15	16S	5E	30A	122 14 53	44 09 17	87	14.2	65-87	1.33 (0.15)	96.5 (1.38)	86.7	115
					44 09 12	85	-	15-85	1.33	54.0	51.0	68
ST DAM 1	16S	5E	30A	122 15 00	44 09 08	80	12.9	65-80	[1.33]	32.1 (3.87)	30.4	[40]
								45-70	-	55.9	53.0	-
ST DAM 2	16S	5E	30A	122 14 36	44 09 18	61	11.7	30-61	1.32	57.1 (0.86)	53.7	71
						87(sic)	-	25-61	1.32	56.3	53.0	70
	16S	5E	31D	122 14 29	44 07 47	79	10.0	-	-	adv.	-	-
RDH-CRFP	16S	6E	02C	122 02 58	44 12 08	150	14.8	115-150	1.74 (0.03)	90.1 (2.44)	94.6	165
						"	-	100-150	1.74	84.1	88.3	153
Bigelow	16S	6E	10C	122 04 33	44 11 06	207	52.	-	-	adv.	-	-
(Limberlost Campground)	16S	6E	14C	122 03 06	44 10 26	23	8.8	17-23	1.30e (0.15)	29.5 (0.66)	23.9	[3]
RDH-CRHC	16S	6E	27B	122 04 41	44 09 04	152	21.6	70-150	1.57 (0.05)	89.8 (1.10)	66.2	104
								30-150	1.57	96.2	70.9	111
-	17S	3E	02A	122 24 26	44 07 20	125	13.9	58-125	1.50e (0.25)	29.8 (0.07)	25.3	38
-	17S	3E	04D	122 26 58	44 06 54	61	11.4	30-61	2.70e (0.25)	13.1 (0.14)	11.1	30

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
	17S	3E	10A	122 25 40	44 06 37	111	11.6	40-111	2.70e	16.6	14.7	40
									(0.25)	(0.14)		
WALKER-CRK	17S	5E	08A	122 13 28	44 06 24	154	13.1	105-154	[1.59]	53.2	51.1	81
										(0.78)		
				122 14 00	44 06 24	155	-	105-155	[1.59]	54.1	52.0	83
RIDER-CRK	17S	5E	20B	122 13 51	44 04 54	154	24.8	120-154	1.64	127	102.	166
									(0.24)	(2.49)		
								60-154	2.64(sic)	128.5	97.5	159
RDH-MQCK	17S	6E	25A	122 01 22	44 03 54	151	11.0	129-151	1.55	75.3	88.7	137
									(0.06)	(1.16)		
								131-151	1.55	76.3	89.9	139
						152	-	115-152	1.55	62.8	73.8	114
RDH-RBCK	18S	5E	11B	122 09 49	44 01 07	150	14.4	-	-	adv.	-	-
						-	-	96-152	1.42	61.1	65.0	92
						152	-	55-78	1.55	34.4	36.6	56
CHRS-CRK	19S	4E	29C	122 22 09	43 53 00	153	16.8	71-153	1.75	64.4	52.8	92
									(0.09)	(0.24)		
						154	-	70-154	1.75	64.0	52.3	92
BRCK-CRK	19S	5E	27B	122 12 37	43 53 23	154	16.1	137-154	1.75	69.7	69.5	122
									(0.09)	(2.26)		
						"	-	135-154	1.75	65.8	65.6	115
RDH-ELKCK	19S	6E	08B	122 01 51	43 56 58	133	18.2	37-133	1.22	39.8	30.6	37
									(0.04)	(0.39)		
						-	-	110-134	1.52	35.5	27.4	41
						135	-	40-135	1.22	43.2	33.3	41
N. FORK	19S	5.5E	25DC	122 04 07	43 52 57	154	18.9	90-154	1.35	93.7	82.5	111
									(0.35)	(3.16)		
								30-154	1.35	78.4	67.5	91

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
BTBR-CRK	20S	2E	35AC	122 32 00	43 47 30	155		20-155	(1.41)	42.6 (2.3)	34.1	48
AE-WW	20S	3E	26CD	122 25 12	43 47 54	124		10-80	(1.59)	25.8 (0.5)	25.6	40
CS-WW	20S	3E	26DA	122 25 00	43 48 00	142		45-70	(1.59)	25.3 (1.8)	25.1	39
								70-140	(1.17)	39.0 (0.5)	38.8	45
WALL-CRK	20S	4E	27DD	122 18 48	43 47 54	137		30-135	1.13 (0.13)	72.6 (0.9)	60.5	69
BTBR-CRK	20S	2E	35AC	122 32 00	43 47 03	155		20-155	(1.41)	42.6 (2.3)	34.1	48
AE-WW	20S	3E	26CD	122 25 12	43 47 53	124		10-80	(1.59)	25.8 (0.5)	25.6	40
CS-WW	20S	3E	26DA	122 25 00	43 48 00	142		45-70	(1.59)	25.3 (1.8)	25.1	39
WALL-CRK	20S	4E	27DD	122 18 48	43 47 54	137		30-135	1.13 (0.13)	72.6 (0.9)	60.5	69
FC-WW	21S	3E	10AD	122 25 54	43 45 36	100		25-100	(1.17)	36.5 (0.5)	35.6	41
OAKR-CW6	21S	3E	17DA	122 28 18	43 44 48	345		70-240	(1.82)	47.7 (2.9)	40.5	74
								240-340	(1.84)	42.3	36.0	66
HILLSCRDM	21S	3E	26CAA	122 25 10	43 43 03	160		30-160	(3.71)	36.9	31.3	116
CR-MCHSE	21S	4E	28AD	122 20 00	43 43 06	154		10-150	1.67	82.3 (0.4)	60.0	99

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
BLCK-CRK	21S	5E	16AC	122 13 00	32 44 54	104		45-104	-	6.2 (0.6)	-	-
BFZ-MB	21S	11E	25BB	121 21 42	43 43 54	35		27.5-35	1.51	65.3 (4.3)	65.3	100
RDH-MHSW	22S	5E	26BC	122 11 18	43 38 12	155		30-150	1.97 (0.06)	54.0 (0.4)	51.8	102
PNTO-CRK	23S	5E	8DA	122 14 00	43 35 30	154		40-154	1.52 (0.04)	83.3 (3.3)	66.1	101
SH-WW	23S	9E	36BB	121 36 06	43 32 36	130		-	-	-	-	0
TBUG-CRK	24S	5E	18CA	122 15 54	43 29 24	155		35-154	-	54.2 (8.6)	-	-
WP-WW	24S	7E	7DB	121 55 48	43 30 18	45		-	-	-	-	-
PPL-TCS	26S	3E	25AA	122 24 00	43 17 00	25		7.5-25	-	41.7	-	-
SHD-1	28S	8E	5AA	121 47 00	43 10 48	75		-	-	-	-	-
CLKPRK	29S	6E	9BC	122 05 24	43 05 36	305		-	-	-	-	-
MZ1-11A	31S	7.5E	10CD	121 59 15	42 53 51	1423		61-701	-	45.8	-	-
USFS-NUC	31S	3E	3DA	122 26 50	42 54 12	52.5		-	-	-	-	-
USFSPRS	32S	3E	29BA	122 29 18	42 45 48	46		-	-	-	-	-
MZ11-1	32S	6E	13D	121 03 58	42 47 50	865		91.4-883.9	-	31.0 (4.2)	-	-
WILDWOOD	33S	2E	11AC	122 32 42	42 43 00	60		-	-	-	-	-
LCRKDAM2	33S	2E	17ADD	122 35 54	42 42 06	92.5		-	-	-	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
LCRKDAM1	33S	2E	17ADC	122 36 00	42 42 12	131		-	-	-	-	-
DMND-CRK	33S	2E	19DD	122 37 18	42 40 54	45		-	-	-	-	-
JVARGO	34S	1E	34AA	122 40 42	42 34 50	40		7.5-35	-	49.7	-	-
MATHER	34S	1E	34BB	121 41 36	42 34 42	52.5		10-52.5	-	33.2	-	-
RAMBO	35S	1E	13AD	122 38 18	42 31 48	40		25-40	(1.59)	29.6 (1.4)	31.0	49
OWENS	36S	1E	18CC	122 45 18	42 26 06	45		10-45	-	35.3 (1.3)	35.3	-
MORTEN	37S	2E	4AD	122 45 58	42 23 00	96.5		30-96.5	-	34.6	-	-
WEYEH	37S	7E	15BA	121 59 00	42 32 26	-		-	-	-	-	42
BUTLER FOR	38S	1E	31DAD	122 44 19	42 13 06	107		70-107	1.90	62.0	-	118
MILLER	38S	2E	25BB	122 32 26	42 14 24	29		10-29	-	50.0	-	-
HARRGTON	38S	2E	27CA	122 34 12	42 14 12	46		20-46	-	68.8	-	-
JM MILLR	38S	2E	35AC	122 32 26	42 13 24	45		15-45	-	14.3	-	-
LILYGLEN	38S	3E	12AD	122 24 30	42 17 00	38.5		-	-	-	-	-
COOK	39S	1E	2BC	122 40 36	42 12 42	180		29-177	-	27.5	-	-
ASLDGRHSE	39S	1E	4BBD	122 42 48	42 12 42	334		180-300 310-330	(1.77) (2.07)	53.5 28.7	- -	95 59
DAREX	39S	1E	4CDD	122 42 31	42 12 03	148		10-50 55-90 100-148	1.77 2.64 2.07	84.8 63.1 41.5	149 167 86	

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
JUSTICE CENT	39S	1E	10BCB	122 41 49	42 11 42	154		65-115 125-154	2.06 1.85	29.8 36.5	61 68	
SOSC GYM	39S	1E	10CDB	122 41 27	42 11 15	123		60-123	1.98	25.1	50	
RAMBO	39S	1E	13DA	122 38 30	42 31 36	69		40-68	-	21.1	-	-
RODEO GRO	39S	1E	14DBB	122 40 04	42 10 37	154		100-150	1.85	33.0	-	61
STURDEVNT	39S	1E	15CDB	122 41 18	42 10 24	257		-	-	18.0	-	-
WC 1	39S	1E	32ACD	122 43 30	42 08 06	310		283-310	3.05 (0.06)	16.27 (0.08)	-	42
LITHIASP	39S	2E	7CC	122 38 12	42 11 18	130		95-130	(2.09)	16.6 (0.3)	15.0	31
RP-WW	39S	8E	31AC	122 55 12	42 08 00	52		15-52	>0.75	55.0	55.0	>42
COLESTIN	40S	1E	36AB	122 38 42	42 08 18	140		10-140	(1.88)	31.2 (0.7)	28.0	52
FORD	40S	2E	6BB	122 32 18	42 05 36	137		20-137	-	24.6	-	-
HARRELL	40S	2E	12ACC	122 31 48	42 06 18	47		10-47	-	47.0	-	-
MURRAY	40S	3E	5DDD	122 29 00	42 06 48	73		45-73	-	26.4	-	-
CORRAL CRE	40S	4E	5DB	122 22 30	42 07 05	99		65-100	1.31	43.5	-	57
VW-WW	40S	8E	3CD2	121 51 54	42 06 48	72		20-72	>0.75	146.0	146.0	>109
EG-17-WW	40S	8E	17BA	121 54 12	42 05 42	55		15-55	>0.75	17.0	17.0	>13
LISKEY-WW	41S	8E	13AC	121 49 18	42 00 18	179		51-179	0.75 (0.01)	16.8 (0.9)	16.8 (0.9)	13

MT HOOD AREA

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
ELIOT BR	1S	9E	26ABA	121 38 59	45 27 33	213		101-160	1.76	24.3 (0.8)	21.9	39
								101-213	1.77 (0.04)	35.1 (2.6)	31.6	56
CLEAR BK	1S	9E	31ACA	121 42 55	45 26 37	311		100-250	1.55 (0.08)	27.3 (0.5)	30	46
								100-311	1.55 (0.08)	24.5 (0.8)	27	42
RDH-RP	1S	10E	9BC	121 33 45	45 29 47	150		10-20	(1.46)	273.0 (3.0)		(400)
								10-150	1.63 (0.10)	<61.0	<56.0	<91
RDH-PD	1S	10E	29CA	121 34 47	45 27 08	135		0-135	1.83 (0.08)	–	–	–
CCPA-WW	2S	7E	34BB	121 56 06	45 21 31	85		10-35		45.4 (0.6)	39.0	-
								35-85	(1.80)	55.5 (1.0)	43.3	78
USGS-MCG	2S	8E	1CDD	121 46 06	45 25 08	595		50-300	(1.26)	102.2 (2.3)	84.3	(106)
								50-595	1.64 (0.10)	92.7 (2.9)	81.4	134
								300-595	1.74 (0.07)	84.7 (1.1)	77.3	135
NNG-LCM1	2S	8E	9AC	121 49 28	45 24 38	150		80-150	1.63 (0.13)	67.5 (0.5)	62.1	101
NNG-OMF2	2S	8E	15CD	121 48 28	45 23 28	1200		100-250	(2.09)	69.4 (0.3)	64.0	(134)
								490-600	(1.55)	67.8 (2.2)	65.0	(101)
								600-850	1.87	51.4	51.4	97

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
									(0.08)	(5.0)		
								1000-1200	1.75	55.0	55.0	96
									(0.06)			
DOEOMF7A	2S	8E	15DA	121 48 20	45 23 44	1790		90-1250	1.82	65.2	62.6	114
										(0.2)		
								1250-1790	2.27	57.0	56.8	129
										(0.3)		
NNG-OMF3	2S	8E	17CC	121 51 04	45 23 15	398		100-398	1.51	63.7	57.9	87
									(0.13)	(2.4)		
NNGOMF10	2S	8E	28AA	121 49 18	45 22 22	130		75-130	1.49	73.7	66.3	99
									(0.08)	(0.4)		
RDH-RD19	3S	7E	03A	121 55 22	45 20 38	65	10.2	25-65	[1.21]	61.0	57.1	[69]
										(5.70)		
						-	-	30-65	[1.21]	57.7	54.0	66
NNG-KC-1	3S	8E	14BC	121 47 42	45 18 56	285	11.6	175-285	2.24	19.4	17.5	39
									(0.08)	(0.05)		
						-	-	100-285	2.24	18.1	16.4	37
CR-LH	3S	8E	16CD	121 49 51	45 18 23	126	10.2	80-125	2.18	23.8	24.8	54
									(0.06)	(0.49)		
								50-120	2.18	26.3	28.0	61
SKI-BOWL	3S	8E	24BBD	121 46 27	45 18 08	60	8.4	-	-	adv.	-	-
								0-60	[1.67]	60.0	55.0	92
THNDRHDL	3S	8E	24ABB	121 45 55	45 18 14	536	24.7	494-536	[2.30]	46.1	>40.8	>94
										(1.06)		
						-	-	500-536	[2.30]	48.7	48.7	112
RDH-SC	3S	8E	29DDC	121 50 33	45 16 34	151	17.7	130-150	-	25.8	-	-
										(0.81)		
								100-150	2.64	34.1	25.2	67

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
CR-SB	3S	8.5E	25AA	121 43 41	45 17 15	82	7.1	65-82	1.67	102.	102.	[170]
									(0.11)	(5.81)		
						-	-	0-82	1.67	-	-	-
NNG-TRLK	3S	8.5E	25CA	121 44 06	45 16 58	315	21.0	175-315	[1.76]	54.1	48.3	85
										(0.20)		
								180-315	[1.76]	53.9	53.9	95
MEADOWS	3S	9E	03CCA	121 39 44	45 19 57	601	29.8	430-601	2.02	81.7	81.7	165
									(0.08)	(1.66)		
								275-354	2.02	61.0	68.5	139
CR-HH	3S	9E	06DD	121 42 30	45 19 53	110	2.6	-	-	iso.	-	-
						-	-	10-115	1.85	-	-	-
RDH-TBLG	3S	9E	07AB	121 42 25	45 19 45	226	10.6	210-226	[1.84]	171.	169.	[311]
										(1.56)		
						-	-	195-225	[1.84]	201.7	201.7	371
USGS-PUC	3S	9E	07DBB	121 42 56	45 19 18	1129	76.6	560-1129	1.79	67.1	72.4	130
									(0.03)	(0.42)		
						-	-	560-1125	1.79	67.2	67.2	121
WHT RIVR	3S	9E	16CAD	121 40 34	45 18 22	303	15.7	-	-	adv.	-	-
								250-303	2.37	10.2	10.2	24
USGS-HWY	3S	9E	30ADB	121 42 41	45 17 10	289	15.4	75-289	[1.76]	41.5	38.2	67
										(0.13)		
						-	-	80-289	[1.76]	41.5	41.5	73
EAST OF CASCADE CREST												
-	3S	11E	01A	121 21 35	45 20 48	126	14.2	50-126	1.65e	42.4	46.0	76
									(0.15)	(0.27)		

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
Palmer	3S	13E	31B	121 14 03	45 16 16	87	21.2	34-87	1.60e (0.15)	24.7 (0.77)	21.2	34
-	3S	14E	07D	121 05 05	45 19 01	65	12.4	45-65	1.60e (0.15)	23.8 (0.60)	23.9	38
-	4S	9E	28D	121 40 08	45 11 15	145	4.2	-	-	iso.	-	-
-	4S	12E	10D	121 16 45	45 13 51	90	14.3	-	-	adv.	-	-
-	4S	12E	17B	121 20 04	45 13 29	150	12.8	115-150	1.40e (0.20)	1.51 (1.05)	<21.6	<30
-	4S	12E	17C	121 20 03	45 13 04	184	14.5	-	-	adv.	-	-
-	4S	13E	01C	121 07 27	45 14 55	75	16.3	-	-	adv.	-	-
-	4S	13E	24C	121 07 34	45 12 22	136	11.3	-	-	iso.	-	-
McElheran	4S	13E	24D	121 07 07	45 12 14	140	11.9	-	-	iso.	-	-
-	4S	13E	27C	121 10 11	45 11 34	104	15.6	-	-	-	-	-
-	4S	133	32D	121 12 06	45 10 29	145	18.6	130-145	1.65e (0.15)	45.8 (2.07)	45.8	76
-	4S	14E	19A	121 05 49	45 12 38	105	11.6	-	-	iso.	-	-
-	4S	14E	33C	121 04 10	45 10 36	70	18.4	40-70	-	adv. 53.9e	-	-
-	5S	11E	14D	121 22 45	45 07 48	245	13.0	180-245	-	24.1 (2.42)	-	-
Harmon	5S	11E	25D	121 22 41	45 06 17	152	17.2	149-152	1.60e (0.15)	62.3 (5.56)	60.2	[96]

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
Kimmel	5S	11E	26A	121 23 19	45 06 28	264	21.4	258-264	1.60e (0.15)	50.7 (1.00)	51.5	[82]
-	5S	12E	08B	121 20 05	45 09 19	35	11.7	-	-	adv.	-	-
-	5S	12E	31A	121 20 20	45 05 55	108	14.9	-	-	adv.	-	-
Garner/ Rainbow Rock	6S	11E	11C	121 23 20	45 03 27	72	16.7	30-72	1.65e (0.15)	95.2 (1.14)	92.0	152
CRITRN 1	6S	14E	13D	120 59 46	45 02 35	120	14.9	50-120	[1.59]	40.2 (1.56)	44.3	[70]
								80-120	[1.59]	44.8	44.8	71
Confederated Tribes	7S	11E	14C	121 23 37	44 57 40	30	15.2	17-30	1.30e (0.15)	97.2 (6.84)	<80.9	[<105]
Confederated Tribes	7S	11E	15D	121 24 40	44 57 22	118	15.3	-	-	adv.	-	-
Indian Health Services	7S	12E	29C	121 19 45	44 55 36	120	19.3	94-110	1.35e (0.20)	75.1 (1.14)	75.6	[102]
Peters	8S	12E	03A	121 16 56	44 54 19	90	13.1	49-90	1.35e (0.20)	22.9 (0.19)	20.7	28
Wolfe	8S	12E	03C	121 17 27	44 54 13	42	11.0	27-42	1.35e (0.20)	102. (1.26)	>98.5	>133
Williams	9S	11E	02B	121 23 25	44 49 26	111	13.8	105-111	1.30e (0.15)	24.6 (1.20)	24.9	[32]
Macy	9S	12E	14D	121 15 36	44 47 10	28	14.1	-	-	adv.	-	-
Perthina	9S	12E	31C	121 20 56	44 44 36	62	17.5	40-62	1.30e (0.15)	77.7 (1.65)	64.5	84
-	9S	12E	34C	121 17 32	44 44 43	24	11.9	-	-	adv.	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
	9S	14E	23B	121 01 30	44 46 39	80	16.7	60-80	1.30e (0.15)	61.0 (3.58)	56.3	[73]
Vibbert	9S	14E	30C	121 06 11	44 45 15	180	19.4	149-180	1.60e (0.15)	37.2 (0.90)	35.0	56
CASTLERX	11S	10E	05A	121 33 28	44 38 47	153	10.4	141-153	1.50e (0.25)	17.5 (0.73)	>18.8	[>28]
								25-153	-	18.2	-	-
City of Madras	11S	13E	01B	121 07 25	44 38 51	162	17.0	149-162	1.30e (0.15)	15.6 (1.31)	14.7	[19]
Belle	11S	13E	07C	121 13 34	44 37 21	242	15.9	235-242	1.30e (0.15)	11.5 (0.41)	11.7	[15]
SCHNDR-1	11S	13E	24A	121 06 49	44 36 21	295	24.9	90-295	1.44	53.8 (0.58)	53.1	76
								70-260	1.44	50.7	48.2	69
-	11S	13E	24A	121 06 50	44 36 06	245	21.1	185-245	1.32e (0.20)	51.5 (0.33)	51.1	68
GREENRDG	12S	9E	01B	121 36 25	44 33 42	105	16.8	60-105	[1.60]	81.0 (0.99)	64.8	104
						152	-	70-105	[1.60]	79.2	63.4	101
Stills	12S	11E	02C	121 22 51	44 38 18	175	13.3	171-175	-	adv. 12.3e	-	-
Wheeler	12S	12E	04B	121 18 02	44 33 41	189	11.7	-	-	iso.	-	-
-	12S	12E	20A	121 19 12	44 31 02	217	11.6	-	-	iso.	-	-
- (by Blue L. airstrip)	13S	8E	27D	121 45 41	44 24 56	46	5.2	-	-	adv.	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
FLY CRK	13S	10E	05A	121 33 25	44 28 46	105	7.3	-	-	iso.	-	-
						120	-	-	-	-	-	-
Hart	13S	12E	21A	121 17 41	44 26 02	177	10.9	-	-	iso.	-	-
-	13S	14E	11C	121 01 13	44 27 12	50	13.9	25-50	1.39e (0.15)	28.1 (1.83)	27.3	36
-	13S	14E	11C	121 01 24	44 26 58	45	14.8	-	-	adv.	-	-
-	13S	14E	11C	121 01 13	44 26 58	45	14.8	-	-	adv.	-	-
Kiewit Pacific Co.	14S	9E	08A	121 40 41	44 22 37	120	5.7	-	-	iso.	-	-
Deschutes Natl Forest	14S	9E	35C	121 37 52	44 18 38	43	6.5	-	-	adv.	-	-
-	14S	10E	07C	121 35 32	44 22 09	180	8.8	-	-	iso.	-	-
Gill	14S	10E	08B	121 34 17	44 22 19	66	8.2	-	-	iso.	-	-
Stangland	14S	10E	26A	121 29 43	44 20 00	203	10.1	-	-	iso.	-	-
Mehring	14S	10E	28D	121 32 15	44 19 31	49	10.0	-	-	adv.	-	-
Wagner	14S	10E	34B	121 31 48	44 18 56	42	8.4	27-41	-	adv. 6.9e	-	-
Gillworth	14S	11E	01D	121 21 04	44 22 43	147	10.5	-	-	iso.	-	-
Veeck	14S	11E	04B	121 25 51	44 23 32	87	9.9	-	-	iso.	-	-
-	14S	11E	28A	121 24 46	44 20 00	188	10.2	-	-	adv.	-	-
-	14S	11E	28C	121 25 20	44 19 35	167	10.1	-	-	iso.	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
-	14S	13E	14A	121 08 08	44 21 33	58	12.9	45-58	1.50e (0.25)	14.7 (1.43)	>13.4	[>20]
-	14S	13E	29C	121 12 22	44 19 33	58	12.3	40-58	-	adv. 8.8e	-	-
SWIFT	14S	14E	18C	121 06 19	44 21 09	60	12.3	- 25-60	- -	iso. 4.5	- -	- -
-	15S	10E	02D	121 29 40	44 17 34	70	9.4	-	-	iso.	-	-
CENTWEST	15S	10E	05B	121 34 22	44 18 19	102 106	9.7 -	- 10-30	- -	iso. 104.8	- -	- -
Reed	15S	10E	06B	121 35 16	44 18 13	61	8.8	-	-	iso.	-	-
-	15S	10E	11B	121 30 12	44 17 23	69	9.4	-	-	iso.	-	-
-	15S	10E	36D	121 28 24	44 13 29	95	10.3	-	-	adv.	-	-
-	15S	11E	07B	121 28 05	44 17 09	130	10.2e	-	-	adv.	-	-
-	15S	11E	09B	121 25 26	44 17 28	123	10.4	-	-	adv.	-	-
Mid-Oregon Crushing Co	15S	11E	16B	121 25 33	44 16 24	86	7.0	-	-	iso.	-	-
-	15S	12E	03B	121 17 13	44 18 03	88	7.2	-	-	iso.	-	-
-	15S	12E	04A	121 17 42	44 17 58	104	7.1	-	-	iso.	-	-
-	15S	12E	09B	121 18 03	44 17 13	156	10.5	-	-	adv.	-	-
-	15S	12E	23B	121 15 43	44 15 39	88	11.0	-	-	adv.	-	-
-	15S	13E	02C	121 08 42	44 17 31	88	15.9	-	-	adv.	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
-	15S	13E	03D	121 09 06	44 17 35	154	17.2	35-154	1.65e (0.15)	42.3 (1.85)	42.3	70
-	15S	13E	03D	121 09 06	44 17 35	88	12.9	-	-	adv.	-	-
-	15S	13E	04C	121 10 52	44 17 52	85	12.5	-	-	iso.	-	-
-	15S	13E	18B	121 13 40	44 16 12	64	11.2	55-64	-	adv. 12.6e	-	-
-	15S	13E	22A	121 09 25	44 15 42	220	11.4	-	-	iso.	-	-
CRABTREE	15S	14E	15D	121 01 41	44 15 55	81 -	12.2 121.8	- -	- -	adv. -	- -	- -
FHRNBKWW	15S	14E	36A	120 59 36	44 13 14	157	31.7	- 20-155	- [1.46]	adv. 128.4	- 120.5	- 176
-	16S	11E	34B	121 23 37	44 09 04	66	11.5	-	-	adv.	-	-
-	16S	11E	34C	121 24 07	44 08 25	49	9.6	-	-	adv.	-	-
-	16S	11E	34C	121 23 50	44 08 24	178	9.7	-	-	iso.	-	-
-	16S	11E	35A	121 21 48	44 09 08	208	10.3	-	-	iso.	-	-
Dearing	16S	12E	20A	121 18 38	44 10 37	169	11.1	-	-	iso.	-	-
-	16S	12E	26B	121 15 38	44 09 37	171	10.6	166-171	1.30e (0.15)	49.3 (5.71)	>47.6	[>62]
-	16S	12E	29C	121 18 58	44 09 25	163	10.9	-	-	iso.	-	-
-	16S	12E	31C	121 20 25	44 08 39	100	10.3	-	-	adv.	-	-
La Moin Brandt	16S	12E	31D	121 19 38	44 08 37	55	10.7	-	-	iso.	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
Heierman	16S	13E	16A	121 09 56	44 11 31	146	10.6	-	-	iso.	-	-
-	16S	14E	16A	121 02 59	44 11 38	460	56.4	200-460	1.50e (0.25)	76.4 (0.57)	73.7	111
ST HWY 1	16S	14E	17D	121 04 00	44 10 52	150	16.2	-	-	adv.	-	-
							"	-	-	-	-	-
MILLER	16S	14E	20A	121 04 20	44 10 29	30	12.6	-	-	adv.	-	-
								10-30	-	-30.4	-	-
SLVDLR R	16S	14E	20D	121 03 58	44 10 22	149	16.9	125-149	-	110. (10.4)	-	-
								10-149	-	-12.5	-	-
SBUTTE 2	16S	14E	35C	121 01 05	44 08 34	142	24.0	95-142	1.65e (0.15)	47.4 (0.84)	45.9	[76]
							24.1	90-140	-	47.3	-	-
Gisler	17S	12E	09D	121 17 23	44 06 36	251	10.5	-	-	iso.	-	-
-	17S	13E	08B	121 11 52	44 07 20	183	10.9	-	-	adv.	-	-
LEWIS	17S	14E	23A	121 00 57	44 05 08	187	18.3	-	-	adv.	-	-
								135-170	-	68.7	-	-
Wolf	18S	11E	23C	121 22 53	43 59 46	128	9.0	123-128	1.55e (0.35)	35.8 (0.20)	35.1	[54]
PATTERSON	18S	11E	25B	121 21 24	43 59 22	130	9.2	-	-	adv.	-	-
								0-130	-	-	-	-
City of Bend	18S	11E	27B	121 24 10	43 59 17	116	9.1	-	-	iso.	-	-
Deschutes Cty.	18S	11E	36A	121 21 12	43 58 28	108	9.1	-	-	iso.	-	-
BS-WW	18S	12E	05B	121 19 03	44 02 48	223	10.3	-	-	adv.	-	-
							-	0.230	-	-	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
USFS	19S	11E	16A	121 24 47	43 55 48	77	7.1	-	-	adv.	-	-
LAVBUTTE	19S	11E	25B	121 21 30	43 54 24	123	9.2	93-123	[1.59]	39.5 (3.22)	>38.4	[>61]
								93-123	[1.59]	38.3	38.3	26(sic)
Moon	19S	14E	02D	121 00 33	43 57 06	264	22.3	-	-	adv.	-	-
Crane	19S	14E	24D	120 59 11	43 54 25	384	21.7	250-380	1.65e (0.15)	30.9 (1.17)	30.9	51
USDA	20S	7E	34A	121 51 51	43 48 02	53	6.8	46-53	1.55e (0.35)	14.1 (0.33)	>12.6	[20]
GEO-N-3	20S	12E	24BCB	121 14 49	43 49 30	1220	57	1174-1220	1.80	53.2	53.2	96
-	20S	14E	13A	120 59 12	43 50 43	108	13.1	70-108	1.50e (0.25)	30.9 (1.12)	32.0	48
BFZ-PMW	20S	14E	25A	120 59 21	43 48 53	125	14.3	65-125	1.65e (0.15)	33.0 (0.27)	32.2	53
								45-125	<1.84	34.4	34.4	<63
BFZ-MB	21S	11E	25B	121 21 42	43 43 56	35	8.3	28-35	1.51	67.6 (2.08)	>64.8	[>98]
								28-35	1.51	65.3	65.3	100
SF NC-01	21S	12E	28BDD	121 17 10	43 43 05	1220	171	336.8-1202.1	1.61 (0.04)	137.5 (0.4)	-	221
								758-1202.1		142.5 (0.3)	-	237
GEO-N-2	21S	12E	29ADC	121 17 21	43 44 42	1336	164	440-1335	1.55 (0.05)	129.2 (0.1)	-	200
USGS-N1	21S	13E	15DDB	121 09 10	43 45 01	386	17	200-363	54.3 (4.5)	-	-	-

NAME	TOWNSHIP	RANGE	SECTION	LONGITUDE	LATITUDE	DEPTH	BOTTOM-HOLE TEMPERATURE	INTERVAL	THERMAL CONDUCTIVITY	GRADIENT	GRADIENT CORRECTED	HEAT FLOW
USGS-N2	21S	13E	31CC	121 13 30	43 42 30	932	265	660-930	(1.46)	1092.0	1092.0	1594
								675-930.7		764.9	-	-
										(10.5)		
								2-930.7		174.3	-	-
										(3.8)		
GEO N-4	21S	13E	35DBD	121 08 54	43 42 51	703	18	450-615	2.07	118.3	-	245
									(0.04)	(5.9)		
								540-615		97.3	-	201
										(2.1)		
SAN-RDO-1	21S	13E	31CCA	121 13 25	43 42 23	424	158	282-418	(1.46)	977.7	-	1466
SF NC 72-03	22S	12E	3ABA	121 16 34	43 42 18	1372	154	510.2-1358.5	1.62	137.0	-	222
									(0.07)	(0.2)		
GEO N-5	22S	12E	8DAA	121 17 09	43 41 36	988	69	650-965	1.57	125.9	-	198
									(0.08)	(0.4)		
GEO N-1	22S	12E	25BD	121 14 27	43 38 15	1387	71	1146-1226	1.80	83.7	83.7	151
										(44.0)		
BFZ-CH	22S	14E	03A	121 02 15	43 41 55	75	5.8	52-75	155.e	9.0	8.0	12
									(0.35)	(0.24)		
								0-75	-	-	-	-

APPENDIX B

TEMPERATURE CALCULATIONS FOR THE CASCADE RANGE AND NEWBERRY VOLCANO

Hole Name - if assigned. Dashes indicate lack of data (in all columns).

Hole Location - given as township, range, and section.

Depth - depth in meters (m).

Bottom Hole Temperature - bottom hole temperature in degrees Centigrade (°C).

Interval - interval over which the uncorrected temperature gradient was measured, in meters (m).

Thermal Conductivity - thermal conductivity in Watts per meter degree Kelvin (W/m°K). The best thermal conductivity value from Appendix A.

Gradient Corrected - terrain corrected temperature gradient in degrees Centigrade per kilometer (°C/km).

Heat Flow - heat flow in milliwatts per square meter (mW/m^2). The product of the terrain corrected temperature gradient and the thermal conductivity.

Temperature at 1 km - projected temperature at a depth of one kilometer in degrees Centigrade (°C).

Temperature at 2 km - projected temperature at a depth of two kilometers in degrees Centigrade (°C).

Temperature at 3 km - projected temperature at a depth of three kilometers in degrees Centigrade (°C).

Depth to 90 °C - depth to a temperature of ninety degrees Centigrade in the well, in kilometers (km).

Depth to 100 °C - depth to a temperature of one hundred degrees Centigrade in the well, in kilometers (km).

Depth to 150 °C - depth to a temperature of one hundred fifty degrees Centigrade in the well, in kilometers (km).

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
-	3S 4E 03A	92	12.2	75-90	1.35e	51.0	69	59	89	121	2.05	2.35	N/A
-	3S 4E 23D	49	11.8	39-49	1.40e	32.8	46	43	63	85	N/A	N/A	N/A
-	3S 4E 27C	50	11.5	38-50	1.40e	52.0	73	61	93	127	1.92	2.21	N/A
-	5S 5E 23D	149	15.9	101-149	1.60e	43.6	70	53	83	117	2.22	2.50	N/A
Roaring R.	5S 6E 06D	40	10.6	23-40	1.60e	43.6	70	52	83	116	2.23	2.51	N/A
TWW	6S 1E 13D	140	14.9	95-140	1.38	37.8	44	47	67	87	N/A	N/A	N/A
MC-WW	6S 1E 35C	195	15.2	110-195	[1.17]	34.8	41	43	61	81	N/A	N/A	N/A
QWW	6S 2E 18B	92	11.7	55-92	1.30e	28.8	37	38	54	72	N/A	N/A	N/A
RDHCRCDR	6S 6E 34C	150	20.9	15-150	1.64	64.7	106	76	122	172	1.31	1.52	2.56
RDH-AHSE	6S 7E 21C	40	17.9	28-40	1.47	109.0	160						
RDHCRAHS	6S 7E 30B	135	55.3	95-135	1.65	166.0	274						
-	6S 7E 30B	293	82.1	146-293	1.50e	62.7	94	126	167	212	0.49	0.58	1.61
CR-BHS	7S 5E 22A	90	13.5	20-90	1.46	66.8	97	74	116	163	1.37	1.61	2.73
H-1-WW	8S 1E 08D	218	15.8	95-215	1.72	27.6	47	37	58	80	N/A	N/A	N/A
WOLFF	8S 1E 09B	103	12.1	30-100	1.60e	38.3	61	46	73	102	2.64	2.93	N/A
SM-WM	8S 1E 17D	112	13.3	65-110	1.60e	45.7	73	54	86	120	2.14	2.41	N/A
CDR-CK	8S 5E 31C	345	17.2	25-345	1.80	28.6	51	36	58	82	N/A	N/A	N/A
EWEB-SB	8S 8E 06D	460	29.8	335-460	1.50e	44.7	67	54	83	115	2.24	2.53	N/A
CTGH-1	8S 8E 28D	1465	87.0	655-1448	1.50e	72.9	109	57	126	178	1.70	1.91	2.46

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
RDH-CBCK	8S 8E 31C	98	6.9	85-97	1.47	26.0	38	30	47	65	N/A	N/A	N/A
-	9S 1E 25D	100	11.4	73-99	1.60e	22.8	37	32	48	66	N/A	N/A	N/A
-	9S 2E 16B	110	14.1	88-107	1.30e	33.1	43	44	62	83	N/A	N/A	N/A
GI-WW	9S 2E 21D	49	10.9	20-48	1.26	46.3	58	55	80	108	2.39	2.72	N/A
EV2-WW	9S 3E 11B	85	11.4	60-85	1.34	26.3	35	35	51	67	N/A	N/A	N/A
EV1-WW	9S 3E 11C	65	10.5	25-60	1.34	23.6	31	33	46	61	N/A	N/A	N/A
GR-WW	9S 3E 28C	54	12.5	30-52	1.30e	30.7	40	42	59	78	N/A	N/A	N/A
-	9S 3E 36B	73	11.9	30-73	1.30e	20.0	26	30	42	54	N/A	N/A	N/A
RDH-BHSW	9S 6E 23B	108	14.7	40-105	1.61	56.4	91	65	105	148	1.63	1.88	N/A
SUN-BRA1	9S 7E 03C	138	12.1	40-138	1.50e	65.6	98	69	111	158	1.50	1.74	2.83
SUN-BR5	9S 7E 07DDB	149	11.7	50-150	[1.38]	61.7	84	64	101	141	1.71	1.98	N/A
BREITENBUSH	9S 7E 20A	482	77.9	-	-	-							
BEAMER 2	9S 7E 20A	87	35.2	58-87	1.40e	253.0	355						
-	9S 7E 20A	433	83.7	378-433	1.50e	101.0	151						
BEAMER 3	9S 7E 20A	310	89.2	255-310	1.50e	44.1	66						
				5-35	1.27	1100.0	1393						
				5-35	1.27	1097.0	393						
				0-310	1.55	<261	404						
BEAMER 1	9S 7E 20A	150	104.8	-	-								
				0-150	[1.46]	521.7	763						
RDH-BHSE	9S 7E 21A	155	22.5	90-150	1.65	82.6	136	92	157	196	0.97	1.13	1.89
SUN-BR11	9S 7E 28CCD	152	27.2	120-152	1.38	130.0	180						

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
SUNEDCO 58-28	9S 7E 28D	2457	141.0	1465-1715	2.2	30.7	68						
			-	250-856	1.51	148.0	222						
				0-2457	1.88	56.0	105						
SUN-BR10	9S 7E 28DAB	152	19.0	30-152	1.38	67.3	93	76	117	161	1.34	1.59	2.76
SUN-BR2	9S 7E 29CCB	84	7.9	70-84	[1.38]	78.0	109	79	127	179	1.22	1.44	2.45
SUN-BRA4	9S 7E 34DBB	151	20.1	20-150	1.38	96.2	130	102	158	220	0.88	0.83	1.78
SUN-BR12	9S 7E 36BAD	154	17.6	50-154	[1.38]	77.3	107	83	130	180	1.15	1.37	2.40
Ingram	10S 5E 02D	65	9.8	55-65	1.30e	26.3	34	34	49	65	N/A	N/A	N/A
FS-DRSWW	10S 5E 03D	180	16.7	10-170	[1.17]	43.0	51	52	74	98	2.72	N/A	N/A
(Southshore	10S 5E 15A	29	9.1	24-29	1.30e	41.7	54	50	73	99	2.72	N/A	N/A
SUN-BRA5	10S 7E 09BBC	152	13.5	115-152	[1.38]	92.6	126	92	147	207	0.98	1.15	2.05
RDH-DVCK	10S 7E 11A	155	16.8	70-155	1.40	72.3	101	78	122	170	1.28	1.50	2.59
SUN-BRA9	10S 7E 20CBB	154	20.6	75-153	[1.38]	78.4	108	87	134	185	1.07	1.28	2.31
SUNBRA10	10S 7E 23BCB	152	20.4	85-152	[1.38]	84.2	117	92	143	198	0.98	1.16	2.13
SUNBRA11	10S 7E 24ACB	147	16.6	50-145	[1.38]	78.9	109	84	131	183	1.13	1.34	2.36
SUNBRA12	10S 7E 34ACA	153	18.6	50-150	[1.38]	71.8	100	79	123	171	1.24	1.47	2.57
RL-WW	11S 1E 07D	58	12.5	40-58	1.34	26.7	35	38	53	70	N/A	N/A	N/A
BUCK MTN	11S 6E 22D	77	8.1	65-77	1.21	72.9	88	75	114	156	1.38	1.64	2.87
RDH-MTCK	11S 7E 10D	109	16.1	45-109	1.64	34.9	57	47	72	99	2.73	N/A	N/A
EWEB-TM	12S 7E 09D	587	31.0	270-587	1.36	70.2	95	60	101	147	1.73	1.97	N/A

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NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
MR-WW	13S 1E 20B	130	13.1	90-130	[1.34]	39.9	53	48	71	96	2.83	N/A	N/A
MWW	13S 1E 35A	150	13.8	75-150	[1.34]	37.2	50	45	67	91	3.05	N/A	N/A
-	13S 2E 36C	125	14.9	55-125	1.30e	27.6	36	39	55	72	N/A	N/A	N/A
-	13S 3E 31D	78	12.5	21-78	1.42e	18.9	27	30	42	55	N/A	N/A	N/A
-	13S 6E 17B	47	10.1	37-47	1.50e	42.1	63	50	78	108	2.45	2.75	N/A
SP77-24	13S 7E 24DDB	929	25.0	718-928	1.66	57.6	96	29	71	117	2.46	2.64	N/A
EWEB-CL	13S 7E 32C	557	24.9	485-555	1.50e	37.5	56	42	66	93	2.99	N/A	N/A
WOLF MDW	14S 6E 32D	154	18.1	40-154	1.46	74.5	109	81	129	180	1.19	1.40	2.41
BH-3Z	16S 4E 14D	48	10.8	12-48	1.80	34.9	63	44	71	101	2.68	2.95	N/A
DDH-15	16S 5E 30A	87	14.2	65-87	1.33	86.7	115	93	143	198	1.60	1.13	2.12
ST DAM 1	16S 5E 30A	80	12.9	65-80	[1.33]	30.4	40	41	58	77	N/A	N/A	N/A
ST DAM 2	16S 5E 30A	61	11.7	30-61	1.32	53.7	71	62	93	127	1.90	2.21	N/A
RDH-CRFP	16S 6E 02C	150	14.8	115-150	1.74	94.6	165	95	167	246	0.94	1.07	1.70
RDH-CRHC	16S 6E 27B	152	21.6	70-150	1.57	66.2	104	78	123	172	1.27	1.49	2.55
-	17S 3E 02A	125	13.9	58-125	1.50e	25.3	38	36	53	71	N/A	N/A	N/A
-	17S 3E 04D	61	11.4	30-61	2.70e	11.1	30	22	35	49	N/A	N/A	N/A
-	17S 3E 10A	111	11.6	40-111	2.70e	14.7	40	25	42	61	N/A	N/A	N/A
WALKER-CRK	17S 5E 08A	154	13.1	105-154	[1.59]	51.1	81	56	92	130	1.96	2.22	N/A
RIDER-CRK	17S 5E 20B	154	24.8	120-154	1.64	102.0	166						
RDH-MQCK	17S 6E 25A	151	11.0	96-152	1.42	65.0	92	66	106	150	1.60	1.85	N/A

effect of groundwater flow in high permeability near-surface, young, volcanic rocks, referred to as the "rain curtain" effect, will be discussed.

Two holes listed in Table 1 are in the state of Washington along the Columbia River near the town of Stevenson. The holes are 300 m and 740 m deep and were drilled at a resort to test for the potential direct use of geothermal fluids. These are the deepest wells in the area. They are located in a trough of low heat flow that occurs along the Columbia River. The trough separates the high heat flow in southern Washington from the high heat flow along the Cascade axis in northern Oregon (see Blackwell et al., 1990a, 1990b). The temperature-depth curves for the deepest well is plotted in Figure 1 and the thermal results are summarized in Table 1.

The low gradients are similar to the low gradients in the shallower wells available previously. The heat flow in the wells is about 45 ± 5 mW/m^2 (no samples are available for thermal conductivity measurements) and cannot exceed 60 mW/m^2 based on reasonable thermal conductivity estimates. The depth of these new wells in the topographically lowest region in the area suggest that the uniformly low gradients along the Columbia River previously observed in shallower wells (typically 100 m to 150 m deep) are not due to groundwater flow, but are due to low regional heat flow. Only if there were some sort of local down flow as part of the nearby Carson Hot Spring system could the low gradient in a hole as deep as the Green Life 1 be due to hydrologic conditions (see Figure 1, GRLTRES 1).

The results for the Santiam Pass well are presented in Table 1 because previous results are available only in an open-file report (Hill, 1992). Furthermore, the hole was relogged in 1992 just before final plugging and after the manuscript was submitted for the Hill (1992) publication. The different thermal logs for the well are shown in Figure 2. The hole continued to cool with time, and the temperature at the bottom of the downflow zone had decreased to 9 ^{o}C by August of 1992. The heat flow in the well is not precisely determined

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NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
CHRS-CRK	19S 4E 29C	153	16.8	71-153	1.75	52.8	92	62	102	145	1.71	1.96	N/A
BRCK-CRK	19S 5E 27B	154	16.1	137-154	1.75	69.5	122	75	128	186	1.28	1.47	2.38
RDH-ELKCK	19S 6E 08B	133	18.2	37-133	1.22	30.6	37	45	61	78	N/A	N/A	N/A
N. FORK	19S 5.5E 25DC	154	18.9	90-154	1.35	82.5	111	89	137	190	1.03	1.23	2.25
BTBR-CRK	20S 2E 35AC	155	17.1	20-155	(1.41)	34.1	48	46	67	90	N/A	N/A	N/A
AE-WW	20S 3E 26CD	124	11.9	10-80	(1.59)	25.6	40	34	52	71	N/A	N/A	N/A
CS-WW	20S 3E 26DA	142	13.0	70-140	(1.17)	38.8	45	46	66	87	N/A	N/A	N/A
WALL-CRK	20S 4E 27DD	137	17.7	30-135	1.13	60.5	69	70	100	133	1.67	2.00	N/A
FC-WW	21S 3E 10AD	100	13.2	25-100	(1.17)	35.6	41	45	63	83	N/A	N/A	N/A
OAKR-CW6	21S 3E 17DAA	345	29.4	240-340	(1.84)	36.0	66	53	82	113	2.29	2.58	N/A
HILLSCRDM	21S 3E 26CAA	160	16.3	30-160	(3.71)	31.3	116	43	93	148	1.94	2.13	N/A
CR-MCHSE	21S 4E 28AD	154	21.2	10-150	1.67	60.0	99	72	115	162	1.42	1.65	2.74
BFZ-MB	21S 11E 25BB	35	8.3	27.5-35	1.51	65.3	100	71	115	162	1.43	1.66	2.74
RDH-MHSW	22S 5E 26BC	155	15.3	30-150	1.97	51.8	102	59	103	152	1.70	1.92	2.96
PNTO-CRK	23S 5E 8DAA	154	16.1	40-154	1.52	66.1	101	72	116	164	1.41	1.64	2.71
RAMBO	35S 1E 13AD	40	11.3	25-40	(1.59)	31.0	49	41	62	86	N/A	N/A	N/A
BUTLER FORD	38S 1E 31DAD	107	20.9	70-107	1.90	62.0	118	76	128	184	1.27	1.46	2.40
ASLDGRHSE	39S 1E 4BBD	334	31.2	300-325	(2.07)	44.4	92	61	101	145	1.73	1.98	N/A
DAREX	39S 1E 4CDD	148	22.4	100-148	2.07	41.5	86	58	95	136	1.86	2.12	N/A
JUSTICE CENTER	39S 1E 10BCB	154	18.0	125-154	1.85	36.5	68	49	78	111	2.39	2.67	N/A

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
SOSC GYM	39S 1E 10CDB	123	16.8	60-123	1.98	25.1	50	39	61	84	N/A	N/A	N/A
RODEO GROUNDS	39S 1E 14DBB	154	17.0	100-150	1.85	33.0	61	45	71	100	2.70	2.98	N/A
WC 1	39S 1E 32ACD	310	16.9	283-310	3.05	16.0	42	28	46	66	N/A	N/A	N/A
LITHIASP	39S 2E 7CCA	130	18.3	95-130	(2.09)	15.0	31	31	45	60	N/A	N/A	N/A
COLESTIN	40S 1E 36AB	140	12.8	10-140	(1.88)	28.0	52	37	59	84	N/A	N/A	N/A
CORRAL CREEK	40S 4E 5DB	99	13.0	65-100	1.31	43.5	57	52	77	104	2.52	2.85	N/A
ELIOT BR	1S 9E 26ABA	213	10.0	101-213	1.77	31.6	56	35	59	86	N/A	N/A	N/A
CLEAR BK	1S 9E 31ACA	311	10.8	100-311	1.55	27.0	42	29	48	68	N/A	N/A	N/A
RDH-RP	1S 10E 9BC	150	20.2	10-150	1.63	56.0	91	68	107	151	1.56	1.81	2.98
USGS-MCG	2S 8E 1CDD	595	59.1	300-595	1.74	77.3	135	90	149	213	1.12	1.16	2.01
NNG-LCM1	2S 8E 9AC	150	13.1	80-150	1.63	62.1	101	66	110	158	1.55	1.78	2.84
NNG-OMF2	2S 8E 15CD	1200	81.6	1000-1200	1.75	55.0	96	69	115	161	1.50	1.74	2.77
DOEOMF7A	2S 8E 15DA	1790	118.9	1250-1790	2.27	56.8	129	66	131	192	1.43	1.61	2.32
NNG-OMF3	2S 8E 17CC	398	31.5	100-398	1.51	57.9	87	66	104	146	1.62	1.89	N/A
NNGOMF10	2S 8E 28AA	130	10.8	75-130	1.49	66.3	99	68	111	159	1.50	1.73	2.82
RDH-RD19	3S 7E 03A	65	10.2	30-65	[1.21]	54.0	66	61	89	121	2.02	2.34	N/A
NNG-KC-1	3S 8E 14BC	285	11.6	175-285	2.24	17.5	39	24	41	60	N/A	N/A	N/A
CR-LH	3S 8E 16CD	126	10.2	80-125	2.18	24.8	54	32	55	81	N/A	N/A	N/A
THNDRHDL	3S 8E 24ABB	536	24.7	500-536	[2.30]	48.7	112	47	96	149	1.88	2.08	N/A
RDH-SC	3S 8E 29DDC	151	17.7	100-150	2.64	25.2	67	39	68	100	2.75	3.00	N/A

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
CR-SB	3S 8.5E 25AA	82	7.1	65-82	1.67	102.0	170	101	175	256	1.20	0.91	1.61
NNG-TRLK	3S 8.5E 25CA	315	21.0	180-315	[1.76]	53.9	95	58	99	144	1.78	2.02	N/A
MEADOWS	3S 9E 03CCA	601	29.8	430-601	2.02	81.7	165	62	134	213	1.38	1.52	2.20
USGS-PUC	3S 9E 07DBB	1129	76.6	560-1129	1.79	72.4	130	69	131	193	1.37	1.55	2.31
USGS-HWY	3S 9E 30ADB	289	15.4	80-289	[1.76]	41.5	73	45	77	111	2.42	2.67	N/A
-	3S 11E 01A	126	14.2	50-126	1.65e	46.0	76	54	87	124	2.08	2.35	N/A
Palmer	3S 13E 31B	87	21.2	34-87	1.60e	21.2	34	41	55	72	N/A	N/A	N/A
-	3S 14E 07D	65	12.4	45-65	1.60e	23.9	38	35	51	69	N/A	N/A	N/A
-	4S 13E 32D	145	18.6	130-145	1.65e	45.8	76	58	91	127	1.98	2.25	N/A
Harmon	5S 11E 25D	152	17.2	149-152	1.60e	60.2	96	68	110	156	1.52	1.76	2.88
Kimmel	5S 11E 26A	264	21.4	258-264	1.60e	51.5	82	59	95	134	1.86	2.13	N/A
Garner/	6S 11E 11C	72	16.7	30-72	1.65e	92.0	152	102	168	241	1.18	0.91	1.66
CRITRN 1	6S 14E 13D	120	14.9	80-120	[1.59]	44.8	71	54	85	119	2.16	2.44	N/A
Confederated	7S 11E 14C	30	15.2	17-30	1.30e	80.9	105	94	139	189	1.67	1.14	2.21
Indian Health	7S 12E 29C	120	19.3	94-110	1.35e	75.6	102	86	130	179	1.09	1.32	2.41
Peters	8S 12E 03A	90	13.1	49-90	1.35e	20.7	28	32	44	57	N/A	N/A	N/A
Wolfe	8S 12E 03C	42	11.0	27-42	1.35e	98.5	133	105	163	227	1.41	0.90	1.79
Williams	9S 11E 02B	111	13.8	105-111	1.30e	24.9	32	36	50	65	N/A	N/A	N/A
Perthina	9S 12E 31C	62	17.5	40-62	1.30e	64.5	84	78	115	155	1.33	1.60	2.88
-	9S 14E 23B	80	16.7	60-80	1.30e	56.3	73	68	100	135	1.68	1.99	N/A

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
Vibbert	9S 14E 30C	180	19.4	149-180	1.60e	35.0	56	48	72	99	2.72	N/A	N/A
CASTLERX	11S 10E 05A	153	10.4	141-153	1.50e	18.8	28	26	38	52	N/A	N/A	N/A
SCHNDR-1	11S 13E 24A	295	24.9	185-245	1.32e	51.1	68	61	90	123	1.98	2.29	N/A
GREENRDG	12S 9E 01B	105	16.8	70-105	[1.60]	63.4	101	74	117	166	1.37	1.60	2.68
-	13S 14E 11C	50	13.9	25-50	1.39e	27.3	36	40	55	73	N/A	N/A	N/A
-	15S 13E 03D	154	17.2	35-154	1.65e	42.3	70	53	83	117	2.22	2.50	N/A
-	16S 12E 26B	171	10.6	166-171	1.30e	47.6	62	50	77	107	2.48	2.78	N/A
-	16S 14E 16A	460	56.4	200-460	1.50e	73.7	111	96	144	197	1.16	1.08	2.10
SBUTTE 2	16S 14E 35C	142	24.0	95-142	1.65e	45.9	76	63	96	133	1.81	2.10	N/A
Wolf	18S 11E 23C	128	9.0	123-128	1.55e	35.1	54	40	63	89	N/A	N/A	N/A
LAVBUTTE	19S 11E 25B	123	9.2	93-123	[1.59]	38.4	61	43	69	98	2.78	N/A	N/A
Crane	19S 14E 24D	384	21.7	250-380	1.65e	30.9	51	41	63	87	N/A	N/A	N/A
USDA	20S 7E 34A	53	6.8	46-53	1.55e	12.6	20	19	27	37	N/A	N/A	N/A
	NEWBERRY VOLCANO HOLES												
GEO-N-3	20S 12E 24BCB	1220	57.0	1174-1220	1.80	53.2	96	45	87	133	2.07	2.28	N/A
-	20S 14E 13A	108	13.1	70-108	1.50e	32.0	48	42	63	85	N/A	N/A	N/A
BFZ-PMW	20S 14E 25A	125	14.3	65-125	1.65e	32.2	53	42	66	91	3.06	N/A	N/A
BFZ-MB	21S 11E 25B	35	8.3	28-35	1.51	65.3	100	71	115	162	1.43	1.66	2.74
SF NC-01	21S 12E 28BDD	1220	171.0	336.8-1202.1	1.61	-	221	171	267	372	0.38	0.26	0.89
				758-1202.1		-	237						
GEO-N-2	21S 12E 29ADC	1336	164.0	440-1335	1.55	-	200	164	251	346	0.49	0.26	0.94

APPENDIX B

NAME	T R S	DEPTH (m)	BOTTM. HOLE TEMP. (C)	INTERVAL (m)	THERM. COND. (W/m K)	GRAD. CORR. (C/km)	HEAT FLOW (mW/m2)	TEMP 1 KM (C)	TEMP 2 KM (C)	TEMP 3 KM (C)	DEPTH 90 C (km)	DEPTH 100 C (km)	DEPTH 150 C (km)
USGS-N2	21S 13E 31CC	932	265.0	660-930	(1.46)	1092.0	1594						
				675-930.7		-							
				2-930.7		-							
GEO N-4	21S 13E 35DBD	703	18.0	450-615	2.07	-	245	18	125	241	1.68	1.77	2.22
				540-615		-	201						
SAN-RDO-1	21S 13E 31CCA	424	158.0	282-418	(1.46)	-	1466						
SF NC 72-03	22S 12E 3ABA	1372	154.0	510.2-1358.5	1.62	-	222	154	251	356	0.71	0.44	1.05
GEO N-5	22S 12E 8DAA	988	69.0	650-965	1.57	-	198	69	155	249	1.24	1.36	1.95
GEO N-1	22S 12E 25BD	1387	71.0	1146-1226	1.80	83.7	151	39	104	176	1.78	1.94	2.64

APPENDIX C

GEOTHERMAL ELECTRICAL GENERATION POTENTIAL CALCULATIONS - CASCADE RANGE

Block - blocks are identified by their township and range.

Area - area (in km^2) of the township that is contained within the study area.

Percent of Area Accessible - the percentage of the area that is *not* included in Wilderness Areas or National Parks.

Depth to 150 °C Isotherm - depth (in Km) to the 150 °C Isotherm. Obtained from Appendix B.

Temperature at 3 km - temperature (in °C) at a depth of 3 Km. Obtained from Appendix B.

Reservoir Thickness - in Km.

Average Reservoir Temperature - in °C.

Accessible Resource Base - the amount of thermal energy contained in the reservoir, in Joules (J), referenced to a mean annual surface temperature of 15 °C.

W_A/q_R - the ratio of available work to the accessible resource base. Obtained from a graph in U.S. Geological Survey Circular 790.

Available Work - the mechanical energy available at the surface for the production of electrical energy (in Joules).

Utilization Factor - factor to account for losses in converting mechanical to electrical energy.

Electrical Energy - electrical energy that can be produced from the block, in MW for 30 years. Does not take into account portions of the block not accessible. Assumes a recovery factor of 25% (see text).

Accessible Electrical Energy - electrical energy that can be generated from those portions of the block that are accessible.

$0.1\ R_g$, $0.01\ R_g$, $0.001\ R_g$ - electrical energy that can be produced from the block, in MW for 30 years. These are attempts to take into account the reduced recovery factors expected in the Cascade Range.

BLOCK (T,R)	AREA (Km2)	PERCENT AREA ACCESS	DEPTH 150 C (Km)	TEMP. 3 KM (C)	RES. THICK (Km)	AVRG RES. TEMP. (C)	ACCESS. RES. BASE (J)	Wa/qR	AVAIL. WORK (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	.01Rg (MW 30 yrs)	.001Rg (MW 30 yrs)
MOUNT HOOD															
1S 8E	8.0	100.0	2.32	192	0.68	171.0	2.29E+18	0.050	1.15E+17	0.4	48.4	48.4	4.8	0.5	0.05
1S 8.5E	8.0	100.0	2.20	203	0.80	176.5	2.79E+18	0.052	1.45E+17	0.4	61.3	61.3	6.1	0.6	0.06
1S 9E	3.8	100.0	2.20	203	0.80	176.5	1.31E+18	0.052	6.80E+16	0.4	28.7	28.7	2.9	0.3	0.03
2S 8E	45.6	50.2	2.32	192	0.68	171.0	1.31E+19	0.050	6.53E+17	0.4	275.9	138.5	13.9	1.4	0.14
2S 8.5E	24.1	0.0	2.20	203	0.80	176.5	8.42E+18	0.052	4.38E+17	0.4	184.9	0.0	0.0	0.0	0.00
2S 9E	45.5	20.3	2.20	203	0.80	176.5	1.59E+19	0.052	8.26E+17	0.4	349.0	70.9	7.1	0.7	0.07
3S 8E	11.7	13.8	3.00	150	0.00	150.0	0.00E+00	0.043	0.00E+00	0.4	0.0	0.0	0.0	0.0	0.00
3S 8.5E	10.9	68.7	3.00	150	0.00	150.0	0.00E+00	0.043	0.00E+00	0.4	0.0	0.0	0.0	0.0	0.00
3S 9E	31.7	100.0	2.20	203	0.80	176.5	1.11E+19	0.052	5.75E+17	0.4	243.0	243.0	24.3	2.4	0.24
									TOTAL		1191.4	590.8	59.1	5.9	0.6
6S 6E	57.3	100.0	2.56	172	0.44	161.0	9.94E+18	0.047	4.67E+17	0.4	197.4	197.4	19.7	2.0	0.20
6S 7E	63.0	100.0	2.56	172	0.44	161.0	1.09E+19	0.047	5.14E+17	0.4	217.0	217.0	21.7	2.2	0.22
6S 8E	6.7	100.0	2.56	172	0.44	161.0	1.16E+18	0.047	5.46E+16	0.4	23.1	23.1	2.3	0.2	0.02
7S 6E	86.6	90.3	2.56	172	0.44	161.0	1.50E+19	0.047	7.06E+17	0.4	298.3	269.3	26.9	2.7	0.27
7S 7E	96.0	100.0	2.56	172	0.44	161.0	1.67E+19	0.047	7.83E+17	0.4	330.7	330.7	33.1	3.3	0.33
7S 8E	73.3	100.0	2.46	178	0.54	164.0	1.59E+19	0.049	7.80E+17	0.4	329.7	329.7	33.0	3.3	0.33
7S 8.5E	6.0	100.0	2.46	178	0.54	164.0	1.30E+18	0.049	6.39E+16	0.4	27.0	27.0	2.7	0.3	0.03
8S 6E	42.3	29.9	2.87	156	0.13	153.0	2.05E+18	0.044	9.01E+16	0.4	38.1	11.4	1.1	0.1	0.01
8S 7E	85.9	100.0	2.46	178	0.54	164.0	1.87E+19	0.049	9.14E+17	0.4	386.3	386.3	38.6	3.9	0.39
8S 8E	84.6	100.0	2.46	178	0.54	164.0	1.84E+19	0.049	9.01E+17	0.4	380.5	380.5	38.0	3.8	0.38
8S 8.5E	30.1	100.0	2.46	178	0.54	164.0	6.54E+18	0.049	3.20E+17	0.4	135.4	135.4	13.5	1.4	0.14
8S 9E	28.3	100.0	2.68	166	0.32	158.0	3.50E+18	0.046	1.61E+17	0.4	68.0	68.0	6.8	0.7	0.07
9S 6E	16.5	100.0	2.87	156	0.13	153.0	7.99E+17	0.044	3.52E+16	0.4	14.9	14.9	1.5	0.1	0.01
9S 7E	93.6	100.0	2.46	178	0.54	164.0	2.03E+19	0.049	9.96E+17	0.4	421.0	421.0	42.1	4.2	0.42
9S 8E	91.7	71.6	2.46	178	0.54	164.0	1.99E+19	0.049	9.76E+17	0.4	412.4	295.3	29.5	3.0	0.30
9S 8.5E	30.7	100.0	2.46	178	0.54	164.0	6.67E+18	0.049	3.27E+17	0.4	138.1	138.1	13.8	1.4	0.14
9S 9E	84.7	100.0	2.68	166	0.32	158.0	1.05E+19	0.046	4.81E+17	0.4	203.4	203.4	20.3	2.0	0.20
9S 10E	6.8	100.0	2.68	166	0.32	158.0	8.40E+17	0.046	3.86E+16	0.4	16.3	16.3	1.6	0.2	0.02
10S 6E	25.6	100.0	2.87	156	0.13	153.0	1.24E+18	0.044	5.46E+16	0.4	23.1	23.1	2.3	0.2	0.02
10S 7E	94.1	91.4	2.46	178	0.54	164.0	2.04E+19	0.049	1.00E+18	0.4	423.2	386.8	38.7	3.9	0.39
10S 8E	94.0	33.9	2.46	178	0.54	164.0	2.04E+19	0.049	1.00E+18	0.4	422.8	143.3	14.3	1.4	0.14
10S 8.5E	30.9	100.0	2.46	178	0.54	164.0	6.71E+18	0.049	3.29E+17	0.4	139.0	139.0	13.9	1.4	0.14
10S 9E	92.6	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.26E+17	0.4	222.4	222.4	22.2	2.2	0.22
10S 10E	18.6	100.0	2.68	166	0.32	158.0	2.30E+18	0.046	1.06E+17	0.4	44.7	44.7	4.5	0.4	0.04
11S 6E	35.4	100.0	2.87	156	0.13	153.0	1.71E+18	0.044	7.54E+16	0.4	31.9	31.9	3.2	0.3	0.03
11S 7E	95.5	93.7	2.87	156	0.13	153.0	4.63E+18	0.044	2.04E+17	0.4	86.0	80.6	8.1	0.8	0.08
11S 7.5E	40.7	9.0	2.46	178	0.54	164.0	8.84E+18	0.049	4.33E+17	0.4	183.0	16.5	1.6	0.2	0.02
11S 8E	91.2	11.5	2.46	178	0.54	164.0	1.98E+19	0.049	9.71E+17	0.4	410.2	47.2	4.7	0.5	0.05
11S 9E	90.2	80.1	2.68	166	0.32	158.0	1.11E+19	0.046	5.13E+17	0.4	216.6	173.5	17.3	1.7	0.17
12S 6E	39.3	100.0	2.87	156	0.13	153.0	1.90E+18	0.044	8.38E+16	0.4	35.4	35.4	3.5	0.4	0.04
12S 7E	96.1	77.8	2.87	156	0.13	153.0	4.65E+18	0.044	2.05E+17	0.4	86.5	67.3	6.7	0.7	0.07
12S 7.5E	55.4	1.6	2.46	178	0.54	164.0	1.20E+19	0.049	5.90E+17	0.4	249.2	4.0	0.4	0.0	0.00
12S 8E	92.7	47.3	2.46	178	0.54	164.0	2.01E+19	0.049	9.87E+17	0.4	416.9	197.2	19.7	2.0	0.20

APPENDIX C

BLOCK (T,R)	AREA (Km2)	PERCENT AREA ACCESS	DEPTH 150 C (Km)	TEMP. 3 KM (C)	RES. THICK (Km)	AVRG RES. TEMP. (C)	ACCESS. RES. BASE (J)	Wa/qR	AVAIL. WORK (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	.01Rg (MW 30 yrs)	.001Rg (MW 30 yrs)
12S 9E	92.6	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.26E+17	0.4	222.4	222.4	22.2	2.2	0.22
13S 6E	53.0	100.0	2.87	156	0.13	153.0	2.57E+18	0.044	1.13E+17	0.4	47.7	47.7	4.8	0.5	0.05
13S 7E	92.2	87.6	2.41	180	0.59	165.0	2.20E+19	0.049	1.08E+18	0.4	456.1	399.6	40.0	4.0	0.40
13S 7.5E	51.8	49.2	2.41	180	0.59	165.0	1.24E+19	0.049	6.07E+17	0.4	256.3	126.1	12.6	1.3	0.13
13S 8E	93.6	78.3	2.41	180	0.59	165.0	2.24E+19	0.049	1.10E+18	0.4	463.0	362.6	36.3	3.6	0.36
13S 9E	93.1	100.0	2.68	166	0.32	158.0	1.15E+19	0.046	5.29E+17	0.4	223.6	223.6	22.4	2.2	0.22
14S 6E	70.8	100.0	2.41	180	0.59	165.0	1.69E+19	0.049	8.29E+17	0.4	350.2	350.2	35.0	3.5	0.35
14S 7E	91.9	46.4	2.41	180	0.59	165.0	2.20E+19	0.049	1.08E+18	0.4	454.6	210.9	21.1	2.1	0.21
14S 7.5E	55.1	26.3	2.41	180	0.59	165.0	1.32E+19	0.049	6.45E+17	0.4	272.6	71.7	7.2	0.7	0.07
14S 8E	91.2	67.4	2.41	180	0.59	165.0	2.18E+19	0.049	1.07E+18	0.4	451.2	304.1	30.4	3.0	0.30
14S 9E	93.1	100.0	2.68	166	0.32	158.0	1.15E+19	0.046	5.29E+17	0.4	223.6	223.6	22.4	2.2	0.22
15S 5E	3.2	100.0	2.87	156	0.13	153.0	1.55E+17	0.044	6.82E+15	0.4	2.9	2.9	0.3	0.0	0.00
15S 6E	94.4	100.0	2.41	180	0.59	165.0	2.26E+19	0.049	1.11E+18	0.4	467.0	467.0	46.7	4.7	0.47
15S 7E	96.4	65.0	2.41	180	0.59	165.0	2.30E+19	0.049	1.13E+18	0.4	476.9	310.0	31.0	3.1	0.31
15S 7.5E	61.8	9.7	2.41	180	0.59	165.0	1.48E+19	0.049	7.24E+17	0.4	305.7	29.7	3.0	0.3	0.03
15S 8E	92.2	13.8	2.41	180	0.59	165.0	2.20E+19	0.049	1.08E+18	0.4	456.1	62.9	6.3	0.6	0.06
15S 9E	92.2	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.24E+17	0.4	221.4	221.4	22.1	2.2	0.22
16S 5E	37.7	100.0	2.87	156	0.13	153.0	1.83E+18	0.044	8.03E+16	0.4	33.9	33.9	3.4	0.3	0.03
16S 6E	88.8	100.0	2.55	172	0.45	161.0	1.58E+19	0.047	7.40E+17	0.4	312.8	312.8	31.3	3.1	0.31
16S 7E	83.7	79.5	2.55	172	0.45	161.0	1.48E+19	0.047	6.98E+17	0.4	294.8	234.4	23.4	2.3	0.23
16S 8E	38.4	16.9	2.55	172	0.45	161.0	6.81E+18	0.047	3.20E+17	0.4	135.3	22.9	2.3	0.2	0.02
16S 8.5E	85.4	2.8	2.55	172	0.45	161.0	1.51E+19	0.047	7.12E+17	0.4	300.8	8.4	0.8	0.1	0.01
16S 9E	86.3	87.8	2.68	166	0.32	158.0	1.07E+19	0.046	4.90E+17	0.4	207.2	181.9	18.2	1.8	0.18
17S 5E	59.0	31.1	2.87	156	0.13	153.0	2.86E+18	0.044	1.26E+17	0.4	53.1	16.5	1.7	0.2	0.02
17S 6E	90.2	59.3	2.55	172	0.45	161.0	1.60E+19	0.047	7.52E+17	0.4	317.7	188.4	18.8	1.9	0.19
17S 6.5E	52.2	0.0	2.55	172	0.45	161.0	9.26E+18	0.047	4.35E+17	0.4	183.9	0.0	0.0	0.0	0.00
17S 7E	94.1	0.0	2.55	172	0.45	161.0	1.67E+19	0.047	7.85E+17	0.4	331.5	0.0	0.0	0.0	0.00
17S 8E	92.6	0.0	2.55	172	0.45	161.0	1.64E+19	0.047	7.72E+17	0.4	326.2	0.0	0.0	0.0	0.00
17S 9E	92.2	43.7	2.68	166	0.32	158.0	1.14E+19	0.046	5.24E+17	0.4	221.4	96.8	9.7	1.0	0.10
18S 4E	2.6	100.0	2.87	156	0.13	153.0	1.26E+17	0.044	5.54E+15	0.4	2.3	2.3	0.2	0.0	0.00
18S 5E	91.7	77.9	2.87	156	0.13	153.0	4.44E+18	0.044	1.95E+17	0.4	82.6	64.3	6.4	0.6	0.06
18S 6E	96.1	9.7	2.55	172	0.45	161.0	1.70E+19	0.047	8.01E+17	0.4	338.5	32.8	3.3	0.3	0.03
18S 6.5E	55.2	0.0	2.55	172	0.45	161.0	9.79E+18	0.047	4.60E+17	0.4	194.4	0.0	0.0	0.0	0.00
18S 7E	93.1	0.0	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	0.0	0.0	0.0	0.00
18S 8E	93.8	56.1	2.55	172	0.45	161.0	1.66E+19	0.047	7.82E+17	0.4	330.4	185.4	18.5	1.9	0.19
18S 9E	93.1	95.4	2.68	166	0.32	158.0	1.15E+19	0.046	5.29E+17	0.4	223.6	213.3	21.3	2.1	0.21
19S 4E	20.6	100.0	2.74	162	0.26	156.0	2.04E+18	0.045	9.18E+16	0.4	38.8	38.8	3.9	0.4	0.04
19S 5E	90.3	100.0	2.74	162	0.26	156.0	8.94E+18	0.045	4.02E+17	0.4	169.9	169.9	17.0	1.7	0.17
19S 5.5E	64.9	85.4	2.25	190	0.75	170.0	2.04E+19	0.050	1.02E+18	0.4	430.3	367.5	36.8	3.7	0.37
19S 6E	78.6	51.3	2.25	190	0.75	170.0	2.47E+19	0.050	1.23E+18	0.4	521.2	267.4	26.7	2.7	0.27
19S 7E	94.1	0.0	2.25	190	0.75	170.0	2.95E+19	0.050	1.48E+18	0.4	624.0	0.0	0.0	0.0	0.00
19S 8E	94.1	80.5	2.55	172	0.45	161.0	1.67E+19	0.047	7.85E+17	0.4	331.5	266.8	26.7	2.7	0.27
19S 9E	92.2	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.24E+17	0.4	221.4	221.4	22.1	2.2	0.22
20S 4E	20.2	100.0	2.74	162	0.26	156.0	2.00E+18	0.045	9.00E+16	0.4	38.0	38.0	3.8	0.4	0.04
20S 5E	89.8	99.4	2.74	162	0.26	156.0	8.89E+18	0.045	4.00E+17	0.4	169.0	168.0	16.8	1.7	0.17
20S 5.5E	66.0	20.1	2.25	190	0.75	170.0	2.07E+19	0.050	1.04E+18	0.4	437.6	88.0	8.8	0.9	0.09
20S 6E	88.9	18.2	2.25	190	0.75	170.0	2.79E+19	0.050	1.40E+18	0.4	589.5	107.3	10.7	1.1	0.11

APPENDIX C

BLOCK (T,R)	AREA (Km2)	PERCENT AREA ACCESS	DEPTH 150 C (Km)	TEMP. 3 KM (C)	RES. THICK (Km)	AVRG RES. TEMP. (C)	ACCESS. RES. BASE (J)	Wa/qR	AVAIL. WORK (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	.01Rg (MW 30 yrs)	.001Rg (MW 30 yrs)
20S 7E	94.6	50.2	2.25	190	0.75	170.0	2.97E+19	0.050	1.48E+18	0.4	627.3	314.9	31.5	3.1	0.31
20S 8E	93.1	100.0	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	328.0	32.8	3.3	0.33
20S 9E	92.2	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.24E+17	0.4	221.4	221.4	22.1	2.2	0.22
21S 4E	28.5	100.0	2.74	162	0.26	156.0	2.82E+18	0.045	1.27E+17	0.4	53.6	53.6	5.4	0.5	0.05
21S 5E	91.2	100.0	2.74	162	0.26	156.0	9.03E+18	0.045	4.06E+17	0.4	171.6	171.6	17.2	1.7	0.17
21S 5.5E	70.1	41.0	2.25	190	0.75	170.0	2.20E+19	0.050	1.10E+18	0.4	464.8	190.6	19.1	1.9	0.19
21S 6E	91.7	86.6	2.25	190	0.75	170.0	2.88E+19	0.050	1.44E+18	0.4	608.0	526.6	52.7	5.3	0.53
21S 7E	92.6	100.0	2.25	190	0.75	170.0	2.91E+19	0.050	1.45E+18	0.4	614.0	614.0	61.4	6.1	0.61
21S 8E	94.1	100.0	2.55	172	0.45	161.0	1.67E+19	0.047	7.85E+17	0.4	331.5	331.5	33.1	3.3	0.33
21S 9E	92.6	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.26E+17	0.4	222.4	222.4	22.2	2.2	0.22
22S 4E	24.4	100.0	2.74	162	0.26	156.0	2.42E+18	0.045	1.09E+17	0.4	45.9	45.9	4.6	0.5	0.05
22S 5E	88.8	100.0	2.74	162	0.26	156.0	8.79E+18	0.045	3.96E+17	0.4	167.1	167.1	16.7	1.7	0.17
22S 5.5E	67.2	78.1	2.55	172	0.45	161.0	1.19E+19	0.047	5.60E+17	0.4	236.7	184.9	18.5	1.8	0.18
22S 6E	89.8	97.8	2.25	190	0.75	170.0	2.82E+19	0.050	1.41E+18	0.4	595.4	582.3	58.2	5.8	0.58
22S 7E	90.3	100.0	2.25	190	0.75	170.0	2.83E+19	0.050	1.42E+18	0.4	598.8	598.8	59.9	6.0	0.60
22S 8E	94.1	100.0	2.55	172	0.45	161.0	1.67E+19	0.047	7.85E+17	0.4	331.5	331.5	33.1	3.3	0.33
22S 9E	92.6	100.0	2.68	166	0.32	158.0	1.14E+19	0.046	5.26E+17	0.4	222.4	222.4	22.2	2.2	0.22
23S 4E	4.4	100.0	2.74	162	0.26	156.0	4.36E+17	0.045	1.96E+16	0.4	8.3	8.3	0.8	0.1	0.01
23S 5E	90.2	75.9	2.74	162	0.26	156.0	8.93E+18	0.045	4.02E+17	0.4	169.8	128.8	12.9	1.3	0.13
23S 5.5E	67.5	22.5	2.55	172	0.45	161.0	1.20E+19	0.047	5.63E+17	0.4	237.8	53.5	5.3	0.5	0.05
23S 6E	90.8	65.6	2.25	190	0.75	170.0	2.85E+19	0.050	1.42E+18	0.4	602.1	395.0	39.5	3.9	0.39
23S 7E	91.7	100.0	2.25	190	0.75	170.0	2.88E+19	0.050	1.44E+18	0.4	608.0	608.0	60.8	6.1	0.61
23S 8E	92.2	100.0	2.55	172	0.45	161.0	1.64E+19	0.047	7.69E+17	0.4	324.8	324.8	32.5	3.2	0.32
23S 9E	51.2	100.0	2.68	166	0.32	158.0	6.33E+18	0.046	2.91E+17	0.4	122.9	122.9	12.3	1.2	0.12
24S 5E	61.2	71.4	2.74	162	0.26	156.0	6.06E+18	0.045	2.73E+17	0.4	115.2	82.2	8.2	0.8	0.08
24S 5.5E	69.5	30.4	2.55	172	0.45	161.0	1.23E+19	0.047	5.79E+17	0.4	244.8	74.4	7.4	0.7	0.07
24S 6E	91.2	62.1	2.25	190	0.75	170.0	2.86E+19	0.050	1.43E+18	0.4	604.7	375.5	37.6	3.8	0.38
24S 7E	93.1	100.0	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	328.0	32.8	3.3	0.33
24S 8E	83.8	100.0	2.68	166	0.32	158.0	1.04E+19	0.046	4.76E+17	0.4	201.2	201.2	20.1	2.0	0.20
24S 9E	14.0	100.0	2.68	166	0.32	158.0	1.73E+18	0.046	7.96E+16	0.4	33.6	33.6	3.4	0.3	0.03
25S 5E	79.8	100.0	2.74	162	0.26	156.0	7.90E+18	0.045	3.55E+17	0.4	150.2	150.2	15.0	1.5	0.15
25S 5.5E	69.8	100.0	2.55	172	0.45	161.0	1.24E+19	0.047	5.82E+17	0.4	245.9	245.9	24.6	2.5	0.25
25S 6E	92.4	100.0	2.25	190	0.75	170.0	2.90E+19	0.050	1.45E+18	0.4	612.7	612.7	61.3	6.1	0.61
25S 7E	93.1	100.0	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	328.0	32.8	3.3	0.33
25S 8E	17.0	100.0	2.68	166	0.32	158.0	2.10E+18	0.046	9.66E+16	0.4	40.8	40.8	4.1	0.4	0.04
25.5S 5E	6.0	100.0	2.74	162	0.26	156.0	5.94E+17	0.045	2.67E+16	0.4	11.3	11.3	1.1	0.1	0.01
25.5S 6E	12.8	100.0	2.55	172	0.45	161.0	2.27E+18	0.047	1.07E+17	0.4	45.1	45.1	4.5	0.5	0.05
25.5S 6.5	11.8	100.0	2.25	190	0.75	170.0	3.70E+18	0.050	1.85E+17	0.4	78.2	78.2	7.8	0.8	0.08
26S 4E	1.7	100.0	2.74	162	0.26	156.0	1.68E+17	0.045	7.57E+15	0.4	3.2	3.2	0.3	0.0	0.00
26S 5E	85.3	100.0	2.74	162	0.26	156.0	8.44E+18	0.045	3.80E+17	0.4	160.5	160.5	16.1	1.6	0.16
26S 6E	94.1	94.1	2.55	172	0.45	161.0	1.67E+19	0.047	7.85E+17	0.4	331.5	311.9	31.2	3.1	0.31
26S 6.5E	81.5	36.4	2.25	190	0.75	170.0	2.56E+19	0.050	1.28E+18	0.4	540.4	196.7	19.7	2.0	0.20
26S 7E	53.4	99.0	2.55	172	0.45	161.0	9.47E+18	0.047	4.45E+17	0.4	188.1	186.2	18.6	1.9	0.19
27S 4E	27.7	100.0	2.74	162	0.26	156.0	2.74E+18	0.045	1.23E+17	0.4	52.1	52.1	5.2	0.5	0.05
27S 5E	88.8	100.0	2.74	162	0.26	156.0	8.79E+18	0.045	3.96E+17	0.4	167.1	167.1	16.7	1.7	0.17
27S 6E	93.1	80.7	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	264.7	26.5	2.6	0.26
27S 6.5E	82.1	14.3	2.25	190	0.75	170.0	2.58E+19	0.050	1.29E+18	0.4	544.4	77.8	7.8	0.8	0.08

BLOCK (T,R)	AREA (Km2)	PERCENT AREA ACCESS	DEPTH 150 C (Km)	TEMP. 3 KM (C)	RES. THICK (Km)	AVRG RES. TEMP. (C)	ACCESS. RES. BASE (J)	Wa/qR	AVAIL. WORK (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	.01Rg (MW 30 yrs)	.001Rg (MW 30 yrs)
28S 4E	63.7	100.0	2.74	162	0.26	156.0	6.31E+18	0.045	2.84E+17	0.4	119.9	119.9	12.0	1.2	0.12
28S 5E	91.2	100.0	2.55	172	0.45	161.0	1.62E+19	0.047	7.60E+17	0.4	321.3	321.3	32.1	3.2	0.32
28S 5.5E	68.9	64.2	2.25	190	0.75	170.0	2.16E+19	0.050	1.08E+18	0.4	456.9	293.3	29.3	2.9	0.29
28S 6E	79.2	45.9	2.25	190	0.75	170.0	2.49E+19	0.050	1.24E+18	0.4	525.2	241.0	24.1	2.4	0.24
29S 3E	17.3	100.0	2.74	162	0.26	156.0	1.71E+18	0.045	7.71E+16	0.4	32.6	32.6	3.3	0.3	0.03
29S 4E	92.5	100.0	2.55	172	0.45	161.0	1.64E+19	0.047	7.71E+17	0.4	325.8	325.8	32.6	3.3	0.33
29S 5E	92.2	29.0	2.25	190	0.75	170.0	2.89E+19	0.050	1.45E+18	0.4	611.4	177.3	17.7	1.8	0.18
29S 5.5E	81.2	33.1	2.25	190	0.75	170.0	2.55E+19	0.050	1.27E+18	0.4	538.4	178.2	17.8	1.8	0.18
29S 6E	92.4	64.8	2.25	190	0.75	170.0	2.90E+19	0.050	1.45E+18	0.4	612.7	397.0	39.7	4.0	0.40
30S 3E	58.9	100.0	2.74	162	0.26	156.0	5.83E+18	0.045	2.62E+17	0.4	110.8	110.8	11.1	1.1	0.11
30S 4E	92.2	97.4	2.55	172	0.45	161.0	1.64E+19	0.047	7.69E+17	0.4	324.8	316.3	31.6	3.2	0.32
30S 5E	91.2	2.3	2.25	190	0.75	170.0	2.86E+19	0.050	1.43E+18	0.4	604.7	13.9	1.4	0.1	0.01
30S 5.5E	81.9	0.0	2.25	190	0.75	170.0	2.57E+19	0.050	1.29E+18	0.4	543.1	0.0	0.0	0.0	0.00
30S 6E	92.9	35.6	2.25	190	0.75	170.0	2.92E+19	0.050	1.46E+18	0.4	616.0	219.3	21.9	2.2	0.22
30S 7E	31.0	100.0	2.55	172	0.45	161.0	5.50E+18	0.047	2.58E+17	0.4	109.2	109.2	10.9	1.1	0.11
31S 2E	8.9	100.0	2.74	162	0.26	156.0	8.81E+17	0.045	3.96E+16	0.4	16.7	16.7	1.7	0.2	0.02
31S 3E	91.0	100.0	2.74	162	0.26	156.0	9.01E+18	0.045	4.05E+17	0.4	171.3	171.3	17.1	1.7	0.17
31S 4E	92.1	97.8	2.55	172	0.45	161.0	1.63E+19	0.047	7.68E+17	0.4	324.4	317.3	31.7	3.2	0.32
31S 5E	93.1	3.9	2.25	190	0.75	170.0	2.92E+19	0.050	1.46E+18	0.4	617.3	24.1	2.4	0.2	0.02
31S 6E	85.4	0.0	2.25	190	0.75	170.0	2.68E+19	0.050	1.34E+18	0.4	566.3	0.0	0.0	0.0	0.00
31S 7.5E	92.6	44.2	2.25	190	0.75	170.0	2.91E+19	0.050	1.45E+18	0.4	614.0	271.4	27.1	2.7	0.27
31S 7E	9.5	100.0	2.55	172	0.45	161.0	1.69E+18	0.047	7.92E+16	0.4	33.5	33.5	3.3	0.3	0.03
32S 2E	37.6	100.0	2.74	162	0.26	156.0	3.72E+18	0.045	1.67E+17	0.4	70.8	70.8	7.1	0.7	0.07
32S 3E	95.1	100.0	2.74	162	0.26	156.0	9.41E+18	0.045	4.24E+17	0.4	179.0	179.0	17.9	1.8	0.18
32S 4E	92.6	100.0	2.55	172	0.45	161.0	1.64E+19	0.047	7.72E+17	0.4	326.2	326.2	32.6	3.3	0.33
32S 5E	93.5	6.2	2.25	190	0.75	170.0	2.93E+19	0.050	1.47E+18	0.4	620.0	38.4	3.8	0.4	0.04
32S 6E	86.3	46.2	2.25	190	0.75	170.0	2.71E+19	0.050	1.35E+18	0.4	572.2	264.4	26.4	2.6	0.26
32S 7.5E	55.0	68.2	2.25	190	0.75	170.0	1.73E+19	0.050	8.63E+17	0.4	364.7	248.7	24.9	2.5	0.25
33S 2E	60.8	100.0	2.74	162	0.26	156.0	6.02E+18	0.045	2.71E+17	0.4	114.4	114.4	11.4	1.1	0.11
33S 3E	94.1	100.0	2.74	162	0.26	156.0	9.31E+18	0.045	4.19E+17	0.4	177.1	177.1	17.7	1.8	0.18
33S 4E	91.7	96.4	2.55	172	0.45	161.0	1.63E+19	0.047	7.65E+17	0.4	323.0	311.4	31.1	3.1	0.31
33S 5E	89.3	1.5	2.25	190	0.75	170.0	2.80E+19	0.050	1.40E+18	0.4	592.1	8.9	0.9	0.1	0.01
33S 6E	80.4	73.7	2.25	190	0.75	170.0	2.52E+19	0.050	1.26E+18	0.4	533.1	392.9	39.3	3.9	0.39
34S 2E	56.2	100.0	2.74	162	0.26	156.0	5.56E+18	0.045	2.50E+17	0.4	105.8	105.8	10.6	1.1	0.11
34S 3E	96.0	100.0	2.74	162	0.26	156.0	9.50E+18	0.045	4.28E+17	0.4	180.7	180.7	18.1	1.8	0.18
34S 4E	91.7	96.2	2.55	172	0.45	161.0	1.63E+19	0.047	7.65E+17	0.4	323.0	310.7	31.1	3.1	0.31
34S 5E	90.2	1.3	2.25	190	0.75	170.0	2.83E+19	0.050	1.42E+18	0.4	598.1	7.8	0.8	0.1	0.01
34S 6E	78.5	75.6	2.25	190	0.75	170.0	2.46E+19	0.050	1.23E+18	0.4	520.5	393.5	39.4	3.9	0.39
35S 2E	48.2	100.0	2.74	162	0.26	156.0	4.77E+18	0.045	2.15E+17	0.4	90.7	90.7	9.1	0.9	0.09
35S 3E	95.7	100.0	2.74	162	0.26	156.0	9.47E+18	0.045	4.26E+17	0.4	180.1	180.1	18.0	1.8	0.18
35S 4E	93.1	84.0	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	275.5	27.5	2.8	0.28
35S 5E	91.0	27.1	2.25	190	0.75	170.0	2.86E+19	0.050	1.43E+18	0.4	603.4	163.5	16.4	1.6	0.16
35S 6E	69.7	100.0	2.25	190	0.75	170.0	2.19E+19	0.050	1.09E+18	0.4	462.2	462.2	46.2	4.6	0.46
36S 2E	42.0	100.0	2.74	162	0.26	156.0	4.16E+18	0.045	1.87E+17	0.4	79.0	79.0	7.9	0.8	0.08
36S 3E	92.6	100.0	2.74	162	0.26	156.0	9.17E+18	0.045	4.12E+17	0.4	174.3	174.3	17.4	1.7	0.17
36S 4E	91.2	79.6	2.74	162	0.26	156.0	9.03E+18	0.045	4.06E+17	0.4	171.6	136.6	13.7	1.4	0.14
36S 5E	93.1	72.6	2.55	172	0.45	161.0	1.65E+19	0.047	7.76E+17	0.4	328.0	238.1	23.8	2.4	0.24

BLOCK (T,R)	AREA (Km2)	PERCENT AREA ACCESS	DEPTH 150 C (Km)	TEMP. 3 KM (C)	RES. THICK (Km)	AVRG RES. TEMP. (C)	ACCESS. RES. BASE (J)	Wa/qR	AVAIL. WORK (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	.01Rg (MW 30 yrs)	.001Rg (MW 30 yrs)
36S 6E	41.6	100.0	2.25	190	0.75	170.0	1.31E+19	0.050	6.53E+17	0.4	275.8	275.8	27.6	2.8	0.28
37S 2E	32.2	100.0	2.74	162	0.26	156.0	3.19E+18	0.045	1.43E+17	0.4	60.6	60.6	6.1	0.6	0.06
37S 3E	92.2	100.0	2.74	162	0.26	156.0	9.13E+18	0.045	4.11E+17	0.4	173.5	173.5	17.4	1.7	0.17
37S 4E	93.6	100.0	2.74	162	0.26	156.0	9.26E+18	0.045	4.17E+17	0.4	176.1	176.1	17.6	1.8	0.18
37S 5E	92.6	100.0	2.55	172	0.45	161.0	1.64E+19	0.047	7.72E+17	0.4	326.2	326.2	32.6	3.3	0.33
37S 6E	92.2	0.0	2.25	190	0.75	170.0	2.89E+19	0.050	1.45E+18	0.4	611.4	0.0	0.0	0.0	0.00
37S 7E	8.2	100.0	2.25	190	0.75	170.0	2.57E+18	0.050	1.29E+17	0.4	54.4	54.4	5.4	0.5	0.05
38S 2E	18.3	100.0	2.74	162	0.26	156.0	1.81E+18	0.045	8.15E+16	0.4	34.4	34.4	3.4	0.3	0.03
38S 3E	92.6	100.0	2.74	162	0.26	156.0	9.17E+18	0.045	4.12E+17	0.4	174.3	174.3	17.4	1.7	0.17
38S 4E	93.6	100.0	2.74	162	0.26	156.0	9.26E+18	0.045	4.17E+17	0.4	176.1	176.1	17.6	1.8	0.18
38S 5E	93.6	100.0	2.55	172	0.45	161.0	1.66E+19	0.047	7.80E+17	0.4	329.7	329.7	33.0	3.3	0.33
38S 6E	93.6	100.0	2.25	190	0.75	170.0	2.94E+19	0.050	1.47E+18	0.4	620.6	620.6	62.1	6.2	0.62
38S 7E	14.9	100.0	2.25	190	0.75	170.0	4.68E+18	0.050	2.34E+17	0.4	98.8	98.8	9.9	1.0	0.10
39S 2E	1.5	100.0	2.74	162	0.26	156.0	1.48E+17	0.045	6.68E+15	0.4	2.8	2.8	0.3	0.0	0.00
39S 3E	82.4	100.0	2.74	162	0.26	156.0	8.16E+18	0.045	3.67E+17	0.4	155.1	155.1	15.5	1.6	0.16
39S 4E	94.1	100.0	2.74	162	0.26	156.0	9.31E+18	0.045	4.19E+17	0.4	177.1	177.1	17.7	1.8	0.18
39S 5E	94.1	100.0	2.55	172	0.45	161.0	1.67E+19	0.047	7.85E+17	0.4	331.5	331.5	33.1	3.3	0.33
39S 6E	94.1	100.0	2.25	190	0.75	170.0	2.95E+19	0.050	1.48E+18	0.4	624.0	624.0	62.4	6.2	0.62
39S 7E	7.3	100.0	2.25	190	0.75	170.0	2.29E+18	0.050	1.15E+17	0.4	48.4	48.4	4.8	0.5	0.05
40S 3E	32.6	100.0	2.74	162	0.26	156.0	3.23E+18	0.045	1.45E+17	0.4	61.4	61.4	6.1	0.6	0.06
40S 4E	90.7	100.0	2.74	162	0.26	156.0	8.98E+18	0.045	4.04E+17	0.4	170.7	170.7	17.1	1.7	0.17
40S 5E	95.1	100.0	2.55	172	0.45	161.0	1.69E+19	0.047	7.93E+17	0.4	335.0	335.0	33.5	3.3	0.33
40S 6E	72.0	100.0	2.25	190	0.75	170.0	2.26E+19	0.050	1.13E+18	0.4	477.4	477.4	47.7	4.8	0.48
41S 4E	29.9	100.0	2.74	162	0.26	156.0	2.96E+18	0.045	1.33E+17	0.4	56.3	56.3	5.6	0.6	0.06
41S 5E	34.0	100.0	2.55	172	0.45	161.0	6.03E+18	0.047	2.83E+17	0.4	119.8	119.8	12.0	1.2	0.12
41S 6E	8.6	100.0	2.25	190	0.75	170.0	2.70E+18	0.050	1.35E+17	0.4	57.0	57.0	5.7	0.6	0.06
									TOTAL		54980.2	36554.6	3655.5	365.5	36.6

APPENDIX D

GEOTHERMAL ELECTRICAL GENERATION POTENTIAL CALCULATIONS - NEWBERRY VOLCANO

Block - blocks are identified by their section.

Area - area (in km^2) of the section that is contained within the study area.

Percent of Area Accessible - the percentage of the area that is *not* included in the Newberry National Monument.

Depth to 150 °C Isotherm - depth (in Km) to the 150 °C Isotherm. Obtained from Figure 2.

Temperature at 3 km - temperature (in °C) at a depth of 3 Km. Obtained from Figure 3.

Reservoir Thickness - in Km.

Average Reservoir Temperature - in °C.

Accessible Resource Base - the amount of thermal energy contained in the reservoir, in Joules (J), referenced to a mean annual surface temperature of 15 °C.

W_A/q_R - the ratio of available work to the accessible resource base. Obtained from a graph in U.S. Geological Survey Circular 790.

Available Work - the mechanical energy available at the surface for the production of electrical energy (in Joules).

Utilization Factor - factor to account for losses in converting mechanical to electrical energy.

Electrical Energy - electrical energy that can be produced from the block, in MW for 30 years. Does not take into account portions of the block not accessible. Assumes a recovery factor of 25% (see text).

Accessible Electrical Energy - electrical energy that can be generated from those portions of the block that are accessible.

$0.1\ R_g$, $0.01\ R_g$, $0.001\ R_g$ - electrical energy that can be produced from the block, in MW for 30 years. These are attempts to take into account reduced recovery factors expected in conduction-dominated terrains.

BLOCK	AREA (Km2)	PERCENT AREA ACCESS.	DEPTH 150 C (Km)	TEMP. 3 Km (C)	RES. THICK (Km)	AVRG. RES. TEMP. (C)	ACCESS. RES. (J)	Wa/qR	AVAIL. WORK BASE (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	0.01Rg (MW 30 yrs)	0.001Rg (MW 30 yrs)
0S 12E 25	1.36	100.0	2.95	157.5	0.05	153.8	2.55E+16	0.045	1.15E+15	0.4	0.5	0.5	0.05	0.00	0.00
26	0.80	26.2	2.95	155.0	0.05	152.5	1.48E+16	0.044	6.53E+14	0.4	0.3	0.1	0.01	0.00	0.00
27	0.13	0.0	2.95	152.5	0.05	151.3	2.39E+15	0.044	1.05E+14	0.4	0.0	0.0	0.00	0.00	0.00
33	1.58	0.0	2.93	157.5	0.07	153.8	4.14E+16	0.045	1.86E+15	0.4	0.8	0.0	0.00	0.00	0.00
34	2.49	0.0	2.88	171.0	0.12	160.5	1.17E+17	0.046	5.40E+15	0.4	2.3	0.0	0.00	0.00	0.00
35	2.59	15.1	2.78	174.0	0.22	162.0	2.26E+17	0.047	1.06E+16	0.4	4.5	0.7	0.07	0.01	0.00
36	2.59	93.3	2.73	189.0	0.27	169.5	2.92E+17	0.049	1.43E+16	0.4	6.0	5.6	0.56	0.06	0.01
0S 13E 28	0.50	100.0	2.93	165.0	0.07	157.5	1.35E+16	0.045	6.06E+14	0.4	0.3	0.3	0.03	0.00	0.00
29	1.18	100.0	2.93	157.5	0.07	153.8	3.09E+16	0.045	1.39E+15	0.4	0.6	0.6	0.06	0.01	0.00
30	1.44	100.0	2.93	157.5	0.07	153.8	3.78E+16	0.045	1.70E+15	0.4	0.7	0.7	0.07	0.01	0.00
31	2.59	100.0	2.68	188.0	0.32	169.0	3.45E+17	0.049	1.69E+16	0.4	7.1	7.1	0.71	0.07	0.01
32	2.59	100.0	2.68	179.0	0.32	164.5	3.35E+17	0.047	1.57E+16	0.4	6.6	6.6	0.66	0.07	0.01
33	2.59	100.0	2.75	170.0	0.25	160.0	2.53E+17	0.046	1.17E+16	0.4	4.9	4.9	0.49	0.05	0.00
34	1.99	100.0	2.83	162.5	0.17	156.3	1.29E+17	0.045	5.81E+15	0.4	2.5	2.5	0.25	0.02	0.00
35	0.69	100.0	2.88	155.0	0.12	152.5	3.07E+16	0.044	1.35E+15	0.4	0.6	0.6	0.06	0.01	0.00
1S 11E 12	0.89	100.0	2.88	156.0	0.12	153.0	3.98E+16	0.044	1.75E+15	0.4	0.7	0.7	0.07	0.01	0.00
13	2.45	100.0	2.70	162.5	0.30	156.3	2.80E+17	0.045	1.26E+16	0.4	5.3	5.3	0.53	0.05	0.01
14	0.19	100.0	2.95	152.5	0.05	151.3	3.49E+15	0.044	1.54E+14	0.4	0.1	0.1	0.01	0.00	0.00
23	0.88	100.0	2.90	155.0	0.10	152.5	3.27E+16	0.044	1.44E+15	0.4	0.6	0.6	0.06	0.01	0.00
24	2.59	100.0	2.53	170.0	0.47	160.0	4.77E+17	0.046	2.19E+16	0.4	9.3	9.3	0.93	0.09	0.01
25	2.59	100.0	2.55	170.0	0.45	160.0	4.56E+17	0.046	2.10E+16	0.4	8.9	8.9	0.89	0.09	0.01
26	1.20	100.0	2.93	155.0	0.07	152.5	3.12E+16	0.044	1.37E+15	0.4	0.6	0.6	0.06	0.01	0.00
35	0.80	100.0	2.95	155.0	0.05	152.5	1.48E+16	0.044	6.53E+14	0.4	0.3	0.3	0.03	0.00	0.00
36	2.59	100.0	2.70	169.0	0.30	159.5	3.03E+17	0.046	1.39E+16	0.4	5.9	5.9	0.59	0.06	0.01
21S 12E 1	2.40	24.4	2.40	247.5	0.60	198.8	7.14E+17	0.057	4.07E+16	0.4	17.2	4.2	0.42	0.04	0.00
2	2.46	0.0	2.45	237.5	0.55	193.8	6.53E+17	0.057	3.72E+16	0.4	15.7	0.0	0.00	0.00	0.00
3	2.46	14.3	2.60	212.5	0.40	181.3	4.42E+17	0.051	2.25E+16	0.4	9.5	1.4	0.14	0.01	0.00
4	2.46	50.0	2.70	195.0	0.30	172.5	3.14E+17	0.049	1.54E+16	0.4	6.5	3.2	0.32	0.03	0.00
5	2.34	100.0	2.90	170.0	0.10	160.0	9.16E+16	0.046	4.21E+15	0.4	1.8	1.8	0.18	0.02	0.00
6	0.78	100.0	2.90	157.5	0.10	153.8	2.92E+16	0.045	1.31E+15	0.4	0.6	0.6	0.06	0.01	0.00
7	2.39	100.0	2.75	170.0	0.25	160.0	2.34E+17	0.046	1.08E+16	0.4	4.5	4.5	0.45	0.05	0.00
8	2.59	100.0	2.58	207.5	0.42	178.8	4.81E+17	0.051	2.45E+16	0.4	10.4	10.4	1.04	0.10	0.01
9	2.59	89.4	2.38	245.0	0.62	197.5	7.91E+17	0.057	4.51E+16	0.4	19.1	17.0	1.70	0.17	0.02
10	2.59	0.0	2.23	280.0	0.77	215.0	1.08E+18	0.060	6.46E+16	0.4	27.3	0.0	0.00	0.00	0.00
11	2.59	16.2	2.08	300.0	0.92	225.0	1.35E+18	0.063	8.51E+16	0.4	36.0	5.8	0.58	0.06	0.01
12	2.59	0.0	1.99	307.5	1.01	228.8	1.51E+18	0.064	9.66E+16	0.4	40.8	0.0	0.00	0.00	0.00
13	2.59	0.0	1.51	343.0	1.49	246.5	2.41E+18	0.067	1.62E+17	0.4	68.3	0.0	0.00	0.00	0.00
14	2.59	73.2	1.60	343.0	1.40	246.5	2.27E+18	0.067	1.52E+17	0.4	64.2	47.0	4.70	0.47	0.05
15	2.59	100.0	1.73	337.5	1.27	243.8	2.03E+18	0.067	1.36E+17	0.4	57.5	57.5	5.75	0.58	0.06
16	2.59	100.0	1.88	305.0	1.12	227.5	1.66E+18	0.064	1.07E+17	0.4	45.0	45.0	4.50	0.45	0.05
17	2.59	100.0	2.13	262.5	0.87	206.3	1.16E+18	0.058	6.75E+16	0.4	28.5	28.5	2.85	0.29	0.03
18	2.41	100.0	2.40	200.0	0.60	175.0	6.25E+17	0.050	3.12E+16	0.4	13.2	13.2	1.32	0.13	0.01
19	2.43	100.0	1.98	212.5	1.02	181.3	1.11E+18	0.051	5.67E+16	0.4	24.0	24.0	2.40	0.24	0.02
20	2.59	100.0	1.58	290.0	1.42	220.0	2.04E+18	0.062	1.26E+17	0.4	53.3	53.3	5.33	0.53	0.05
21	2.59	100.0	1.35	343.0	1.65	246.5	2.67E+18	0.067	1.79E+17	0.4	75.6	75.6	7.56	0.76	0.08
22	2.59	86.3	1.20	343.0	1.80	246.5	2.91E+18	0.067	1.95E+17	0.4	82.5	71.2	7.12	0.71	0.07
23	2.59	11.3	1.10	343.0	1.90	246.5	3.08E+18	0.067	2.06E+17	0.4	87.1	9.8	0.98	0.10	0.01
24	2.59	0.0	1.05	343.0	1.95	246.5	3.16E+18	0.067	2.12E+17	0.4	89.4	0.0	0.00	0.00	0.00

APPENDIX D

BLOCK	AREA (Km2)	PERCENT AREA ACCESS.	DEPTH 150 C (Km)	TEMP. 3 Km (C)	RES. THICK (Km)	AVRG. RES. TEMP. (C)	ACCESS. RES. (J)	Wa/qR	AVAIL. WORK BASE (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	0.01Rg (MW 30 yrs)	0.001Rg (MW 30 yrs)
25	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
26	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
27	2.59	21.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	19.2	1.92	0.19	0.02
28	2.59	100.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	91.7	9.17	0.92	0.09
29	2.59	100.0	1.13	300.0	1.87	225.0	2.75E+18	0.063	1.73E+17	0.4	73.1	73.1	7.31	0.73	0.07
30	2.44	100.0	1.90	220.0	1.10	185.0	1.23E+18	0.052	6.41E+16	0.4	27.1	27.1	2.71	0.27	0.03
31	2.47	100.0	2.18	212.5	0.82	181.3	9.09E+17	0.051	4.64E+16	0.4	19.6	19.6	1.96	0.20	0.02
32	2.59	100.0	1.60	292.5	1.40	221.3	2.02E+18	0.062	1.25E+17	0.4	52.9	52.9	5.29	0.53	0.05
33	2.59	100.0	1.05	343.0	1.95	246.5	3.16E+18	0.067	2.12E+17	0.4	89.4	89.4	8.94	0.89	0.09
34	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
35	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
36	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
21S 13E 1	0.94	100.0	2.90	157.5	0.10	153.8	3.52E+16	0.045	1.58E+15	0.4	0.7	0.7	0.07	0.01	0.00
2	2.07	100.0	2.70	167.5	0.30	158.8	2.41E+17	0.046	1.11E+16	0.4	4.7	4.7	0.47	0.05	0.00
3	2.15	100.0	2.55	190.0	0.45	170.0	4.05E+17	0.049	1.98E+16	0.4	8.4	8.4	0.84	0.08	0.01
4	2.22	100.0	2.43	210.0	0.57	180.0	5.64E+17	0.051	2.88E+16	0.4	12.1	12.1	1.21	0.12	0.01
5	2.26	100.0	2.35	230.0	0.65	190.0	6.94E+17	0.054	3.75E+16	0.4	15.8	15.8	1.58	0.16	0.02
6	2.26	100.0	2.35	245.0	0.65	197.5	7.24E+17	0.057	4.13E+16	0.4	17.4	17.4	1.74	0.17	0.02
7	2.55	100.0	1.93	292.5	1.07	221.3	1.52E+18	0.062	9.42E+16	0.4	39.8	39.8	3.98	0.40	0.04
8	2.59	100.0	1.98	275.0	1.02	212.5	1.41E+18	0.060	8.45E+16	0.4	35.7	35.7	3.57	0.36	0.04
9	2.59	100.0	2.08	242.5	0.92	196.3	1.17E+18	0.056	6.53E+16	0.4	27.6	27.6	2.76	0.28	0.03
10	2.59	100.0	2.23	217.5	0.77	183.8	9.09E+17	0.052	4.72E+16	0.4	20.0	20.0	2.00	0.20	0.02
11	2.59	100.0	2.53	190.0	0.47	170.0	5.09E+17	0.049	2.50E+16	0.4	10.5	10.5	1.05	0.11	0.01
12	2.59	100.0	2.70	170.0	0.30	160.0	3.04E+17	0.046	1.40E+16	0.4	5.9	5.9	0.59	0.06	0.01
13	2.59	100.0	2.64	195.0	0.36	172.5	3.97E+17	0.049	1.94E+16	0.4	8.2	8.2	0.82	0.08	0.01
14	2.59	100.0	2.38	215.0	0.62	182.5	7.26E+17	0.051	3.70E+16	0.4	15.6	15.6	1.56	0.16	0.02
15	2.59	78.3	2.05	245.0	0.95	197.5	1.21E+18	0.057	6.91E+16	0.4	29.2	22.9	2.29	0.23	0.02
16	2.59	47.6	1.69	287.5	1.31	218.8	1.87E+18	0.062	1.16E+17	0.4	48.9	23.3	2.33	0.23	0.02
17	2.59	47.6	1.50	322.5	1.50	236.3	2.32E+18	0.065	1.51E+17	0.4	63.7	30.3	3.03	0.30	0.03
18	2.55	47.6	1.48	343.0	1.52	246.5	2.42E+18	0.067	1.62E+17	0.4	68.6	32.6	3.26	0.33	0.03
19	2.54	0.0	1.03	343.0	1.97	246.5	3.13E+18	0.067	2.10E+17	0.4	88.5	0.0	0.00	0.00	0.00
20	2.59	0.0	1.08	343.0	1.92	246.5	3.11E+18	0.067	2.08E+17	0.4	88.0	0.0	0.00	0.00	0.00
21	2.59	0.0	1.44	312.5	1.56	231.3	2.36E+18	0.064	1.51E+17	0.4	63.8	0.0	0.00	0.00	0.00
22	2.59	52.4	1.83	270.0	1.17	210.0	1.60E+18	0.060	9.57E+16	0.4	40.4	21.2	2.12	0.21	0.02
23	2.59	100.0	2.14	230.0	0.86	190.0	1.05E+18	0.054	5.68E+16	0.4	24.0	24.0	2.40	0.24	0.02
24	2.59	100.0	2.55	202.5	0.45	176.3	5.07E+17	0.050	2.54E+16	0.4	10.7	10.7	1.07	0.11	0.01
25	2.59	100.0	2.45	210.0	0.55	180.0	6.35E+17	0.051	3.24E+16	0.4	13.7	13.7	1.37	0.14	0.01
26	2.59	100.0	2.08	245.0	0.92	197.5	1.17E+18	0.057	6.69E+16	0.4	28.3	28.3	2.83	0.28	0.03
27	2.59	52.4	1.63	282.5	1.37	216.3	1.93E+18	0.061	1.18E+17	0.4	49.7	26.0	2.60	0.26	0.03
28	2.59	0.0	1.20	335.0	1.80	242.5	2.86E+18	0.066	1.89E+17	0.4	79.9	0.0	0.00	0.00	0.00
29	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
30	2.54	0.0	1.00	343.0	2.00	246.5	3.18E+18	0.067	2.13E+17	0.4	89.9	0.0	0.00	0.00	0.00
31	2.53	0.0	1.00	343.0	2.00	246.5	3.16E+18	0.067	2.12E+17	0.4	89.5	0.0	0.00	0.00	0.00
32	2.59	0.0	1.00	343.0	2.00	246.5	3.24E+18	0.067	2.17E+17	0.4	91.7	0.0	0.00	0.00	0.00
33	2.59	0.0	1.28	325.0	1.72	237.5	2.68E+18	0.066	1.77E+17	0.4	74.6	0.0	0.00	0.00	0.00
34	2.59	52.4	1.70	285.0	1.30	217.5	1.84E+18	0.061	1.12E+17	0.4	47.4	24.9	2.49	0.25	0.02
35	2.59	100.0	2.08	245.0	0.92	197.5	1.17E+18	0.057	6.69E+16	0.4	28.3	28.3	2.83	0.28	0.03
36	2.59	100.0	2.45	210.0	0.55	180.0	6.35E+17	0.051	3.24E+16	0.4	13.7	13.7	1.37	0.14	0.01

APPENDIX D

BLOCK	AREA (Km2)	PERCENT AREA ACCESS.	DEPTH 150 C (Km)	TEMP. 3 Km (C)	RES. THICK (Km)	AVRG. RES. TEMP. (C)	ACCESS. RES. (J)	Wa/qR	AVAIL. WORK BASE (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	0.01Rg (MW 30 yrs)	0.001Rg (MW 30 yrs)
21S 14E 7	0.74	100.0	2.94	157.5	0.06	153.8	1.66E+16	0.045	7.49E+14	0.4	0.3	0.3	0.03	0.00	0.00
17	0.14	100.0	2.99	155.0	0.01	152.5	5.20E+14	0.044	2.29E+13	0.4	0.0	0.0	0.00	0.00	0.00
18	2.39	100.0	2.90	162.5	0.10	156.3	9.11E+16	0.045	4.10E+15	0.4	1.7	1.7	0.17	0.02	0.00
19	2.48	100.0	2.80	175.0	0.20	162.5	1.98E+17	0.046	9.09E+15	0.4	3.8	3.8	0.38	0.04	0.00
20	0.80	100.0	2.95	155.0	0.05	152.5	1.48E+16	0.044	6.53E+14	0.4	0.3	0.3	0.03	0.00	0.00
29	1.24	100.0	2.95	157.5	0.05	153.8	2.32E+16	0.045	1.05E+15	0.4	0.4	0.4	0.04	0.00	0.00
30	2.48	100.0	2.75	180.0	0.25	165.0	2.51E+17	0.047	1.18E+16	0.4	5.0	5.0	0.50	0.05	0.00
31	2.48	100.0	2.75	180.0	0.25	165.0	2.51E+17	0.047	1.18E+16	0.4	5.0	5.0	0.50	0.05	0.00
32	1.21	100.0	2.95	157.5	0.05	153.8	2.27E+16	0.045	1.02E+15	0.4	0.4	0.4	0.04	0.00	0.00
22S 11E 1	2.59	100.0	2.75	162.5	0.25	156.3	2.47E+17	0.045	1.11E+16	0.4	4.7	4.7	0.47	0.05	0.00
2	0.35	100.0	2.98	152.5	0.02	151.3	2.58E+15	0.044	1.13E+14	0.4	0.0	0.0	0.00	0.00	0.00
12	1.52	100.0	2.85	157.5	0.15	153.8	8.54E+16	0.045	3.84E+15	0.4	1.6	1.6	0.16	0.02	0.00
13	0.09	100.0	2.94	152.5	0.06	151.3	1.99E+15	0.044	8.74E+13	0.4	0.0	0.0	0.00	0.00	0.00
22S 12E 1	2.59	0.0	1.08	343.0	1.92	246.5	3.11E+18	0.067	2.08E+17	0.4	88.0	0.0	0.00	0.00	0.00
2	2.59	0.0	1.08	343.0	1.92	246.5	3.11E+18	0.067	2.08E+17	0.4	88.0	0.0	0.00	0.00	0.00
3	2.59	0.0	1.20	332.5	1.80	241.3	2.85E+18	0.066	1.88E+17	0.4	79.4	0.0	0.00	0.00	0.00
4	2.59	100.0	1.53	305.0	1.47	227.5	2.18E+18	0.063	1.38E+17	0.4	58.1	58.1	5.81	0.58	0.06
5	2.59	100.0	1.90	250.0	1.10	200.0	1.42E+18	0.058	8.25E+16	0.4	34.9	34.9	3.49	0.35	0.03
6	2.59	100.0	2.40	197.5	0.60	173.8	6.66E+17	0.050	3.33E+16	0.4	14.1	14.1	1.41	0.14	0.01
7	2.59	100.0	2.52	177.5	0.48	163.8	4.99E+17	0.047	2.35E+16	0.4	9.9	9.9	0.99	0.10	0.01
8	2.59	100.0	2.13	217.5	0.87	183.8	1.03E+18	0.052	5.34E+16	0.4	22.6	22.6	2.26	0.23	0.02
9	2.59	33.0	1.78	262.5	1.22	206.3	1.63E+18	0.058	9.46E+16	0.4	40.0	13.2	1.32	0.13	0.01
10	2.59	0.0	1.63	295.0	1.37	222.5	1.99E+18	0.062	1.23E+17	0.4	52.1	0.0	0.00	0.00	0.00
11	2.59	0.0	1.53	315.0	1.47	232.5	2.24E+18	0.064	1.43E+17	0.4	60.5	0.0	0.00	0.00	0.00
12	2.59	0.0	1.53	317.5	1.47	233.8	2.25E+18	0.065	1.46E+17	0.4	61.8	0.0	0.00	0.00	0.00
13	2.59	0.0	1.98	275.0	1.02	212.5	1.41E+18	0.060	8.45E+16	0.4	35.7	0.0	0.00	0.00	0.00
14	2.59	66.8	1.98	267.5	1.02	208.8	1.38E+18	0.060	8.29E+16	0.4	35.0	23.4	2.34	0.23	0.02
15	2.59	97.8	2.00	247.5	1.00	198.8	1.28E+18	0.058	7.45E+16	0.4	31.5	30.8	3.08	0.31	0.03
16	2.59	75.0	2.15	220.0	0.85	185.0	1.01E+18	0.052	5.25E+16	0.4	22.2	16.7	1.67	0.17	0.02
17	2.59	100.0	2.38	192.5	0.62	171.3	6.77E+17	0.049	3.32E+16	0.4	14.0	14.0	1.40	0.14	0.01
18	2.04	100.0	2.70	162.5	0.30	156.3	2.33E+17	0.045	1.05E+16	0.4	4.4	4.4	0.44	0.04	0.00
19	0.18	100.0	2.85	155.0	0.15	152.5	1.00E+16	0.044	4.41E+14	0.4	0.2	0.2	0.02	0.00	0.00
20	2.04	100.0	2.70	162.5	0.30	156.3	2.33E+17	0.045	1.05E+16	0.4	4.4	4.4	0.44	0.04	0.00
21	2.59	100.0	2.50	185.0	0.50	167.5	5.33E+17	0.048	2.56E+16	0.4	10.8	10.8	1.08	0.11	0.01
22	2.59	100.0	2.40	202.5	0.60	176.3	6.77E+17	0.050	3.38E+16	0.4	14.3	14.3	1.43	0.14	0.01
23	2.59	94.1	2.33	220.0	0.67	185.0	7.97E+17	0.052	4.14E+16	0.4	17.5	16.5	1.65	0.16	0.02
24	2.59	26.7	1.95	225.0	1.05	187.5	1.27E+18	0.053	6.71E+16	0.4	28.4	7.6	0.76	0.08	0.01
25	2.59	72.2	2.65	177.5	0.35	163.8	3.64E+17	0.047	1.71E+16	0.4	7.2	5.2	0.52	0.05	0.01
26	2.59	87.1	2.65	177.5	0.35	163.8	3.64E+17	0.047	1.71E+16	0.4	7.2	6.3	0.63	0.06	0.01
27	2.59	100.0	2.73	170.0	0.27	160.0	2.74E+17	0.046	1.26E+16	0.4	5.3	5.3	0.53	0.05	0.01
28	1.10	100.0	2.80	160.0	0.20	155.0	8.32E+16	0.045	3.74E+15	0.4	1.6	1.6	0.16	0.02	0.00
29	0.15	100.0	2.88	152.5	0.12	151.3	6.62E+15	0.044	2.91E+14	0.4	0.1	0.1	0.01	0.00	0.00
34	0.26	100.0	2.93	155.0	0.07	152.5	6.76E+15	0.044	2.97E+14	0.4	0.1	0.1	0.01	0.00	0.00
35	0.98	100.0	2.90	157.5	0.10	153.8	3.67E+16	0.045	1.65E+15	0.4	0.7	0.7	0.07	0.01	0.00
36	1.20	100.0	2.90	157.5	0.10	153.8	4.50E+16	0.045	2.02E+15	0.4	0.9	0.9	0.09	0.01	0.00
22S 13E 1	2.59	100.0	2.60	200.0	0.40	175.0	4.48E+17	0.050	2.24E+16	0.4	9.5	9.5	0.95	0.09	0.01
2	2.59	100.0	2.25	232.5	0.75	191.3	9.24E+17	0.054	4.99E+16	0.4	21.1	21.1	2.11	0.21	0.02
3	2.59	52.4	1.93	265.0	1.07	207.5	1.44E+18	0.059	8.50E+16	0.4	35.9	18.8	1.88	0.19	0.02

BLOCK	AREA (Km2)	PERCENT AREA ACCESS.	DEPTH 150 C (Km)	TEMP. 3 Km (C)	RES. THICK (Km)	AVRG. RES. TEMP. (C)	ACCESS. RES. (J)	Wa/qR	AVAIL. WORK BASE (J)	UTIL. FACT.	ELECT. ENER. (MW 30 yrs)	ACCESS. ELECT. ENER. (MW 30 yrs)	0.1Rg (MW 30 yrs)	0.01Rg (MW 30 yrs)	0.001Rg (MW 30 yrs)
4	2.59	27.4	1.58	300.0	1.42	225.0	2.09E+18	0.063	1.31E+17	0.4	55.5	15.2	1.52	0.15	0.02
5	2.59	0.0	1.38	330.0	1.62	240.0	2.55E+18	0.066	1.68E+17	0.4	71.1	0.0	0.00	0.00	0.00
6	2.59	0.0	1.20	343.0	1.80	246.5	2.91E+18	0.067	1.95E+17	0.4	82.5	0.0	0.00	0.00	0.00
7	2.59	0.0	1.64	310.0	1.36	230.0	2.04E+18	0.064	1.31E+17	0.4	55.3	0.0	0.00	0.00	0.00
8	2.59	0.0	1.78	292.5	1.22	221.3	1.76E+18	0.062	1.09E+17	0.4	46.1	0.0	0.00	0.00	0.00
9	2.59	100.0	1.98	265.0	1.02	207.5	1.37E+18	0.059	8.10E+16	0.4	34.2	34.2	3.42	0.34	0.03
10	2.59	100.0	2.18	240.0	0.82	195.0	1.03E+18	0.056	5.78E+16	0.4	24.4	24.4	2.44	0.24	0.02
11	2.59	100.0	2.48	212.5	0.52	181.3	6.05E+17	0.051	3.08E+16	0.4	13.0	13.0	1.30	0.13	0.01
12	2.59	100.0	2.88	187.5	0.12	168.8	1.29E+17	0.049	6.32E+15	0.4	2.7	2.7	0.27	0.03	0.00
13	2.59	100.0	2.85	167.5	0.15	158.8	1.51E+17	0.046	6.94E+15	0.4	2.9	2.9	0.29	0.03	0.00
14	2.59	100.0	2.70	187.5	0.30	168.8	3.23E+17	0.049	1.58E+16	0.4	6.7	6.7	0.67	0.07	0.01
15	2.59	100.0	2.53	207.5	0.47	178.8	5.38E+17	0.051	2.74E+16	0.4	11.6	11.6	1.16	0.12	0.01
16	2.59	100.0	2.33	230.0	0.67	190.0	8.20E+17	0.054	4.43E+16	0.4	18.7	18.7	1.87	0.19	0.02
17	2.59	28.1	2.15	250.0	0.85	200.0	1.10E+18	0.058	6.38E+16	0.4	26.9	7.6	0.76	0.08	0.01
18	2.59	0.0	2.08	265.0	0.92	207.5	1.24E+18	0.059	7.31E+16	0.4	30.9	0.0	0.00	0.00	0.00
19	2.59	80.1	2.40	217.5	0.60	183.8	7.08E+17	0.052	3.68E+16	0.4	15.6	12.5	1.25	0.12	0.01
20	2.59	100.0	2.48	207.5	0.52	178.8	5.95E+17	0.051	3.04E+16	0.4	12.8	12.8	1.28	0.13	0.01
21	2.59	100.0	2.63	197.5	0.37	173.8	4.11E+17	0.050	2.05E+16	0.4	8.7	8.7	0.87	0.09	0.01
22	2.59	100.0	2.80	182.5	0.20	166.3	2.12E+17	0.047	9.94E+15	0.4	4.2	4.2	0.42	0.04	0.00
23	2.59	100.0	2.88	165.0	0.12	157.5	1.20E+17	0.045	5.38E+15	0.4	2.3	2.3	0.23	0.02	0.00
24	0.85	100.0	2.95	157.5	0.05	153.8	1.59E+16	0.045	7.16E+14	0.4	0.3	0.3	0.03	0.00	0.00
26	0.49	100.0	2.99	157.5	0.01	153.8	1.84E+15	0.045	8.26E+13	0.4	0.0	0.0	0.00	0.00	0.00
27	2.18	100.0	2.93	162.5	0.07	156.3	5.82E+16	0.045	2.62E+15	0.4	1.1	1.1	0.11	0.01	0.00
28	2.59	100.0	2.85	172.5	0.15	161.3	1.53E+17	0.046	7.06E+15	0.4	3.0	3.0	0.30	0.03	0.00
29	2.59	100.0	2.80	175.0	0.20	162.5	2.06E+17	0.046	9.49E+15	0.4	4.0	4.0	0.40	0.04	0.00
30	2.59	100.0	2.69	180.0	0.31	165.0	3.25E+17	0.047	1.53E+16	0.4	6.5	6.5	0.65	0.06	0.01
31	1.28	100.0	2.91	157.5	0.09	153.8	4.32E+16	0.045	1.94E+15	0.4	0.8	0.8	0.08	0.01	0.00
32	1.28	100.0	2.95	157.5	0.05	153.8	2.40E+16	0.045	1.08E+15	0.4	0.5	0.5	0.05	0.00	0.00
33	0.48	100.0	2.97	155.0	0.03	152.5	5.35E+15	0.044	2.35E+14	0.4	0.1	0.1	0.01	0.00	0.00
34	0.05	100.0	2.99	152.5	0.01	151.3	1.84E+14	0.044	8.09E+12	0.4	0.0	0.0	0.00	0.00	0.00
22S 14E 5	0.48	100.0	2.95	155.0	0.05	152.5	8.91E+15	0.044	3.92E+14	0.4	0.2	0.2	0.02	0.00	0.00
6	2.59	100.0	2.81	172.5	0.19	161.3	1.94E+17	0.046	8.94E+15	0.4	3.8	3.8	0.38	0.04	0.00
7	0.24	100.0	2.88	160.0	0.12	155.0	1.09E+16	0.045	4.90E+14	0.4	0.2	0.2	0.02	0.00	0.00
18	0.36	100.0	2.98	157.5	0.02	153.8	2.70E+15	0.045	1.21E+14	0.4	0.1	0.1	0.01	0.00	0.00
											4784.7	2017.9	201.8	20.2	2.0

A SUMMARY OF DEEP THERMAL DATA FROM THE CASCADE RANGE

and

ANALYSIS OF THE "RAIN CURTAIN" EFFECT

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ABSTRACT

This report summarizes data from several deep geothermal exploration wells in the Cascade Range in Oregon and southern Washington. Temperature-depth data from 17 wells are included. Thermal conductivity measurements were made on over 110 samples from 8 of the wells and are also summarized. Heat flow values are calculated for 5 of the wells. All of the thermal data in the area of Newberry volcano are presented and briefly discussed. The problem of determining the depth of groundwater domination on the ground temperatures is discussed. In many cases in the literature the depth of the "rain curtain" has been over estimated. The data from the deep wells and data from electrical studies are integrated to investigate the problem. Throughout most of the Cascade Range, exposure to temperatures of 30 °C to 50 °C results in a drastic decrease in the permeability of the mafic volcanic rocks. This decrease results in a predominance of conductive heat transfer over depths of at least hundreds of meters. The electrical resistivity generally decreases by a factor of 50 percent to 100 percent in association with the alteration. Therefore resistivity soundings can be a good indication of the depth required to drill a geothermal gradient test well to obtain useful thermal data.

INTRODUCTION

Extensive new thermal data have been collected for wells in the Cascade Range. The results are briefly summarized in this report. Thermal conductivity measurements have been made on over 110 core samples from 8 deep wells, 7 in Oregon and 1 in California. The temperature data reported for the wells was taken from new measurements, open-file reports, and other sources. The wells will be briefly discussed in order from north to south except for the cluster of wells in the Newberry Volcano area, which will be discussed separately. The because the temperature gradient is disturbed by the local fluid downflow in the well bore. The heat flow below 718 m is equal to or greater than 96 mW/m^2. The thick, low gradient, portion of the well is due to the fact that it was drilled at the crest of the Cascade Range. Resistivity data also indicates deep fluid downflow by the great thickness of high resistivity near-surface rock (Blackwell et al., 1992).

Data are available for two wells drilled in the vicinity of Crater Lake National Park. The temperature data from the wells have been made available by California Energy and are in the form of Custer bomb type of logs. These logs may or may not represent equilibrium temperatures. The temperatures in the upper part of the MZ1-11A well have been described by Blackwell and Steele (1987). The temperature-depth curves are shown in Figure 1 (MZ1-11A and MZ 11-1). Thermal conductivity measurements were made on a few core samples and the average thermal conductivity was determined. Although the heat flow is high in the upper part of well MZ1-11A, the heat flow values based on gradients calculated from bottom hole temperatures and mean annual surface temperatures of the two wells are low. Both wells may be affected over their entire depths by fluid flow. In the case of MZ1-11A the flow is away from the axis of the volcano and the ground water has been heated to temperatures of over 110 ^{o}C throughout the depth range of the well. However, any higher temperature area is probably within Crater Lake National Park and not available for geothermal development. The temperatures in the flow regime in the MZ11-1 well are above the shallow groundwater temperature but are still quite low (not exceeding 30 ^{o}C to a depth of almost 900 m). Below about 275 m the MZ11-1 well was drilled in a hypabyssal intrusive. The core samples from this intrusive have very low porosities (the densities are 2.67 to 2.77 gm/cc). Hence the high permeability implied by thermal indications of active flow (i.e., the very low temperature gradients to depths of almost 900 m) must result from fracture permeability. These results confirm the situation often encountered in the Cascade Range in that the shallow intrusive rocks are more permeable because fractures are abundant and open in these rocks. In contrast the basaltic/andesitic volcanic rocks tend to have very low permeability when subjected to even low temperature alteration. In any case the situation for geothermal resources of the grade sufficient for the generation of electrical energy in the vicinity of the two holes at the edge of Crater Lake National Park appears to be unfavorable.

The southernmost well is the Medicine Lake 88-12 well. The temperature-depth curve was described by Blackwell et al. (1990a) and is shown in Figure 3. Samples were collected from the University of Utah Research Institute (UURI) core repository in Salt Lake City and thermal conductivity measurements were made on 16 samples in the depth range 695 m to 1175 m. The temperatures are not completely at equilibrium as indicated by the notches in the temperature-depth curve at 850 m and 1050 m, but the bottom part of the well has a linear gradient of 85 $^{o}C/km$. The heat flow in that section of the well is 173 mW/m^2. The well is in a topographically high position between Medicine Lake and Mt. Shasta. The low gradient zone extends to only about 400 m in the well, in spite of its high topographic position. The heat flow in shallow holes in the California Cascade Range is near zero in 150 m to 300 m holes (Mase et al., 1982). The gradient is higher between 500 m and 1000 m than in the bottom of the well. The temperatures in this region of the well may be dominated by intermediate scale regional groundwater downflow or the section may be dominated by intrahole downflow (see discussion below for the characteristics of the temperature-depth curve in this case). If the shape of the curve is dominated by intrahole flow the depth of the low gradients due to groundwater flow is only about 100 m. Without more information these two cases cannot be resolved. In either case, the site of the well at high relative elevation makes a high relative head likely in the shallowest aquifers. The heat flow, as in the case of the Oregon Cascade Range, appears to be high below the fluid flow zone, whatever its detailed nature.

A final well is not in the Cascade Range but is of interest to the geothermal setting in Oregon. A temperature log of unknown quality obtained from Union Geothermal was openfiled by DOGAMI for a well near Vale, Oregon. The well is located along the western margin of the Cow Hollow geothermal anomaly (Bowen and Blackwell, 1975). Cow Hollow is a northwest-southeast trending linear anomaly that lies southeast of Vale. Its northern terminus is at Vale Hot Spring. The temperature-depth curve is shown in Figure 4. The log does not appear to be an equilibrium one, and its quality is problematical. The gradient is high in the 150 m to 750 m depth interval (130^{o}C/km), but drops to about 60 ^{o}C/km in the 800 m to 1150 m interval. The bottom hole temperature is quite high at just over 135 ^{o}C. The change in gradient is (speculatively) due in part to a lithologic contact between overlying clays and underlying basalt. The temperatures may be higher east of Cow Hollow (see Bowen and Blackwell, 1975).

NEWBERRY VOLCANO

Thermal data are available from 12 deep wells in the Newberry volcano area. The sites of ten of the wells are shown in Figure 5 and the temperature-depth curves are shown in Figure 6. The data for the Occidental wells are from Potter and Arnstead (1988). The data for the GEO N-1 and N-3 wells have been discussed by several authors (Swanberg and Combs, 1986, Swanberg et al., 1988; Blackwell and Steele, 1987). The data from the USGS-1 and USGS-2 wells have also been discussed (Sammel, 1981, Sammel et al., 1988) and the Sandia RD-01 well has been briefly described (Black et al., 1984). The detailed thermal data from the GeoNewberry (GEO) N-2, N-4, and N-5 wells are presented for the first time. Thermal conductivity values have been determined on core samples for 7 of the wells, 5 of which are described for the first time here. The thermal conductivity values for all but one of the wells are almost identical at 1.60 ± 0.5 W/m/°K in spite of the drastic differences in percentage of basalt to rhyolite and ashes to lava flows in the various wells. The only well with a significantly different thermal conductivity is the GEO N-4 well on the east side of the caldera.

In addition to the detailed data available there are some data from additional wells used in the resource analysis of the Newberry National Monument (Davis et al., 1990). There are average gradients and depth of "rain curtain" available for two California Energy wells (CE N-3 and CE N-4). These data have been incorporated into the analysis of the "rain curtain" effects in the following section.

Heat flow values for the wells are listed in Table 1. The highest heat flow values outside the caldera are over 200 mW/m^2. Heat flow values are 200 mW/m^2 in two or three wells, 220 mW/m^2 in two wells, and 240 mW/m^2 in one or two wells. The heat flow values are generally consistent with the relative gradient values except in the case of GEO N-4 on the east side of the caldera. The measured thermal conductivity for GEO N-4 is 25% higher than for the other wells.

The high thermal conductivity in the GEO N-4 well results in heat flow contours that are more elongated west to east than the geothermal gradient values. This elongation seems to be opposite to the expected regional permeability, which might be expected to parallel the trend of dike injection. In many geothermal areas dikes are barriers to fluid flow so that the regional permeability might be expected to be anisotropic. Of course it has not yet been established that the thermal anomaly outside the caldera is due to fluid flow. So from a thermal point of view the area east of the caldera is almost as attractive as the area on the west side of the caldera, particularly if the thermal conductivity increases with depth along the west side, or decreases with depth on the east side.

The electrical resistivity results (Fitterman et al., 1988) are interesting to compare to the thermal data. Two figures are shown here (Figures 7 and 8). The interpreted resistivity at 250 m is of interest in outlining the low resistivity material in the caldera. The remainder of the area has a relatively high resistivity in the near surface region because it is generally within the region of low temperatures in the wells. These low temperatures are due to groundwater flow. The depth to the top of the first electrically conductive layer is shown in Figure 8. As described in a following section, this depth, where there is well control, appears to correspond to temperatures in the wells of 40-50 °C. Elsewhere in the Cascade Range a similar temperature interval has also proved to appear as a resistivity boundary (Blackwell et al., 1992). Alteration is the probable cause of the relation (see Wright and Nielson, 1986). The shape of the contours on Figure 8 corroborates the west to east elongation seen in the heat flow data (although there is a paucity of data points along the north side of the caldera on the resistivity map).

"RAIN CURTAIN"

Because of the high permeability of the surface volcanic rocks in the High Cascade Range the temperature gradients in shallow holes are often low. These low gradients result from the rapid downgradient flow of groundwater, which displaces the heat to the cold springs at lower elevations. One of the major questions affecting the use of geothermal gradient exploration is the depth to which holes must be drilled to obtain gradient information typical of deep conditions and unaffected by the shallow ground water flow. This shallow effect has been referred to as the "rain curtain" effect (Swanberg et al., 1988) This phenomenon will be discussed briefly here, primarily with respect to the conditions at Newberry. Newberry is used as the example because of the large quantity of high quality data there and because most of the typical situations occur there.

The depth to the bottom of the "rain curtain" in the Cascade Range, based on data from the deep wells drilled so far, varies from 0 m to about 550 m. The depth is primarily a function of the thickness of unaltered rock at a particular site. There is a decrease in permeability with increasing depth due to progressive alteration of the mafic volcanic rocks with increasing depth of burial (due to the associated temperature increase). Also, at deeper depths below the topography there is decreased topographic drive on the groundwater column, resulting in lower groundwater flow rates. At many of the sites so far drilled the transition to regional conductive temperature gradients is quite abrupt and occurs over depths of a few meters or tens of meters. An example of this situation is shown in the case of well SF-NC-72-3 (Figure 6). This well is the only one at Newberry that has an easy-to-pick bottom of the "rain curtain", although the 20 °C temperature in the groundwater zone is curious.

Two of the wells, GEO N-1 and N-3 (Figure 6), have temperature-depth curves that are altered by the effects of intrahole fluid flow so that the effects of the "rain curtain" cannot be unequivocally determined. The "rain curtain" in these wells has been described incorrectly (Swanberg et al., 1988), so that "rain curtain" effects are misunderstood in the literature (Ingebritsen et al., p. 4607, 1992). In Figure 6 the inferred rock temperatures are shown for several wells by dotted lines. In the case of well GEO N-1 the intrahole flow is down from an entry point at 400 m to 500 m and out of the well predominantly in the 1100 m region, although some water starts to exit at 1000 m. Similarly in well GEO N-4 there is downflow from about 400 m to an exit point at about 540 m. The downflow pattern is clearest in well GEO N-2 where the inlet point at 190 m is below the "rain curtain" bottom at about 100 m. Thus the deep gradient from below the outlet point at 310 m to 400 m can be extrapolated to connect with the top of the flow disturbance at 190 m.

In the case of well GEO N-3 the intrahole flow is artesian and the water enters the well at about 1150 m and exits the well at 600 m. The presence of such a shallow water table and of an aquifer at 1150 m depth with a water table at a depth of only 600 m is interesting in and of itself.

The Santa Fe NC-01 well presents a different example of near surface effect. The temperatures are from a commercial temperature log of uncertain calibration and limited resolution. None-the-less the general shape of the temperature-depth curve seems well established. It shows a near isothermal zone followed by a zone with a higher gradient than is seen in the deeper parts of the log. This type of curve has one of two general possible explanations, both of which imply a very shallow rain curtain effect at this site. The isothermal zone stops at 200 m in SF NC-01. Extrapolation of the gradient from depth suggests that the apparent depth of the isothermal zone is only about 40 m. This type of curve might be due to intrahole downflow and so borehole related only. It also might be due to local deeper aquifer flow, but the high gradient would imply that the aquifer flow is local only.

In all the wells the depth to the "rain curtain" is not the depth of intrahole flow, but rather the depth at which the gradient that is observed in the bottom of the hole begins. This depth is about 500 m, 550 m, and 350 m for holes GEO N-1, N-3, and N-4 respectively . A comparison of two interpretations of the depth to the base of the "rain curtain" is shown on Table 2. In general the interpretation of the depth to the bottom of the "rain curtain" by Swanberg et al. (1988) and Davis et al. (1990) is too deep because the effects of intrahole flow have been confused with the "rain curtain" effect. The deepest "rain curtain" influence is on the order of 500 m to 600 m, not 1000 m (also cited by Ingebritsen et al., 1992). Furthermore, in every case in which the well has sufficient depth below the bottom of the "rain curtain", the gradient is essentially constant from the base of the "rain curtain" to the maximum depth of the hole. Thus the bottom of the "rain curtain" appears, in the Cascade Range at least, to be a region of major permeability change, and below that depth thermal conditions are dominated by conduction, not convection, except in exceptional situations.

CORRELATION OF RESISTIVITY AND TEMPERATURE

The relatively large number of deep wells with equilibrium temperature gradients and the rather extensive electrical sounding data at Newberry Volcano allow an interesting comparison of the two data sets. In Figures 9 and 10 the depths to the 40 °C and 50 °C isotherms determined from the temperature logs are compared to the depth to the base of the surface resistive layer (top of the first conductive layer) from the transient electromagnetic

(TEM) soundings of Fitterman et al. (1988) (Figure 8). The plots in Figures 9 and 10 show a nearly 1:1 correlation of the data sets. At shallower depths (400 m to 700 m) the best correlation is with the 50 °C isotherm. At deeper depths the best correlation is with the 40 °C isotherm. The equation relating the depth to the 40 °C isotherm to the depth to the base of the resistive layer is:

depth to base of resistive layer = 228 m + 0.635*(depth to 40 °C)

In the Newberry Volcano case the temperatures are probably at their highest at the present time, so the depth of the resistivity change correlates with a present day temperature. In other areas, such as the Santiam Pass area, the resistivity change corresponds to alteration related to higher past temperatures than occur at the present time. However, even though resistivity correlates with temperature, the geothermal gradient cannot be obtained from the correlation, except in a qualitative sense. The unknown, and variable, depth of the "rain curtain" means that the appropriate depth for the shallow or upper temperature point cannot be fixed, and so a gradient cannot be calculated.

The correlation of resistivity to alteration has been tested by direct measurement of the resistivity of several core samples from the Santiam Pass and GEO N-1 wells. The results are shown in Table 4. The measurements were made by Core Laboratories in Bakersfield, California. The measurements were made on 2.5 cm diameter by 3.5 cm long cylinders. The measurements were made after saturating the samples with a fluid with a resistivity of 36 ohm-meters, about that typical of the groundwater in the Cascade Range. The measurements were run at 25 °C. With the exception of sample N-1-2250, all the resistivity values show a binary relationship with depth. They are either over 800 ohm-meters in the shallower parts of the wells or below 494 ohm-meters in the deeper parts of the wells. This relationship is in qualitative agreement with the field observations.

The close correlation of the resistivity and thermal data sets means that in a setting like the Cascade Range resistivity soundings can be used to obtain an estimate of the depth necessary to reach rocks that have been subjected to a temperature well above ambient and above that occurring in the groundwater flow zone. These rocks will have had their permeability drastically reduced due to alteration. In spite of the close correlation of temperature and resistivity, the temperature gradient cannot be determined except by drilling. The resistivity data allow planning of the appropriate depth of drill hole to obtain high quality thermal data, and so allow a more rational exploration plan, than drilling blindly until thermal data are obtained.

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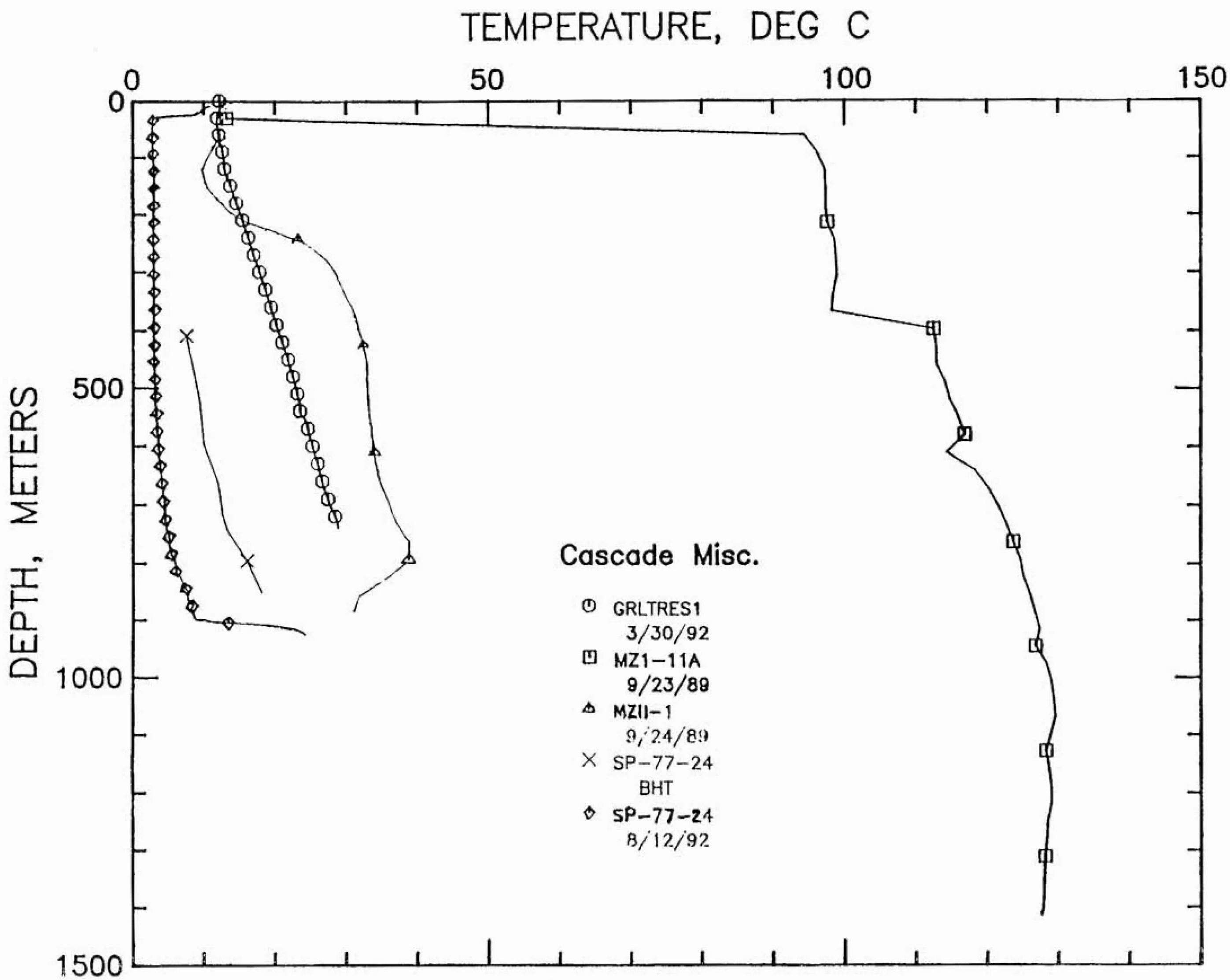


Figure 1. Temperature-depth curves for several deep wells in the Cascade Range.

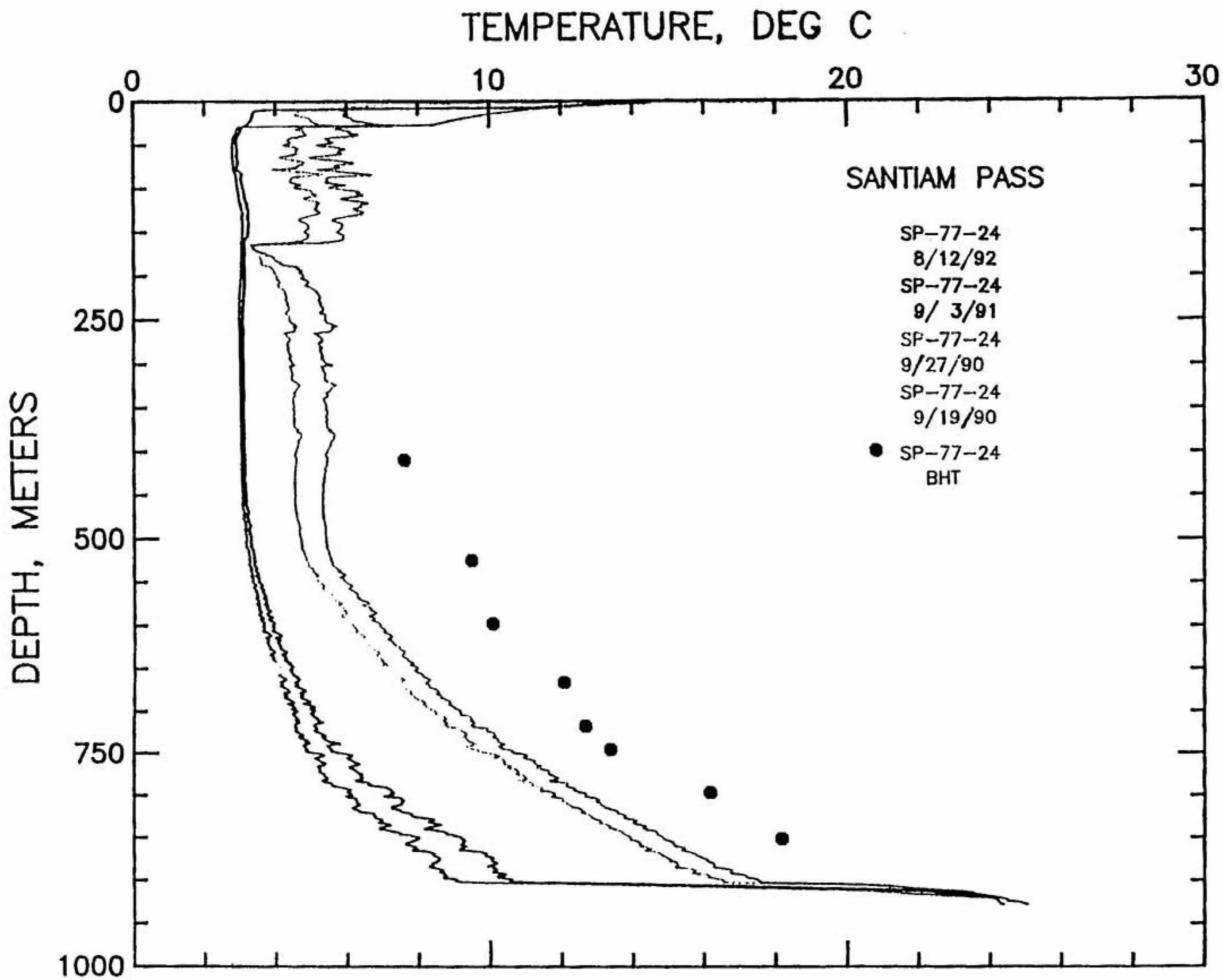


Figure 2. Temperature-depth curves for several logs of the Santiam Pass deep well. The bottom hole temperatures measured as drilling proceeded are shown as dots.

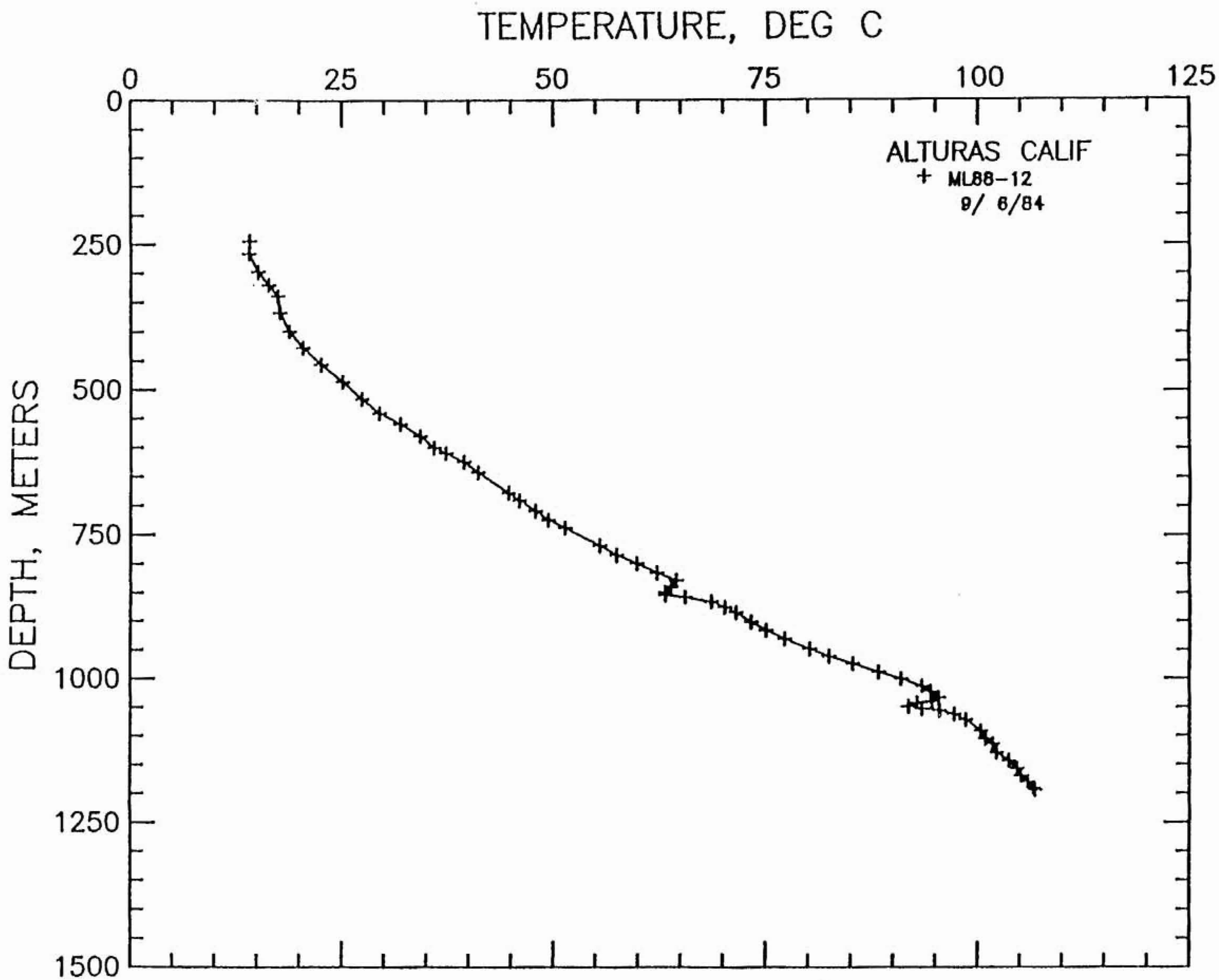


Figure 3. Temperature-depth curve for the temperature gradient well ML88-12.

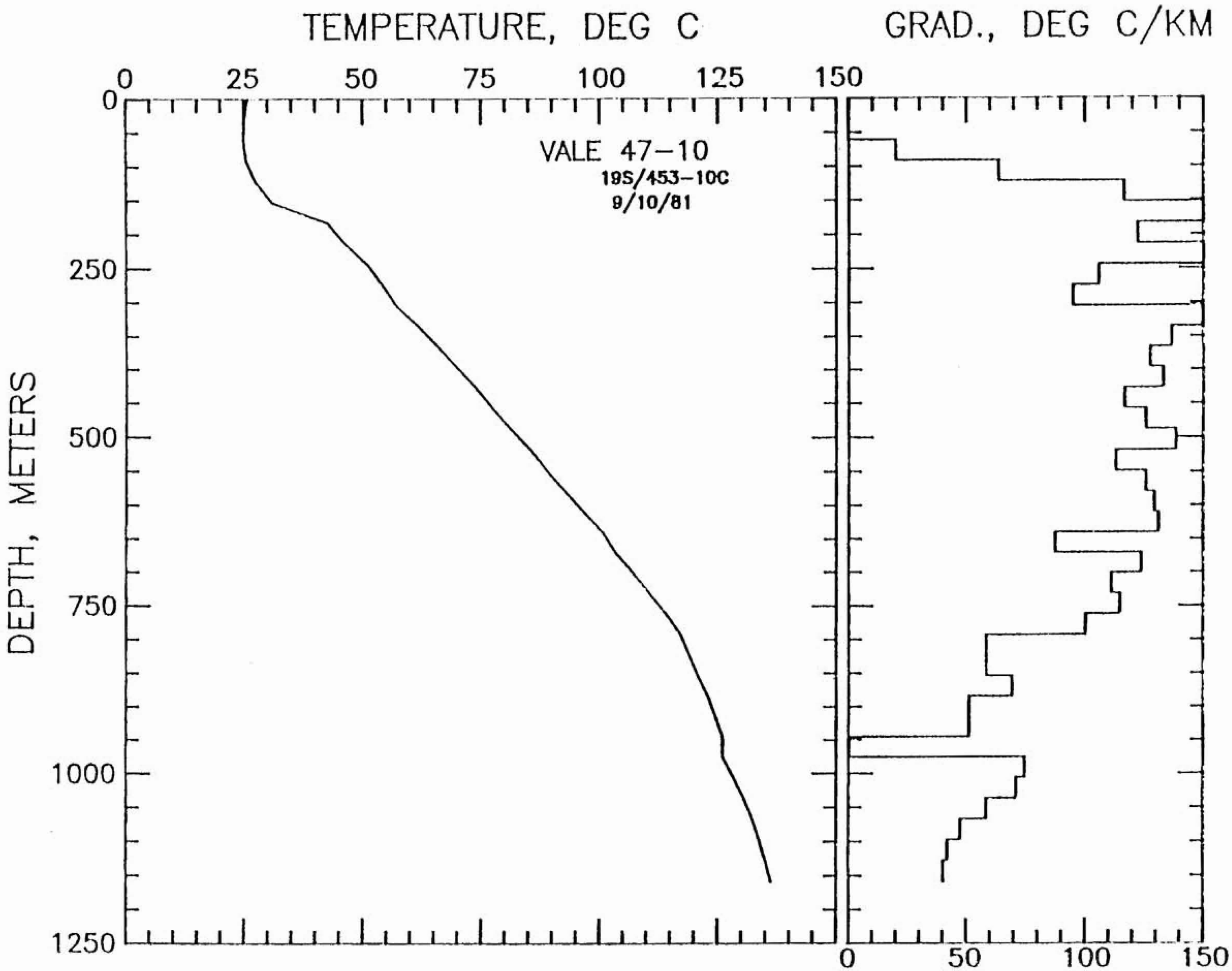
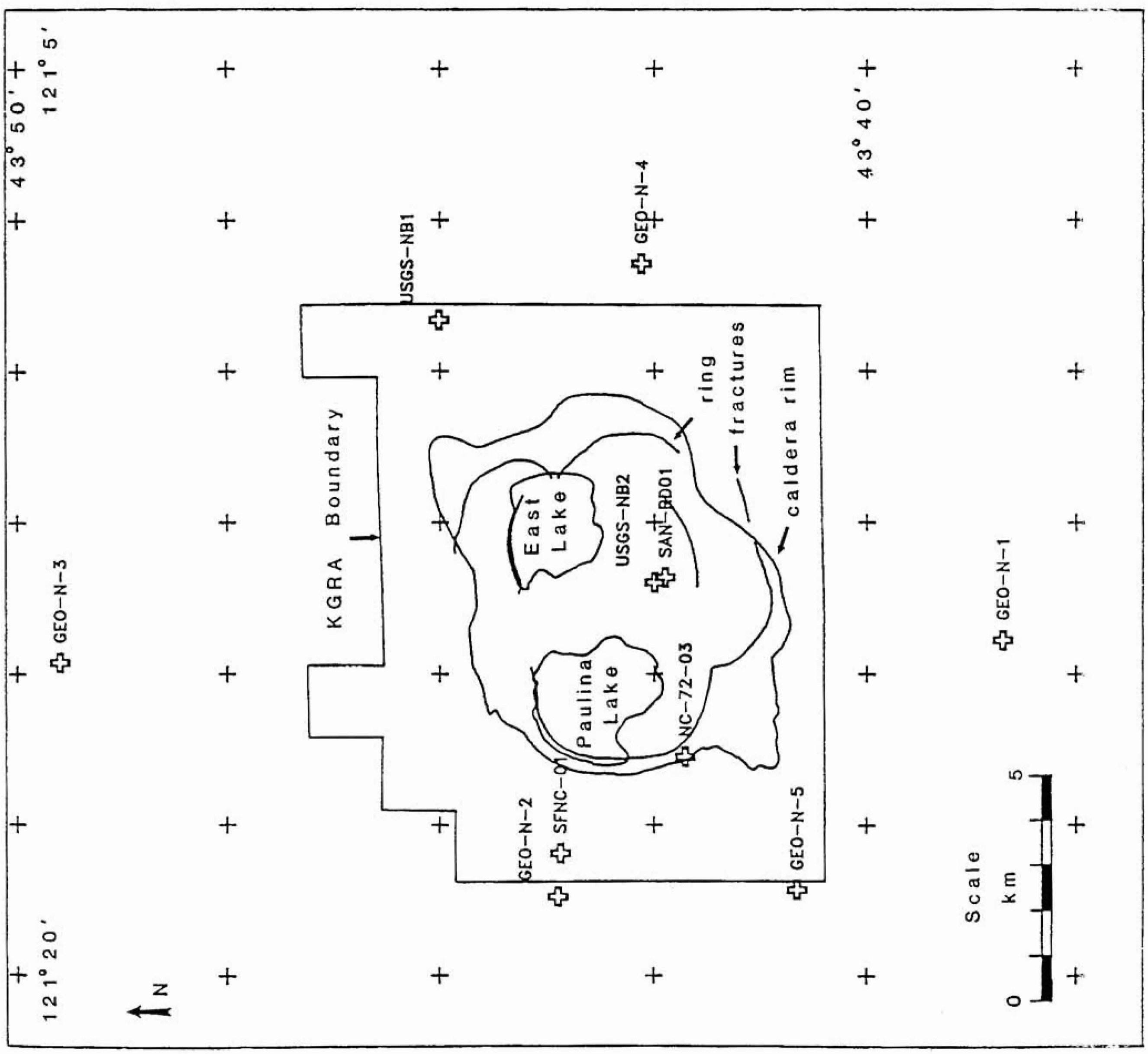


Figure 4. Temperature-depth curve for the temperature gradient well Vale 47-10.

Figure 5. Sites of ten of the temperature gradient wells at Newberry Volcano. Well locations are marked by crosses.



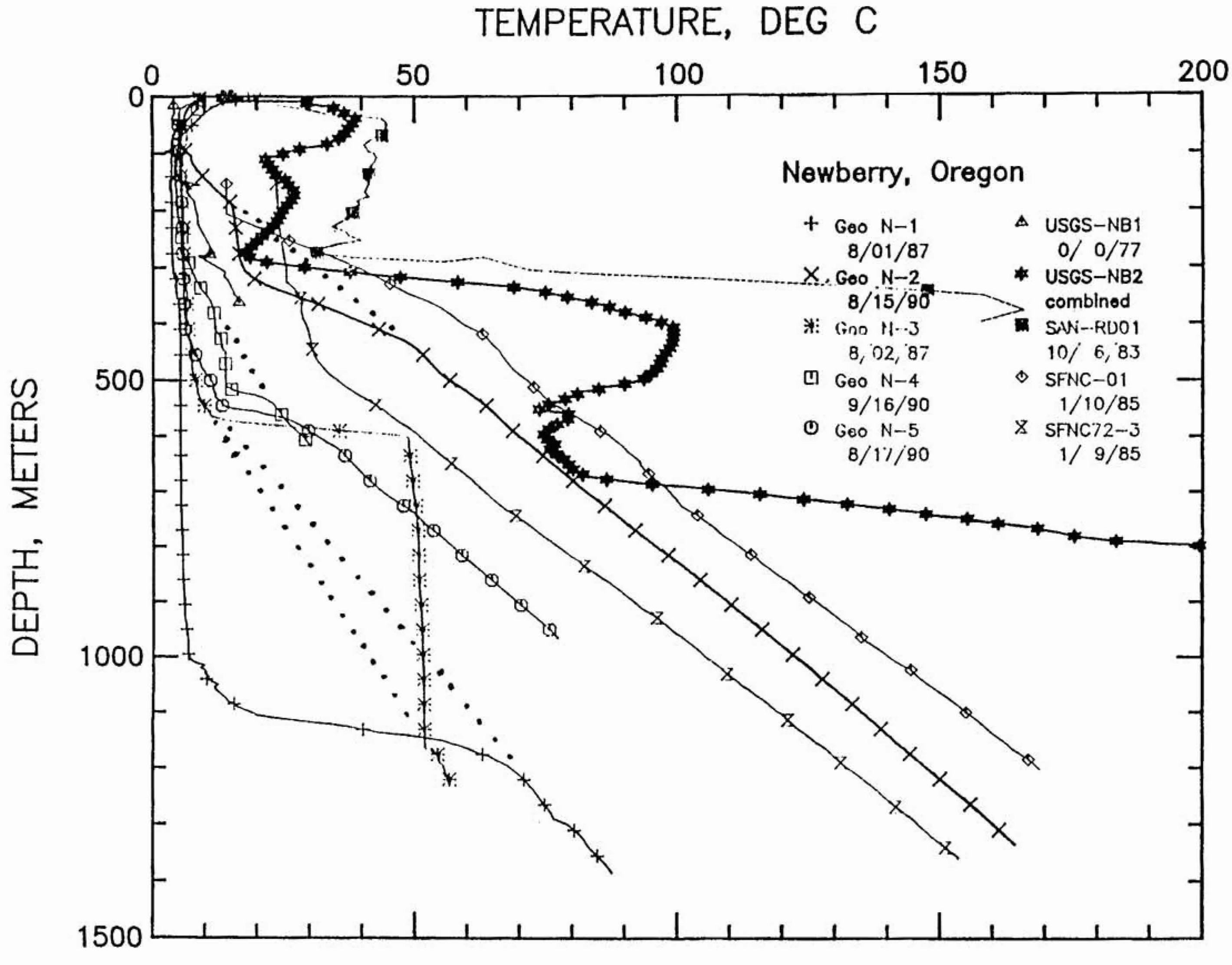


Figure 6. Temperature-depth curves for ten of the temperature gradient wells at Newberry volcano. Selected temperature points are shown by symbols. Dots on four of the wells are inferred rock temperatures (see text).

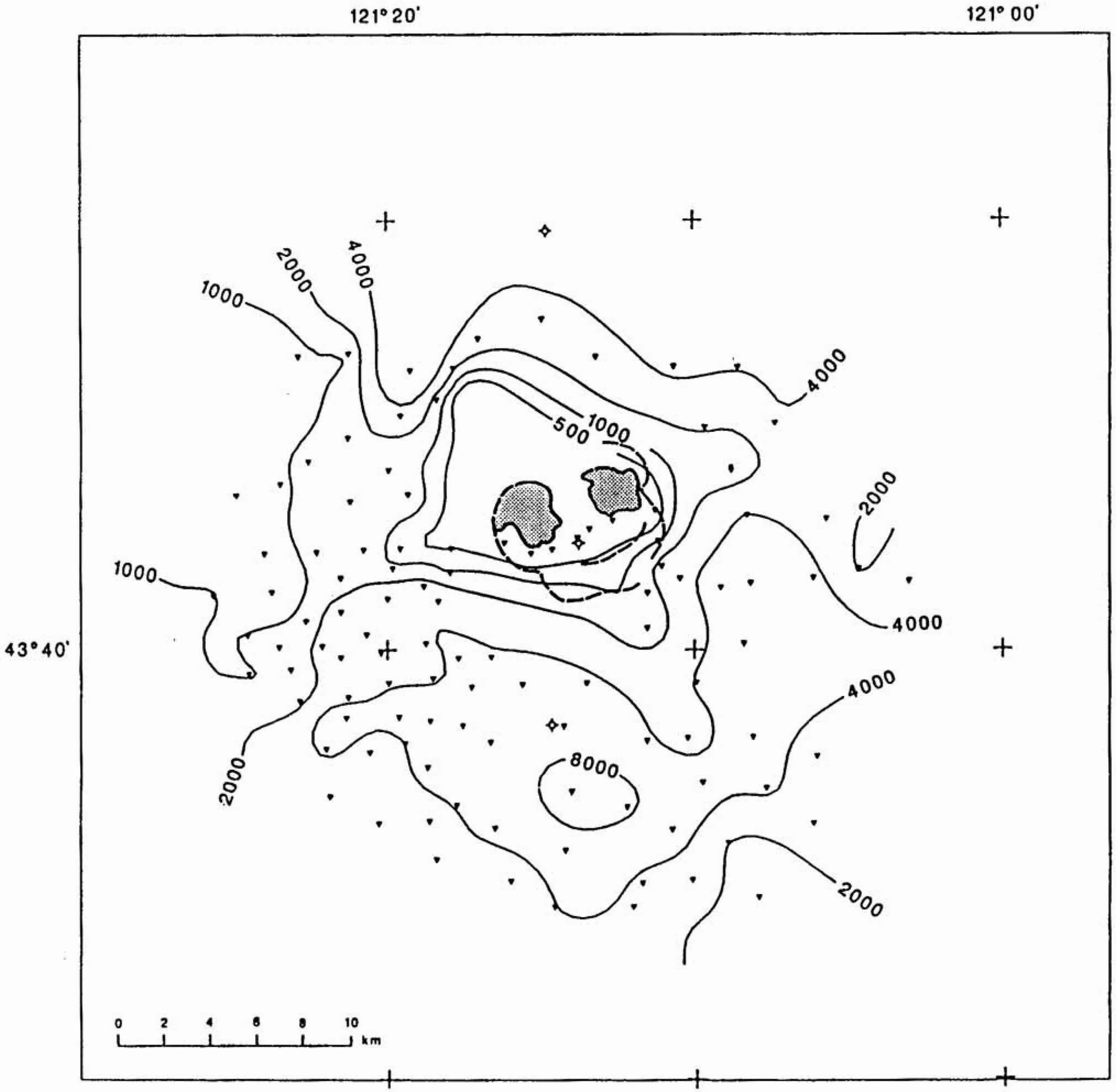


Figure 7. Map of interpreted Schlumberger resistivity in ohm meters at a depth of 250 m (from Fitterman et al., 1988). Triangles are station locations. The caldera ring fracture (heavy dashed line), wells (ticked circles), and lakes (shaded) are shown.

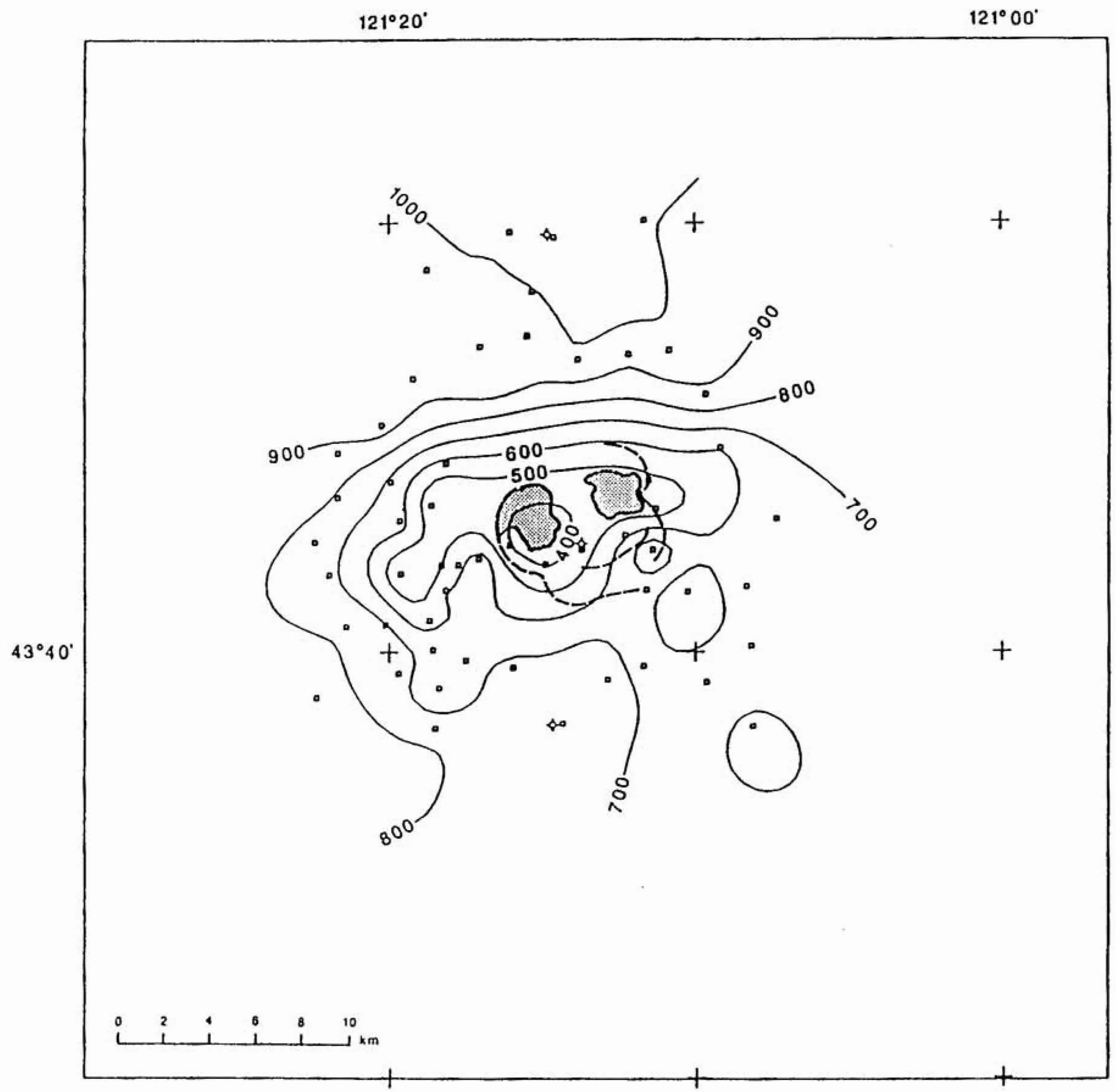


Figure 8. Interpreted depth in meters to the conductive second layer from TEM data (after Fitterman et al., 1988). Squares are station locations. The caldera ring fracture (heavy dashed line), wells (ticked circles), and lakes (shaded) are shown.

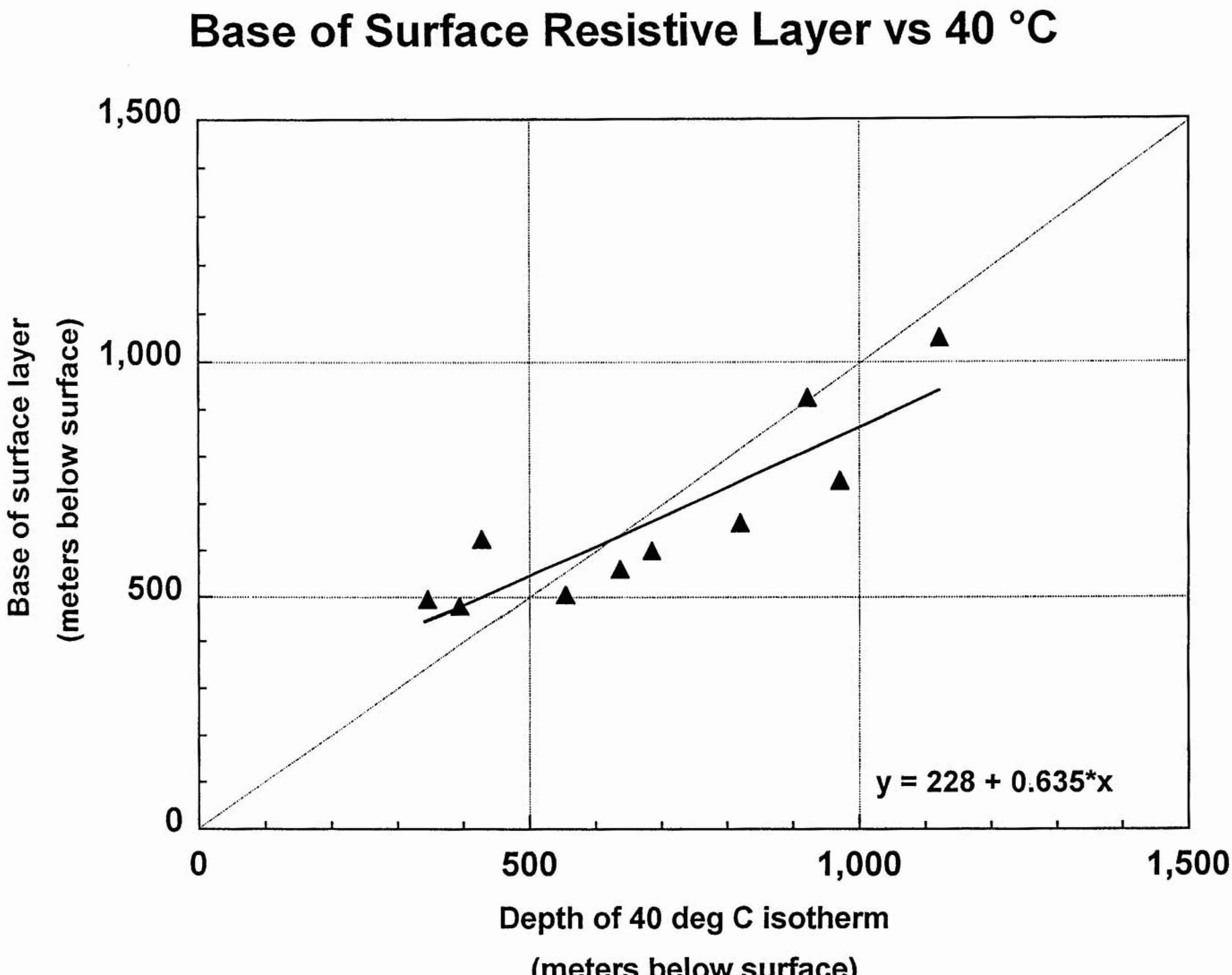


Figure 9. Comparison of the depth to the base of the surface resistive layer (from Figure 8) and the depth to the 40 °C isotherm (from deep well data) at Newberry volcano.

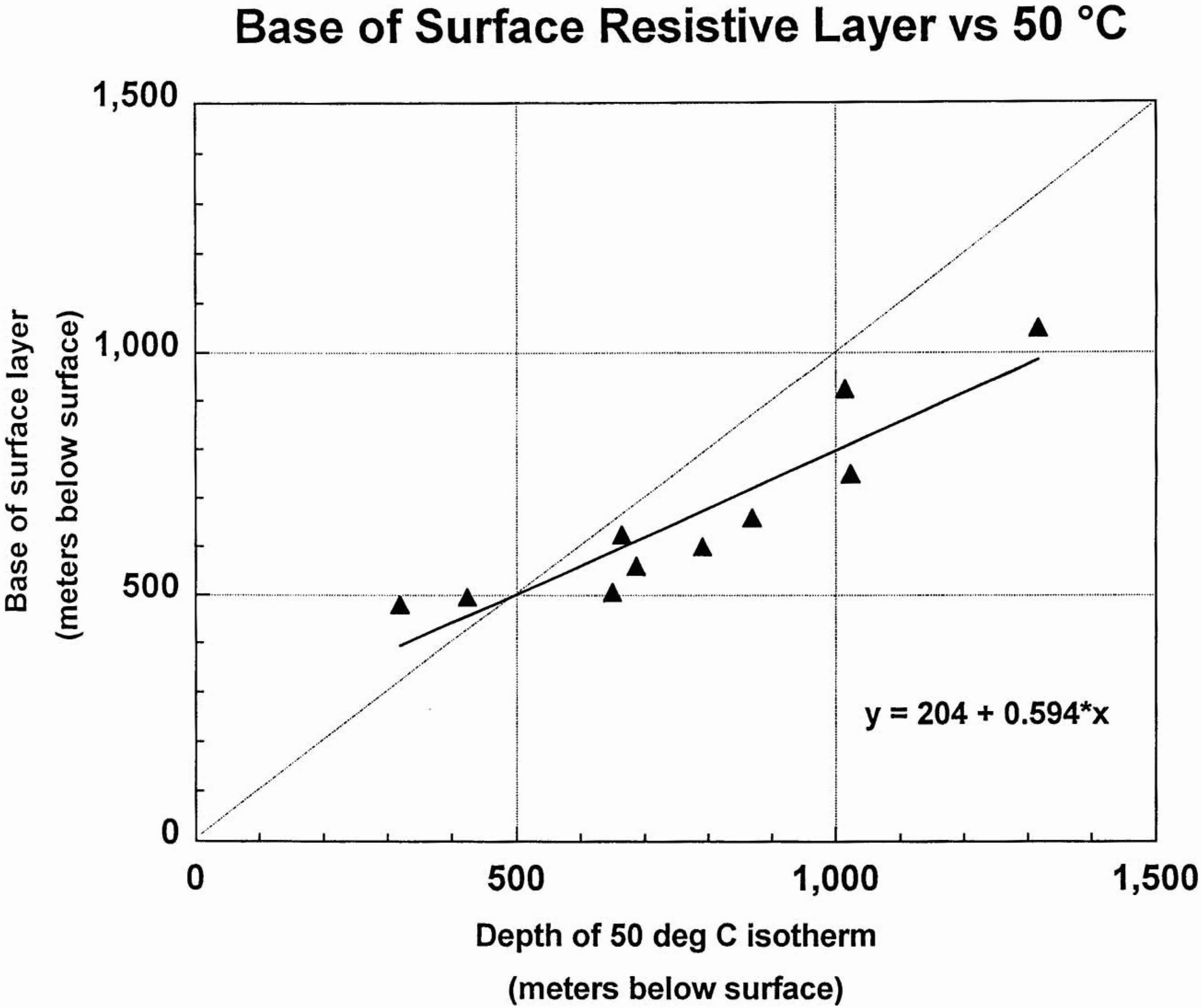


Figure 10. Comparison of the depth to the base of the surface resistive layer (from Figure 8) and the depth to the 50 °C isotherm (from deep well data) at Newberry volcano.

Table 1. Deep Cascades data, in SI units.

TWN/RNG SECTION	N LAT DEG MIN	W LONG DEG MIN	HOLE NAME (DATE)	COLLAR ELEV m	DEPTH RANGE m	AVG TCU <SE> W/m/K	NO TCU	UN GRAD <SE> Deg C/km	CO GRAD <SE> Deg C/km	CO H.F. <SE> mW/m2	LITHOLOGY SUMMARY
				NEWBERRY WELLS							
20S/12E	43-49.50	121-14.82	GEO-N-3	1786	1174.0	1.80		53.2	53.2	96	BASALT AND
24BCB			9/ 6/86		1220.0			11.0			RHY TUFF
21S/13E	43-45.02	121- 9.16	USGS-NB1	1914	15.2						VOLCANICS
15DDB			0/ 0/77		200.0						
					200.0						
					363.9						
					200.6			54.3			
					363.6			4.5			
21S/13E	43-42.38	121-13.42	SAN-RD01	1960	281.9	(1.5)		977.7		1466	TUFF, RHYO
31CCA			10/ 6/83		417.6						& OBSIDIAN
					0.0			261.3			
					417.6			35.1			
21S/12E	43-44.70	121-17.35	GEO-N-2	1786	440.0	1.55	10	129.2		200	BASALT TO
29ADC			8/15/90		1335.0	0.05		0.1			DACITE
21S/12E	43-43.08	121-17.16	SFNC-01	1832	336.8	1.61	14	137.5		221	BASALT TO
28BDD			1/10/85		1202.1	0.04		0.4			DACITE
					758.0			142.5			
					1202.1			0.3		237	
21S/13E	43-42.85	121- 8.90	GEO-N-4	1908	450.0	2.07	5	118.3		245	BASALT TO
35DBD			9/16/90		615.0	0.04		5.9			DACITE
					540.0			97.3		201	
					615.0			2.1			
22S/12E	43-42.30	121-16.56	NC-72-03	1987	510.2	1.62		137.0		222	BASALT TO
3ABA			1/ 9/85		1358.5	0.07		0.2			DACITE
22S/12E	43-41.60	121-17.15	GEO-N-5	1731	650.0	1.57		125.9		198	BASALT TO
8DAA			8/17/90		965.0	0.08		0.4			RHYOLITE
22S/12E	43-38.25	121-14.45	GEO-N-1	1754	1146.0	1.80		83.7	83.7	151	BASALT AND
25BD			9/25/86		1226.0			44.0			RHY TUFF

TWN/RNG SECTION	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE) (DATE)	COLLAR ELEV m	DEPTH RANGE m	AVG TCU <SE> W/m/K	NO TCU	UN GRAD <SE> Deg C/km	CO GRAD <SE> Deg C/km	CO H.F. <SE> mW/m2	LITHOLOGY SUMMARY
21S/13E	43-42.50	121-13.50	USGS-NB2	1943	660.0	(1.46)		1092.0	1092.0	1594	TUFF, SED,
31CC			7/17/81		930.0						BASALT
					675.0			764.9			
					930.7			10.5			
					2.0			174.3			
					930.7			3.8			
					OTHER CASCADE WELLS						
3N/ 8E			GRLTRES1	24	100.0	(1.80)		25.4	22.0	45	BASALT
31CC			3/30/92		740.0			0.1			
3N/ 8E			GRLTRES2	24							BASALT
31CC			1/29/92								
13S/ 7E	44-25.50	121-50.45	SP77-24	1447	718.0	1.66	28	57.6		96	BASALTIC
24DDB			9/ 3/91		928.0	0.07		6.7			ANDESITE
19S/45E	43-55.68	117-12.00	VALE4710		213.4			123.6			
10C			9/10/81		792.5			0.9			
					823.0			51.2			
					1158.2			1.4			
31S/ 7E	42-53.85	121-59.25	MZ1-11A	1859	61.0			45.8			
10CD			9/23/89		701.0			3.7			
32S/ 6E	42-47.83	121- 3.96	MZ11-1	1421	91.4			31.0			
13D			9/24/89		883.9			4.2			
42N/ 1W	49-29.75	121-54.40	ML88-12	1694	266.1	1.92	16	114.6	220		ANDESIT &
12DD			9/ 6/84		1194.2	0.02		2.0			BASALT
					1022.6	2.04	6	84.6	173		
					1194.2	0.04		5.6			

Table 2

	Collar Elev	Gradient	Heat Flow	RC Depth 1	RC Depth 2	depth del	Temp @ RC
	m	Deg C/km	mW/m^2	m	m	m	Deg C
GEO-N-1	1,729	95	131	550	937	387	5
GEO-N-2	1,832	132	205	100	357	257	7
GEO-N-3	1,786	53	96	500	627	127	7
GEO-N-4	1,907	118	97	270			6
GEO-N-5	1,731	130	204	350	545	195	6
USGS-NB1	1,914	51	107	150?			6
CE-NB3*	1,993	98			372		9
CE-NB4*	1,756	115			657		9
SFNC-01	1,832	138	221	50	210	160	13
SFNC-72-03	1,986	139	225	450	478	28	22

* = elev approx.

Table 2. Comparison of the "rain curtain " depth from Davis et al. (1990) in column 6 to that inferred in this study (column 5). Column 7 is the difference between columns 5 and 6. Column 8 is the temperature at the base of the "rain curtain".

Table 3

	'400 Deg F #1	'400 Deg F #2	Con Surf Layer	'50 Deg C	'40 Deg C
	m	m	m	m	m
GEO-N-1	2,646	3,033	750	1,023	918
GEO-N-2	1,592	1,849	495	424	348
GEO-N-3	4,226	4,353	1,050	1,316	1,128
GEO-N-4	1,948		625	641	557
GEO-N-5	1,873	2,068	560	687	610
USGS-NB1	3,894		660	870	674
CE-NB3	2,364	2,364	600	791	689
CE-NB4	2,355	2,355	925	1,014	927
SFNC-01	1,437	1,597	480	319	247
SFNC-72-03	1,759	1,787	505	650	578

(all values are depths below surface)
(400 °F = 204 °C)

Table 3. Comparison of the depths to the 204 °C isotherm from Davis et al. (1990) in column 3 and those from this study (column 2). The depths to the 40 °C and 50 °C isotherms used in Figures 9 and 10 are shown in the final two columns.

Table 4. Core laboratory measurements of electrical resistivity of core samples from Santiam Pass 77-24 and GeoNewberry N-1.

Hole	Depth meters	Resistivity ohm-meters
SP	554	824
"	655	1550
"	771	1610
"	797	383
"	888	263
N-1	686	488
"	842	1600
"	1112	494
"	1144	320
"	1192	241

Appendex A. Thermal conductivity data

Table A1. Geo-Newberry divided bar measurements.

Depth feet	Porosity %		Dry Density gm/cc	Thermal Conductivity W/m °K
1801	39.6	N1	1.28	0.92
458	2.65	N2	2.77	1.82
542	4.25		2.46	1.98
1556	4.52		2.54	1.50
1907	5.39		2.37	1.84
1994	35.60		1.67	1.22
2600	9.10		2.39	1.31
2999	6.82		2.37	1.47
3400	5.16		2.50	1.79
3500	2.39		2.53	1.53
3700	4.67		2.44	1.59
3900	12.11		2.36	1.71
4150	1.80		2.59	1.86
1401	14.5	N4	2.43	1.88
1800	1.2		2.86	2.19
1978	1.8		2.83	2.09
2097	1.4		2.81	2.19
2301	2.0		2.76	2.02
1900	0.4	N5	2.81	1.98
2044	5.8		2.17	2.44
2098	5.5		2.31	2.13
2135	3.4		2.39	2.21
2248	4.2		2.16	1.78
2305	7.1		2.50	1.73
2350	22.3		1.80	1.39
2548	16.9		1.89	1.23
2650	27.0		1.69	1.32
2673	14.6		1.87	1.07
2750	1.7		2.21	1.39
2850	28.4		1.63	1.11
3147	10.2		2.28	2.09

Table A2. Oxy-Newberry divided bar measurements.

Depth feet	Porosity %	Dry Density gm/cc	Thermal Conductivity W/m °K
		NC-1	
1498	2.06	2.67	1.74
1600	31.72	1.59	1.27
2300	2.97	2.53	1.77
2534	2.75	2.62	1.73
2600	3.10	2.58	1.51
2801	30.04	1.76	1.18
2905	5.79	2.48	1.51
3003	7.05	2.38	1.37
3096	16.47	2.24	1.68
3200	4.67	2.57	1.57
3402	9.77	2.42	1.65
3500	1.37	2.68	1.73
3600	17.65	2.21	1.76
3700	18.65	2.17	1.68
3801	0.59	2.75	1.82
3903	10.75	2.41	1.81
3950	14.11	2.36	1.92
		72-03	
1597	17.60	2.04	1.59
1794	30.70	1.69	0.98
2102	3.20	2.56	1.95
2293	5.10	2.48	1.60
2492	1.80	2.75	1.71
2600	2.30	2.71	1.71
3300	14.90	2.22	1.51
3398	13.20	2.30	1.52
3502	2.50	2.76	1.71
3596	7.10	2.46	1.48
3702	10.80	2.39	1.63
3807	4.00	2.56	1.51
3905	10.80	2.40	1.50
4005	11.50	2.40	1.74
4100	1.50	2.75	1.73
4187	15.80	2.19	2.06
4300	7.90	2.53	2.06
4398	1.20	2.74	1.72
4487	1.80	2.66	1.83

Table A3. Crater Lake MCZ divided bar measurements.

Depth feet	Porosity %	Dry Density gm/cc	Thermal Conductivity W/m °K
	I-IIA		
575	1.45	2.40	1.82
609	10.66	1.99	1.20
800	1.24	2.48	1.96
900	12.87	2.13	1.55
986	16.55	1.93	1.53
1200	14.52	2.13	1.72
1547	5.90	2.32	1.85
1897	15.46	2.18	1.78
2280	15.28	2.21	1.81
2596	10.22	2.40	1.81
3282	14.48	2.29	1.87
3989	10.65	2.36	1.71
	II-I		
489	19.6	1.87	1.31
820	12.1	2.26	1.55
921	0.8	2.67	2.11
1260	1.9	2.71	2.13
1369	5.2	2.63	2.17
1476	4.3	2.65	2.12
1583	3.4	2.66	2.21
1699	3.6	2.68	2.29
1809	3.9	2.67	2.27
1919	3.0	2.73	2.40
2016	2.5	2.75	2.33
2134	2.2	2.75	2.42
2244	1.7	2.77	2.33
2360	1.6	2.77	2.39
2469	3.2	2.67	2.17
2579	3.0	2.70	2.38

Table A4. California, Medicine Lake 88-12 divided bar measurements.

Depth feet	Porosity %	Dry Density gm/cc	Thermal Conductivity W/m °K
2278	0.5	2.62	1.85
2294	0.8	2.52	1.75
2314	1.2	2.51	1.72
2937	3.5	2.51	1.93
2950	4.8	2.45	2.07
2964	2.4	2.53	1.89
2990	8.9	2.39	1.69
3107	10.5	2.38	2.08
3125	12.5	2.30	1.72
3140	9.3	2.38	2.03
3637	6.4	2.52	2.20
3646	5.6	2.53	2.13
3661	8.4	2.46	2.11
3867.5	16.3	2.25	2.02
3836.5	15.7	2.27	2.02
3854	19.8	2.16	1.79

Appendex B. Temperature data

LOCATION: VALE FEDERAL WELL 47-10
T/R-S: 19S/453-10C
HOLE NAME: VALE4710
DATE MEASURED: 9/10/81

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
0.0	0.0	25.667	78.20	0.0	0.0
30.5	100.0	24.944	76.90	-23.7	-1.3
61.0	200.0	24.778	76.60	-5.5	-0.3
91.4	300.0	25.389	77.70	20.0	1.1
121.9	400.0	27.333	81.20	63.8	3.5
152.4	500.0	30.889	87.60	116.7	6.4
182.9	600.0	42.667	108.80	386.4	21.2
213.4	700.0	46.389	115.50	122.1	6.7
243.8	800.0	51.111	124.00	154.9	8.5
274.3	900.0	54.333	129.80	105.7	5.8
304.8	1000.0	57.222	135.00	94.8	5.2
335.3	1100.0	61.944	143.50	154.9	8.5
365.8	1200.0	66.111	151.00	136.7	7.5
396.2	1300.0	70.000	158.00	127.6	7.0
426.7	1400.0	74.056	165.30	133.1	7.3
457.2	1500.0	77.611	171.70	116.7	6.4
487.7	1600.0	81.444	178.60	125.8	6.9
518.2	1700.0	85.667	186.20	138.5	7.6
548.6	1800.0	89.111	192.40	113.0	6.2
579.1	1900.0	92.944	199.30	125.8	6.9
609.6	2000.0	96.889	206.40	129.4	7.1
640.1	2100.0	100.889	213.60	131.2	7.2
670.6	2200.0	103.556	218.40	87.5	4.8
701.0	2300.0	107.333	225.20	123.9	6.8
731.5	2400.0	110.722	231.30	111.2	6.1
762.0	2500.0	114.222	237.60	114.8	6.3
792.5	2600.0	117.278	243.10	100.2	5.5
823.0	2700.0	119.056	246.30	58.3	3.2
853.4	2800.0	120.833	249.50	58.3	3.2
883.9	2900.0	122.944	253.30	69.3	3.8
914.4	3000.0	124.500	256.10	51.0	2.8
944.9	3100.0	126.056	258.90	51.0	2.8
975.4	3200.0	126.056	258.90	0.0	0.0
1005.8	3300.0	128.333	263.00	74.7	4.1
1036.3	3400.0	130.500	266.90	71.1	3.9
1066.8	3500.0	132.278	270.10	58.3	3.2
1097.3	3600.0	133.722	272.70	47.4	2.6
1127.8	3700.0	135.000	275.00	41.9	2.3
1158.2	3800.0	136.222	277.20	40.1	2.2

LOCATION: CRESCENT ORE
T/R-S. 21S/12E-28DD
HOLE NAME: [illegible]
DATE MEASURED: 01/10/85

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	TEMPERATURE DEG F	GEOTHERMAL GRADIENT DEG C/KM	GEOTHERMAL GRADIENT DEG F/100 FT	DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	TEMPERATURE DEG F	GEOTHERMAL GRADIENT DEG C/KM	GEOTHERMAL GRADIENT DEG F/100 FT
152.4	500.0	14.167	57.50	0.0	0.0	554.7	1820.0	79.000	174.20	199.9	11.0
171.3	562.0	14.111	57.40	-2.9	-0.2	563.6	1849.0	80.778	177.40	201.1	11.0
190.5	625.0	14.111	57.40	0.0	0.0	573.6	1882.0	82.389	180.30	160.2	8.8
205.4	674.0	14.056	57.30	-3.7	-0.2	581.3	1907.0	83.889	183.00	195.9	10.9
212.8	698.0	16.056	60.90	273.4	15.0	589.8	1935.0	85.333	185.60	169.2	9.3
219.2	719.0	17.667	63.80	251.7	13.8	597.7	1961.0	87.111	188.80	224.2	12.3
225.5	740.0	19.389	66.90	259.1	14.8	608.4	1996.0	88.444	191.20	125.0	6.9
233.5	766.0	21.444	70.60	259.4	14.2	617.8	2027.0	89.778	192.60	141.1	7.7
242.3	795.0	23.833	74.90	270.3	14.8	626.7	2056.0	90.556	195.00	88.0	4.8
251.8	826.0	26.167	79.10	246.9	13.6	635.5	2085.0	91.778	197.20	138.3	7.6
260.9	856.0	28.778	83.80	285.6	15.7	644.0	2113.0	92.889	199.20	130.2	7.1
270.7	888.0	31.722	89.10	301.9	16.6	651.4	2137.0	93.111	199.60	30.4	1.7
279.2	916.0	34.111	93.40	279.9	15.4	658.4	2160.0	93.667	200.60	79.2	4.3
288.0	945.0	36.389	97.50	257.7	14.1	666.3	2186.0	94.556	202.20	112.2	6.2
295.4	969.0	38.222	100.80	250.6	13.8	673.6	2210.0	95.333	203.60	106.3	5.8
303.9	997.0	40.333	104.60	247.4	13.6	679.7	2230.0	96.278	205.30	154.9	8.5
312.1	1024.0	41.889	107.40	189.0	10.4	689.2	2261.0	97.500	207.50	129.4	7.1
319.7	1049.0	43.556	110.40	218.7	12.0	696.8	2286.0	98.389	209.10	116.7	6.4
328.0	1076.0	45.278	113.50	209.3	11.5	704.7	2312.0	99.056	210.30	84.1	4.6
336.8	1105.0	47.000	116.60	194.8	10.7	712.3	2337.0	99.889	211.80	109.4	6.0
346.5	1137.0	49.000	120.20	205.1	11.3	724.8	2378.0	100.833	213.50	75.6	4.1
360.6	1183.0	52.722	126.90	265.5	14.6	732.4	2403.0	102.056	215.70	160.4	8.8
370.3	1215.0	54.833	130.70	216.4	11.9	741.3	2432.0	103.889	219.00	207.4	11.4
382.2	1254.0	56.722	134.10	158.9	8.7	749.9	2460.0	105.000	221.00	130.2	7.1
390.8	1282.0	57.889	136.20	135.7	7.5	758.0	2487.0	106.222	223.20	148.5	8.2
402.0	1319.0	59.500	139.10	142.9	7.8	766.6	2515.0	107.389	225.30	135.7	7.5
410.9	1348.0	61.500	142.70	225.3	12.4	774.5	2541.0	108.167	226.70	98.1	5.4
417.9	1371.0	62.889	145.20	198.1	10.9	782.7	2568.0	109.333	228.80	141.8	7.8
427.0	1401.0	63.944	147.10	115.4	6.3	791.6	2597.0	110.833	231.50	169.7	9.3
436.8	1433.0	64.889	148.80	96.8	5.3	799.2	2622.0	111.889	233.40	138.5	7.6
447.4	1468.0	66.111	151.00	114.5	6.3	807.4	2649.0	113.056	235.50	141.9	7.8
458.1	1503.0	66.833	152.30	67.7	3.7	813.5	2669.0	114.056	237.30	164.0	9.0
468.5	1537.0	67.722	153.90	85.8	4.7	821.1	2694.0	115.333	239.60	167.7	9.2
478.8	1571.0	68.667	155.60	91.1	5.0	830.3	2724.0	116.222	241.20	97.2	5.3
489.8	1607.0	70.000	158.00	121.5	6.7	838.2	2750.0	117.500	243.50	161.2	8.8
499.9	1640.0	71.556	160.80	154.7	8.5	846.7	2778.0	118.611	245.50	130.2	7.1
511.1	1677.0	72.667	162.80	99.5	5.4	855.9	2808.0	120.056	248.10	158.0	8.7
520.3	1707.0	73.889	165.00	132.7	7.3	863.5	2833.0	121.333	250.40	167.7	9.2
527.9	1732.0	74.611	166.30	94.8	5.2	872.3	2862.0	122.444	252.40	125.7	6.9
536.8	1761.0	75.611	168.10	113.1	6.2	881.5	2892.0	123.556	254.40	121.5	6.7
545.3	1789.0	77.111	170.90	175.8	9.5	890.9	2923.0	125.111	257.20	164.6	9.0

LOCATION: CRESCENT, ORE

T/R-S. 21S/12E-28BDD

HOLE NAME: SFNC-01

DATE MEASURED: 01/10/85

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT		I	DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT	I	METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
899.9	2949.0	126.500	259.70	175.3	9.6	I	1048.5	3440.0	147.611	297.70	138.3	7.6
908.3	2979.0	127.722	261.90	133.7	7.3	I	1056.1	3465.0	148.889	300.00	157.7	9.2
917.1	3009.0	129.056	264.30	145.8	8.0	I	1063.4	3489.0	149.944	301.90	144.3	7.9
924.5	3033.0	130.000	266.00	129.1	7.1	I	1072.9	3520.0	151.444	304.50	158.8	8.7
933.6	3063.0	131.222	268.20	133.7	7.3	I	1082.6	3552.0	152.778	307.00	136.7	7.5
942.1	3091.0	132.611	270.70	152.7	8.9	I	1090.9	3579.0	153.889	309.00	135.0	7.4
949.1	3114.0	133.500	272.30	126.8	7.0	I	1100.0	3609.0	155.000	311.00	121.5	6.7
955.5	3135.0	134.278	273.70	121.5	6.7	I	1110.7	3644.0	156.567	314.00	156.2	8.6
963.2	3160.0	135.056	275.10	102.1	5.6	I	1118.3	3669.0	157.567	315.80	131.2	7.2
969.9	3182.0	135.833	276.50	116.0	6.4	I	1129.6	3706.0	159.000	318.20	118.2	6.5
976.3	3203.0	136.889	278.40	164.9	9.1	I	1138.7	3736.0	160.111	320.20	121.5	6.7
983.6	3227.0	138.000	280.40	151.9	8.3	I	1147.6	3765.0	161.444	322.60	150.8	8.3
989.7	3247.0	139.000	282.20	164.0	9.0	I	1157.3	3797.0	162.889	325.20	148.1	8.1
997.0	3271.0	140.000	284.00	136.7	7.5	I	1165.2	3826.0	163.833	326.90	105.8	5.9
1003.7	3293.0	140.944	285.70	140.8	7.7	I	1176.2	3859.0	165.500	329.90	165.7	9.1
1010.1	3314.0	142.056	287.70	173.6	9.5	I	1184.8	3887.0	166.833	332.30	156.2	8.6
1016.2	3334.0	143.167	289.70	182.3	10.0	I	1192.1	3911.0	167.833	334.10	136.7	7.5
1022.3	3354.0	144.444	292.00	209.6	11.5	I	1202.1	3944.0	169.000	336.20	115.0	6.4
1031.4	3384.0	145.333	293.60	97.2	5.3	I	1207.0	3960.0	170.111	338.20	227.8	12.5
1039.7	3411.0	146.389	295.50	128.3	7.0							

LOCATION: NEWBERRY
T/R-S:. 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	DEG F	GEOTHERMAL GRADIENT DEG C/KM	DEG F/100 FT
5.0	16.4	9.102	48.38	0.0	0.0
10.0	32.8	8.156	46.68	-189.2	-10.4
15.0	49.2	7.521	45.54	-127.0	-7.0
20.0	65.6	7.034	44.66	-97.4	-5.3
25.0	82.0	6.681	44.03	-70.6	-3.9
30.0	98.4	6.424	43.56	-51.4	-2.8
35.0	114.8	6.247	43.24	-35.4	-1.9
40.0	131.2	6.069	42.92	-35.6	-2.0
45.0	147.6	5.871	42.57	-39.6	-2.2
50.0	164.0	5.701	42.26	-34.0	-1.9
55.0	180.4	5.585	42.05	-23.2	-1.3
60.0	196.9	5.507	41.91	-15.6	-0.9
65.0	213.3	5.460	41.83	-9.4	-0.5
70.0	229.7	5.441	41.79	-3.8	-0.2
75.0	246.1	5.462	41.83	4.2	0.2
80.0	262.5	5.345	41.62	-23.4	-1.3
85.0	278.9	5.554	42.00	41.8	2.3
90.0	295.3	5.839	42.51	57.0	3.1
95.0	311.7	6.333	43.40	98.8	5.4
100.0	328.1	6.861	44.35	105.6	5.8
105.0	344.5	7.495	45.49	126.8	7.0
110.0	360.9	7.547	45.58	10.4	0.6
115.0	377.3	7.680	45.82	26.6	1.5
120.0	393.7	7.926	46.27	49.2	2.7
125.0	410.1	8.338	47.01	82.4	4.5
130.0	426.5	8.750	47.75	82.4	4.5
135.0	442.9	9.249	48.65	99.8	5.5
140.0	459.3	9.625	49.33	75.2	4.1
145.0	475.7	10.156	50.28	106.2	5.8
150.0	492.1	10.825	51.49	133.8	7.3
155.0	508.5	11.383	52.49	111.6	6.1
160.0	524.9	11.823	53.28	88.0	4.8
165.0	541.3	12.375	54.27	110.4	6.1
170.0	557.7	12.989	55.38	122.8	6.7
175.0	574.1	13.531	56.36	108.4	5.9
180.0	590.6	14.183	57.53	130.4	7.2
185.0	607.0	14.888	58.80	141.0	7.7
190.0	623.4	15.235	59.42	69.4	3.8
195.0	639.8	15.388	59.70	30.6	1.7
200.0	656.2	15.533	59.96	29.0	1.6
205.0	672.6	15.683	60.23	30.0	1.6

LOCATION:NEWBERRY
T/R-S: 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
210.0	689.0	15.746	60.34	12.6	0.7
215.0	705.4	15.794	60.43	9.6	0.5
220.0	721.8	15.849	60.53	11.0	0.6
225.0	738.2	15.897	60.61	9.6	0.5
230.0	754.6	16.001	60.80	20.8	1.1
235.0	771.0	16.065	60.92	12.8	0.7
240.0	787.4	16.168	61.10	20.6	1.1
245.0	803.8	16.242	61.24	14.8	0.8
250.0	820.2	16.309	61.36	13.4	0.7
255.0	836.6	16.410	61.54	20.2	1.1
260.0	853.0	16.475	61.65	13.0	0.7
265.0	869.4	16.550	61.79	15.0	0.8
270.0	885.8	16.627	61.93	15.4	0.8
275.0	902.2	16.681	62.03	10.8	0.6
280.0	918.6	16.725	62.10	8.8	0.5
285.0	935.0	16.838	62.31	22.6	1.2
290.0	951.4	17.023	62.64	37.0	2.0
295.0	967.8	17.231	63.02	41.6	2.3
300.0	984.3	17.484	63.47	50.6	2.8
305.0	1000.7	17.762	63.97	55.6	3.1
310.0	1017.1	18.239	64.83	95.4	5.2
315.0	1033.5	18.910	66.04	134.2	7.4
320.0	1049.9	19.539	67.17	125.8	6.9
325.0	1066.3	20.716	69.29	235.4	12.9
330.0	1082.7	21.548	70.79	166.4	9.1
335.0	1099.1	22.750	72.95	240.4	13.2
340.0	1115.5	24.060	75.31	262.0	14.4
345.0	1131.9	25.727	78.31	333.4	18.3
350.0	1148.3	27.157	80.88	286.0	15.7
355.0	1164.7	28.592	83.47	287.0	15.8
360.0	1181.1	30.184	86.33	318.4	17.5
365.0	1197.5	31.725	89.10	308.2	16.9
370.0	1213.9	33.059	91.51	266.8	14.6
375.0	1230.3	34.213	93.58	230.8	12.7
380.0	1246.7	35.641	96.15	285.6	15.7
385.0	1263.1	36.843	98.32	240.4	13.2
390.0	1279.5	37.988	100.38	229.0	12.6
395.0	1295.9	39.415	102.95	285.4	15.7
400.0	1312.3	40.654	105.18	247.8	13.6
405.0	1328.7	41.857	107.34	240.6	13.2
410.0	1345.1	43.221	109.80	272.8	15.0

LOCATION: NEWBERRY
T/R-S: 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	TEMPERATURE DEG F	GEOTHERMAL GRADIENT DEG C/KM	GEOTHERMAL GRADIENT DEG F/100 FT
415.0	1361.5	44.337	111.81	223.2	12.2
420.0	1378.0	45.460	113.83	224.6	12.3
425.0	1394.4	46.801	116.24	268.2	14.7
430.0	1410.8	48.086	118.55	257.0	14.1
435.0	1427.2	48.967	120.14	176.2	9.7
440.0	1443.6	49.822	121.68	171.0	9.4
445.0	1460.0	50.430	122.77	121.6	6.7
450.0	1476.4	51.022	123.84	118.4	6.5
455.0	1492.8	51.628	124.93	121.2	6.7
460.0	1509.2	52.098	125.78	94.0	5.2
465.0	1525.6	52.624	126.72	105.2	5.8
470.0	1542.0	53.159	127.69	107.0	5.9
475.0	1558.4	53.692	128.65	106.6	5.9
480.0	1574.8	54.213	129.58	104.2	5.7
485.0	1591.2	54.726	130.51	102.6	5.6
490.0	1607.6	55.269	131.48	108.6	6.0
495.0	1624.0	56.000	132.80	146.2	8.0
500.0	1640.4	56.792	134.23	158.4	8.7
505.0	1656.8	57.567	135.62	155.0	8.5
510.0	1673.2	58.434	137.18	173.4	9.5
515.0	1689.6	59.310	138.76	175.2	9.6
520.0	1706.0	60.080	140.14	154.0	8.5
525.0	1722.4	60.790	141.42	142.0	7.8
530.0	1738.8	61.505	142.71	143.0	7.8
535.0	1755.2	62.216	143.99	142.2	7.8
540.0	1771.7	62.986	145.37	154.0	8.5
545.0	1788.1	63.660	146.59	134.8	7.4
550.0	1804.5	64.201	147.56	108.2	5.9
555.0	1820.9	64.829	148.69	125.6	6.9
560.0	1837.3	65.356	149.64	105.4	5.8
565.0	1853.7	65.908	150.63	110.4	6.1
570.0	1870.1	66.460	151.63	110.4	6.1
575.0	1886.5	67.016	152.63	111.2	6.1
580.0	1902.9	67.596	153.67	116.0	6.4
585.0	1919.3	68.135	154.64	107.8	5.9
590.0	1935.7	68.716	155.69	116.2	6.4
595.0	1952.1	69.381	156.89	133.0	7.3
600.0	1968.5	70.043	158.08	132.4	7.3
605.0	1984.9	70.752	159.35	141.8	7.8
610.0	2001.3	71.382	160.49	126.0	6.9
615.0	2017.7	72.010	161.62	125.6	6.9

LOCATION: NEWBERRY
T/R-S: 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
620.0	2034.1	72.652	162.77	128.4	7.0
625.0	2050.5	73.254	163.86	120.4	6.6
630.0	2066.9	73.933	165.08	135.8	7.5
635.0	2083.3	74.519	166.13	117.2	6.4
640.0	2099.7	75.168	167.30	129.8	7.1
645.0	2116.1	75.793	168.43	125.0	6.9
650.0	2132.5	76.465	169.64	134.4	7.4
655.0	2149.0	77.138	170.85	134.6	7.4
660.0	2165.4	77.764	171.98	125.2	6.9
665.0	2181.8	78.353	173.04	117.8	6.5
670.0	2198.2	78.982	174.17	125.8	6.9
675.0	2214.6	79.594	175.27	122.4	6.7
680.0	2231.0	80.218	176.39	124.8	6.8
685.0	2247.4	80.820	177.48	120.4	6.6
690.0	2263.8	81.429	178.57	121.8	6.7
695.0	2280.2	82.133	179.84	140.8	7.7
700.0	2296.6	82.758	180.96	125.0	6.9
705.0	2313.0	83.458	182.22	140.0	7.7
710.0	2329.4	84.218	183.59	152.0	8.3
715.0	2345.8	84.902	184.82	136.8	7.5
720.0	2362.2	85.619	186.11	143.4	7.9
725.0	2378.6	86.299	187.34	136.0	7.5
730.0	2395.0	86.978	188.56	135.8	7.5
735.0	2411.4	87.668	189.80	138.0	7.6
740.0	2427.8	88.330	190.99	132.4	7.3
745.0	2444.2	88.954	192.12	124.8	6.8
750.0	2460.6	89.619	193.31	133.0	7.3
755.0	2477.0	90.236	194.42	123.4	6.8
760.0	2493.4	90.796	195.43	112.0	6.1
765.0	2509.8	91.492	196.69	139.2	7.6
770.0	2526.2	92.137	197.85	129.0	7.1
775.0	2542.7	92.829	199.09	138.4	7.6
780.0	2559.1	93.492	200.29	132.6	7.3
785.0	2575.5	94.190	201.54	139.6	7.7
790.0	2591.9	94.875	202.77	137.0	7.5
795.0	2608.3	95.562	204.01	137.4	7.5
800.0	2624.7	96.262	205.27	140.0	7.7
805.0	2641.1	96.898	206.42	127.2	7.0
810.0	2657.5	97.619	207.71	144.2	7.9
815.0	2673.9	98.411	209.14	158.4	8.7
820.0	2690.3	99.154	210.48	148.6	8.2

LOCATION: NEWBERRY
T/R-S: 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	DEG F	GEOTHERMAL GRADIENT DEG C/KM	DEG F/100 FT
825.0	2706.7	99.818	211.67	132.8	7.3
830.0	2723.1	100.514	212.93	139.2	7.6
835.0	2739.5	101.261	214.27	149.4	8.2
840.0	2755.9	101.830	215.29	113.8	6.2
845.0	2772.3	102.534	216.56	140.8	7.7
850.0	2788.7	103.183	217.73	129.8	7.1
855.0	2805.1	103.859	218.95	135.2	7.4
860.0	2821.5	104.528	220.15	133.8	7.3
865.0	2837.9	105.178	221.32	130.0	7.1
870.0	2854.3	105.890	222.60	142.4	7.8
875.0	2870.7	106.543	223.78	130.6	7.2
880.0	2887.1	107.195	224.95	130.4	7.2
885.0	2903.5	107.869	226.16	134.8	7.4
890.0	2919.9	108.524	227.34	131.0	7.2
895.0	2936.4	109.168	228.50	128.8	7.1
900.0	2952.8	109.773	229.59	121.0	6.6
905.0	2969.2	110.396	230.71	124.6	6.8
910.0	2985.6	111.055	231.90	131.8	7.2
915.0	3002.0	111.701	233.06	129.2	7.1
920.0	3018.4	112.364	234.26	132.6	7.3
925.0	3034.8	113.006	235.41	128.4	7.0
930.0	3051.2	113.640	236.55	126.8	7.0
935.0	3067.6	114.295	237.73	131.0	7.2
940.0	3084.0	114.942	238.90	129.4	7.1
945.0	3100.4	115.596	240.07	130.8	7.2
950.0	3116.8	116.263	241.27	133.4	7.3
955.0	3133.2	116.958	242.52	139.0	7.6
960.0	3149.6	117.617	243.71	131.8	7.2
965.0	3166.0	118.241	244.83	124.8	6.8
970.0	3182.4	118.822	245.88	116.2	6.4
975.0	3198.8	119.523	247.14	140.2	7.7
980.0	3215.2	120.168	248.30	129.0	7.1
985.0	3231.6	120.863	249.55	139.0	7.6
990.0	3248.0	121.460	250.63	119.4	6.6
995.0	3264.4	122.122	251.82	132.4	7.3
1000.0	3280.8	122.774	252.99	130.4	7.2
1005.0	3297.2	123.523	254.34	149.8	8.2
1010.0	3313.6	124.165	255.50	128.4	7.0
1015.0	3330.1	124.803	256.65	127.6	7.0
1020.0	3346.5	125.467	257.84	132.8	7.3
1025.0	3362.9	126.047	258.88	116.0	6.4

LOCATION: NEWBERRY
T/R-S: 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
1030.0	3379.3	126.551	259.79	100.8	5.5
1035.0	3395.7	127.085	260.75	106.8	5.9
1040.0	3412.1	127.688	261.84	120.6	6.6
1045.0	3428.5	128.349	263.03	132.2	7.3
1050.0	3444.9	129.021	264.24	134.4	7.4
1055.0	3461.3	129.633	265.34	122.4	6.7
1060.0	3477.7	130.327	266.59	138.8	7.6
1065.0	3494.1	130.838	267.51	102.2	5.6
1070.0	3510.5	131.577	268.84	147.8	8.1
1075.0	3526.9	132.107	269.79	106.0	5.8
1080.0	3543.3	132.788	271.02	136.2	7.5
1085.0	3559.7	133.409	272.14	124.2	6.8
1090.0	3576.1	134.034	273.26	125.0	6.9
1095.0	3592.5	134.722	274.50	137.6	7.6
1100.0	3608.9	135.210	275.38	97.6	5.4
1105.0	3625.3	135.892	276.61	136.4	7.5
1110.0	3641.7	136.433	277.58	108.2	5.9
1115.0	3658.1	137.045	278.68	122.4	6.7
1120.0	3674.5	137.714	279.89	133.8	7.3
1125.0	3690.9	138.330	280.99	123.2	6.8
1130.0	3707.3	138.808	281.85	95.6	5.2
1135.0	3723.8	139.510	283.12	140.4	7.7
1140.0	3740.2	140.035	284.06	105.0	5.8
1145.0	3756.6	140.755	285.36	144.0	7.9
1150.0	3773.0	141.194	286.15	87.8	4.8
1155.0	3789.4	141.835	287.30	128.2	7.0
1160.0	3805.8	142.454	288.42	123.8	6.8
1165.0	3822.2	143.097	289.57	128.6	7.1
1170.0	3838.6	143.717	290.69	124.0	6.8
1175.0	3855.0	144.335	291.80	123.6	6.8
1180.0	3871.4	144.987	292.98	130.4	7.2
1185.0	3887.8	145.629	294.13	128.4	7.0
1190.0	3904.2	146.276	295.30	129.4	7.1
1195.0	3920.6	146.896	296.41	124.0	6.8
1200.0	3937.0	147.543	297.58	129.4	7.1
1205.0	3953.4	148.190	298.74	129.4	7.1
1210.0	3969.8	148.815	299.87	125.0	6.9
1215.0	3986.2	149.449	301.01	126.8	7.0
1220.0	4002.6	150.079	302.14	126.0	6.9
1225.0	4019.0	150.695	303.25	123.2	6.8

LOCATION: NEWBERRY
T/R-S: 21S/12E-29ADC
HOLE NAME: GEO N-2
DATE MEASURED: 8/90

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	TEMPERATURE DEG F	GEOTHERMAL GRADIENT DEG C/KM	GEOTHERMAL GRADIENT DEG F/100 FT
1235.0	4051.8	151.980	305.56	127.8	7.0
1240.0	4068.2	152.627	306.73	129.4	7.1
1245.0	4084.6	153.284	307.91	131.4	7.2
1250.0	4101.0	153.917	309.05	126.6	6.9
1255.0	4117.5	154.580	310.24	132.6	7.3
1260.0	4133.9	155.228	311.41	129.6	7.1
1265.0	4150.3	155.869	312.56	128.2	7.0
1270.0	4166.7	156.514	313.73	129.0	7.1
1275.0	4183.1	157.139	314.85	125.0	6.9
1280.0	4199.5	157.756	315.96	123.4	6.8
1285.0	4215.9	158.340	317.01	116.8	6.4
1290.0	4232.3	158.928	318.07	117.6	6.5
1295.0	4248.7	159.536	319.16	121.6	6.7
1300.0	4265.1	160.115	320.21	115.8	6.4
1305.0	4281.5	160.715	321.29	120.0	6.6
1310.0	4297.9	161.311	322.36	119.2	6.5
1315.0	4314.3	161.956	323.52	129.0	7.1
1320.0	4330.7	162.561	324.61	121.0	6.6
1325.0	4347.1	163.168	325.70	121.4	6.7
1330.0	4363.5	163.789	326.82	124.2	6.8
1335.0	4379.9	164.388	327.90	119.8	6.6

LOCATION: NEWBERRY
T/R-S: 21S/13E-35DBD
HOLE NAME: GEO N-4
DATE MEASURED: 9/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
20.0	65.6	8.774	47.79	0.0	0.0
25.0	82.0	8.174	46.71	-120.0	-6.6
30.0	98.4	7.682	45.83	-98.4	-5.4
35.0	114.8	7.249	45.05	-86.6	-4.8
40.0	131.2	6.876	44.38	-74.6	-4.1
45.0	147.6	6.537	43.77	-67.8	-3.7
50.0	164.0	6.239	43.23	-59.6	-3.3
55.0	180.4	5.994	42.79	-49.0	-2.7
60.0	196.9	5.772	42.39	-44.4	-2.4
65.0	213.3	5.544	41.98	-45.6	-2.5
70.0	229.7	5.360	41.65	-36.8	-2.0
75.0	246.1	5.227	41.41	-26.6	-1.5
80.0	262.5	5.130	41.23	-19.4	-1.1
85.0	278.9	5.052	41.09	-15.6	-0.9
90.0	295.3	4.984	40.97	-13.6	-0.7
95.0	311.7	4.890	40.80	-18.8	-1.0
100.0	328.1	4.808	40.65	-16.4	-0.9
105.0	344.5	4.754	40.56	-10.8	-0.6
110.0	360.9	4.712	40.48	-8.4	-0.5
115.0	377.3	4.681	40.43	-6.2	-0.3
120.0	393.7	4.658	40.38	-4.6	-0.3
125.0	410.1	4.257	39.66	-80.2	-4.4
130.0	426.5	4.321	39.78	12.8	0.7
135.0	442.9	4.381	39.89	12.0	0.7
140.0	459.3	4.445	40.00	12.8	0.7
145.0	475.7	4.406	39.93	-7.8	-0.4
150.0	492.1	4.406	39.93	0.0	0.0
155.0	508.5	4.454	40.02	9.6	0.5
160.0	524.9	4.596	40.27	28.4	1.6
165.0	541.3	4.697	40.45	20.2	1.1
170.0	557.7	4.598	40.28	-19.8	-1.1
175.0	574.1	4.574	40.23	-4.8	-0.3
180.0	590.6	4.591	40.26	3.4	0.2
185.0	607.0	4.626	40.33	7.0	0.4
190.0	623.4	4.684	40.43	11.6	0.6
195.0	639.8	4.740	40.53	11.2	0.6
200.0	656.2	4.797	40.63	11.4	0.6
205.0	672.6	4.884	40.79	17.4	1.0
210.0	689.0	4.976	40.96	18.4	1.0
215.0	705.4	5.062	41.11	17.2	0.9
220.0	721.8	5.174	41.31	22.4	1.2

LOCATION: NEWBERRY
T/R-S: 21S/13E-35DBD
HOLE NAME: GEO N-4
DATE MEASURED: 9/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
225.0	738.2	5.317	41.57	28.6	1.6
230.0	754.6	5.446	41.80	25.8	1.4
235.0	771.0	5.521	41.94	15.0	0.8
240.0	787.4	5.571	42.03	10.0	0.5
245.0	803.8	5.619	42.11	9.6	0.5
250.0	820.2	5.661	42.19	8.4	0.5
255.0	836.6	5.655	42.18	-1.2	-0.1
260.0	853.0	5.618	42.11	-7.4	-0.4
265.0	869.4	5.524	41.94	-18.8	-1.0
270.0	885.8	5.406	41.73	-23.6	-1.3
275.0	902.2	5.592	42.07	37.2	2.0
280.0	918.6	5.930	42.67	67.6	3.7
285.0	935.0	6.451	43.61	104.2	5.7
290.0	951.4	6.934	44.48	96.6	5.3
295.0	967.8	7.189	44.94	51.0	2.8
300.0	984.3	7.396	45.31	41.4	2.3
305.0	1000.7	7.604	45.69	41.6	2.3
310.0	1017.1	7.873	46.17	53.8	3.0
315.0	1033.5	8.072	46.53	39.8	2.2
320.0	1049.9	8.292	46.93	44.0	2.4
325.0	1066.3	8.623	47.52	66.2	3.6
330.0	1082.7	8.917	48.05	58.8	3.2
335.0	1099.1	9.215	48.59	59.6	3.3
340.0	1115.5	9.616	49.31	80.2	4.4
345.0	1131.9	10.086	50.15	94.0	5.2
350.0	1148.3	10.497	50.89	82.2	4.5
355.0	1164.7	10.894	51.61	79.4	4.4
360.0	1181.1	11.179	52.12	57.0	3.1
365.0	1197.5	11.436	52.58	51.4	2.8
370.0	1213.9	11.611	52.90	35.0	1.9
375.0	1230.3	11.727	53.11	23.2	1.3
380.0	1246.7	11.818	53.27	18.2	1.0
385.0	1263.1	11.894	53.41	15.2	0.8
390.0	1279.5	11.956	53.52	12.4	0.7
395.0	1295.9	12.007	53.61	10.2	0.6
400.0	1312.3	12.021	53.64	2.8	0.2
405.0	1328.7	12.049	53.69	5.6	0.3
410.0	1345.1	12.102	53.78	10.6	0.6
415.0	1361.5	12.295	54.13	38.6	2.1
420.0	1378.0	12.764	54.98	93.8	5.1
425.0	1394.4	13.127	55.63	72.6	4.0

LOCATION: NEWBERRY
T/R-S: 21S/13E-35DBD
HOLE NAME: GEO N-4
DATE MEASURED: 9/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
430.0	1410.8	13.135	55.64	1.6	0.1
435.0	1427.2	13.259	55.87	24.8	1.4
440.0	1443.6	13.348	56.03	17.8	1.0
445.0	1460.0	13.531	56.36	36.6	2.0
450.0	1476.4	14.071	57.33	108.0	5.9
455.0	1492.8	13.981	57.17	-18.0	-1.0
460.0	1509.2	14.014	57.23	6.6	0.4
465.0	1525.6	13.999	57.20	-3.0	-0.2
470.0	1542.0	14.015	57.23	3.2	0.2
475.0	1558.4	14.033	57.26	3.6	0.2
480.0	1574.8	14.055	57.30	4.4	0.2
485.0	1591.2	14.056	57.30	0.2	0.0
490.0	1607.6	14.058	57.30	0.4	0.0
495.0	1624.0	14.070	57.33	2.4	0.1
500.0	1640.4	14.106	57.39	7.2	0.4
505.0	1656.8	14.081	57.35	-5.0	-0.3
510.0	1673.2	14.224	57.60	28.6	1.6
515.0	1689.6	15.173	59.31	189.8	10.4
520.0	1706.0	16.698	62.06	305.0	16.7
525.0	1722.4	19.541	67.17	568.6	31.2
530.0	1738.8	21.264	70.28	344.6	18.9
535.0	1755.2	22.150	71.87	177.2	9.7
540.0	1771.7	23.074	73.53	184.8	10.1
545.0	1788.1	23.528	74.35	90.8	5.0
550.0	1804.5	23.924	75.06	79.2	4.3
555.0	1820.9	24.307	75.75	76.6	4.2
560.0	1837.3	24.681	76.43	74.8	4.1
565.0	1853.7	25.043	77.08	72.4	4.0
570.0	1870.1	25.451	77.81	81.6	4.5
575.0	1886.5	25.961	78.73	102.0	5.6
580.0	1902.9	26.442	79.60	96.2	5.3
585.0	1919.3	27.045	80.68	120.6	6.6
590.0	1935.7	27.688	81.84	128.6	7.1
595.0	1952.1	28.292	82.93	120.8	6.6
600.0	1968.5	28.858	83.94	113.2	6.2
605.0	1984.9	29.301	84.74	88.6	4.9
610.0	2001.3	29.743	85.54	88.4	4.9
615.0	2017.7	30.147	86.26	80.8	4.4

LOCATION: CRESCENT, ORE
T/R-S: 22S/12E-3ABA
HOLE NAME: SFNC72-3
DATE MEASURED: 01/09/85

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT		I	DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT	I	METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/10C
152.4	500.0	23.611	74.50	0.0	0.0	I	699.2	2294.0	63.333	146.00	119.5	6.6
228.6	750.0	24.278	75.70	8.7	0.5	I	710.5	2331.0	64.556	148.20	108.4	5.9
304.8	1000.0	25.611	78.10	17.5	1.0	I	721.5	2367.0	65.944	150.70	125.6	6.9
311.8	1023.0	25.611	78.10	0.0	0.0	I	732.4	2403.0	67.500	153.50	141.9	7.8
319.1	1047.0	25.611	78.10	0.0	0.0	I	742.8	2437.0	69.389	156.90	182.3	10.0
325.5	1068.0	25.611	78.10	0.0	0.0	I	753.5	2472.0	70.889	159.60	140.6	7.7
331.9	1089.0	26.389	79.50	121.5	6.7	I	766.9	2516.0	72.722	162.90	136.7	7.5
338.6	1111.0	27.222	81.00	124.3	6.8	I	775.4	2544.0	73.833	164.90	130.2	7.1
345.3	1133.0	27.778	82.00	82.8	4.5	I	786.7	2581.0	75.444	167.80	142.9	7.9
353.6	1160.0	28.333	83.00	67.5	3.7	I	795.8	2611.0	76.833	170.30	151.9	8.3
362.1	1188.0	28.556	83.40	26.0	1.4	I	805.6	2643.0	78.278	172.90	148.1	8.1
369.4	1212.0	28.500	83.30	-7.6	-0.4	I	816.9	2680.0	79.833	175.70	137.9	7.6
378.9	1243.0	28.500	83.30	0.0	0.0	I	825.1	2707.0	81.278	178.30	175.5	9.6
389.5	1278.0	28.722	83.70	20.8	1.1	I	834.5	2738.0	82.389	180.30	117.5	6.5
397.8	1305.0	29.167	84.50	54.0	3.0	I	845.8	2775.0	84.167	183.50	157.6	8.7
407.8	1338.0	29.611	85.30	44.2	2.4	I	856.8	2811.0	85.833	186.50	151.9	8.3
418.5	1373.0	29.944	85.90	31.2	1.7	I	866.2	2842.0	87.444	189.40	170.5	9.4
433.4	1422.0	30.222	86.40	18.6	1.0	I	877.2	2878.0	88.944	192.10	136.7	7.5
445.0	1460.0	30.500	86.90	24.0	1.3	I	889.4	2918.0	90.500	194.90	127.6	7.0
456.6	1498.0	31.000	87.80	43.2	2.4	I	899.2	2950.0	91.889	197.40	142.4	7.8
467.6	1534.0	31.722	89.10	65.8	3.6	I	912.0	2992.0	93.389	200.10	117.2	6.4
478.8	1571.0	32.778	91.00	93.6	5.1	I	919.9	3018.0	94.833	202.70	182.3	10.0
488.9	1604.0	33.722	92.70	93.9	5.2	I	928.1	3045.0	96.278	205.30	175.5	9.5
499.6	1639.0	35.333	95.60	151.0	8.3	I	940.0	3084.0	97.778	208.00	126.2	6.9
510.2	1674.0	36.722	98.10	130.2	7.1	I	953.4	3128.0	99.333	210.80	116.0	6.4
522.7	1715.0	38.778	101.80	164.5	9.0	I	964.1	3163.0	101.056	213.90	161.4	8.9
533.1	1749.0	40.722	105.30	187.6	10.3	I	974.1	3196.0	102.389	216.30	132.6	7.3
543.5	1783.0	42.611	108.70	182.3	10.0	I	985.1	3232.0	103.944	219.10	141.8	7.8
554.1	1818.0	44.333	111.80	161.4	8.9	I	997.9	3274.0	105.333	221.60	108.5	6.0
563.9	1850.0	45.556	114.00	125.3	6.9	I	1008.6	3309.0	106.944	224.50	151.0	8.3
575.2	1887.0	47.222	117.00	147.8	8.1	I	1019.9	3346.0	108.500	227.30	137.9	7.6
584.0	1916.0	48.833	119.90	182.3	10.0	I	1029.9	3379.0	109.611	229.30	110.5	6.1
594.7	1951.0	50.389	122.70	145.8	8.0	I	1039.7	3411.0	111.056	231.90	148.1	8.1
606.9	1991.0	51.722	125.10	109.4	6.0	I	1051.3	3449.0	112.444	234.40	119.9	6.6
617.8	2027.0	53.111	127.60	126.6	6.9	I	1059.5	3476.0	113.778	236.80	162.0	8.9
627.0	2057.0	54.222	129.60	121.5	6.7	I	1069.8	3510.0	115.167	239.30	134.0	7.4
648.6	2128.0	57.056	134.70	130.9	7.2	I	1078.1	3537.0	116.556	241.80	168.8	9.3
659.3	2163.0	58.389	137.10	125.0	6.9	I	1087.2	3567.0	117.667	243.80	121.5	6.7
669.0	2195.0	59.778	139.60	142.4	7.8	I	1097.5	3601.0	119.000	246.20	128.7	7.1
679.1	2228.0	61.056	141.90	127.0	7.0	I	1105.5	3627.0	120.556	249.00	196.3	10.8
689.5	2262.0	62.167	143.90	107.2	5.9	I	1113.4	3653.0	121.111	250.00	70.1	3.8

LOCATION: CRESCENT. ORE PAGE 2
T/R-S: 22S/12E-3ABA
HOLE NAME: SFNC72-2
DATE MEASURED: 01/09/85

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT		I	DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT	I	METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100
1122.3	3682.0	122.111	251.80	113.1	6.2	I	1250.9	4104.0	139.278	282.70	112.2	6.2
1130.8	3710.0	123.157	253.70	123.7	5.8	I	1250.7	4135.0	140.389	284.70	113.9	6.3
1138.4	3735.0	124.389	255.90	160.4	8.8	I	1269.2	4164.0	141.667	287.00	149.7	8.2
1145.4	3758.0	125.333	257.60	134.7	7.4	I	1276.8	4189.0	142.722	299.90	138.5	7.5
1154.3	3787.0	126.444	259.60	125.7	6.9	I	1284.1	4213.0	143.722	290.70	136.7	7.5
1161.9	3812.0	127.778	252.00	175.0	9.6	I	1290.8	4235.0	144.833	292.70	155.7	9.1
1169.2	3836.0	128.833	263.90	144.3	7.9	I	1297.8	4258.0	145.611	294.10	110.9	6.1
1179.3	3869.0	129.778	265.60	93.9	5.2	I	1303.9	4278.0	146.222	295.20	100.2	5.5
1190.2	3905.0	131.157	268.10	126.6	6.9	I	1313.4	4309.0	147.444	297.40	129.4	7.1
1198.8	3933.0	132.222	270.00	123.7	6.8	I	1322.2	4338.0	148.444	299.20	113.1	6.2
1207.0	3960.0	133.556	272.40	162.0	8.9	I	1331.1	4367.0	149.778	301.60	150.8	8.3
1214.9	3986.0	134.722	274.50	147.2	8.1	I	1340.5	4398.0	151.111	304.00	141.1	7.7
1224.[illegible]	4015.0	135.889	276.60	127.6	7.0	I	1349.7	4428.0	152.389	306.30	139.7	7.7
1233.9	4048.0	137.278	279.10	142.4	7.8	I	1359.5	4457.0	153.500	308.30	125.7	6.9
1243.0	4078.0	138.389	281.10	121.5	6.7	I	1365.[illegible]	4492.0	154.944	310.90	189.6	10.4

LOCATION: NEWBERRY
T/R-S: 22S/12E-8DDA
HOLE NAME: GEO N-5
DATE MEASURED: 8/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
5.0	16.4	9.275	48.69	0.0	0.0
10.0	32.8	8.232	46.82	-208.6	-11.4
15.0	49.2	6.518	43.73	-342.8	-18.8
20.0	65.6	5.626	42.13	-178.4	-9.8
25.0	82.0	5.376	41.68	-50.0	-2.7
30.0	98.4	5.207	41.37	-33.8	-1.9
35.0	114.8	5.141	41.25	-13.2	-0.7
40.0	131.2	5.093	41.17	-9.6	-0.5
45.0	147.6	5.055	41.10	-7.6	-0.4
50.0	164.0	5.032	41.06	-4.6	-0.3
55.0	180.4	5.032	41.06	0.0	0.0
60.0	196.9	5.046	41.08	2.8	0.2
65.0	213.3	5.054	41.10	1.6	0.1
70.0	229.7	5.071	41.13	3.4	0.2
75.0	246.1	5.093	41.17	4.4	0.2
80.0	262.5	5.131	41.24	7.6	0.4
85.0	278.9	5.167	41.30	7.2	0.4
90.0	295.3	5.174	41.31	1.4	0.1
95.0	311.7	5.186	41.33	2.4	0.1
100.0	328.1	5.196	41.35	2.0	0.1
105.0	344.5	5.215	41.39	3.8	0.2
110.0	360.9	5.246	41.44	6.2	0.3
115.0	377.3	5.267	41.48	4.2	0.2
120.0	393.7	5.307	41.55	8.0	0.4
125.0	410.1	5.328	41.59	4.2	0.2
130.0	426.5	5.369	41.66	8.2	0.5
135.0	442.9	5.396	41.71	5.4	0.3
140.0	459.3	5.429	41.77	6.6	0.4
145.0	475.7	5.466	41.84	7.4	0.4
150.0	492.1	5.525	41.94	11.8	0.6
155.0	508.5	5.558	42.00	6.6	0.4
160.0	524.9	5.588	42.06	6.0	0.3
165.0	541.3	5.632	42.14	8.8	0.5
170.0	557.7	5.643	42.16	2.2	0.1
175.0	574.1	5.646	42.16	0.6	0.0
180.0	590.6	5.647	42.16	0.2	0.0
185.0	607.0	5.648	42.17	0.2	0.0
190.0	623.4	5.647	42.16	-0.2	0.0
195.0	639.8	5.650	42.17	0.6	0.0
200.0	656.2	5.653	42.18	0.6	0.0
205.0	672.6	5.653	42.18	0.0	0.0

LOCATION: NEWBERRY

T/R-S: 22S/12E- 8DAA

HOLE NAME: GEO N-5

DATE MEASURED: 8/17/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
210.0	689.0	5.658	42.18	1.0	0.1
215.0	705.4	5.677	42.22	3.8	0.2
220.0	721.8	5.677	42.22	0.0	0.0
225.0	738.2	5.702	42.26	5.0	0.3
230.0	754.6	5.695	42.25	-1.4	-0.1
235.0	771.0	5.713	42.28	3.6	0.2
240.0	787.4	5.723	42.30	2.0	0.1
245.0	803.8	5.700	42.26	-4.6	-0.3
250.0	820.2	5.706	42.27	1.2	0.1
255.0	836.6	5.708	42.27	0.4	0.0
260.0	853.0	5.720	42.30	2.4	0.1
265.0	869.4	5.771	42.39	10.2	0.6
270.0	885.8	5.725	42.31	-9.2	-0.5
275.0	902.2	5.760	42.37	7.0	0.4
280.0	918.6	5.761	42.37	0.2	0.0
285.0	935.0	5.819	42.47	11.6	0.6
290.0	951.4	5.820	42.48	0.2	0.0
295.0	967.8	5.863	42.55	8.6	0.5
300.0	984.3	5.821	42.48	-8.4	-0.5
305.0	1000.7	5.868	42.56	9.4	0.5
310.0	1017.1	5.828	42.49	-8.0	-0.4
315.0	1033.5	5.838	42.51	2.0	0.1
320.0	1049.9	5.916	42.65	15.6	0.9
325.0	1066.3	6.045	42.88	25.8	1.4
330.0	1082.7	5.947	42.70	-19.6	-1.1
335.0	1099.1	5.980	42.76	6.6	0.4
340.0	1115.5	6.002	42.80	4.4	0.2
345.0	1131.9	6.014	42.83	2.4	0.1
350.0	1148.3	5.985	42.77	-5.8	-0.3
355.0	1164.7	6.037	42.87	10.4	0.6
360.0	1181.1	6.082	42.95	9.0	0.5
365.0	1197.5	6.119	43.01	7.4	0.4
370.0	1213.9	6.212	43.18	18.6	1.0
375.0	1230.3	6.170	43.11	-8.4	-0.5
380.0	1246.7	6.156	43.08	-2.8	-0.2
385.0	1263.1	6.243	43.24	17.4	1.0
390.0	1279.5	6.269	43.28	5.2	0.3
395.0	1295.9	6.271	43.29	0.4	0.0
400.0	1312.3	6.296	43.33	5.0	0.3
405.0	1328.7	6.315	43.37	3.8	0.2
410.0	1345.1	6.255	43.26	-12.0	-0.7

LOCATION: NEWBERRY
T/R-S: 22S/12E- 8DAA
HOLE NAME: GEO N-5
DATE MEASURED: 8/90

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT
415.0	1361.5	6.349	43.43	18.8	1.0
420.0	1378.0	6.491	43.68	28.4	1.6
425.0	1394.4	6.880	44.38	77.8	4.3
430.0	1410.8	7.227	45.01	69.4	3.8
435.0	1427.2	7.420	45.36	38.6	2.1
440.0	1443.6	7.614	45.71	38.8	2.1
445.0	1460.0	7.728	45.91	22.8	1.3
450.0	1476.4	7.880	46.18	30.4	1.7
455.0	1492.8	8.236	46.82	71.2	3.9
460.0	1509.2	8.519	47.33	56.6	3.1
465.0	1525.6	9.032	48.26	102.6	5.6
470.0	1542.0	9.168	48.50	27.2	1.5
475.0	1558.4	9.313	48.76	29.0	1.6
480.0	1574.8	9.608	49.29	59.0	3.2
485.0	1591.2	10.075	50.13	93.4	5.1
490.0	1607.6	10.147	50.26	14.4	0.8
495.0	1624.0	10.886	51.59	147.8	8.1
500.0	1640.4	11.160	52.09	54.8	3.0
505.0	1656.8	11.603	52.89	88.6	4.9
510.0	1673.2	11.834	53.30	46.2	2.5
515.0	1689.6	11.648	52.97	-37.2	-2.0
520.0	1706.0	11.842	53.32	38.8	2.1
525.0	1722.4	12.133	53.84	58.2	3.2
530.0	1738.8	12.131	53.84	-0.4	0.0
535.0	1755.2	12.679	54.82	109.6	6.0
540.0	1771.7	13.386	56.09	141.4	7.8
545.0	1788.1	13.433	56.18	9.4	0.5
550.0	1804.5	15.312	59.56	375.8	20.6
555.0	1820.9	19.854	67.74	908.4	49.9
560.0	1837.3	21.580	70.84	345.2	18.9
565.0	1853.7	24.195	75.55	523.0	28.7
570.0	1870.1	26.093	78.97	379.6	20.8
575.0	1886.5	27.306	81.15	242.6	13.3
580.0	1902.9	28.390	83.10	216.8	11.9
585.0	1919.3	29.272	84.69	176.4	9.7
590.0	1935.7	29.912	85.84	128.0	7.0
595.0	1952.1	30.782	87.41	174.0	9.5
600.0	1968.5	31.626	88.93	168.8	9.3
605.0	1984.9	32.486	90.47	172.0	9.4
610.0	2001.3	33.271	91.89	157.0	8.6
615.0	2017.7	34.207	93.57	187.2	10.3

LOCATION: NEWBERRY
T/R-S: 22S/12E- 8DAA
HOLE NAME: GEO N-5
DATE MEASURED: 8/90

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	DEG F	GEOTHERMAL GRADIENT DEG C/KM	DEG F/100 FT
620.0	2034.1	35.138	95.25	186.2	10.2
625.0	2050.5	35.833	96.50	139.0	7.6
630.0	2066.9	36.347	97.42	102.8	5.6
635.0	2083.3	36.861	98.35	102.8	5.6
640.0	2099.7	37.418	99.35	111.4	6.1
645.0	2116.1	37.835	100.10	83.4	4.6
650.0	2132.5	38.412	101.14	115.4	6.3
655.0	2149.0	38.892	102.01	96.0	5.3
660.0	2165.4	39.398	102.92	101.2	5.6
665.0	2181.8	39.944	103.90	109.2	6.0
670.0	2198.2	40.365	104.66	84.2	4.6
675.0	2214.6	40.999	105.80	126.8	7.0
680.0	2231.0	41.596	106.87	119.4	6.6
685.0	2247.4	42.132	107.84	107.2	5.9
690.0	2263.8	42.749	108.95	123.4	6.8
695.0	2280.2	43.346	110.02	119.4	6.6
700.0	2296.6	44.034	111.26	137.6	7.6
705.0	2313.0	44.740	112.53	141.2	7.7
710.0	2329.4	45.435	113.78	139.0	7.6
715.0	2345.8	46.353	115.44	183.6	10.1
720.0	2362.2	47.136	116.84	156.6	8.6
725.0	2378.6	47.961	118.33	165.0	9.1
730.0	2395.0	48.900	120.02	187.8	10.3
735.0	2411.4	49.497	121.09	119.4	6.6
740.0	2427.8	50.239	122.43	148.4	8.1
745.0	2444.2	50.830	123.49	118.2	6.5
750.0	2460.6	51.304	124.35	94.8	5.2
755.0	2477.0	51.818	125.27	102.8	5.6
760.0	2493.4	52.407	126.33	117.8	6.5
765.0	2509.8	53.021	127.44	122.8	6.7
770.0	2526.2	53.730	128.71	141.8	7.8
775.0	2542.7	54.359	129.85	125.8	6.9
780.0	2559.1	54.983	130.97	124.8	6.8
785.0	2575.5	55.694	132.25	142.2	7.8
790.0	2591.9	56.222	133.20	105.6	5.8
795.0	2608.3	56.802	134.24	116.0	6.4
800.0	2624.7	57.447	135.40	129.0	7.1
805.0	2641.1	57.964	136.34	103.4	5.7
810.0	2657.5	58.448	137.21	96.8	5.3
815.0	2673.9	59.080	138.34	126.4	6.9
820.0	2690.3	59.755	139.56	135.0	7.4

LOCATION: NEWBERRY
T/R-S: 22S/12E- 8DAA
HOLE NAME: GEO N-5
DATE MEASURED: 8/17/90

DEPTH METERS	DEPTH FEET	TEMPERATURE DEG C	TEMPERATURE DEG F	GEOTHERMAL GRADIENT DEG C/KM	GEOTHERMAL GRADIENT DEG F/100 FT
825.0	2706.7	60.445	140.80	138.0	7.6
830.0	2723.1	61.068	141.92	124.6	6.8
835.0	2739.5	61.672	143.01	120.8	6.6
840.0	2755.9	62.286	144.11	122.8	6.7
845.0	2772.3	62.936	145.28	130.0	7.1
850.0	2788.7	63.534	146.36	119.6	6.6
855.0	2805.1	64.147	147.46	122.6	6.7
860.0	2821.5	64.779	148.60	126.4	6.9
865.0	2837.9	65.418	149.75	127.8	7.0
870.0	2854.3	66.049	150.89	126.2	6.9
875.0	2870.7	66.658	151.98	121.8	6.7
880.0	2887.1	67.270	153.09	122.4	6.7
885.0	2903.5	67.887	154.20	123.4	6.8
890.0	2919.9	68.513	155.32	125.2	6.9
895.0	2936.4	69.116	156.41	120.6	6.6
900.0	2952.8	69.721	157.50	121.0	6.6
905.0	2969.2	70.346	158.62	125.0	6.9
910.0	2985.6	70.978	159.76	126.4	6.9
915.0	3002.0	71.605	160.89	125.4	6.9
920.0	3018.4	72.232	162.02	125.4	6.9
925.0	3034.8	72.872	163.17	128.0	7.0
930.0	3051.2	73.488	164.28	123.2	6.8
935.0	3067.6	74.100	165.38	122.4	6.7
940.0	3084.0	74.670	166.41	114.0	6.3
945.0	3100.4	75.244	167.44	114.8	6.3
950.0	3116.8	75.833	168.50	117.8	6.5
955.0	3133.2	76.410	169.54	115.4	6.3
960.0	3149.6	76.922	170.46	102.4	5.6
965.0	3166.0	77.372	171.27	90.0	4.9

LOCATION:
T/R-S:
HOLE NAME: CEMZII-1
DATE MEASURED: 09/24/89

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT		I	DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT	I	METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100
61.0	200.0	12.333	54.20	0.0	0.0	I	487.7	1600.0	33.000	91.40	3.6	0.2
91.4	300.0	11.056	51.90	-41.9	-2.3	I	518.2	1700.0	33.222	91.80	7.3	0.4
121.9	400.0	9.778	49.60	-41.9	-2.3	I	548.6	1800.0	33.333	92.00	3.6	0.2
152.4	500.0	10.389	50.70	20.0	1.1	I	579.1	1900.0	33.722	92.70	12.8	0.7
182.9	600.0	12.833	55.10	80.2	4.4	I	609.6	2000.0	33.944	93.10	7.3	0.4
213.4	700.0	14.567	58.40	90.1	5.0	I	640.1	2100.0	34.500	94.10	18.2	1.0
243.8	800.0	23.278	73.90	282.5	15.5	I	670.6	2200.0	35.000	95.00	16.4	0.9
274.3	900.0	26.889	80.40	118.5	6.5	I	701.0	2300.0	36.167	97.10	38.3	2.1
304.8	1000.0	28.567	83.50	58.3	3.2	I	731.5	2400.0	37.167	98.90	32.8	1.8
335.3	1100.0	29.722	85.50	34.6	1.9	I	762.0	2500.0	38.944	102.10	58.3	3.2
365.8	1200.0	31.000	87.80	41.9	2.3	I	792.5	2600.0	38.944	102.10	0.0	0.0
396.2	1300.0	31.722	89.10	23.7	1.3	I	823.0	2700.0	36.167	97.10	-91.1	-5.0
426.7	1400.0	32.500	90.50	25.5	1.4	I	853.4	2800.0	32.056	89.70	-134.9	-7.4
457.2	1500.0	32.889	91.20	12.8	0.7	I	883.9	2900.0	[illegible]	89.00	-31.0	-1.7

LOCATION: K. FALLS, ORE   OEMZ
T/R-S: 31S/7.5E-10CD
HOLE NAME: 111A
DATE MEASURED: 09/23/89

DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT		I	DEPTH	DEPTH	TEMPERATURE		GEOTHERMAL GRADIENT	
METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100 FT	I	METERS	FEET	DEG C	DEG F	DEG C/KM	DEG F/100
30.5	100.0	13.167	55.70	0.0	0.0	I	762.0	2500.0	123.567	254.60	32.8	1.8
61.0	200.0	94.333	201.80	2662.9	146.1	I	792.5	2600.0	124.667	256.40	32.9	1.8
91.4	300.0	96.111	205.00	58.3	3.2	I	823.0	2700.0	125.111	257.20	14.6	0.8
121.9	400.0	97.222	207.00	36.5	2.0	I	853.4	2800.0	126.000	258.80	29.2	1.5
152.4	500.0	97.333	207.20	3.6	0.2	I	883.9	2900.0	126.667	250.00	21.9	1.2
182.9	600.0	97.333	207.20	0.0	0.0	I	914.4	3000.0	127.333	261.20	21.9	1.2
213.4	700.0	97.555	207.60	7.3	0.4	I	944.9	3100.0	126.778	260.20	-18.2	-1.0
243.8	800.0	98.556	209.40	32.8	1.8	I	975.4	3200.0	128.333	263.00	51.0	2.8
274.3	900.0	98.778	209.80	7.3	0.4	I	1005.8	3300.0	129.000	254.20	21.9	1.2
304.8	1000.0	98.889	210.00	3.6	0.2	I	1036.3	3400.0	129.333	264.80	10.9	0.6
335.3	1100.0	98.333	209.00	-18.2	-1.0	I	1066.8	3500.0	129.556	255.20	7.3	0.4
365.8	1200.0	98.111	208.60	-7.3	-0.4	I	1097.3	3600.0	128.889	264.00	-21.9	-1.2
396.2	1300.0	112.444	234.40	470.3	25.8	I	1127.8	3700.0	128.222	252.80	-21.9	-1.2
426.7	1400.0	112.833	235.10	12.8	0.7	I	1158.2	3800.0	128.567	263.50	14.6	0.8
457.2	1500.0	112.833	235.10	0.0	0.0	I	1188.7	3900.0	129.000	254.20	10.9	0.5
487.7	1600.0	114.000	237.20	38.3	2.1	I	1219.2	4000.0	129.000	264.20	0.0	0.0
518.2	1700.0	114.667	238.40	21.9	1.2	I	1249.7	4100.0	128.444	263.20	-18.2	-1.0
548.6	1800.0	115.889	240.60	40.1	2.2	I	1280.2	4200.0	128.333	263.00	-3.6	-0.2
579.1	1900.0	116.778	242.20	29.2	1.6	I	1310.6	4300.0	128.111	262.60	-7.3	-0.4
609.6	2000.0	114.222	237.60	-83.8	-4.6	I	1341.1	4400.0	128.000	262.40	-3.6	-0.2
640.1	2100.0	118.222	244.80	131.2	7.2	I	1371.6	4500.0	127.889	262.20	-3.6	-0.2
670.6	2200.0	120.111	248.20	62.0	3.4	I	1402.1	4600.0	127.778	262.00	-3.6	-0.2
701.0	2300.0	121.556	250.80	47.4	2.6	I	1412.7	4635.0	127.556	261.60	-20.8	-1.1
731.5	2400.0	122.667	252.80	36.5	2.0							