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HEAT FLOW AND GEOTHERMAL RESOURCES OF IDAHO

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INTRODUCTION

General Discussion

During the past ten years the geothermal resources of the State of Idaho have been extensively studied in order to evaluate the energy potential (electric power production or space heating) they represent. The most direct technique, which can be used to evaluate possible concentrations of geothermal energy in the earth, is the heat flow and/or temperature gradient measurement. Temperature increases with depth in the earth because heat from the interior of the earth is escaping to the exterior. The heat that comes from within the earth is derived from radioactive decay of potassium, uranium, thorium, and from the original heat of accretion and differentation transported to a depth of 50-150 km (kilometers), by mantle convection. In its most energetically useful form this heat may be moved even closer to the surface by a magma where it may be transmitted at high temperature to groundwater and thus tapped to produce electrical power. The outstanding example in the United States is The Geysers in California where 1.8 megawatts of electrical power are produced from 240°C steam that is geothermally heated (DiPippo, 1986)✓. That area is associated with very young silicic volcanism and is underlain by a still cooling magma chamber.

A heat flow study measures the heat which originates within the earth and flows out at the surface of the earth. The units used at the present time for heat flow are based on the SI system. In an earlier report in this series Brott et al. (1976) used the CGS system. Conversions between the two systems and some quantities in the English system of units are shown in Table 1. In SI units the worldwide average heat flow is about 60 mWm^{-2}. Typical low values of heat flow are 20 to 40 mWm^{-2} and typical high values of heat flow are 80 to 120 mWm^{-2}. Values greater than about 120 mWm^{-2} are not usually found except in geothermal areas. The heat loss represented by the average heat flow value is very small. For example if the thermal energy could be converted to electrical energy with an efficiency of 10% (which it cannot be at low temperature differences), it would require the heat from 1000 m^2 (10,758 square feet) of the surface to light a 60 watt bulb. However, the total flow over the surface of the earth is on the order of 1.1×10^{13} W, a very large amount.

By a measurement of heat flow in shallow boreholes (30 to 150 m in depth), areas of local concentration of heat at depth may be directly identified. Subsequent characterization of such geothermal anomalies, which may be due to any one of many causes such as hot water flow along a fault zone, a magma chamber, etc., are the objects of geothermal exploration. A subsidiary quantity, which is measured, is the geothermal gradient or the rate of temperature increase with depth increase. For low-temperature geothermal applications the geothermal gradient is the quantity of most interest because if, it is known, the prediction of the temperatures to be encountered in aquifers at various depths is possible. The temperature of the water in turn determines the type of geothermal possible applications (see Mitchell et al., 1980, Figure 4).

Purpose and Scope

Idaho has a wide variety of geology and many volcanic and tectonic processes have been active within the environs of the State over the last few million years, particularly in the southern part of the State. The object of this study is to present an area by area heat flow and geothermal gradient analysis of the various physiographic provinces of Idaho, in order to identify the nature of geothermal anomalies (if any) related to the tectonism, volcanism and other geologic situations in the various areas will be identified on a reconnaissance level. Several of these areas have been the subject of special reports emphasizing many geological and geophysical aspects. The detailed investigation of specific anomalies is not the objective of this study although data collection has been concentrated in some areas of special geothermal interest. [illegible] The results of this study can also be used for the constraints on regional tectonic interpretations and because of the ability of moving water to transport heat, the study also furnishes information on flow of water in regional aquifer systems. Measurements are presented from a total of over 300 wells whose temperatures have been measured as a function of depth during this project or whose geothermal data have been published (the locations are shown on Plate 1). Samples (core or cuttings) were collected from many of the holes for thermal conductivity measurements (the property of the rock which measures its ability to conduct heat).

Of these 300+ wells a total of 97 were drilled for the specific purpose of geothermal evaluation. These holes were drilled by private geothermal exploration companies, by the Idaho Department of Water Resources, and by Southern Methodist University using research funds from various government

Dave - we have nearly complete core for our 1952 test hole (1100' deep) stored in Boise - if you ever want to sample the thermal conductivity of this, let us know.

agencies as summarized in the Acknowledgements. Most of these exploration holes were drilled to depths on the order of 100 to 150 m. The holes which were drilled for geothermal studies were logged for gradients and core or cutting samples were obtained for thermal conductivity measurement as a function of depth in the holes. In addition, several deep geothermal, hydrologic, and hydrocarbon exploration tests have been drilled in Idaho during the last few years. Thermal results from some of these holes will be discussed as well.

Previous Investigations

The Snake River Plain (Figure 1) has been a focus of an extensive series of heat flow studies which were presented in one Idaho Department of Water Resources publication in this series (Brott et al., 1976) and in two journal articles (Brott et al., 1978, 1981). The purpose of this report is to discuss new temperature gradient and heat flow data for the western Snake River Plain not included in the previous discussions and to summarize all existing data in the Snake River Plain. Also presented is an extensive collection of information for areas of Idaho outside the Snake River Plain, especially the southern part of the Idaho batholith. These data allow a detailed analysis of the heat flow, the geothermal gradient distribution, and the regional geothermal potential of the various physiographic provinces in Idaho.

The only published heat flow studies dealing with for Idaho not in this series have been local in nature (Sass, et al., 1971, Urban and Diment, 1975; Nathenson et al., 1980). A more extensive study of the western Snake River Plain, the results of which are included as part of this study is presented by Smith (1980, 1981). Several reports of geothermal potential emphasing well and spring temperatures have been published. Ross (1971) described the known locations and the uses of thermal water in an early stage of the evaluation process. Most recently, statewide information has been published by Mitchell et al. (1980) and on the State geothermal map (NOAA, 1982). Reports dealing with thermal waters in specific areas will be discussed in appropriate sections of this report.

Well and Spring Numbering System

The numbering system used by the Idaho Department of Water Resources and the U.S. Geological Survey in Idaho is used in this report. This system indicates the locations of wells and springs within the official rectangular subdivision of public lands with reference to the Boise baseline and meridian. The first two segments of the number designate the township and range. The third segment gives the section number followed by three letters and one or more numerals which indicate the quarter section, the 40 acre tract, and 10 acre tract, and the serial number of the well within the tract respectively. In this report the serial number is generally omitted. Quarter sections are lettered A, B, C, D, in counterclockwise order from the northeast quarter of each section (Figure 2). Within the quarter sections 40-acre and 10-acre tracts are lettered in the same manner. Well 1S/19E - 23CAC is in the
w. of the 1/4 w/ 1
SE1/4 NE of the SE1/4 of Section 23, Township 7 South, Range 19 East.

International System of Units

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Table 1 and Figure 3 are included for the convenience of the reader in making a conversion to systems of units other than those used in this report. The CGS system was used in heat flow reports until about five years ago and indeed was used in the previous report by Brott et al. (1976). To assist the reader in understanding the units related to geothermal studies the following example is given. If an area has a uniform heat flow of 100 mWm^{-2} and a uniform thermal conductivity of 1.6 Wm^{-1} K^{-1} the corresponding heat flow in CGS units would be 2.5 x 10^{-6} cal/cm sec°C (2.5 HFU), and the thermal conductivity would be 4 x 10^{-3} cal/cm sec°C. In this case the temperature gradient would be 62.5 mKm^{-1} (which equals 62.5°C/km which equals in turn 3.4°F/100 ft.) and a temperature of 200°C (392°F) would be reached at a depth of about 3040 m (9971 ft.) if the surface temperature was 10°C (50°F).

GEOLOGY OF IDAHO

Introduction

The State of Idaho can be divided into a number of different physiographic provinces. These physiographic provinces are based on the landforms associated with different areas which in turn are related in a complex way to the underlying geology and to various geologic processes which effect the evolution of landforms (Ross, 1949). Idaho can be divided into eight areas as shown by the solid lines in Figure 1 for the purposes of a discussion of the geothermal potential. Several of the major areas can be further subdivided to differentiate the 13 regions shown by the solid and dashed lines in Figure 1. Seven of these areas are north of the Snake River Plain, four are subdivisions of the Snake River Plain, and two are south of the Snake River Plain. The four major areas north of the Snake River Plain are the Southern Idaho Batholith, the Central Idaho Basin and Range Province, the Northern Rocky Mountains/ Northern Idaho Batholith, and the remainder of Northern Idaho. The reasons for this division relate to the thermal characteristics of the areas and to the geology or physiography.

North of the Snake River Plain there are two major physiographic provinces conventionally identified (Ross, 1958), the Northern Rocky Mountains and the Columbia Plateau. The Columbia Plateau can be divided into three subprovinces. From north to south these subprovinces are the Blue ~~Hills~~ Mountains ~~section~~, the Tristate Upland section, and the Wallowa-Seven Devils ~~section~~. From a thermal point of view these three subprovinces are not differentiated in this discussion. The Northern Rocky Mountains within Idaho were not subdivided formally by Ross (1958), however, the U.S. Forest Service has divided the province into a number of sections (Bennett, 1974). For the purposes of this discussion the Northern Rocky Mountain province can be divided into 3 areas. These are the southern Idaho batholith and Challis sections which are considered together in this paper, the central Idaho Basin-Range ~~section~~, and all the remainder of the Northern Rocky Mountain physiographic province which includes the northern Idaho batholith, Lochsa Uplands, not shown and others.

I suggest you only discuss those areas shown on fig 1

The Snake River Plain region is divided into four different areas, the Western Snake River Plain, which in this discussion includes the Western Snake River Basin and the Weiser area, the Eastern Snake River Plain, the Camas Prairie/Mount Bennett Hill subarea, and the Island Park caldera region. South of the Snake River Plain two physiographic divisions, the Owyhee Uplands and the Southeast Idaho Basin and Range Province are considered as separate areas for the purposes of this report.

The geologic features of these various provinces are well known. The Columbia Plateaus province within Idaho is an area covered by the mid-Miocene Columbia Plateau basalts. These basalts are recognized as far south as the northwestern border of the Western Snake River Plain. These Micocene basalts

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The State of Idaho was divided into thirteen areas for the purpose of a discussion of the geothermal potential. These areas were modified from Ross and Forrester (19[illegible]), Ross and Forrester (19[illegible]) and Bennett (1974).
they are: 1. Blue Mountain Province

2. Camas Prairie-Mt Bennett Hills

3. Central Idaho Basin and Range province

4. Challis section

5. Eastern Snake River Plain

6. Island Park

7. Owyhee uplands

8. Northern Idaho batholith

9. Northern Rocky Mountains

10. Southeast Basin and Range province

11. ~~Wallowa~~ Southern Idaho batholith

12. Wallowa-Seven Devils province

13. Western Snake River plain.

The geologic features of these various areas are well known. The Blue Mountain province and the Wallowa-Seven Devils province are covered by the mid-Miocene Columbia River Basalt Group. ~~These basalts~~ this Group is recognized as far south as the northwestern border of the western Snake River plain. These Miocene age basalts.

sit on an older basement about which little is known except in a few places such as along the Hells Canyon of the Snake River where Mesozoic sedimentary and igneous rocks similar to those in the Blue Mountains and the Wallowa Mountains are exposed. In the northern part of Idaho, the Northern Rocky Mountains includes a batholithic terrain which intrudes Precambrian Belt Series sedimentary rocks. In many places, the Precambrian rocks have been metamorphosed by the intrusions. The age of the intrusive activity ranges from mid-Mesozoic to early Cenozoic. Numerous extensive regions of faulting crosscut the area with the faulting being predominantly strike-slip in the northern part of Idaho.

The southern Idaho batholith and Challis sections ~~of the Northern Rocky Mountains~~ are composed almost exclusively of granitic and volcanic rocks. Again, the granitic rocks range in age from mid-Mesozoic to early Cenozoic. Most of the rocks at the surface are thought to be Mesozoic in age, although recently evidence of an extensive early Cenozonic (Eocene) plutonic episode has been recognized (Armstrong and others, 1975; Criss et al., 1983, 1984). The Challis ~~region~~ section contains the eastern part of the Idaho batholith and has extensive exposures of volcanic rocks associated with this Eocene magmatic activity. These volcanic rocks sit on a complex basement of granitic rocks and Paleozoic/Precambrian sedimentary/metamorphic rocks. The area is crosscut by numerous linear valleys with various orientations. The origin of these valleys is differential erosion along faults and/or zones of fracturing. This area, unlike the areas to the north, is characterized by extensive hot spring activity, particularily along some of these major linear zones. It is for this reason, that the area is discussed separately from the area to the north.

Not in references

A major ~~portion~~ part of the Northern Rocky Mountain province in Idaho ~~is~~ identified as the central Idaho Basin and Range province. ~~This area~~ is characterized ~~composed~~ ~~of Basin and Range topography and structure with~~ high relief ranges of separated by alluvial valleys. The general trend of the topography is northeast/southwest. The youthfulness of the ranges in this area is clearly indicated by the numerous fresh fault scraps and the occurence of the magnitude 7.3 Borah Peak earthquake beneath the Lost River valley near Mackey on October 28, 1983 (Dosier and Smith, 1985; Scott and others, 1985). The bedrock of the ranges consists of folded and thrust faulted Paleozoic and Precambrian sedimentary rocks. The structure and hydrology of this area is extremely complex.

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The eastern and western Snake River Plain provinces comprises the area of southern Idaho modified by a moving hot spot during the late Cenozoic. As a major igneous/-tectonic event propagated eastward at a rate of approximately 3.5 cm/year (Armstrong and others, 1975), a predictable sequence of geologic events followed. The initial stages were the formation of large scale silicic ash flows and associated caldera systems similar to those that ~~are now~~ characteri~~stic~~ze of the Yellowstone Plateau. Subsequent to the passage of the hot spot, the area began to subside due to thermal contraction. Then ~~and~~ basaltic volcanism became dominant. The result was an extensive basalt plain with as much as 1 kilometer of extruded basalts. This stage is represented by the eastern Snake River Plain. The youngest stage of silicic volcanism whose site is now covered by basalt is the area directly west of Island Park. The calderas formed during this episode of silicic volcanism between 2 and 5 MY ago have been described by Morgan and others (1984). Following continued subsidence, in the western Snake River Plain deposition of lacustrine and fluvatile sediments occurred in the trough resulting in the formation of ~~a~~ formed deep sedimentary basin associated with minor basaltic volcanic activity. ~~This~~ area is now represented by the western Snake River Plain.

Two "anomalous" east-west trending range and valley areas are associated with the Snake River Plain. These are the Camas Prairie-Mt. Bennett Hills area in central Idaho, and the Centennial Mountains-Redrock Valley area of southwestern Montana included in the central Idaho Basin and Range province. In this report, the heat flow and geothermal gradients in the Camas Prairie-Mt. Bennett Hills are discussed separately from the surrounding areas.

South of the Snake River Plain, there are two major physiographic provinces; the Owyhee Uplands on the west and the southeastern Idaho Basin and Range province on the east. The Owyhee Uplands consists of an extensive volcanic plateau of late Cenozoic ash flows and basalts sitting on top of an essentially unknown basement. Relief is relatively subdued and tectonic activity in the last few million years has been relatively minor. Malde (1987) points out that this province also represents a southwestward continuation of the Snake River Plain hot spot track.

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The southeastern Idaho Basin and Range province is an area of complicated geology and active tectonics. The effects of late Ceozoic Basin and Range normal faulting are superimposed on the Northern Rocky Mountain thrust fault terrain of late Mesozoic to early Cenozoic age. Sedimentary rocks of Mesozoic to Precambrian age are involved in the thrusting. The geology and hydrology of this area are extremely complex, and are of great interest at the moment. Several significant hydrocarbon discoveries have been made in the Utah portion of this province in recent years and several deep exploration tests have been drilled in Idaho. ~~so that~~ Therefore some information on the deep thermal character of the area is available (Ralston and Mayo, 1983). The province is crossed by the Intermountain Seismic Belt (Smith and Sbar, 1974) along its eastern margin. Numerous small (micro) earthquakes occur each year in this area of Idaho (Arabasz, 1980). Very young volcanism has occurred in this provi~~dence~~nce. The rocks are both basaltic and rhyolitic in composition and are extensive near Gray's Lake and Blackfoot Reservoir (see a discussion of the geothermal potential by Mitchell, 1976a).

TECHNIQUES OF HEAT FLOW MEASUREMENT

Introduction

In a thermal study of an area, there are three quantities of interest. Two of these are measured and the third is calculated from measurements of the first two. The three quantities are: temperature gradient, thermal conductivity, and heat flow. In order to obtain the heat flow measurement, the rate of temperature increase with depth, the geothermal gradient, and thermal conductivity of the rocks must be known. Thermal conductivity is a property of the rock which describes the ability of the rock to conduct heat. Thermal conductivity measurements must be made in the laboratory on core or cutting samples from a well, or from representative outcrop samples. The laboratory technique used in this study is the divided bar measurement for core and cuttings samples (Birch, 1950; Sass, et al., 1971). The units used for thermal conductivity are watts per meter per degree Kelvin ($Wm^{-1}K^{-1}$). These units can be related to the thermal conductivity units (TCU) used in the report by Brott et al. (1976) and Smith (1980, 1981) (see Table 1).

The geothermal gradient is obtained by making temperature measurements at discrete depth intervals within a drill hole. On a plot of temperature versus depth, the slope of a straight line through the points is the geothermal gradient. An example from hole 6N/2E-29ba drilled in homogeneous granite at the northwest edge of the Snake River Plain is shown in Figure 4. The units used for geothermal gradient in this report and Brott et al. (1976) ✓ are degrees Celsius centigrade per kilometer (equal to S.I. units millidegrees Kelvin per meter). Outside of areas where the transfer of heat is dominated by groundwater movements, and in an area where the rocks are horizontally layered, there will be an inverse relationship between the geothermal gradient measured in a particular unit and the thermal conductivity of the unit. Therefore, the thermal conductivity and the temperature gradient must be known for specific geologic units before the heat flow can be obtained and before temperatures can be calculated at greater depth. Heat flow is the product of geothermal gradient and thermal conductivity. Units used for heat flow are milliwatts per square meter (mWm^{-2}). The relationship of these units to the heat flow units (HFU, microcalories/cm^2 sec) used by Brott et al. (1976) ✓ is shown in Table 1. As an example the heat flow in the hole 6N/2E-29ba, shown in Figure 4, is (176 on fig 4) 173 mWm^{-2} which is a product of the geothermal gradient of 63°C/km (mKm^{-1}) times the thermal conductivity (2.75 $mWm^{-1}K^{-1}$).

not included?

Causes of Variations and Disturbances in Geothermal Gradients

The temperature-depth curve of well 6N/2E-29ba shown in Figure 4 represents an ideal case, because the thermal conductivity is uniform throughout the depth of the hole and the heat flow is constant with depth, therefore the geothermal gradient is constant as well. In many cases, the geothermal gradient may not be uniform and causes of this nonuniformity must be known ~~understood~~ in order to understand the significance of a temperature gradient or heat flow measurement.

Figure 4 also shows a case where the geothermal gradient varies because ~~of~~ thermal conductivity ~~changes~~ varies with ~~due to~~ changes in stratigraphy (well 7N/42E-19dc). The upper stratigraphic unit is welded tuff with a measured thermal conductivity of 2.05 $Wm^{-1}K^{-1}$. The deeper unit is a tuffaceous conglomerate with a measured thermal conductivity of 0.97 $Wm^{-1}K^{-1}$. The geothermal gradients are 91.3 and 194.8°C km^{-1} respectively. The heat flow, computed as the product of the geothermal gradient and the thermal conductivity is 188 mWm^{-2} in both units in the well and so is constant with depth. These results imply conductive heat transfer and horizontal layering. The values of temperature gradient and heat flow are very high in this well because it is ~~part of~~ located in the Newdale geothermal anomaly (Brott et al., 1976). ✓

[illegible]

At depths of less than 20 meters, temperatures may be affected by the annual temperature change at the surface which has an amplitude of 10°C or more ~~and so is~~ substantially larger than the typical change in temperature associated with the geothermal gradient over a few ten's of meters. The depth at which the annual surface temperature ceases to effect the geothermal gradient depends on the thermal conductivity of the rocks and the period of the surface temperature variation. For most rocks, the annual temperature ~~oscillation~~ range has an effect to a depth of only 10 to 20 meters. The effect is discussed in much more detail in Bowen and Blackwell (1972) and Brott et al. (1976). ✓

not in references

Disturbances to the geothermal gradients may arise from topographical features, circulation of water, temporal changes in the mean ground surface temperature, and temperature anomalies at the surface resulting from contrasts in vegetation (Blackwell et al., 1979). The geothermal gradient may also vary because of complexities in geology reflected as lateral thermal conductivity

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variations. In much of the Snake River Plain and the Owyhee Uplands ~~Plateau~~, the topographical, cultural, and vegetation disturbances are moderate and do not have significant effects on the temperature gradients. In the mountaineous regions of central and northern Idaho, however, such effects cause significant gradient variations perturbations. Terrain corrections have been made to the holes in areas where the effects are significant. In the heat flow data tables, a column titled "corrected heat flow" includes values after terrain corrections have been made (if needed). Most of the heat flow determinations were made in relatively flat lying rocks or in regions of homogeneous rocks such as the granite of the Idaho batholith; therefore, disturbances in gradient due to geological complications are usually small.

Water Circulation Disturbances

Disturbances in geothermal gradient due to the circulation of water cannot be easily eliminated, and in fact, in the case of geothermal exploration, the object is to find areas where hot water approaches the surface. Also, because many of the holes used for this study were originally drilled as water wells, the intention of the owner was to encounter an area where water could be produced. Thus, there is a possibility of water being naturally in motion in these areas. In fact, most of the thermal measurements in the eastern part of the Snake River Plain give more information on water circulation than they do on the regional temperature gradient and heat flow. coming ~~conductively~~ from the interior of the earth.

Water circulation disturbances can be confined to a single well or they can be of a regional nature. The influence of circulating water on rock temperatures is a consequence of the heat transport by thermal convection instead of thermal conduction through the rock. Local water disturbances are caused by the movement of water up or down a well between ~~previously unconnected~~ separated by a confining layer aquifers, following their connection by drilling. The circulating water tends to remain isothermal because of the relatively rapid motion of the water compared to the time taken to heat or cool it from the sides of the hole. Local water disturbances can be suppressed by installing casing and filling the annulus around the casing with chemical grout or cement (Roy and others, 1972; Moses and Sass, 1979).✓ [illegible] A number of the wells discussed in the following sections show temperature gradient anomalies due to local water circulation; and mention of these ~~sorts of~~ effects will be made when temperature-depth data from the wells are discussed.

A common phenomenon observed in the Snake River Plain effects the temperature as a function of depth in an unusual way. In some wells, particularly wells that are drilled in vesicular basalts, ~~very~~ nonlinear temperature depth curves were observed above the water table. This effect was first described by Brott et al. (1976).✓ An example of this type of curve is shown in Figure 5 for well 4N/40E-12dab. The water table is at 160 meters and the mean surface temperature is about 10°C. Another example, 4N/41E-4bda, is also shown. The hole was logged at 3 dfferent times with very different temperatures observed above 50m. Several other examples of this phenomenon are shown in some of the subsequent temperature-depth figures. In these types of wells, which typically exhale air during ~~the day~~ (periods of low atmospheric pressure) and inhale ~~at night~~ (air during periods of high pressure), the temperature depth curve during the summer time is reversed negative throughout the zone of high permeability. Because of the large disturbance, no geothermal gradient can be determined for the well shown. If the well were drilled below the disturbance a gradient might be obtained from the bottom part of the hole. However, since the rocks must be extremely permeable for this effect to occur, the groundwater in these units is typically in motion and conductive gradients are not measured either below or above the water table.

Regional water disturbances are caused by ~~naturally occuring~~ downward water movement from the surface, and ~~in and~~ between major aquifers due to differences in potentiometric heads in ~~piezometric levels along and between the aquifers~~. For example low temperature water may enter an aquifer from the surface, with the resulting ~~that the~~ in a geothermal gradient That is decreased above the aquifer because the lower temperature water absorbs heat and transports it downward or laterally in the aquifer. In other instances ~~"Downstream"~~, the water flow may be up, i.e. the aquifers may have positive potential heads increasing with depth. The geothermal gradient below the aquifer will be higher than the regional value of the geothermal gradient and in the aquifer will be lower than the regional value (see Domenico and Palciauskus, 1973, for some simple models). In another area, high temperature water from depth may enter an shallower aquifer along a fault or fracture zone and cause the geothermal gradient to be anomalously high above the shallower aquifer. Regional water circulation effects will cause similar disturbances in all wells in the same region. This phenomena is clearly shown in some of the examples from the Western and Eastern Snake River Plains discussed in succeeding sections.

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HEAT FLOW AND GEOTHERMAL GRADIENT NORTH OF SNAKE RIVER PLAIN

Discussion of Data

A summary of the geothermal data available for the northern and western parts of ~~the state of~~ Idaho is listed in Table 2. Data from eastern Idaho will be presented in a subsequent section. The wells are located on Plate 1. Included in Table 2 are results from over 175 wells for which geothermal gradient and heat flow can be reliably measured or estimated. The wells are identified by both township-range-section and by latitude and longitude. In addition, the name of each hole as shown is as the tectonic province. The depth interval over which the geothermal gradient and heat flow were calculated is indicated. In holes which did not have a uniform gradient with depth, gradient and heat flow over several intervals may be shown. In cases where the intervals coincide with variations in conductivity, the confidence level associated with the calculated heat flow value is increased. Where variations do not correspond to changes in conductivity, non-conductive influences on the heat flow data or errors in gradient or thermal conductivity values are indicated. Average thermal conductivity values for each hole are also shown. Thermal conductivity values in parenthesis are assumed values based on knowledge of the rock type and/or measurements on the same rock type in nearby wells or from surface samples. Since many of the measurements of thermal conductivity were made on cuttings, a major potential error source for the thermal conductivity is a lack of knowledge of the *in situ* porosity of the rocks (Sass and others, 1971).✓ The number of thermal conductivity measurements on samples from a particular well is shown. Columns for corrected and uncorrected gradient, and corrected heat flow are shown. The values in the corrected gradient column indicate the gradient after corrections have been made for topographic effects. Calculated standard error values are shown for uncorrected gradient.

In cases where both the corrected heat flow and uncorrected heat flow values are the same, the topographic effects were calculated or estimated to be less than 5%. The topographic corrections were made by the technique discussed by Blackwell and others (1979). Almost all of the measurements outside

not in references under 1979

the Snake River Plain required terrain corrections. The error of these corrections is approximately 10% of the correction. The total error in most cases will be less than 5% of the corrected heat flow. No statistical error of the determination is associated with corrected heat-flow values because it is difficult to establish reasonable error limits which take into account the many environmental factors which might effect heat flow. Thus, overall error estimation is given qualitatively in the column to the right of the corrected heat flow. Sites which are estimated to have heat flow values with an error of ±5% or less are of A quality, sites with estimated error of ±10% or less are of B quality, and sites with estimated errors of ± 25% or less are of C quality. Data indicated by a G are within a geothermal system and do not reflect regional heat flow values. If no information was available on the lithology of the hole so that no heat flow can be calculated, the heat flow column is blank. Lower quality data are available from many additional holes not listed in Table 2. These hole locations are listed in Appendix A along with estimates of some of the geothermal information where possible. The locations are not shown on Plate 1 or on any of the figures.

A brief lithologic summary for each hole is included. The age of the rock units is given when known. The final column in the table is a reference to the source of the data. All published heat flow data available for this part of Idaho are included in this table. Many of the data come from the publications of Brott and others (1976, 1978, and 1981) and Smith (1980, 1981) as referenced. These data have been included here for completeness. In a few cases the data values for the same sites shown in Table 2 will be different due to collection of additional information and/or changes in interpretation because of additional information such as new, deep temperature data in a given area. Thus these values supersede the results of the five previously mentioned reports. Other published information is also included with this table for completeness. The abbreviations refer to the individual reports listed at the end of the table.

The large amount of data included in this report can be used to evaluate the credibility of the various geothermal patterns. Many of the wells used for geothermal measurements were water wells which were obviously not grouted to stop water flow between aquifers, and from which only a minimum sample of the rock is available for thermal conductivity measurement. Thus, in many cases interpretation of the type of influences present and the rock encountered by the hole is necessary ~~in order~~ to determine the geothermal gradient appropriate for the region. Some of the gradients and heat flow values are interpreted from groups of wells in the same area. Geothermal gradients from deeper wells can be used to test interpretations based on data from shallower wells.

Blue Mountains provinces,

Northern Idaho batholith, Northern Rocky Mountains, and the Wallowa-Seven Devils provinces

~~Thep~~ These are the ~~The~~ simplest areas to discuss ~~is northern Idaho~~ because, in general, most of the heat flow/temperature gradient measurements indicate that heat transfer is primarily by conduction, and interpretation of the results is straightforward. There are three different geologic terrains present in th~~is~~ese areas of Idaho ~~and four different physiographic provinces~~ (see Figure 1). These geologic terrains are ~~one~~ composed of the Precambrian Belt Series low-grade metamorphic-rocks (northern Rocky Mountains), ~~two composed of~~ Mesozoic and Cenozoic age granitic intrusive rocks ~~comprising the~~ (northern ~~part of the~~ Idaho batholith ~~and associated granitic plutons,~~ and the Blue Mountains-Wallowa-Seven Devils province~~s,~~) and ~~one composed of~~ Miocene basalts, ~~comprising the east edge of the Columbia Plateau province and~~

~~overlying a variety of older rocks of the~~ Blue Mountains and Wallowa-Seven Devils provinces ~~especially in the Weiser area at the southwest~~ edge of the prov~~ince.~~ Histograms of geothermal gradients and heat flow for sites in these three different terrains are shown in Figure 6. Average gradients range from approximately 40°C/km in basalt to 22°C/km in granite and in the Belt Series rocks. The~~se~~ is range ~~variations~~ reflects differences in the average thermal conductivity of the rock, ~~because~~ the variation in heat flow values is quite small as shown by the histogram in Figure 6. The average heat flow for this area of Idaho is 65±3 mWm^{-2} based on 23 determinations. This value is typical of the heat flow in the Northern Rocky Mountains in the United States and Canada (Blackwell, 1969, 1974, 1978; Davis and Lewis, 1984). Based on a typical average radioactivity of the granitic rock, this average heat flow value is within the range of average heat flow values in the Basin and Range province (Roy and others, 1972; Blackwell, 1978). This value is characteristic of the conductive heat flow for much of the interior part of the North American Cordillera from British Columbia to central Mexico where active volcanism has not taken place in the last 10 to 15 my.

Southern Idaho Batholith and Challis Section

The thermal regimen in the southern ~~part of the~~ Idaho batholith stands in distinct contrast to that in the northern ~~part of the~~ Idaho batholith because there are major effects on the heat flow associated with deeply circulating groundwater. As shown in Plate 1, and on Figure 7, hot springs are common in the southern ~~part of the~~ Idaho batholith and locally these hot springs occur with a spacing of only a few kilometers along major topographic lows. The details of these hot springs including their flow rates, observed temperatures, and geochemical temperatures, have been discussed in detail by Ross (1971), Mitchell and others (1980), and Lewis and Young (1980a, 1982). Estimates of the heat loss from the hot springs within this area using the geochemical temperatures and observed flow rates suggest a total heat loss from the hot springs in excess of 4×10^7W. This value corresponds to 10 to 20% of the regional heat flow in this area of Idaho, so that major effects on the conductive transport pattern can be expected.

The regional heat flow in the granite rocks of the Southern Idaho batholith is slightly higher (about 10 mWm^{-2}) than the heat flow in the Northern Idaho batholith. Histograms of gradient and heat flow are shown in Figure 6. The average "background" values are about 26°C/km and about 75 mWm^{-2}. The holes considered to represent "background" are at least 10 km from the nearest hot spring or major topographic lineament and are not near the margin of the Snake River Plain. These gradients and heat flow values are generally of high quality and were obtained from either cored mining exploration holes or from holes drilled in 1976 specifically to investigate the background heat flow (holes with SMU-IB identifier in the name listed in Table 2). The heat flow values and the location of hot springs are shown on Figure 7. The correspondence of high heat flow values (greater than 85mWm^{-2}) with hot spring locations/lineations or the margin of the Snake River Plain can be seen. Some of the values shown on the map are from the Bayhorse-Challis area and will be discussed in a subsequent section.

Many of these values are not within a km or less of the nearest hot spring, so significant areas of high heat flow are indicated around many of the hot spring sites. Because of their possible use as energy sources, it would be useful to know more about the size and controls on the subsurface flow systems. However, because many of the hot springs are near major topographic lineaments, geophysical exploration of the systems is difficult due to the rugged nature of the topography and the limited accessi~~bilit~~y.

The area with the most geothermal gradient and heat flow data is just west of Garden Valley along the South Fork of the Payette River. The topography, hot spring locations and measured temperatures, and heat flow/geothermal gradient sites are shown in Figure 8. Temperature-depth plots for the heat flow holes are shown in Figure 9. The hot springs all exit along the banks of, or in, the South Fork of the Payette River at elevations of about 1000m. Measured spring temperatures range from 41-61°C (Mitchell and others, 1980). Detailed geochemical information for the springs has been discussed by Lewis and Young (1980a). A simple model of the hot spring circulation would envision flow driven primarily by head differences. So regional water flow would be down in the topographically high areas north and south of the Payette River lineament and the heat flow there should be depressed to subregional values. Surprisingly, high heat flow values are found 3-4 km from the Payette River near Grimes Creek (8N/6E) in mineral exploration holes at elevations of over 1800 m. An even higher heat flow is found in Reservoir Creek (8N/5E-16bcc) about 1 1/2 km from the river and its topographic lineament.

In an attempt to explore the size of the thermal anomaly a profile of ~~4~~ four holes (SMU GV-1,-2,-3 and -4) was drilled along Wash Creek (8N/4E) approximately perpendicular to, and south of, the Payette River along the only road providing suitable access. The two holes most distant from the river have near regional heat flow values of 81 and 87 mWm^{-2}. The ~~2~~ two holes closest to the river have significantly anomalous heat flow. While these data do not definitively outline the anomaly associated with the hot spring alignment, it is clear that an area several Tens ~~10's~~ of square km in size has anomalous temperature gradients and heat flow.

Observed tempertures in the hot springs shown in Figure 8 range from 41-61°C. Geochemical temperatures for each spring (Lewis and Young, 1980a) typically range from a high value of 100-122°C based on the SiO_2-quartz geothermometer to 56-69°C for the SiO_2-chalcedony geothermometer ($H_3SiO_4^-$ corrected). In general, reservoir temperatures are interpreted to be 10-20°C above the observed surface temperatures. Thus if the surface temperatures are 5-10°C and the "reservoir" temperatures are 50-80°C then the minimum depth of circulation for different springs, in the average gradient of 25°C/km, would be 1.6 - 3 km.

Even with the data available ~~in this area~~ along the South Fork of the Payette River, the origin of, and controls on, hot fluid circulation within the Idaho batholith remain enigmatic. Apparently, the zones of thermal disturbance (high gradients and heat flow) may not be confined to the immediate vicinity of the actual hot spring site, as is the case for many hot springs associated with topographically driven flow (and no magmatic heat source). The existence of high heat flow values over such a broad area rules out the hypothesis that the circulation systems associated with the hot springs are very local in extent, that they are narrowly confined to the valleys alone, or that they represent simple deep down flow from high elevations discharging along narrow linear zones at low elevation.

In contrast to the southern part of the Idaho batholith, many low to moderate temperature hot springs do not have large areas of anomalous heat flow associated with them. For example such widespread anomalies are not

[illegible]

generally associated with hot springs in major drainages in the Western Cascade Range of Oregon (Blackwell and others, 1982). Of interest is the fact that Lewis and Young (1980a) found no simple geochemical correlation between the thermal and nonthermal water. Thus the nature of the geothermal system is still unknown and further studies are needed.

This conclusion that large zones of thermal disturbance are associated with many of the springs in the southern part of the Idaho batholith seems to be strengthened by results from elsewhere within the batholith. As shown on Figure 7, many of the heat flow values observed in holes with this part of Idaho exceed the background value seen in holes away from the hot spring lineaments or in Northern Idaho. Some of the holes with anomalous heat flow are 15N/3E-5aad, 11N/14E-21ccd, 10N/4E-32ccb, and 9N/4E-19dc. There may be significant potential for development of some of these systems for space and/or process heating where nearby developments exist.

Challis Section

The Challis section as shown on Figure 1 is included with the Southern Idaho batholith. Geothermal and gradient data are very sparse in this area consisting primarily of a series of holes in the Eocene Challis volcanics and Paleozoic sediments near the town of Challis and in the Bayhorse mining district. Two holes near the Salmon River are in the east edge of the Idaho batholith. All the data sites are shown on Figure 7. Average heat flow values of this small data set appear to be 10-20% higher than in the Idaho batholith and gradients are significantly higher because the volcanic rocks have lower thermal conductivity than the granites. Significant high heat flow anomalies occur in the Bayhorse mining district (12N/8E) and along the Salmon

Shown [illegible]

River (hole 11N/14E-21ccd). The anomalous value along the Salmon River is not surprising because this part of the Salmon River flows along a major hot spring lineament. The Salmon River zone is colinear with the lineament of hot springs along the South Fork of the Payette River. The high geothermal gradients and heat flow in the Bayhorse mining district are not near any known geothermal manefestations and suggest the presence of a blind geothermal system in this area.

The data are geographically too sparce to draw detailed conclusions. However, the abundance of geothermal systems, both exposed and unexposed, make the area more similar to the Southern Idaho batholith region than the Central Idaho Basin and Range province. Clearly significant geothermal potential may be present locally in this province.

Central Idaho Basin and Range Province

Geologically and tectonically the Central Idaho Basin and Range province differs from the remainder of the provinces north of the Snake River Plain. In addition, hot springs are rare in this area (see Plate 1). Because of the undeveloped nature of the area very little is known about the hydrology and the geothermal character away from the margin of the Eastern Snake River Plain (discussed below). A few low quality sites show low gradients in shallow holes drilled for mineral or water exploration. Several relatively high quality geothermal gradients and heat flow values have been obtained in the
(need a map location); only lat-long in table!
vicinity of the Gilmore Mining district (13N/26E and 27E). Heat flow values in the bedrock of the Lemhi Range are 55-59 mWm^{-2}, significantly below average values elsewhere in the greater Northern Rocky Mountain province. On the other hand, the gradient in a deep hole in the adjacent Lemhi River valley is 84°C/km and the estimated heat flow is greater than 105 mWm^{-2}. As is the case with

the Southeastern Idaho Basin and Range province (discussed below), deep drill holes will be required to evaluate the intrinsic thermal characteristics of this province.

Weiser Area

Several holes are available from the Columbia River basalt terrain at the ~~eastern edge~~ ~~Southwestern corner~~ of the Southern ~~Idaho batholith~~ ~~(shown as the~~ Wallowa-Seven Devils and the northwestern part [illegible] ~~province on~~ (Figure 1). This area has attracted some geothermal exploration activity because of the presence of Weiser and Crane Creek hot springs (Young and others, 1977; Mitchell and others, 1980). The thermal values from shallow holes are quite scattered with gradients and heat flow values ranging from 20.4°C/km and 32 mWm^{-2} (hole 11N/3W-23abd) to 84°C/km and 102 mWm^{-2} (hole 11N/2W-22dbb). The average heat flow value is 57 mWm^{-2} and the average gradient is 45°C/km. Histograms of heat flow and geothermal gradient for these holes are shown in Figure 10. Not much contrast in gradient between sedimentary rocks and basalts is apparent because most of the sedimentary rocks are relatively coarse grained lithic and quartz rich sands and arkoses sourced from the Idaho batholith.

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The heat flow in the Weiser area is more typical of that expected for the Northern Idaho area than that of the Snake River Plain. In spite of the presence of two hot springs, gradients are moderate and heat flow values are modest. No edge anomaly along the Snake River Plain margin is observed in this area. The common age of formation of the structure and rocks found in this area with the initiation of the volcanic activity in the Western Snake River Plain may indicate small differences in crustal structure to the north and south at the edge of the Snake River Plain here. Major changes in the geologic section nonetheless do exist as shown by Smith (1980, 1981) based on deep wells Christiansen #A-1 (11N/3W-29bbb) near Weiser which has a 2000 m thick section of basalt and interbedded sedimentary rocks above Idaho batholith granite, and the Assmussen #1 well (9N/3W-8) which encountered 1000 m of sedimentary rocks and no basalt. A nonequilibrium bottom hole temperature for the Christiansen #A-1 well is 130°C, resulting in an estimated gradient of greater than 48°C/km, and an estimated heat flow of 76 mWm^{-2}. The heat flow and gradient are significantly lower than those found in the Western Snake River plain Basin. Further comparison of the temperature-depth data from the Christiansen #A-1 well to other deep temperature data from Idaho is presented in a subsequent section.

HEAT FLOW AND GEOTHERMAL GRADIENTS OF THE SOUTHWESTERN IDAHO WESTERN SNAKE RIVER PLAIN, ~~AND~~ THE OWYHEE UPLANDS AND CAMAS PRAIRIE-MT BENNETT HILLS.

Heat Flow Data
Western Snake ~~River Plain~~

The Western Snake River Plain has received extensive attention in the past. It was first studied in detail by Brott and others (1976, 1978). Subsequently studies were carried out by Smith (1980, 1981) and by Anderson and others (1981). Detailed aspects of smaller parts of the feature have also been discussed. The Weiser and the Bruneau-Grand View-Oreana areas have been the object of several studies (Young and others, 1978, 1980, 1982). The summary in this section builds on these previous studies. New data and reinterpretations of some of the data contained in the papers by Brott and others (1976, 1978) and by Smith (1980, 1981) are included in the data tabulated in Table 2. Included in this discussion, as well, are heat flow values in the Idaho batholith marginal to the Snake River Plains and in the Owyhee Uplands along the southern margin of the Snake River Plains. In spite of the extensive data base, the patterns of heat flow and geothermal gradient

Not in reference

remain uncertain and subject to further study. The broad outlines of the distribution are quite clear at this point, however. The results are demonstrated by a heat flow map of the western Snake River Plain shown in Figure 11 (included in less detail as part of Plate 1). The contours in Figure 11 near the Oregon border are based on data from the western Snake River Plain in Oregon (Blackwell and others, 1978).

Almost all of the holes drilled in the Snake River Plain, for which data have been collected, were drilled for the purpose of water development and no core or cuttings were saved for thermal conductivity measurements. A single value of thermal conductivity measured on a sample collected from the surface cuttings ~~piles~~ may be available at best. Only in a very few cases, are there multiple samples available from the same hole. Therefore, in general, it has been necessary to estimate mean conductivity values for holes or sections of holes based on lithology from cuttings piles and well logs. This procedure is relatively unreliable and may miss significant variations in thermal conductivity with depth. Thus the deeper holes are likely to yield more reliable heat flow estimates because they are more likely to sample the predominant lithology in the area. To some extent there is safety in numbers, therefore, and a large number of measurements of similar gradient increases the reliability of the heat flow value determined for a single well that is part of a larger group. The various areas of contrasting heat flow and geothermal gradient are shown on Figure 11 and identified by name for ease of reference in this discussion. Typical heat flow values in the high heat flow regions are 120-150 mWm^{-2} while in the low heat flow region of the central Western Snake Plain the heat flow values are less than 80 mWm^{-2}.

There are quite a number of deep wells ~~from~~ in this area with over twenty holes ranging in the depth range from 300 to 500 m. Some of the typical temperature-depth curves from holes in the ~~depth range of~~ 75 to 200 m depth range are shown in Figure 12. Shown in Figure 13 are temperature-depth curves for most of the holes deeper than 200 m. The data within the Western Snake River Plain in general fall into two categories. These categories correspond to areas of relatively high gradient and heat flow (on the order of 100°C/km and 120 to 150 mWm^{-2}), and areas of moderate gradients (about 40°C/km) and average heat flow values (60-80 mWm^{-2}). The remainder of the area is transitional and of intermediate gradient and heat flow. Histograms of gradient and heat flow are shown in Figure 14. Most of the gradients range between 45 and 85°C/km. Heat flow values show more variation ranging from 50-150 mWm^{-2} with an average of 100 ± 10 mWm^{-2}. The lithology in most of the holes is lacustrine sediment with a few of the holes drilled in basalt.

An example of the variations in gradient are illustrated by geothermal data from 6 six relatively deep holes in the northwestern corner of the Western Snake River ~~Basin~~ plain (Smith, 1980, 1981). Temperature-depth curves from these holes are shown in Figure 13a. Gradients in these holes vary from 45 to 87°C/km. No samples were available for thermal conductivity but estimated heat flow values for these 6 six holes drilled exclusively in sedimentary rocks of Plio-Pleistocene age average 110 mWm^{-2} and are thought to be characteristic of the Western Snake River ~~Basin.~~ plain.

The areas of high heat flow are distributed in two bands along the northwestern and the southern margins of the Snake River Plain. The low gradients and heat flow are found along the axis of the western Snake River Plain between Caldwell and Mountain Home. The heat flow map is shown in Figure 11.

A heat-flow cross-section is shown in Figure 15. The line of the section is shown on Figure 11. The observed pattern was discussed in detail by Brott and others (1978) on the basis of a substantially smaller amount of data and more recently by Smith (1980, 1981). With additional data, the origin of some parts of the pattern has now become clearer. Deep drilling in the Boise front area and in the Bruneau-Grand View ~~region~~ area has demonstrated that the high heat flow values there are related to intermediate temperature (40-80°C) geothermal systems and relatively local geothermal anomalies. The approximate heat flow pattern is shown by the dashed lines on Figure 15. Typical temperature-depth curves in the Boise front geothermal system and in the Bruneau-Grand View geothermal system are shown in Figure 13b (3N/2E-11ab and 11bc, 6S/2E-34bd, 6S/2E-20ab, 7S/4E-18bb). These holes show isothermal or low gradient sections starting between 80 and 280m. Thus the high gradients and heat flow which are measured in holes 50-200 m deep do not project to great depth. Maximum temperatures in the depth range 200-500 m in the wells range from 40-80°C. This pattern of heat flow and gradient is probably due to systematic regional flow of groundwater toward the margins of the Snake River Plain from mountainous regions further away. The flow is driven by potentiometric head elevation differences. ~~on the water table~~ The possible effects on the regional heat flow are shown by the dotted curve in Figure 15. Very low heat flow also, possibly representing part of the pattern, occurs south of the Bruneau-Grand View area (see Figure 11). At the edge of the Snake River Plain, hydraulic boundaries cause upflow which gives rise to the geothermal systems at the various locations. The effects on the heat flow are generally modest, however. The average heat flow values observed are only on the order of 50-100% above the regional background values.

Along the south edge of the western Snake River Plain and the extreme southwest border of the eastern Snake River Plain, warm water is generally encountered in wells that go into silicic volcanics. Brott and others (1976) gave detailed logs from area they called the Blue Bulch area (in 9S/13E).

Warm water occurs at nearby Bandury Hot Springs (8S/14E-33c) and the occurrance of warm water in wells along the Snake River has been described by Lewis and Young (1980b). Geochemistry suggests that maximum temperatures in the geothermal system, if one exists, are 70-100°C. The maximum observed temperature is 71.5°C in well 8S/14E-30DBA1 (approximately 135 m deep). The origin of most of the warm water may be similar to that in the Boise and Bruneau-Grand View area~~s~~.

Outside the areas of most active fluid flow, temperature-depth curves are linear to depths of at least 400-500m, and in the case of the Bostic 1-A well (4S/3E-25cbb, Arney and others, 1982, Arney, 1982) to a depth of 2500m (see below). Typical temperatures in these wells (2S/6E-11dac1, 4S/10E-30bba, and 6S/3E-10bab in Figure 13b and, 11N/6W-3bd 9N/3W-36ddb, etc. in Figure 13a) which may approximate regional conditions are in excess of 50°C at a depth of 500m. Some areas of lower temperature do exist, for example wells 8N/3W-36cad (34°C at 420m) and 2N/3E-35bbc (25°C at 330m) have significantly lower, but well determined, gradients and heat flow.

High gradients and heat flow values are also found in holes drilled in granitic rocks on both margins of the Snake River Plain (Urban and Diment, 1975; Brott and others, 1978; this report, Table 2). The high heat flow in these rocks, presumably not major participants in the regional groundwater flow systems, is related to the large scale nature of crustal disruption associated with the Snake River Plain margins (Brott and others, 1978). These holes are shown by a special symbol on Figure 11.

The heat flows that may represent regional values are connected on Figure 15 by a solid line. The regional heat flow is about 100 mWm^{-2} south of the Snake River Plain and about 75 mWm^{-2} north of the Snake River Plain. In the center of the Snake River Plain the heat flow is about 60-75 mWm^{-3} while on the margins, the heat flow is 25-50% higher than in the center because of the refraction effect discussed by Brott and others (1978).

One of the major observations based on the measurements is that large areas of the Western Snake River Plain have temperatures of over 50°C at depths of 500 m or less. Even the lowest gradient areas of the Western Snake River Plain have values equal to the continental average and a temperature of 40°C can be expected at a depth of approximately 500 m. Thus fluids and temperatures suitable for many low temperature geothermal resource applications exist in most places. Active large scale groundwater flow modifies temperatures along the edges of the Snake River Plain and results in heat flow anomalies in the Bruneau-Grand View area, along the western part of the Snake River in Idaho, and along the Boise front. One area where the fluid flow pattern does not seem to dominate is near the southeastern edge of the map along the line of AA'.

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Owyhee Uplands

The Owyhee Uplands province is south of the Snake River Plain. Although it is part of the Basin and Range physiographic province it actually has few of the characteristics of that province. It is a low relief volcanic plateau built on a largely unknown basement. The boundary between the Snake River Plain and the Owyhee Uplands is not abrupt at the surface but is probably marked in the subsurface by buried faults. These structures may be the hydraulogic barriers that locate the geothermal systems of the Western Snake River plain such as in the Bruneau-Grand View, and Twin Falls areas. The south to north lateral flow model of the geothermal systems proposed by Young and others (1981) [illegible] suggests that lower than regional heat flow values should be characteristic of at least part of the ~~province~~ plain (see Figure 15).

Temperature depth curves from several of the holes in this area ~~province~~ are shown in Figure 16 and histograms of geothermal gradient and heat flow are shown in Figure 17. Gradients range from over 100°C/km in hole 9S/5E-4da at the northern magin of the province to 16°C/km in well 12S/4E-14bc. 16 on F.16 The low values may be due to regional down flow because the two lowest values are directly south of the Bruneau-Grand View area. The average geothermal gradient in the area ~~province~~ is 51±4°C/km and the average heat flow is 98±7 mWm^{-2}. These values are not well determined because the data spacing away from the margin of the Snake River Plain is large. The average heat flow is not as much less than the Western Snake River Plain as is the average geothermal gradient. The rocks encountered in the drill holes are mostly silicic volcanic rocks with higher average thermal conductivity values than the sedimentary rocks in the Western Snake River Plain, thus the lower gradients for a similar heat flow.

There are clearly high heat flow and gradient sites within the area ~~province~~, so there are potential geothermal resources. Three holes in 14S/15E southwest of Rogerson have extremely high geothermal gradients (178-234°C/km). This area is not shown by Mitchell and others (1981) because the holes are very shallow, so they are not very hot. If the gradients extend to even modest depths (200-500 m), however, temperatures at relatively shallow depths may be 40-80°C or more.

Camas Prairie/Mt. Bennett Hills

The Camas Prairie/Mt. Bennett Hills area is discussed seperately to emphasize the apparent geothermal potential of the area. The general geothermal features have been discussed by Mitchell (1976a). The existence of high geothermal gradients in the Camas Prairie was pointed out by Walton (1962) based on the increase in flowing temperature with well depth in the [illegible] artesian wells in the valley. He calculated an average gradient of 92°C/km. Temperature-depth curves from [illegible] 8 shallow wells in the area are shown in Figure 18. The gradient value determined by Walton (1962) is [illegible] verified by the gradients in wells 1S/12E-13baal, 1S/13E-7dca (not shown), and 1S/15E-21abc. The holes are in low thermal conductivity clays, but the estimated heat flow values are still high (100-123 mWm^{-2}) and significantly above those in the adjacent Idaho batholith. A single value in the Mt. Bennett Hills in a hole drilled specifically for heat flow studies is 69 mWm^{-2} and the gradient is 51°C/km in silicic volcanic rocks (2S/14E-36dcc). Intrahole water flow disturbs the lower part of well 1S/13E-7db. The nature of water flow required to cause the observed curve is indicated on the figure. A hole at the south edge of the area subprovince, near the north edge of the Eastern Snake River Plain has a gradient of 95°C/km and a heat flow of 146 mWm^{-2} (5S/15E-6cbb). These values are anomalous. Sketchy results from a 600 m hole drilled nearby and discussed in the section on deep holes confirm the high values.

There is a one well ~~anomaly~~ (1S/14E-20cdd) in the Camas Prairie has an anomalous ~~with a~~ gradient of 181°C/km and a heat flow of 250 mWm^{-2}. This well may represent a real anomaly or the temperatures in the well may be affected by up flow of water from a deeper aquifer in the well below the depth reached by logging. Additional data are required to evaluate this anomaly.

All of the holes are relatively shallow and little is known about the deep thermal conditions. The gradients will decrease with depth in the valley and decrease by a further factor of 100% or so when the basement is encountered. At least 300 m of valley fill are present (Walton, 1962). Thus, temperatures of at least 40-50°C may be encountered associated with artesian flow so the area has potential for low temperature geothermal uses. not in references.

The high heat flow values may be due to overestimation of the thermal conductivity values, transfer of heat into the basin by the active groundwater flow, or presence of a large scale thermal anomaly. The first two hypotheses in combination are favored because of the more typical value observed in the one hole in the Mt. Bennett Hills. More geothermal evaluation is definitely justified, however.

In addition to the high geothermal gradients in the valley, there are several hot springs in the area. Maximum temperatures in these springs, with one exception, are expected to be 100°C or so based on geochemical thermometry (Mitchell, 1976a). There are extensive exposures of Quaternary basalts in the east end of the area. These Quaternary basalts have been cut by normal faults in several locations, demonstrating both active volcanism and tectonism in this area within the last few million years. Mitchell (1976a) reports geochemical data from 79 m deep well (1S/17E-23aabl) at the northern end of Magic Reservoir with a surface temperature of 74°C. Based on the assumption that the hot water has mixed with shallow groundwater he argues for a possible subsurface temperature as high as 200°C.

Two holes were drilled for heat flow in granite of the Idaho batholith about 5 km west and southwest of the hot well and one water well 5 km south of the hot well was logged for temperature. The heat flow values from these three holes were presented by Brott and others (1981, see also Table 2, this paper) and temperature-depth curves are shown in Figure 18. The gradients in the granite holes are comparable to those in the unconsolidated sedimentary rocks so the heat flow values are exceptionally high. The heat flow value is 89 mWm^{-2} in hole 1S/18E-16dcc 5 km west of the hot well and 156 mWm^{-2} in hole 1S/18E-32acc 5 km southeast of the hot well. The highest gradient and temperature are found in an abandond well at 2S/17E-2acc 5 km southwest of the hot well. The gradient between 50 and 100 m is over 200°C/km and the minimum gradient over the whole hole is 136°C/km.

These anomalous gradients and heat flow values suggest the presence of a large geothermal anomaly and possible resource in this area. The area encompassed must be at least 7-10 km^2. Mitchell (1976a) suggests that the hot well is located along a fault intersection. Hole 1S/18E-32acc is along the trend of the major fault system. Struhsacker and others (1982) mapped the vicinity of the hot well and dated the nearby ash flows and a silicic flow. The ages they obtained ranged from 4.9 to 6.0 m.y. compared to 3.1 m.y. for the Wedge Butte rhyolite dome 10 km southeast of the hot well (Armstrong and others, 1975) and about 10-11 m.y. for the Mt. Bennett Hills rhyolites (the typical age of volcanism associated with the Snake River Plain hot spot). The ages of 6 m.y. or less are much younger than the age of the hot spot event which generated the Mt. Bennett Hill rhyolites and suggests long continued or recurrent silicic volcanism in this area. Leeman (1982) has argued that the rhyolites near Magic Reservoir and Wedge Butte mark the ring of a large caldera system. However, Struhsacker and others (1982) point out that these ages, although relatively young, are too old to support the hypothesis that residual heat from the silicic magma chamber associated with the ash flows is the source of the heat causing the geothermal anomaly. Thus the heat source is either deep groundwater circulation in the typical Snake River Plain margin thermal setting, remnant heat associated with the young basaltic volcanism, unusually deep circulation along fractured areas associated with the young faulting, a more recent phase of silicic intrusion with no surface effects, or some combination of these possible causes.

In any event, the Camas Prairie, especially the Magic Reservoir area, has above average geothermal potential. Only information from very shallow drilling is available at this time, so the maximum temperatures that might be encountered are not known. However, temperatures are certainly in the range of 30-40°C at depths of 300± m and may be high enough for commercial electric power production in the most favorable case. High gradients and heat flow are also indicated along the north and south edges of the Mount Bennett Hills.

HEAT FLOW AND GEOTHERMAL GRADIENT OF THE EASTERN SNAKE RIVER PLAIN AND ISLAND PARK

Heat Flow Data

Geothermal data from 55 holes in the Eastern Snake River Plain and Island Park area are listed in Table 3. Much of ~~this~~ these data ~~was~~ were presented by Brott and others (1981) although a number of new sites are included in the table. A large group of holes, discussed in detail by Brott and others (1981) are included in Appendix B. These holes are ones whose temperatures are controlled by flow in the Snake River Plain aquifer. The data from the Snake River Plain aquifer do not represent heat flow measurements in the conventional sense and so are included in an appendix. The data are summarized in Figure 19 where the 'corrected' heat flow values from Table 3 and the 'above' heat flow values (see below) from Appendix B are plotted (for locations where two or more wells are too close to be resolved, a representative value is shown). Most of the wells in the study were drilled for water, but ~~8~~ eight of the wells, averaging 100 m in depth, were drilled specifically for heat flow, and ~~4~~ four wells over 500 m in depth were drilled in the Snake River Plain aquifer for geothermal studies. In addition, a set of data from a geothermal exploration project was made available by Oxy Geothermal Incorporated. This set of data includes holes drilled for geothermal and gradient studies to depths of up to 300 m. Several holes within the Island Park caldera are included in this data set.

Data categories shown in Table 3 are the same as in the previous heat flow table. Terrain corrections were applied to the few holes for which such corrections were necessary. The heat flow quality rankings are also the same as in Table 2. New holes in the Snake River Plain aquifer are indicated by an appropriate symbol. The lithology encountered in most of these wells consists of rhyolite ash flows (welded and unwelded). In some holes, basalt and Cenozoic sedimentary rocks were also encountered. Typical thermal conductivity values of the rhyolites are approximately 1.9 to 2.4 W m^{-1} K^{-1}. Lower values in Table 3 indicate that the holes or intervals were in Cenozoic sedimentary rocks or basalts. Only a few of the holes encountered pre-Cenozoic rocks. These holes included 9N/30E-2cdd and 9N/32E-30bca, which were drilled in Paleozoic limestone; and hole 8N/28E-3ccc1, which was drilled in Paleozoic quartzite.

Figure 20 shows a composite ~~cross~~ section of the heat flow values across the eastern part of the eastern Snake River Plain. The heat flow values are plotted on a scale which shows their perpendicular distance from the axis of the Snake River Plain. The figure shows generally high heat flow values (many over 100 mWm^{-2}) on the margins and low values (mostly in the range of -30 to 20 mWm^{-2}) in the Snake River Plain aquifer. Although a qualitatively similar heat flow distribution is observed in the Western Snake River Plain (~~shown in~~ Figure 15), i.e., low heat flow in the Snake River Plain and high heat flow on the margins, the causes for the pattern ~~there~~ in the western Snake River Plain are somewhat more complicated. The low heat flow in the Western Snake River Plain results from large-scale refraction of heat due to crustal thermal conductivity contrasts, as well as regional aquifer motion, while the low heat flow in the central part of the Eastern Snake River Plain is caused by regional cold groundwater circulation in a major aquifer system. The thermal refraction effect in the Eastern Snake River Plain is minor because a large, deep sedimentary basin has not developed.

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The division of the northern and southern margins of the Eastern Snake River Plain into eastern and western parts is along a line which passes approximately through Arco and Pocatello. The values east of this line are associated with silicic volcanic~~s~~ rocks, which are younger than 5 m.y. ~~old or younger~~. The low heat flow values on the northern margin near Arco are due to lateral movement of groundwater into the Snake River Plain aquifer, and these values are not included in the averages. The average values for the northern margins are poorly constrained due to the paucity of accessible wells. Most of the wells along the northern margin, 8 out of 11, were drilled specifically for heat flow. The large variation of values internal to each of the areas suggests that geothermal systems have a major effect on the distribution of surface heat flow along the margins of the Snake River Plain aquifer. In spite of these complexities, the average surface heat flow values are clearly anomalously high on the margins of the plain and anomalously low in the Snake River Plain aquifer.

Snake River Plain Aquifer

The data shown within the dashed line in Figure 19 are from wells that bottom in or pass through the Snake River Plain aquifer. The predominant lithology of these holes is basalt although ~~volumetrically~~ minor interbeds of sedimentary rocks are present. The interval gradient, and heat flow data from wells located within the boundary of the Snake River Plain aquifer as shown in Figure 19 can be divided into as many as three heat flow regimes identified as 'above,' 'in,' and 'below' the aquifer system as discussed by Brott and others (1981). Abbreviations for these categories are shown in place of the heat flow quality in Appendix B. The 'above' regime appears to be generally conductive; the heat flow is controlled by the difference between the mean annual surface temperature and the local aquifer temperature and may be negative over large areas. Holes within the area of the Snake River Plain Aquifer are listed in Table 3 only if they pass through the aquifer and give information on the thermal conditions below the aquifer or if they were not described by Brott and others (1981). Within the top tens of meters of the aquifer, the heat flow regime is convective and the temperatures are approximately isothermal due to the mixing of circulating fluid. Below the aquifer system, the heat flow regime is little known. ~~as~~ only a few holes are deep enough to sample subaquifer conditions. These holes are discussed below.

In a significant fraction of the holes, the 'above' temperatures are disturbed by the 'vesicular' basalt effect (see previous discussions in Brott and others (1976) and the earlier part of this report). No 'above' values of gradient or heat flow are reported in Appendix B for holes which display this disturbance. No terrain corrections are needed for any of the holes in the aquifer.

The Snake River Plain aquifer is approximately 95 km wide and 300 km long (Mundorff and others 1964). The heavy solid lines on Figure 21 show the recharge areas, and the dashed lines show the discharge areas of the aquifer. Each flow line on the figure represents 18.5 $m^3\ s^{-1}$ flow of groundwater. The two solid lines which cross the aquifer show the locations of the Mud Lake (eastern) and Arco (western) hydrologic barriers. The water table drops approximately 30 to 60 m across each of these barriers. Haskett and Hampton (1979) suggested that these barriers may be sediment zones on the 'downstream' side of old centers of volcanic activity which now are covered by younger basalt flows. Wells from Appendix B are shown on Figure 21 with the observed aquifer temperature given by the coded symbols. Generally, the aquifer temperature ranges from 8° to 9°C in the recharge zones to 14° to 15°C in the discharge zone. The temperatures in the central part of the aquifer vary from 10° to 20°C, with a general trend toward high aquifer temperatures to the west.

The hydrological features of the Snake River Plain aquifer have been extensively described by Mundorff and others (1964), Norvitch and others (1969), Haskett and Hampton (1979), Lindholm (1985), Whitehead (1986), and many others. The total discharge of the aquifer is approximately 185 $m^3 s^{-1}$ and occurs primarily on the western edge of the aquifer at Thousand Springs. Reported horizontal flow rates range from about one to several meters per day, but the average horizontal flow rate is less than 1.6 km yr^{-1}. The aquifer system is composed of many Quaternary basalt flows with occasional interbedded sediments. In the western part of the Snake River Plain aquifer, the younger flows (basalt of the Snake River Group) overlie a thick sequence of older basalt flows, consolidated sedimentary rocks, and silicic volcanic rocks of Cenozoic age (Malde and Powers, 1962). In general, the permeability of these older rocks is less than that of the Snake River Group, and they are not considered to be part of the aquifer system. Moreland (1976) reported that a large number of the springs in the canyon walls at Thousand Springs occur at the contact between the Tertiary and Quaternary basalts. Results from a test well recently drilled near Wendell (7S/15E-12cbal) have emphasized this difference. Whitehead and Lindholm (198~~5~~4) found that the permeability in this well decreased drastically at the cont~~rast~~act between the older and younger basalts.

Snake River Plain Aquifer Thermal Model

Brott and others (1981) presented a transient two-dimensional Snake River Plain aquifer thermal model (reproduced in Figure 22). The illustrated results were obtained by a finite difference solution of the two-dimensional heat flow equation with a one-dimensional velocity term. Because of its importance to understanding the thermal chamber of the Eastern Snake River Plain, the model of Brott and others (1981) is briefly summarized here. Hydrological models of the Snake River Plain aquifer were constructed by Mantei (1974) and Moreland (1976). The aquifer parameters used in the thermal model were selected to be consistent with these hydrological models. The initial temperature distribution and the heat flow at the base of the model were obtained from the finite-width moving-source regional model discussed by Brott and others (1981). The surface temperature distribution of the model was obtained from a least squares linear fit to surface temperature versus elevation for 300 wells in the Eastern Snake River Plain. The surface elevation in the model was obtained from a third-order polynomial fit to the observed elevation in the Snake River Plain. The surface geothermal gradient profile without convection is shown above the model (dashed line at top of Figure 22). The individual isotherms without convection (which are not shown) have approximately the same shape as the topographic surface.

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The model velocity assumed for the flow in the aquifer was 1 km yr^{-1} (about 3 m d^{-1}). The active convection zone shown in Figure 22 extends from approximately the Island Park area to Thousand Springs. The top of the convection zone is the water table and corresponds to the result of a third-order polynomial fit to the observed water table. The thickness of the aquifer was assumed to range from about 200 to over 300 m. The aquifer may vary in thickness up to 750 m or more (Robertson and others, 1974), but the effect of the aquifer on the near-surface isotherms would be the same. The temperature distribution does not change above and within the aquifer after a period of circulation of about 10,000 years. The temperature distribution below the aquifer shown in Figure 22 corresponds to the numerical solution after convection has occurred for a period of 100,000 years. The actual temperatures below the aquifer will depend on the history of evolution of the aquifer, which is currently unknown, and therefore the isotherms below the aquifer are hypothetical. At a lateral distance of 5-10 km from the aquifer its effects on temperatures are negligable. In the aquifer approximately 100 km 'downstream' from the inflow region, the calculated gradient profile above the aquifer becomes positive, indicating that the fluid has been heated to a temperature greater than the surface temperature.

The simple two-dimensional aquifer model was developed to evaluate the effects of rapid groundwater flow and to see if such effects could explain the observed temperature-depth curves. The model is not to be taken literally because of its simplicity. For example, the western inflow regions (of which there are several) are not taken into account. In addition, many of the pertinent aquifer parameters are currently uncertain.

Comparison of Snake River Plain Aquifer Model to Observed Data

Brott and others (1981) illustrated the types of temperature-depth curves observed in the Eastern Snake River Plain in comparison to the predictions shown in Figure 22. As another illustration of these effects, a combined map and temperature-depth plot of curves observed in wells on the Idaho National Engineering Laboratory (INEL) are shown in Figure 23. The highest gradients are observed in holes along the margin of the Eastern Snake River Plain and the aquifer (19, 22, and 23). In addition, Ross (1971) reported data from hole 3N/27E-9ab) at Butte City where a temperature of 42°C was measured at a depth of 150m. The behavior of the gradient at greater depth is unknown because none of these holes penetrate more than 30m below the water table. Zero or reversed temperature gradients probably occur at some depth as is typical of other places along the margins.

As in other areas of the Snake River Plain aquifer, the temperature-depth curves of wells in the recharge areas show negative or very low temperature gradients (ANP-7, PW, 8, 86), heat flow and very low aquifer temperatures. These characteristics occur because the recharge water, which originates mainly from snow melt at high elevations, is at a lower temperature than the mean annual surface temperature of the recharge areas (see Figure 22, the theoretical model). The aquifer thermal model is two-dimensional, whereas in reality, water enters the aquifer at many locations along the aquifer boundary (see Figure 21).

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As the groundwater becomes heated in the aquifer, the temperature of the water becomes equal to, or greater than, the mean annual surface temperature. At this point the temperature-depth curves will become isothermal. At greater distances or in regions of low flow rate or higher heat flow from below the aquifer, temperatures will increase with depth. Temperature-depth curves at various locations in the aquifer show that gradients become isothermal or positive at a distance of 10-100 km from the inflow areas of the aquifer. Holes on the INEL test site demonstrate this change as higher gradients above the aquifer occur away from the vicinity of the Big Lost River, Little Lost River, and Birch Creek sink areas. Figure 21 shows the trend of increasing aquifer temperatures as a function of time or distance from the input point, from 8° to 9°C in the recharge areas to values of 14° to 15°C in the discharge area. Figure 19 shows a similar trend of increasing surface heat flow from negative values in the recharge areas to values of about 60 mWm^{-2} in the discharge area of the aquifer. These observed trends and their magnitude are consistent with the predictions based on the two-dimensional model. Also shown in Figure 23 is the close association of holes which do, and do not, show the "vesicular" basalt effect (HW1 and HW2; 15 and 12; 23 and 17).

As another way of evaluating the thermal effects of the aquifer the observed aquifer temperatures as a function of distance of flow and residence time of the water in the aquifer were analysized. Temperatures in wells along various flow paths (marked N, NC, SC, S in Figure 21) are plotted as a function of distance from the recharge point (Figure 24a) and average residence time in the aquifer (Figure 24b). The residence times in Figure 24b were calculated assuming a permeability of 0.8km/day and the water table given by Mundorff and others (1964)[1]. The results in both cases show an increase in aquifer temperatures downstream, although there is significant scatter. Most of the scatter is near the recharge area or margins of the aquifer, no major anomalies are found in the central part of the aquifer. These results, while not outlining major anomalies, can be used as background values if additional geothermal evaluation of the aquifer is attempted.

Heat Flow Below the Aquifer

Temperature-depth curves of several wells which are deeper than 300 m (see heat flow data section) are shown in Figure 25. Wells USGS-G3 and the

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Madison County well are located in the recharge area near the eastern boundary of the aquifer. Three holes were drilled near the northern margin of the aquifer east of Arco (see Figure 19 and Table 3). Two of the wells (USGS-G1 and G2A) have positive gradients beginning between 400 and 500 m which locate a lower boundary for the aquifer. INEL-GT1 has a positive gradient beginning near 250 m, apparently indicating a shallower and thinner aquifer at that site. The curve labeled INEL-GT1 (Figure 22) shows local gradient disturbances at 800 m and 1050 m. These disturbances are due to natural flow along fracture zones. Below the aquifer system, wells USGS-G2A and INEL-GT1 have heat flow values of 110 and 109 mWm^{-2}, respectively (Table 3). The results from deep well INEL-GT1 are compared to other deep wells in a following section on deep holes in the Snake River Plain.

Numerous wells with anomalous geothermal gradients and heat flow values were described by Brott and others (1976) in the Rexburg Bench area, T4-8N R40-43E. Some holes along the trend of the area to the northeast also have slightly anomalous gradients (Table 3 and Plate 1). Two 400 m exploration wells (5N/40E-5cd and 6N/40E-31bba1, Figure 25) and one 1500 m deep production well (the Madison County well at 6N/40E-31bba2) were drilled at the margin of the anomalous area. The data described in this report shed no new light on the source of the thermal anomaly, and the reader is referred to the discussion in Brott and others (1976) for more details and a large scale map of the area.

None of the wells whose temperature-depth curves are shown in Figure 25 are drilled in areas which may be considered typical of the Snake River Plain aquifer. The three wells drilled east of Arco are located in an area where aquifer temperatures and surface heat flow are higher than in the areas to the south and west (Figures 19 and 21). This difference implies that the flow rates are restricted and the aquifer is thinner and/or less permeable, and/or the volume of water flow less than areas to the east and south. The four wells near Rexburg are also located in an area which may not be characteristic of the aquifer. The aquifer temperature in USGS-G3 is higher than surrounding areas in the aquifer, which may indicate leakage of hot water from the Newdale geothermal anomaly (which is about 10 km to the east (Brott and others, 1976) into the aquifer system. Temperature and hydrologic data indicate that much of the recharge for the Snake River Plain Aquifer occurs along the Snake River between Rexburg and Idaho Falls. Apparently fluid flow also goes quite deep in this area. The Madison County well was drilled as a geothermal test. It proved to be off of the Newdale geothermal anomaly and has extraordinarily low temperatures at depth. This case illustrates the advantage that might have be gained by using thermal exploration data to more effectively site the deep exploration test.

Other areas along the southern edge of the Eastern Snake River Plain also have wells with relatively high temperatures and geothermal gradients. Corbett and others (1980) discussed the Tyhee area near Pocatello. Highest water temperatures in wells there are just over 40°C. Struhsacker and others (1983) discussed warm water occurrences in wells near the Rock Creek Hills (11S/18-20E). The highest temperatures found there are 49°C. They discussed geochemical techniques of evaluation of such low temperature systems.

Heat Budget Analysis

Brott and others (1981) made a heat budget analysis of the Snake River Plain aquifer. The surface heat flow within the boundaries of the Snake River Plain aquifer (Figures 19) was areally integrated, and the total loss of heat above the aquifer was calculated to be 42.3 MW. The total discharge of the aquifer is approximately 185 m^3s^{-1}. The heat required to change the temperature of this volume of water from 8°C to 14.5°C is 287.3 MW. Thus the total amount of heat required from below the aquifer system would be 329.6 MW or an average heat flow of approximately 190 mWm^{-2}. The heat flow values actually measured below the aquifer in wells USGS-G2A and INEL-GT1 are 110 and 109 mWm^{-2}, respectively (Table 3). A similar areal integration was done using the heat flow predicted by the finite-with time-progressive regional thermal model presented by Brott and others (1981). The predicted heat loss is 221 MW, and the predicted temperature increase is 4.9°C. This predicted temperature increase is consistant with the observed temperature increase (see Figure 24).

Island Park Caldera and Vicinity

The youngest very large silicic volcanic feature in the Snake River Plain is the Island Park caldera (Hamilton, 1965). Christiansen (1982) has redefined that feature, a part of the larger Yellowstone volanic system formed during a major ash flow eruption 1.3 MY ago, as the Henrys Fork caldera (see Hildreth and others, 1984). According to Smith and Shaw (1978) this area contains over 50% of the total thermal energy in igneous complexes of the United States (outside national parks). However, there are no known thermal manifestations and groundwater temperatures in shallow wells (30-60 m deep) are generally low (Brott and others, 1976). Although the 1:250,000 scale Ashton topographic map indicates hot springs in 11S/41E-14 and 15, no surface evidence of a geothermal system is present at this time. Hoover and Long (1975), based on electrical resistivity studies, suggested that the area had little geothermal potential. Recently, however, Hoover and others (1985) recanted their earlier conclusions. Whitehead (1978) noted that groundwater temperatures at the south edge of the caldera are elevated and suggested possible input of geothermal heat into the system.

In 1977 and 1978 a geothermal exploration company carried out a major drilling project in the area. The results of that study have been released and are discussed in this section. Two 300 m deep and one 100 m deep holes were drilled in the general vicinity of the reported hot springs in Antelope Flats (11S/41E-14 and 15). This area is a topographic breach in the caldera, and the hole locations are one or two kilometers west of the edge of the caldera. The results of these drill holes (Figure 26) indicate a very deep water table (150-200 m) and suggest that the area is in the recharge zone of the Snake River Plain aquifer. The two deep holes were essentially isothermal to total depth, both having gradients less than 10°C/km below 150 m (one positive and one negative).

Another heat flow test hole was drilled to a depth of 278 m in 12N/44E-10bbc (HFT-18). This hole has the typical temperature-depth curve expected in a lateral or down-flow section of a major aquifer system. The gradient is essentially zero to a depth of approximately 180 m. At that point it increases to 12.7°C/km between 150 and 300 m. A 300 m hole was also drilled near the center of the caldera in 12N/42E-36ccb. This hole has a temperature-depth curve indicating that it cuts through a major aquifer system (the gradient increases with depth); however, the values are much greater than those observed in 12N/44E-10bbc. In this hole (HFT-19), gradient increases systematically from 27.3°C/km to 65.5°C/km with depth. Of course the gradient may continue to increase with depth below 300 m. Thus the results from this hole suggest that there may be geothermally interesting gradients in the vicinity of this site.

A significant geothermal anomaly may be located at the northwestern edge of the caldera in 13N/42E, sections 24 and 25. Two holes were measured near the shores of Island Park ~~Lake~~ Reservoir, about 1.5 km northeast of the north rim of the Island Park caldera (see Table 3). These holes are only 38 m deep; however, they show very uniform and high gradients. The hole in section 24 has an average gradient of 189°C/km, while the hole in section 25 has an average gradient of 102°C/km. These gradients imply heat-flow values of about 310 and 201 mWm^{-2}, which are distinctly anomalous with respect to regional values and document the presence of a geothermal anomaly in the area. A hole several kilometers further north on the south flank of the Centennial Range (13N/42E-1bc, Appendex B), and a hole 6.5 km to the west (HFT-20 13N/42E-22caal), do not show high gradients. The size of the area is open to the south and east; i.e., in the direction of the Island Park caldera.

This anomaly is blind, in the sense that there are no thermal manifestations. Also, the wells were so shallow that the area had not been recognized to have anomalous temperatures; indeed, the bottom hole temperatures of the wells are only 10 and 13°C. However, these temperatures have to be considered in conjunction with the average ground temperature, which is approximately 5-6°C, as contrasted to the average ground surface temperature in the Eastern Snake River Plain, at much lower elevation, of approximately 10-13°C.

A high thermal gradient was encountered just south of the caldera rim in hole 9N/43E-11bda. A gradient of 155°C/Km was measured between 60 and 135 m depth in that hole (see Figure 26). A deep well was subsequently drilled nearby (Strum #1, 9N/43E-19). A nonequilibrium temperature log shows a distinctly anomalous temperature of about 30-35°C at 200 m, but a more normal temperature of 65°C at 1200 m (see a following section).

HEAT FLOW AND GEOTHERMAL GRADIENTS OF ~~THE~~ SOUTHEASTERN IDAHO BASIN AND RANGE PROVINCE

The geology of the southeastern Idaho Basin and Range province, summarized in an earlier section, is complicated. Because of the extensive faulting, the high topographic relief and the nature of the rocks, predominantly carbonates, the hydrology of the province is complicated as well. Furthermore, unlike the Snake River Plain groundwater system, there has been little study of the hydrologic systems.

Shallow exploration holes and groundwater wells were logged as part of this project. The results from these sites were uniformly poor and most of the holes are not listed in Table 3 (see Appendex A). Several sites where poor quality data were obtained are listed in Appendix A.

In spite of the results from the shallow holes, the area is not one of uniformly low to negative gradients as is the Eastern Snake River Plain. There are several hot springs in this province, most notably Cleveland, Maple Grove, Squaw, and Battle Creek hot springs (Mitchell and others, 1980). Geochemistry of the thermal water suggests temperatures of 150-200°C for some of the hot springs although the chemistry of the water is not the most suitable for application of chemical geothermometers and these estimates may be high. There have been several geothermal test wells drilled in this province.

The results from two gradient test wells 450 m and 2300 m deep are shown in Figure 27. Well 15S/39E-6ca (SUN-1001) is about 2 km from Battle Creek (Wayland) Hot Springs and about 3.5 km from Squaw Hot Springs. The temperatures in this well are dominated by shallow lateral flow of hot water (almost 110°C at this location) in the shallow groundwater aquifer recharged by upflow of hot water, some of which comes to the surface at the hot springs. This temperature is the highest observed at shallow depth in any of the holes described in this report.

The Hubbard #25-1 well (7S/4E-25) is near the Blackfoot Reservoir. Numerous Quaternary rhyolite and basalt volcanoes are found in the vicinity. Geochemistry of groundwater shows no evidence of high temperature geothermal systems, however (Mitche~~tt~~ll, 1976b). The temperatures were measured 4 four months following completion by a commercial well logging company. Typical temperature logs obtained by logging companies are of poor quality due to instrument limitations and the fact that logging usually occurs within a few days following well completion. There is a 2°C offset at 1200 m in the log, apparently due to different calibrations between tools used for two separate runs, but otherwise the log looks satisfactory. There are no samples available for thermal conductivity measurement, so a heat flow cannot be determined although an estimate can be made based on the lithology. The average geothermal gradient from 600 to 2300 m, below the Cenozoic section, is 30°C/km and the maximum temperature reached at 2300 m is 68°C. The lithologies encountered are predominantly shale and limestone with some sandstone. Based on a typical thermal conductivity of limestone of 2.7 $Wm^{-1}K^{-1}$ an upper limit for the heat flow is 82 mWm^{-2}.

Ralston and Mayo (1983) summarized geothermal gradients from temperature logs and bottom hole temperature measurements in oil wells in this province. These data are of poor quality (the values are probably ±50%), but in the deep holes do give some idea of possible geothermal gradients. The sites and geothermal gradients are shown in Figure 19. Two of the wells in the northern part of the province have apparent average geothermal gradients to depths of

2-4 km of over 50°C/km. This value is higher than expected for the province and anomalous heat flow is suggested in these areas if the temperature measurements are valid and if the thermal conductivity values are not anomalously low. Based on the data of Ralston and Mayo (1983) the gradients decrease to the south and east. Since the thermal conductivity has not been measured for those wells, the actual heat flow variations associated with this gradient variation (if any) are unknown.

Based on the hot springs and high geothermal gradients, and based on some oil well bottom hole temperature data, areas within the province may have significant geothermal potential. Additional studies are necessary to evaluate this potential as present data are scarce sketchy and imperfect.

TEMPERATURE IN DEEP WELLS IN THE SNAKE RIVER PLAIN

Most of the thermal data discussed in previous sections have been obtained from wells drilled for water or for heat flow and geothermal gradient exploration. Typical hole depths are 150-300 m. In this depth range the results that have been discussed have clearly shown that much of this thermal data, especially in the Snake River Plain and its margins, is affected by groundwater flow. In other areas the effects on the shallower temperatures and gradients are varied. Temperature and heat flow data from deep holes are obviously extremely valuable in investigating the deep conditions for comparison with the shallow conditions. In this section data from several wells over 500 m deep in the Snake River Plain are discussed.

The locations of the holes are shown in Figure 28 (also shown in this figure are the sites of holes depth range 300-500 m). The deep holes to be specifically discussed in this section are listed in Table 4. Table 4 includes the name of the hole, the location, and some information on the depth, gradient, and heat flow. Accurate equilibrium temperature-depth information are available for the Ore-Ida #1, Bostick #1-A, INEL-GT#1 and the Anderson Camp wells. Logs of unknown quality measured shortly following completion of drilling are available for the Sturm #1, the Madison County #1, the Federal 60-13 #1, Mountain Home Air Force Base, and the Christiansen #A-1 wells. Only bottom hole temperature information of questionable quality are available for the James #1, Wink #1, and Palacio #1 are available. All these wells penetrate the typical geologic sequence of the Snake River Plain for their location and so the lithologies in the holes are volcanic rocks of rhyolitic and basaltic composition and lacustrian sedimentary rocks. The Federal 60-13 #1 well bottoms in Idaho batholith granite as does the Christiansen #A-1 well.

Figure 29a shows a highly diagramatic longitudinal section along the Snake River Plain based on well log and lithologic information from the Sturm #1, INEL-GT1, Bostick #1-A and Ore-Ida #1 wells. Whitehead (1986)✓ has recently presented a detailed set of geophysical maps of the Snake River Plain and numerous cross sections based on well data. The sections presented in figure 29 are more generalized and extend to greater depths than those of Whitehead (1986).✓ This diagramatic section illustrates the trangressive eastward sequence at each point along the Snake River Plain consisting initially of rhyolitic volcanic rocks followed by basaltic volcanic rocks followed by continental lacustrian sedimentary rocks.

A ~~cross-~~ geologic section across the Snake River Plain at any location may show significant variation from this highly generalized longitudional section. Figure 29b shows a transverse section across the western Snake River Plain

It might help to have a label or arrow sort for each well discussed above so the reader could look at the map figure and pick out the well.

from the Federal 60-13 #1 well through a recently drilled well at Mountain Home Air Force Base (personel communication from R. E. Lewis, 1987) to the Bostick #1-A well. This section shows a thicker sedimentary package on either margin with the thickest basaltic section in the middle, and the second thickest basaltic section on the east side. This sort of relationship is not likely to extend to all parts of the Snake River Plain, but the types of lateral variations that might occur are illustrated. The James #1, Ore-Ida #1, and Christiansen #A-1 wells are somewhat anomalous in that they cut a predominently sedimentary and basalt section with few if any rhyolitic volcanic rocks. The Christensen #A-1 well bottoms in the Idaho batholith granite, while the James #1 well bottoms in volcanic rocks of unknown age.

Temperature-depth curves for the wells are shown in Figure 30. Only bottom-hole temperature data are shown for those wells for which no other data are available. The difference between equilibrium and non-equilibrium logs is indicated by the pattern. Temperature-depth curves for most of these holes are quite complicated and require some interpretation, but the overall conclusion is that temperatures at a depth of about 3 km are 25-50°C warmer in the Western Snake River Plain than in the Eastern Snake River Plain. In the Eastern Snake River Plain, the upper part of the INEL-GT1 well has very low gradients and near isothermal conditions characteristic of the Snake River Plain aquifer. The temperature-gradient below a depth of approximately 200 m averages 40°C/km with variations associated with local water movements.

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The temperature measurements for the Sturm #1 well, at the edge of, but outside the Island Park caldera, are not at equilibrium and have the characteristic pattern of a thermal drilling disturbance, i.e. high temperatures at shallow depths and a hook at the deep end of the curve as the temperature-depth curve approaches equilibrium. This well was drilled totally in silicic volcanic rocks even though it is on the flanks of, and not inside, the Island Park caldera. Based on data from a shallow gradient test well nearby (9S/43E-11bda), the high temperatures (30-35°C) at shallow depth may be real rather than an effect of the drilling. This high temperature is consistent with the presence of a geothermal heat input as most groundwater temperatures within and adjacent to the Island Park caldera are barely in excess of the mean annual temperature of 5-7°C (Whitehead, 1978).

As discussed in a previous section, the temperatures are anomously low at the site of the Madison County #1 well. The drilling history of this hole was complicated. A lot of lost circulation and caving occurred and well logs were not obtained for much of the well. Thus temperature quality is poor. Nevertheless, temperatures in this well appear to be extremely low at depth as is characteristic of shallower holes in this vicinity.

There is a large distance between the INEL-GT1 and Madison County wells and the next deep hole to the west. There are three holes on the order of 600 m deep in this gap, two on the north margin that were drilled for geothermal exploration (Wink #1, and Palacio #1) and for which only bottom hole temperature data are available and one drilled near the southern margin (Anderson Camp) for which detailed temperature data are available as shown in Figure 30. These data indicate typical gradients for this section of the Snake River Plain of 60°C/km or more. These results are consistant with the accurately determined gradient in well 5S/15E-6bbc (see Table 3 and Figure 18) of 94.9°C/km only about 1 km from the site of Palacio #1. Basalt thickness at the sites of the holes is between 150 and 500 m.

Data from the 2.9 kilometer deep Bostic #1-A well have been discussed in detail by Arney and others (1982) and Arney, 1982). Arney (1982) published the temperature-depth curve shown in Figure 30. This curve is from a commercial well log but shows the characteristics that might be expected of a good temperature-depth log with higher gradients at shallow depths associated with the lower thermal conductivity sedimentary rocks and lower gradients at depth associated with the higher thermal conductivity basaltic and silicic volcanic rocks. Temperatures from a nonequilibrium log in the Mountain Home Air Force Base are very close to those in the upper part of the Bostic #1-A well about 20 km southeast.

Temperature-depth data from the Federal 60-13 #1 also show characteristics of a recently-drilled well with high shallow temperatures and near isothermal conditions (not plotted). The gradient in the depth range of 1500 m to total depth averages over 32°C/km. As is the case with the Sturm #1 well the upper part of this hole may in fact not be as disturbed as it appears. Drill holes in the depth range 300-500 m in the immediate vicinity are part of the Bruneau-Grand View geothermal anomaly and temperatures of 40-60°C occur at depths of 200-400 m (see Figure 13b). This system appears to be quite shallow as deeper temperatures are not anomalously high for the Snake River Plain.

The highest reliably documented temperature is observed in the Ore-Ida #1 well at the extreme western end of the Snake River Plain. This hole has an extraordinarily thick sedimentary package because almost the total depth of the hole is composed of sedimentary rocks, only the bottom few hundred meters has interbedded basalts, sedimentary units and tuffs. The measured bottom hole temperature at a depth of 3.2 km is approximately 195°C. The hole is artesian from perforations in casing at a depth of 1660 m so the upper part of the curve is affected by this artesian flow. Nevertheless the gradient seems to average approximately 90°C/km between the surface and 1 km and 60°C/km between 1 and 3 km.

The primary difference between the temperatures in these holes is associated with the lithologic variations, and not heat flow, as a function of the position along the Snake River Plain. Unpublished analyses of thermal conductivity of the various lithologic sections, combined with the temperature-depth data, suggest that heat flow values for the Sturm #1, INEL-GT1, Bostick #1-A and Ore-Ida #1 wells are on the order of 100±20 mWm^{-2}. So the temperature differences are associated with the difference in the geologic sections, i.e. the presence or absence of the thick, low thermal conductivity, sedimentary package.

DISCUSSION AND CONCLUSIONS

Most holes drilled at depths of 500-1000 m in the Western Snake River Plain encounter artesian aquifers at depth and (may) [illegible] about [illegible] m. flow ~~at~~ with temperatures between 25 and 60°C. Whether or not artesian hot water would be encountered at depth near the central part of the Eastern Snake River Plain is unknown, as no wells have been drilled in that area. However, the present data suggest that in most places the thermal effect of the Snake River Plain aquifer is confined to the upper 200-300 m and geothermal gradients below that depth range will be on the order of 50°C/km. The almost continuous presence of low temperature geothermal aquifers along the margins of the Snake River Plain has been proved over and over again by drilling. Temperatures in the 40-80°C range have been encountered in so many locations along the margins as to suggest that their occurrence is ubiquitous. Regional temperatures exceed 200°C at a depth of 3 to 4 km all over the Snake River Plain. Thus it seems clear that, if significant pathways for deep fluid circulation exist, high temperature geothermal systems should exist.

The geothermal gradient and heat flow data discussed in this report are summarized in Table 5. In general, in Idaho north of the Snake River Plain the heat flow varies between 60 and 80 mWm^{-2} and average gradients range from 20-25°C/km in high conductivity rocks to 45-55°C/km in low conductivity surficial rocks. In the Snake River Plain, gradients average about 70°C/km and heat flow values are typically 100 mWm^{-2}. Almost ubiquous ubiquitous geothermal anomalies are present along the margins of the Snake River Plain where gradients of 100-200°C/km are common and temperatures of 40-80°C are typically found at 200-500 m. Gradients and heat flow are low above the Snake River Plain aquifer and similar to the Western Snake River Plain below the aquifer. South of the Snake River Plain, ~~the~~ gradients in the Owyhee ~~Plateau~~ uplands are about 50°C/km and heat flow values are about 100 mWm^{-2}. These values are significantly above those in central and northern Idaho. The average heat flow and geothermal gradient in ~~the~~ Southeastern Idaho are not known, although values maybe more similar to the area north of the Snake River Plain than to the Owyhee ~~Plateau.~~ uplands

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Jack is now retired from USGS

note:
Those references not checked (✓) were not found in [illegible]

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FIGURES

Figure 1. Physiographic province map of Idaho. Boundaries of major provinces are shown as solid lines.

Figure 2. Diagram showing the well- and spring-numbering system (using well 1S/19E-23cac).

Figure 3. Graph showing Celsius (°C) and Fahrenheit (°F) temperature relationship.

Figure 4. Temperature-depth plot of wells 6N/2E-29ba and 7N/42E-19dc showing a uniform geothermal gradient in an area of uniform lithology and a change in gradient due to a change in thermal conductivity (at 170 m in 7N/42E-19dc).

Figure 5. Examples of vesicular basalt disturbance. The geothermal gradients of many wells which penetrate basalt have a similar disturbance. The wells that have this disturbance exhale air during the day and inhale air at night. The background temperature gradient cannot be determined from these types of curve.

Figure 6a. Histograms of geothermal gradient for the Northern Idaho batholith and western Rocky Mountains and the southern Idaho batholith. The dominant lithology at each site is shown by a pattern (granite, caret; basalt, large dots; Precambrian sediments, triangles, unconsolidated sediment, dots, andesite, A). 6b. Histograms of heat flow for Northern Idaho batholith and the southern Idaho batholith. The dominant lithology of each site is shown by the same pattern as in Figure 6a. M stands for hole near the margin of the Snake River Plain.

Figure 7. Location map of hot springs (asterisks) and heat flow sites in the southern two-thirds of the Idaho batholith. Heat flow values are shown in mWm^{-2}. Values characteristic of geothermal systems are shown as solid squares, regional values in granite are shown as circles, regional values in sedimentary or volcanic rocks are shown as dots, and a single value in basalt in the Smith Prairie area is shown by a triangle.

Figure 8. Topographic and location map of the Garden Valley area along the South Fork of the Payette River. Sites of heat flow measurements are shown as circled stars and sites of hot springs are shown as asterisks. Heat flow values (mWm^{-2}), geothermal gradients (°C/km, small numbers) and measured spring temperatures (°C) are shown.

Figure 9. Temperature-depth curves for the heat flow sites shown in Figure 8 in the vicinity of the South Fork of the Payette River. Every 5th temperature point is shown by the appropriate symbol.

Figure 10a. Histogram of geothermal gradient for the Weiser area. The lithology at each site is basalt or unconsolidated sediment. Figure 10b. Histogram of heat flow for the the Weiser area.

Figure 11. Detailed heat flow map of southwestern Idaho. Contours of heat flow at $20mWm^{-2}$ intervals are shown. Locations of deep wells discussed in the text are shown as are the names of areas discussed in the text (WSRPL is low heat flow band and WSR is western Snake River high heat flow anomaly). The line of the cross section (AA') in Figure 15 is shown.

Figure 12. Example temperature-depth curves of wells less than 200 m deep in the Western Snake River Plain. Temperature-depth curves for the northern margin are shown by solid lines, the temperature-depth curves for the central part are shown by dots, and the temperature-depth curves for the southern margin are shown by dashed lines.

Figure 13a. Temperature-depth curves for deep wells in the western end of the Western Snake River Plain. Every 5th point is shown by the appropriate symbol. 13b. Temperature-depth curves of wells greater than 200 m deep in the Western Snake River Plain. Temperature-depth curves for the central low heat flow region (dots), the west-central area (dashes), the northern margin, Boise front (solid), the Western Snake River Pl -(19?) anomaly (solid line with asterisks), and Bruneau-Grand View anomaly (dash-dot line) are shown.

Figure 14a. Histograms of geothermal gradient for the Western Snake River Plain area. The holes are all in basalt or sedimentary rocks. 14b. Histograms of heat flow gradient for the Western Snake River Plain area.

Figure 15. Heat flow cross section of the Western Snake River Plain. The line of the cross section is shown on Figure 11. Points on the cross section are shown by dots. Generalized heat flow east and west of the line of the section is shown diagramatically and the moderate-temperature areas identified.

Figure 16. Temperature-depth curves for wells in the Owyhee Uplands. Most holes were drilled in silicic volcanic rocks. Every 5th point is shown with the appropriate symbol.

Figure 17. Histograms of geothermal gradient and heat flow for the Owyhee ~~Plateau~~ Uplands. Holes in granite are shown by the caret pattern.

Figure 18. Temperature-depth curves for wells in the Camas Prairie-Mt. Bennett Hills area. Every 5th point is shown with the appropriate symbol.

Figure 19. Generalized heat flow map of southeastern Idaho. The heat flow values are coded as shown. The Snake River Plain aquifer outline is generalized. Small heat flow symbols are plotted for heat flow values above the aquifer. Large symbols are heat flow values outside or below the aquifer. Gradients from wells in the southwest Idaho area (Ralston and Mayo, 1983) are shown.

Figure 20. Heat flow profiles perpendicular to the axis of the Snake River Plain. The solid curve is the smoothed eastern Snake River Plain profile (fit to the data represented by solid and open circles) and the dashed curve is a theoretical heat flow profile (from the model 1, 12.5 m.y. solution of Brott and others, 1978) which best fits the western Snake River Plain data. The open and solid circles represent data taken inside and outside the Snake River Plain aquifer. These data are projected into the composite profile from a 50-km strike length extending east from a line between Arco and Pocatello. The values are plotted on a scale which shows their perpendicular distance from the axis (after Brott and others, 1981).

Figure 21. Temperatures in the Snake River Plain aquifer. The solid heavy lines show the locations of recharge and the dashed lines show the locations of discharge (after Mundorff and others, 1964). The internal heavy solid lines show the location of the Mud Lake (western) and Arco (eastern) hydrological barriers See note to J.F. (after Haskett and Hampton, 1979). The aquifer temperatures are listed in Brott and others (1981) and in Appendex B. The locations of five deep (i.e., >400 m) holes are shown. Each narrow line is a flow line representing 18.5 m^3 s^{-1} of water flow. After Brott and others (1981). Flow paths for temperatures plotted in Figure 24 shown by N, NC, SC, and S labels.

Figure 22. Two-dimensional transient Snake River Plain aquifer model. The model contains three layers. The upper layer represents the rocks above the aquifer; the mechanism for the transport of heat in this layer is purely conductive. The center layer represents the aquifer convection zone and the mechanisms for the transport of heat are convection and conduction. The lower layer is below the aquifer, and the mechanism of heat transfer

is purely conductive. The surface geothermal gradient profiles before initiation of convection and in the presence of convection are shown above the model (dashed and solid lines, respectively). Figure from Brott and others (1981).

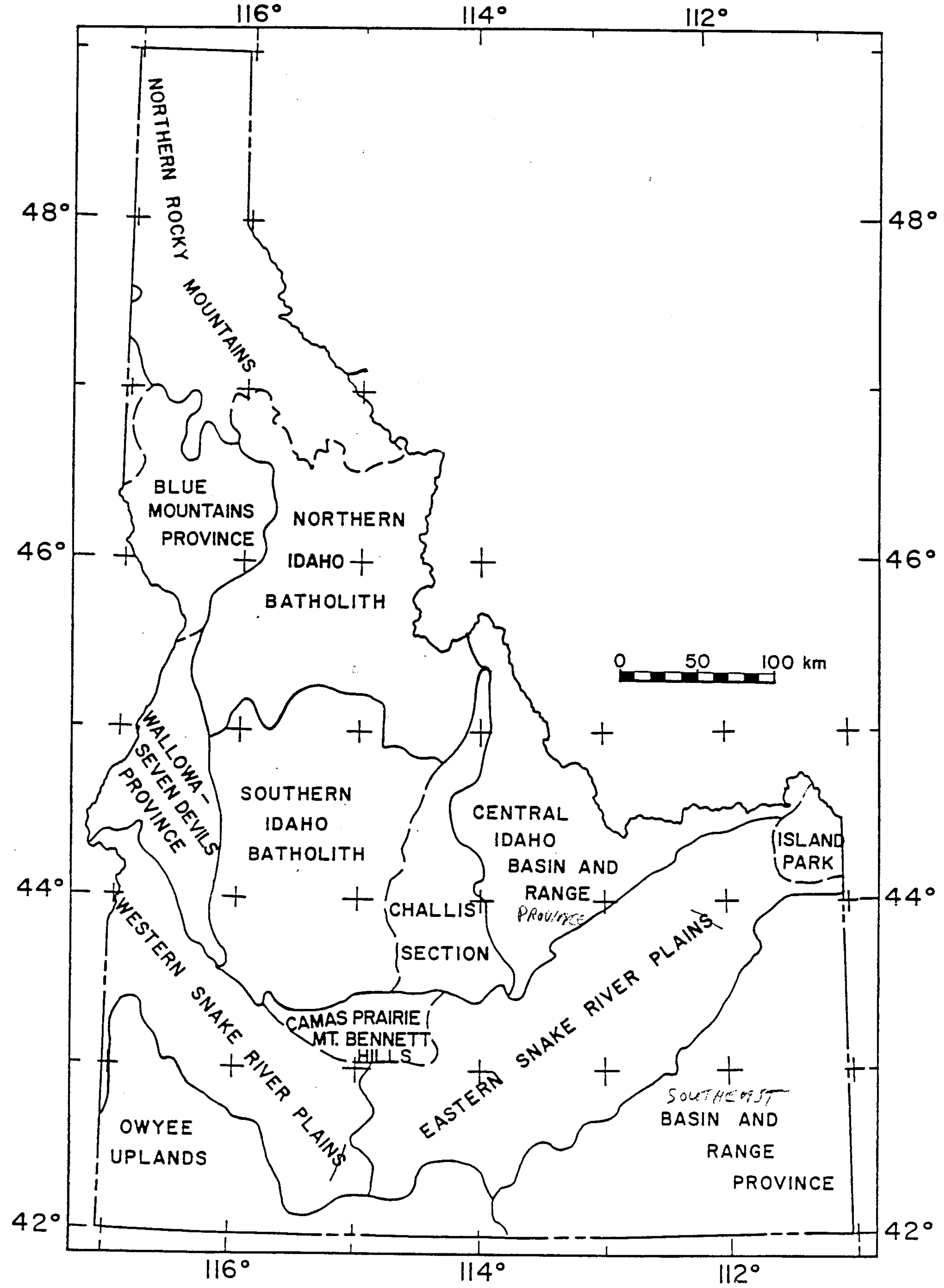
Figure 23. Map and temperature-depth plots for geothermal data on and near the Idaho National Engineering Laboratory, eastern Idaho. Origin of each temperature-depth axis, scaled as shown in the right corner, is at well site. Sites of wells with the vesicular basalt disturbance are shown as circles. Wells with anomalously high gradients are shown by asterisks. Deep wells are shown by squares.

Figure 24a. Aquifer temperature versus distance along the northern, north-central, south-central, and southern part of the Snake River Plain aquifer. 24b. Aquifer temperatures versus residence time along the northern, north-central, south-central, and southern part of the Snake River Plain aquifer. The locations are given in Figure 21.

Figure 25. Temperature in intermediate depth wells in the area of the Snake River Plain aquifer. A non-equilibrium log (Kunze and Marlor, 1982) is shown for the Rogers [illegible] Potatoes-Madison County Geothermal well (6N/40E-31bbal). Every 5th point is shown by the appropriate symbol.

Figure 26. Temperature-depth curves for holes in the Island Park ~~region~~ area. Every 5th point is shown by the appropriate symbol.

Figure 27. Temperature-depth curves and bottom hole temperature for holes in the Southeastern Basin and Range province. Gradients based on bottom hole temperature data are from Ralston and Mayo (1983).


116°
114°
112°
48°
46°
44°
42°
NORTHERN ROCKY MOUNTAINS
BLUE MOUNTAINS PROVINCE
NORTHERN IDAHO BATHOLITH
0 50 100 km
WALLOWA-SEVEN DEVILS PROVINCE
SOUTHERN IDAHO BATHOLITH
CENTRAL IDAHO BASIN AND RANGE PROVINCE
ISLAND PARK
CHALLIS SECTION
WESTERN SNAKE RIVER PLAINS
CAMAS PRAIRIE MT. BENNETT HILLS
EASTERN SNAKE RIVER PLAINS
OWYEE UPLANDS
SOUTHEAST BASIN AND RANGE PROVINCE

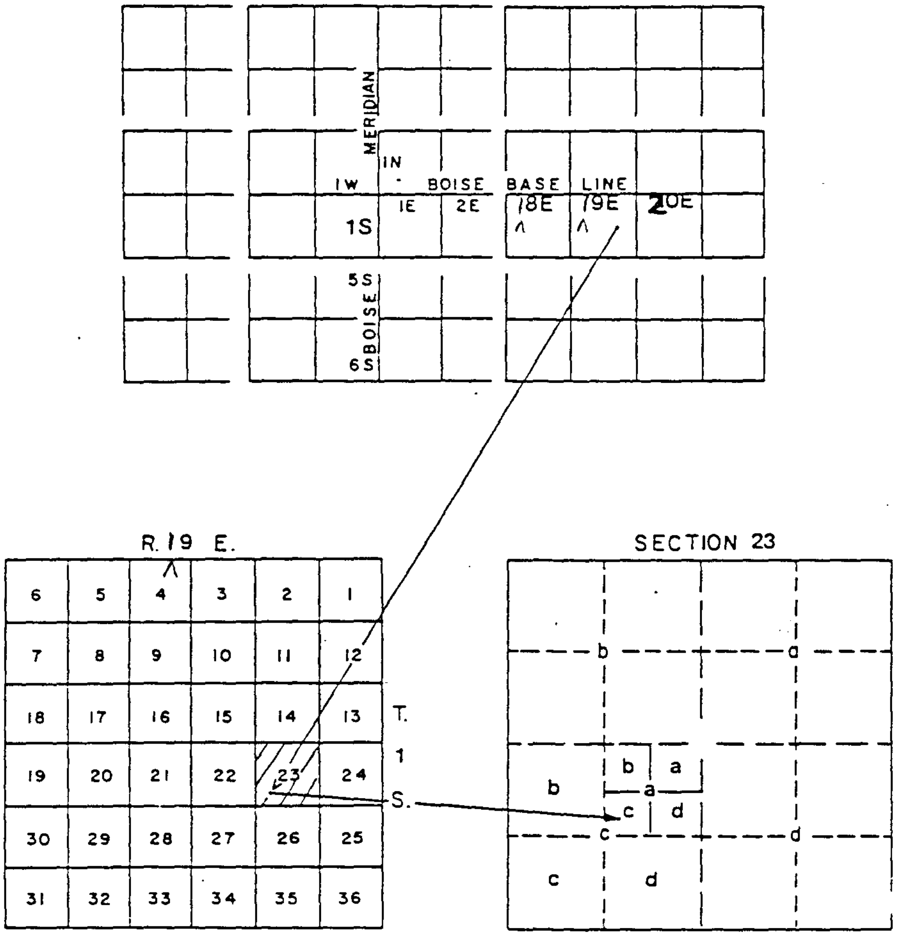
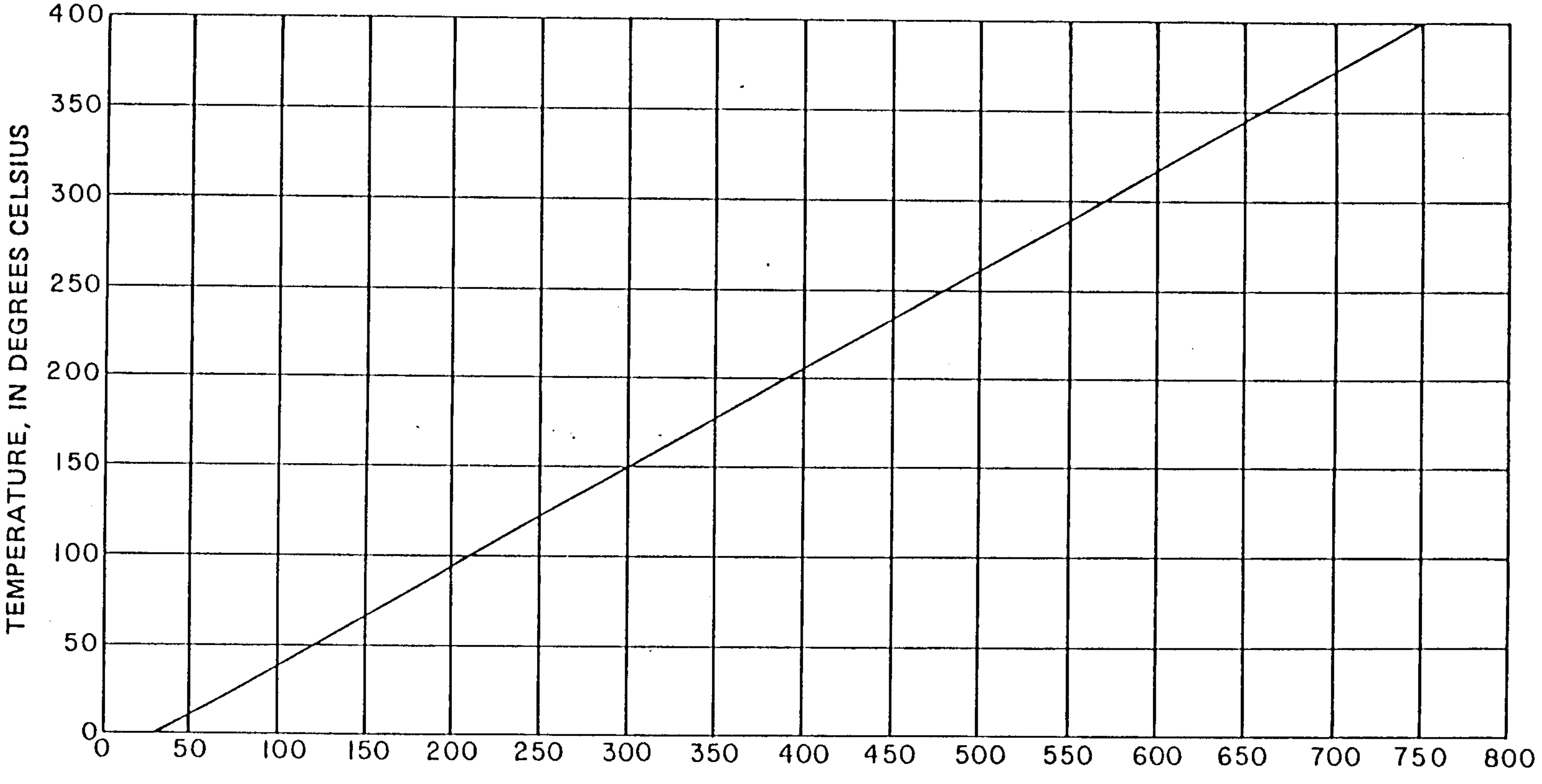


FIGURE Diagram showing the well- and spring-numbering system.
(Using well 1S-19E-23cac.)

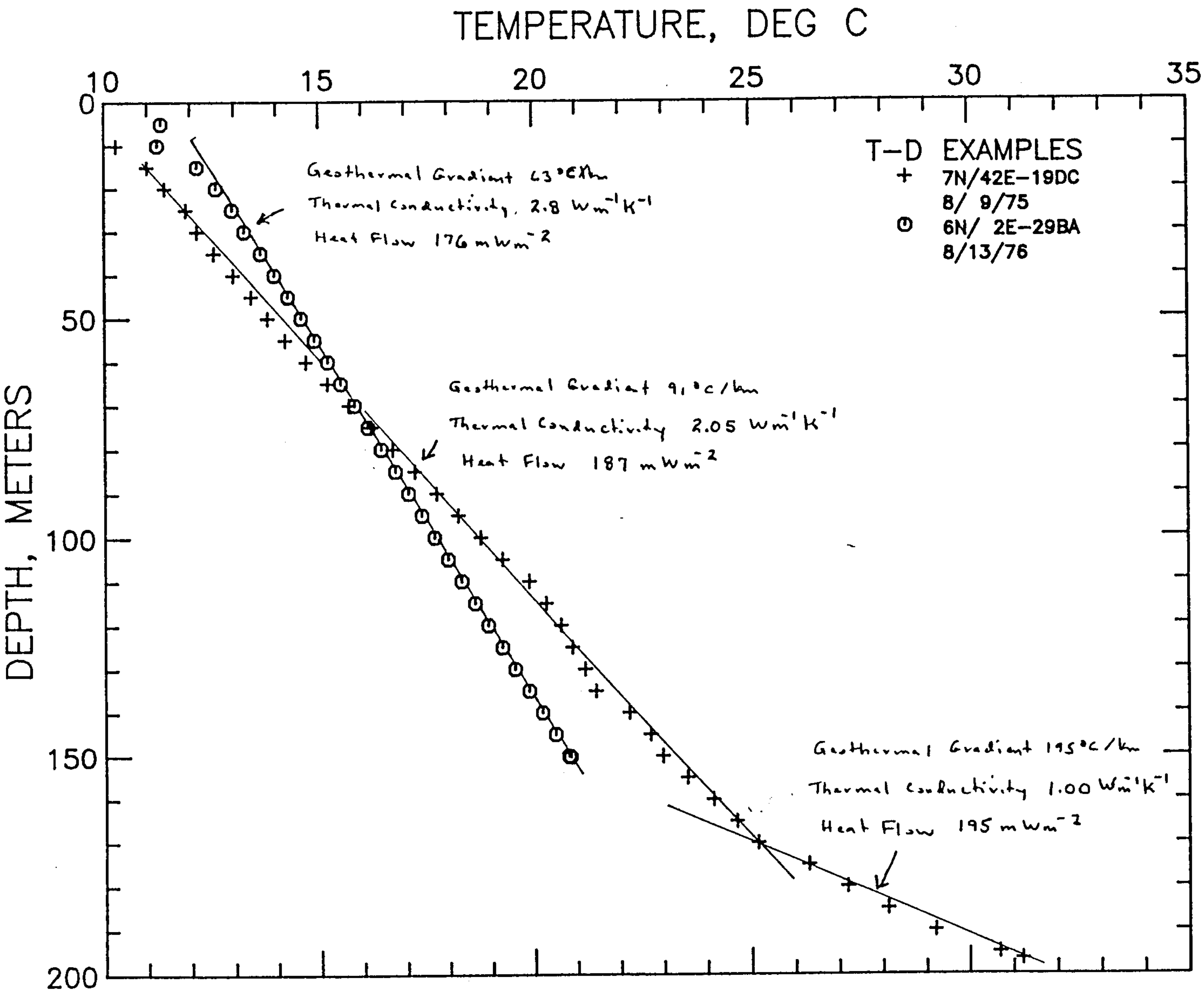
FIGURE 2



Conversion of degrees Celsius (°C) to degrees Fahrenheit (°F) is based on the equation, °F = 1.8°C + 32.

FIGURE. Graph showing Celsius (°C) and Fahrenheit (°F) temperature relationship.

FIGURE 2


TEMPERATURE, DEG C
10
15
20
25
30
35
0
50
100
150
200
DEPTH, METERS
T-D EXAMPLES
+ 7N/42E-19DC
8/ 9/75
ʘ 6N/ 2E-29BA
8/13/76
Geothermal Gradient 63°C/km
Thermal Conductivity, 2.8 Wm^{-1}K^{-1}
Heat Flow 176 mWm^{-2}
Geothermal Gradient 91°C/km
Thermal Conductivity 2.05 Wm^{-1}K^{-1}
Heat Flow 187 mWm^{-2}
Geothermal Gradient 195°C/km
Thermal Conductivity 1.00 Wm^{-1}K^{-1}
Heat Flow 195 mWm^{-2}

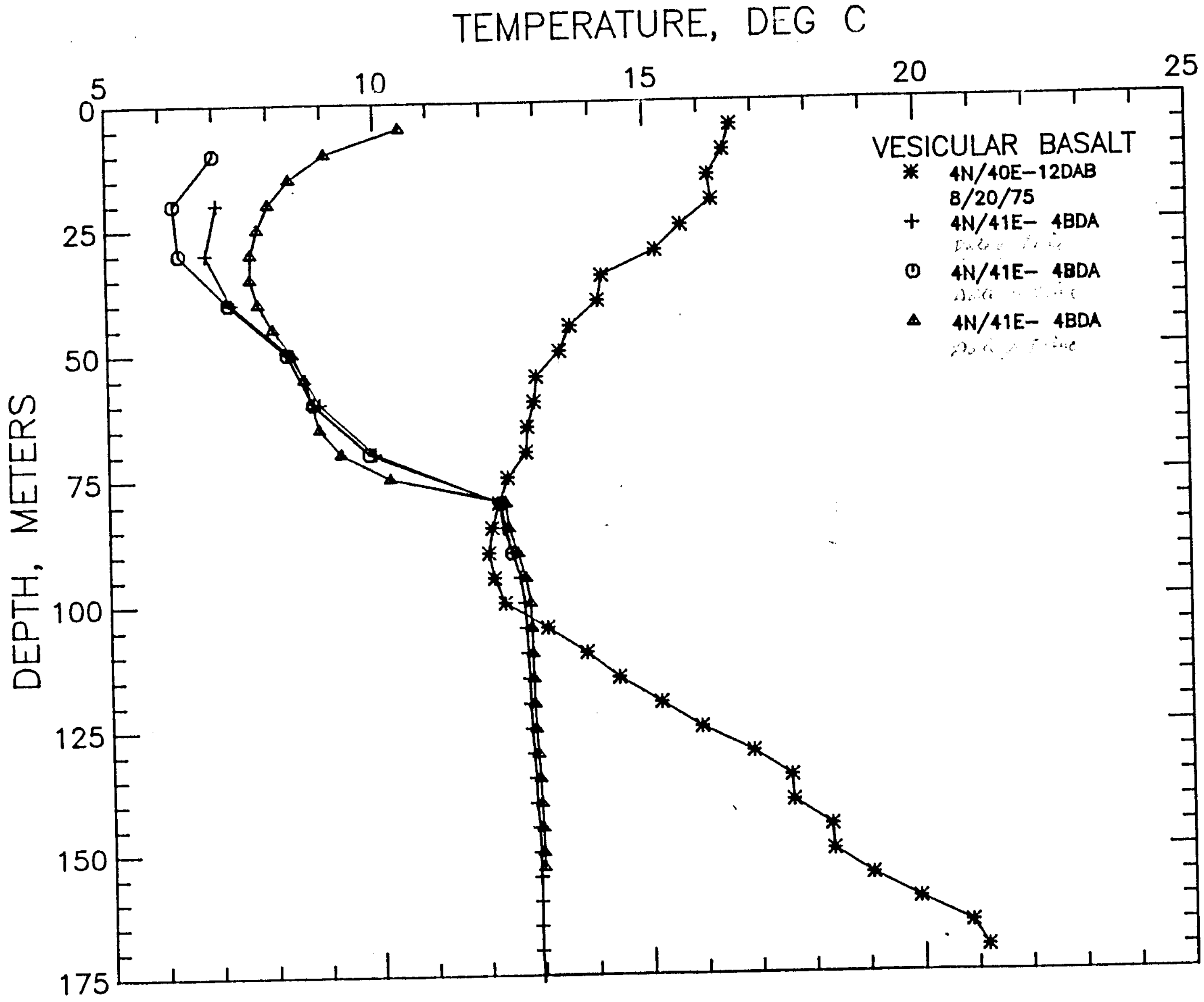
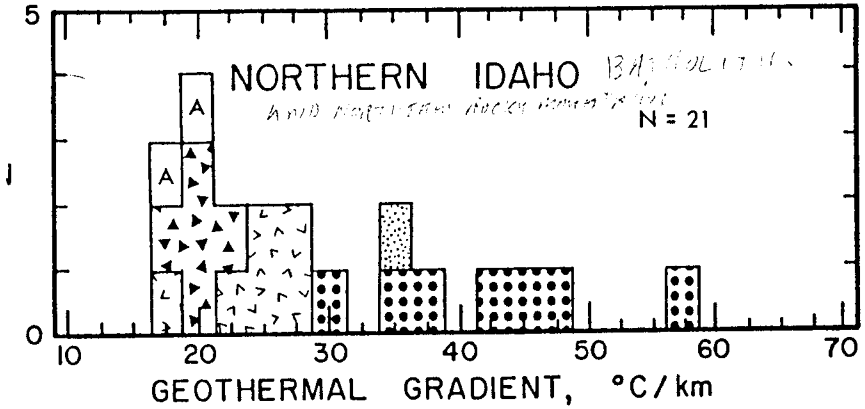
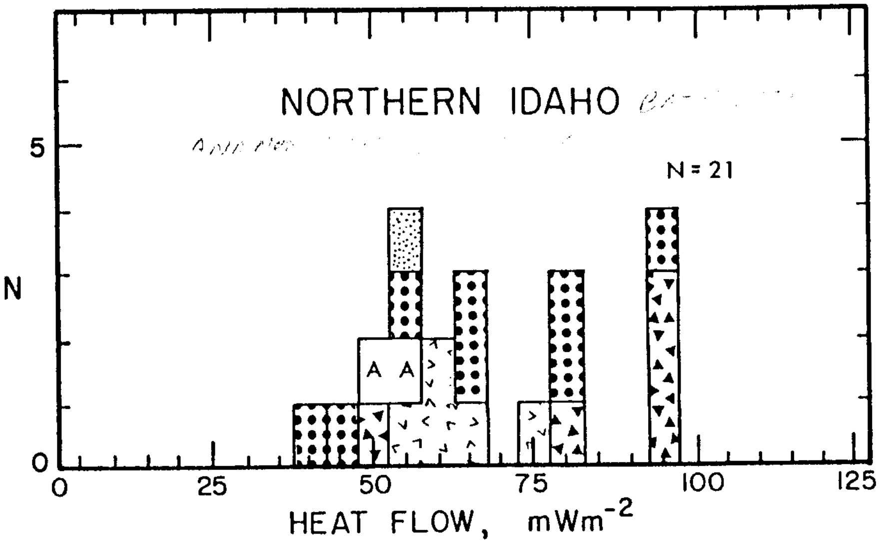
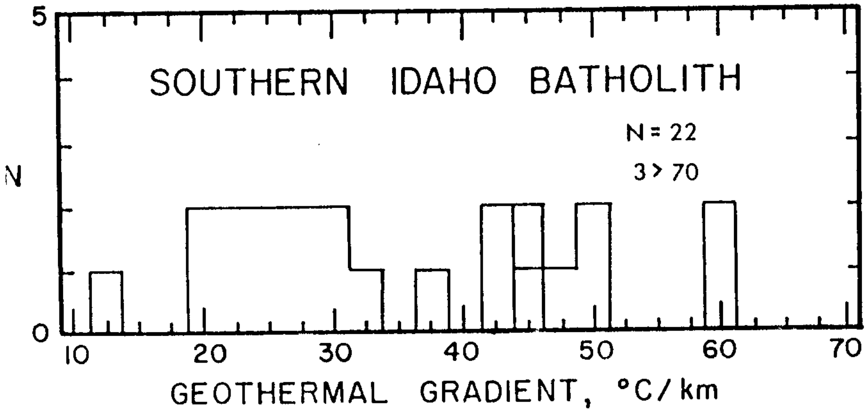

TEMPERATURE, DEG C
5
10
15
20
25
DEPTH, METERS
0
25
50
75
100
125
150
175
VESICULAR BASALT
✱ 4N/40E–12DAB
8/20/75
+ 4N/41E– 4BDA
Date [illegible]
○ 4N/41E– 4BDA
Date [illegible]
▲ 4N/41E– 4BDA
Date [illegible]

Figure 5


NORTHERN IDAHO BATHOLITH
AND NORTHERN ROCKY MOUNTAINS
N = 21
A
A
5
0
10
20
30
40
50
60
70
GEOTHERMAL GRADIENT, °C/km


NORTHERN IDAHO
AND NOR
N = 21
A A
5
N
0
0
25
50
75
100
125
HEAT FLOW, mWm-2


SOUTHERN IDAHO BATHOLITH
N = 22
3 > 70
5
N
0
10
20
30
40
50
60
70
GEOTHERMAL GRADIENT, °C/km

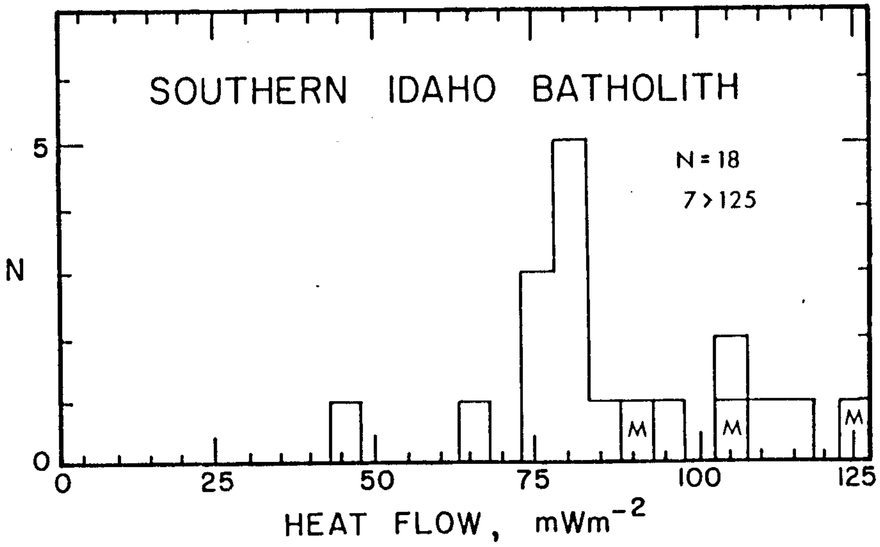

SOUTHERN IDAHO BATHOLITH
N = 18
7 > 125
M
M
M
5
N
0
0
25
50
75
100
125
HEAT FLOW, mWm-2

Figure 28. Location of intermediate depth and deep wells in the Snake River Plain. Wells discussed in the text are S (Sturm #1), MC (Madison County), G (INEL-GT1), P (Palacio #1), AC (Anderson Camp), B (Bostic #1-A), MH (Mountain Home Air Force Base), F (Anschutz Federal 60-13 #1), H (Hubbert #1), RR (Raft River geothermal system), J (James #1), C (Christiansen #A-1), and O (Ore-Ida #1). Lines of section in Figure 29 are shown.

Figure 29a. Diagramatic longitudinal geologic section of the Snake River Plain based on Sturm #1, INEL #GT1, Bostic #1-A, and Ore-Ida #1 wells. 29b. East-west transverse section across the Western Snake River Plain based on Bostic #1-A, Mountain Home Air Force Base and Anschutz Federal 60-13 #1 wells. These sections are intended to illustrate the general changes in the geologic section to 3 km. The actual section at any given point may be quite different than that shown.

Figure 30. Temperature-depth curves for selected deep wells along the Snake River Plain. Equilibrium curves are solid, nonequilibrium logs are dashed.

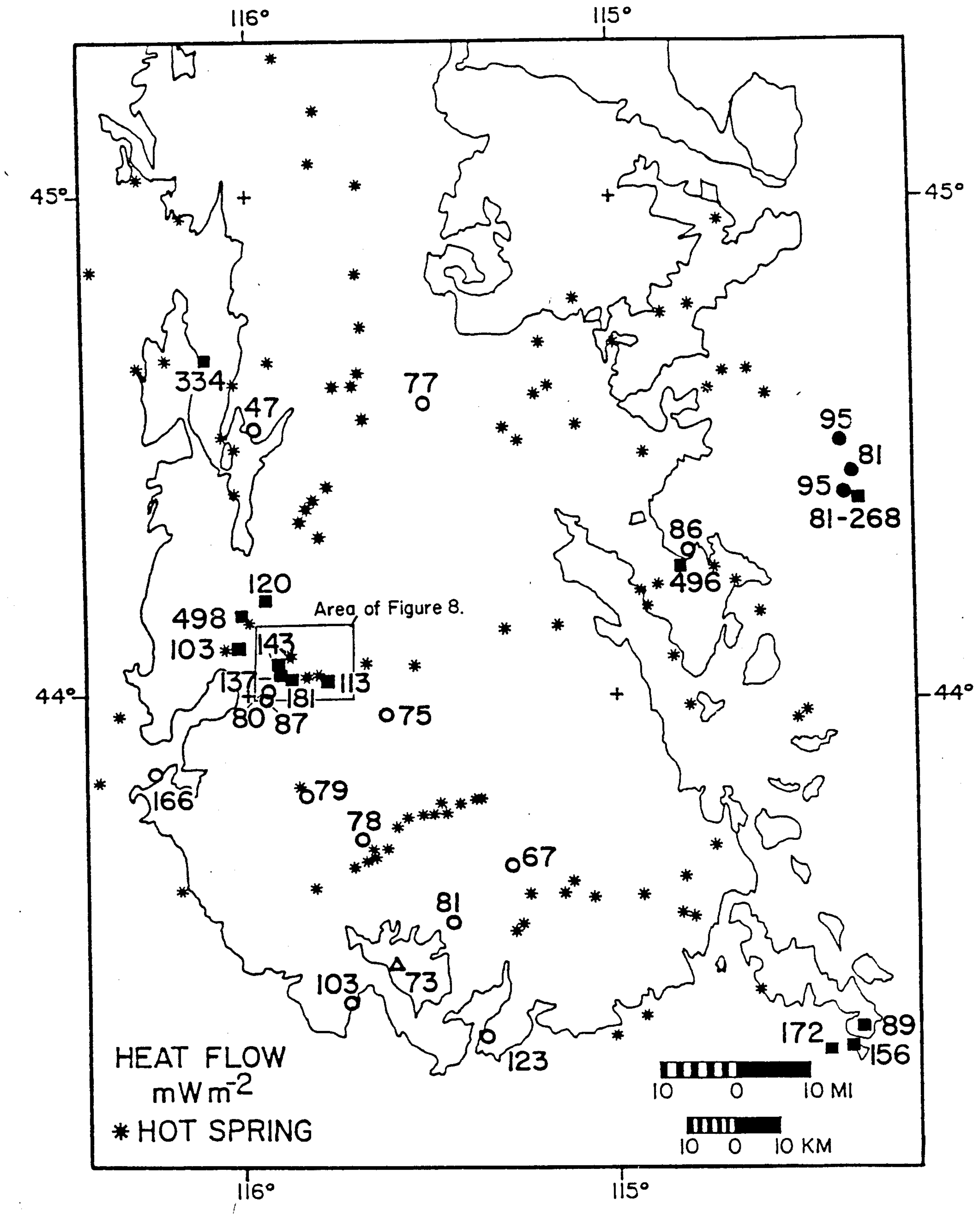

116°
115°
45°
45°
44°
44°
116°
115°
334
47
77
95
81
95
81-268
86
496
120
498
103
143
137
181
113
80
87
75
Area of Figure 8.
166
79
78
67
81
73
103
123
172
89
156
HEAT FLOW
mWm^{-2}
* HOT SPRING
10 0 10 MI
10 0 10 KM

Figure 7

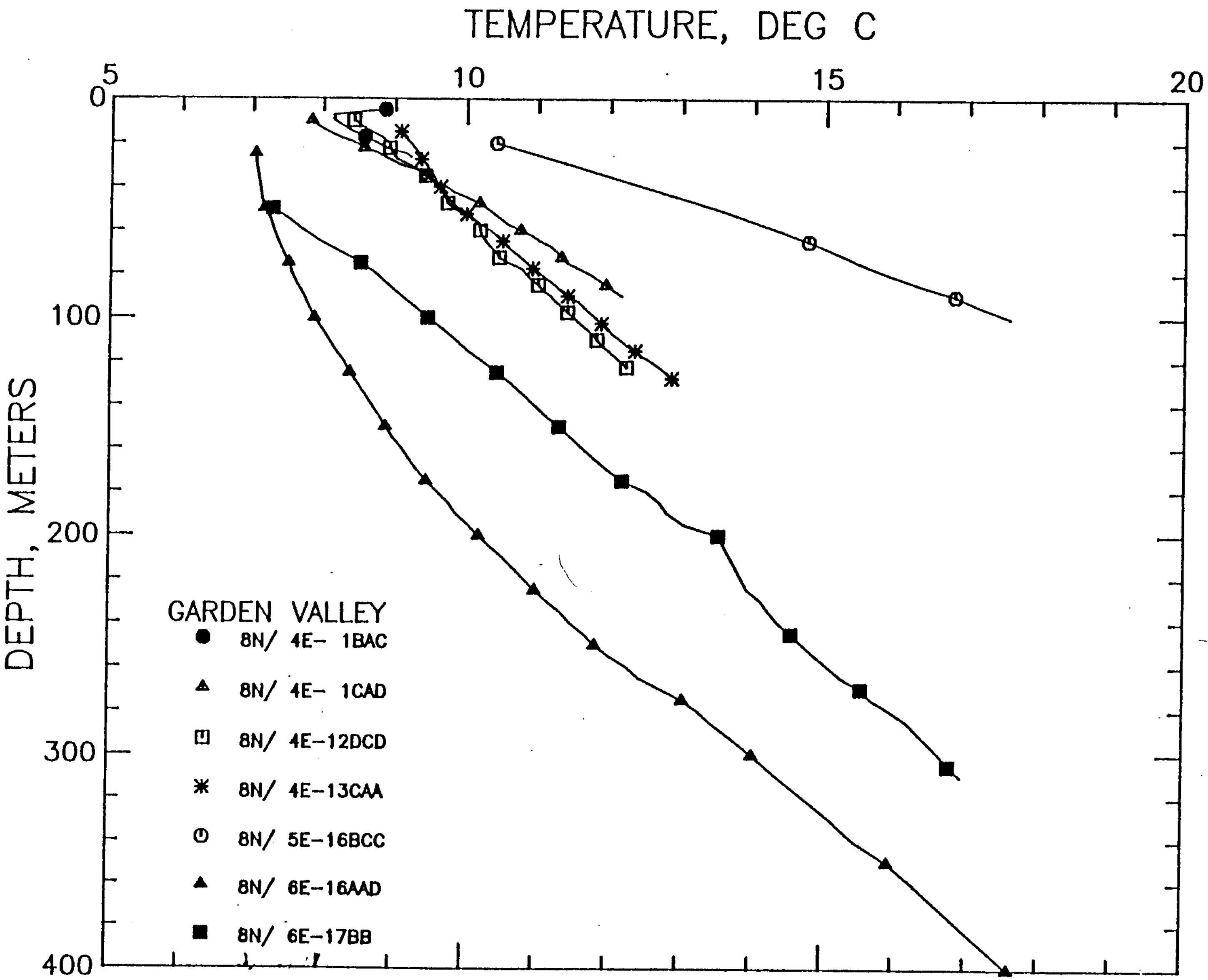

TEMPERATURE, DEG C
5
10
15
20
DEPTH, METERS
0
100
200
300
400
GARDEN VALLEY
● 8N/ 4E- 1BAC
△ 8N/ 4E- 1CAD
□ 8N/ 4E-12DCD
✳ 8N/ 4E-13CAA
○ 8N/ 5E-16BCC
▲ 8N/ 6E-16AAD
■ 8N/ 6E-17BB

Figure 9

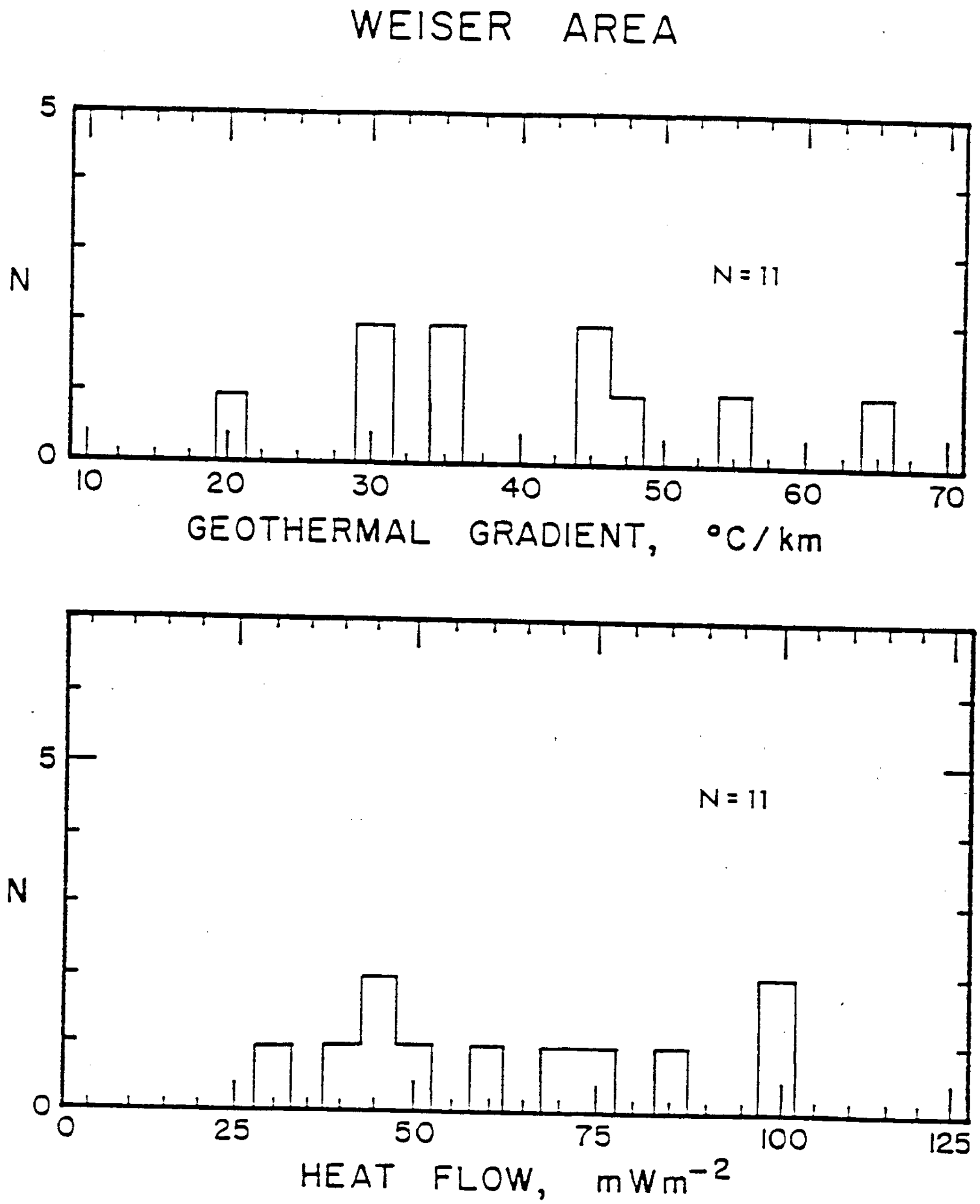
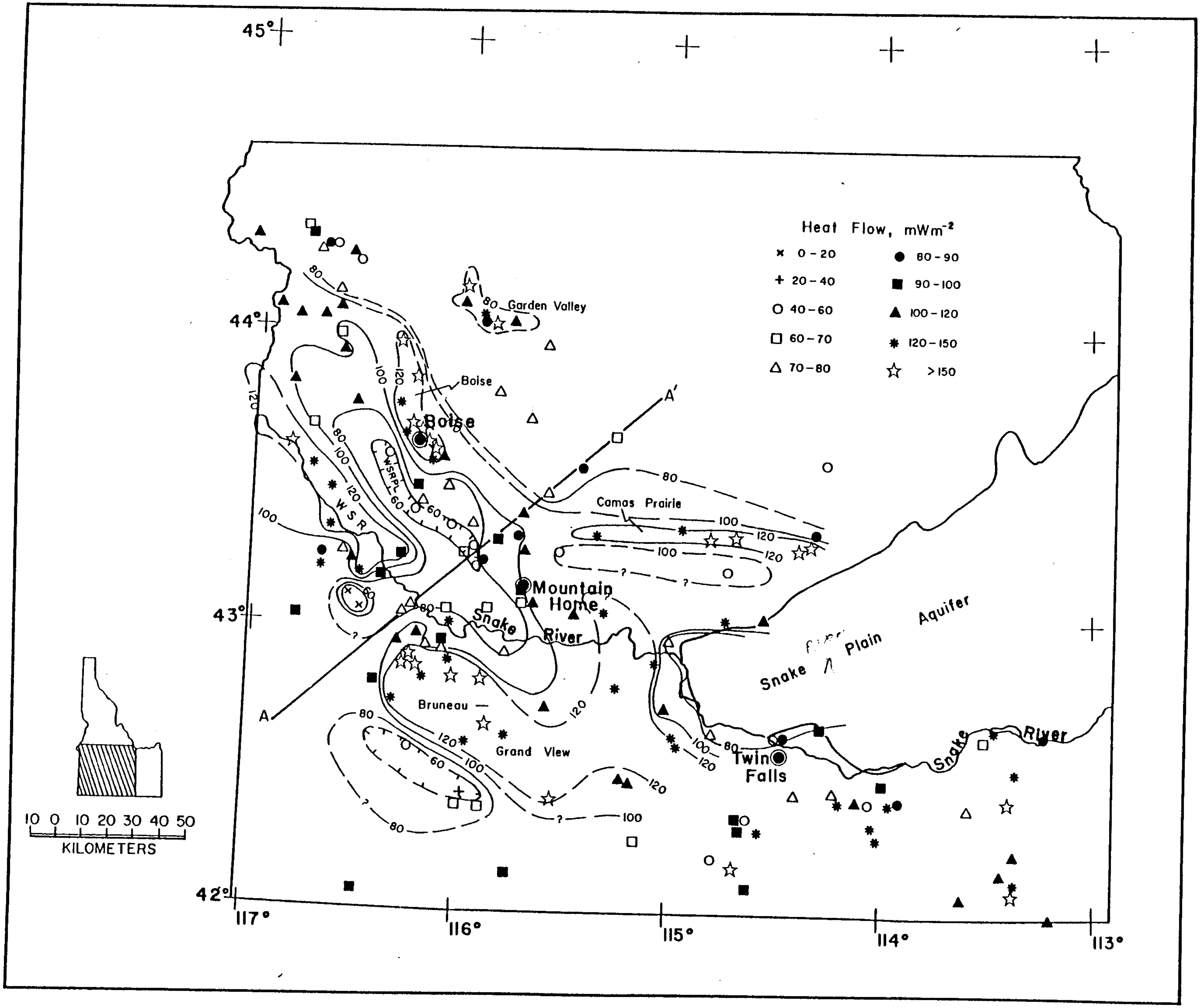
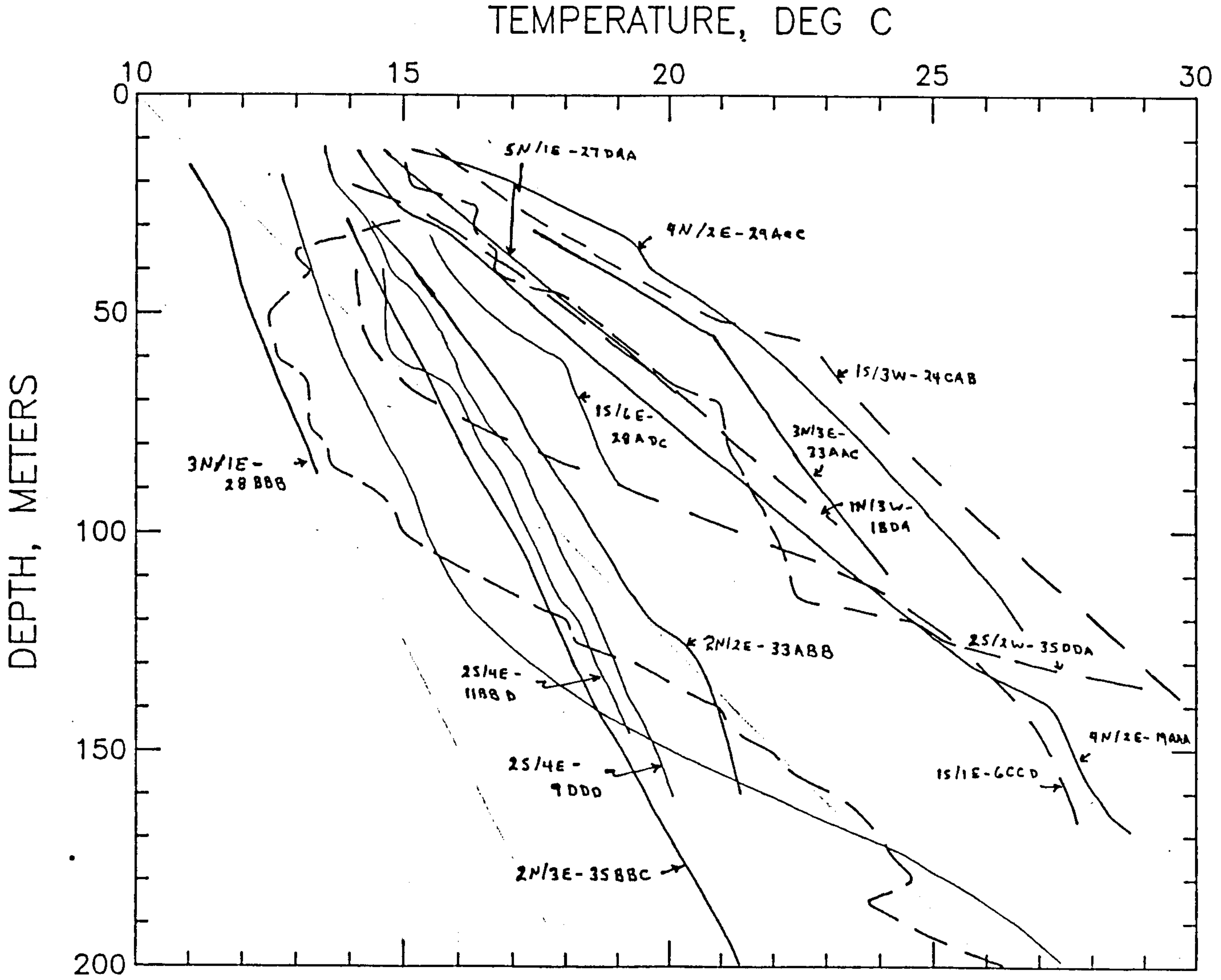

WEISER AREA
5
N
0
N = 11
10
20
30
40
50
60
70
GEOTHERMAL GRADIENT, °C/km
5
N
0
N = 11
0
25
50
75
100
125
HEAT FLOW, mWm⁻²

Figure 10


45°
44°
43°
42°
117°
116°
115°
114°
113°
Heat Flow, mWm⁻²
× 0-20
+ 20-40
○ 40-60
□ 60-70
△ 70-80
● 80-90
■ 90-100
▲ 100-120
✱ 120-150
☆ >150
Garden Valley
Boise
Boise
Camas Prairie
Mountain Home
Snake River
Snake River Plain Aquifer
Bruneau
Grand View
Twin Falls
Snake River
WSR
WSRPL
A
A'
80
100
120
60
?
10 0 10 20 30 40 50
KILOMETERS


TEMPERATURE, DEG C
10
15
20
25
30
0
50
100
150
200
DEPTH, METERS
5N/1E-27DAA
9N/2E-29AAC
1S/3W-24CAB
1S/6E-29ADC
3N/3E-23AAC
1N/3W-18DA
3N/1E-28BBB
2N/2E-33ABB
2S/4E-11BBD
2S/4E-9DDD
2S/2W-35DDA
9N/2E-14AAA
1S/1E-6CCD
2N/3E-35BBC

12

Fig 12

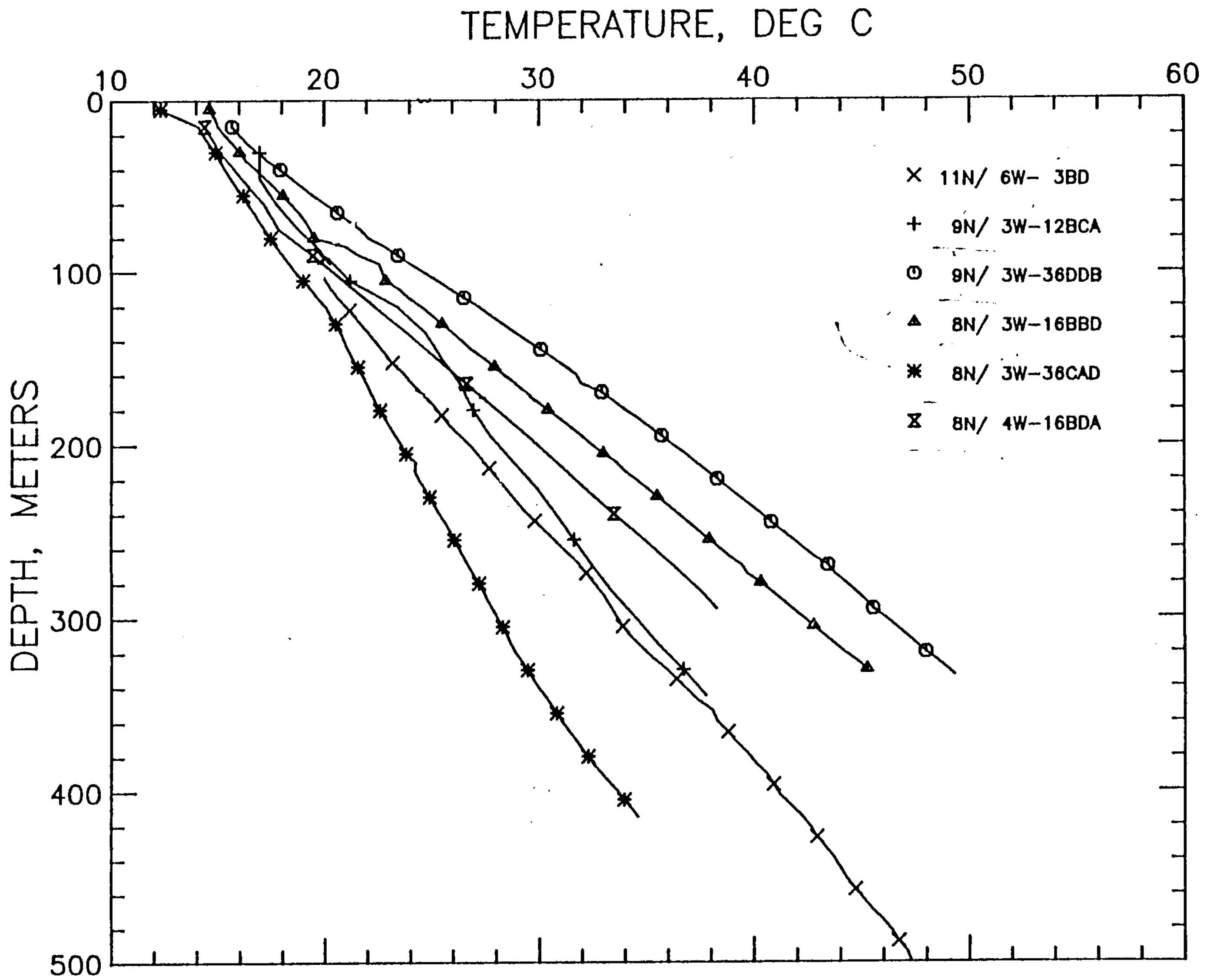

TEMPERATURE, DEG C
10
20
30
40
50
60
0
100
200
300
400
500
DEPTH, METERS
× 11N/ 6W- 3BD
+ 9N/ 3W-12BCA
○ 9N/ 3W-36DDB
▲ 8N/ 3W-16BBD
✳ 8N/ 3W-36CAD
⧗ 8N/ 4W-16BDA

Figure 13a

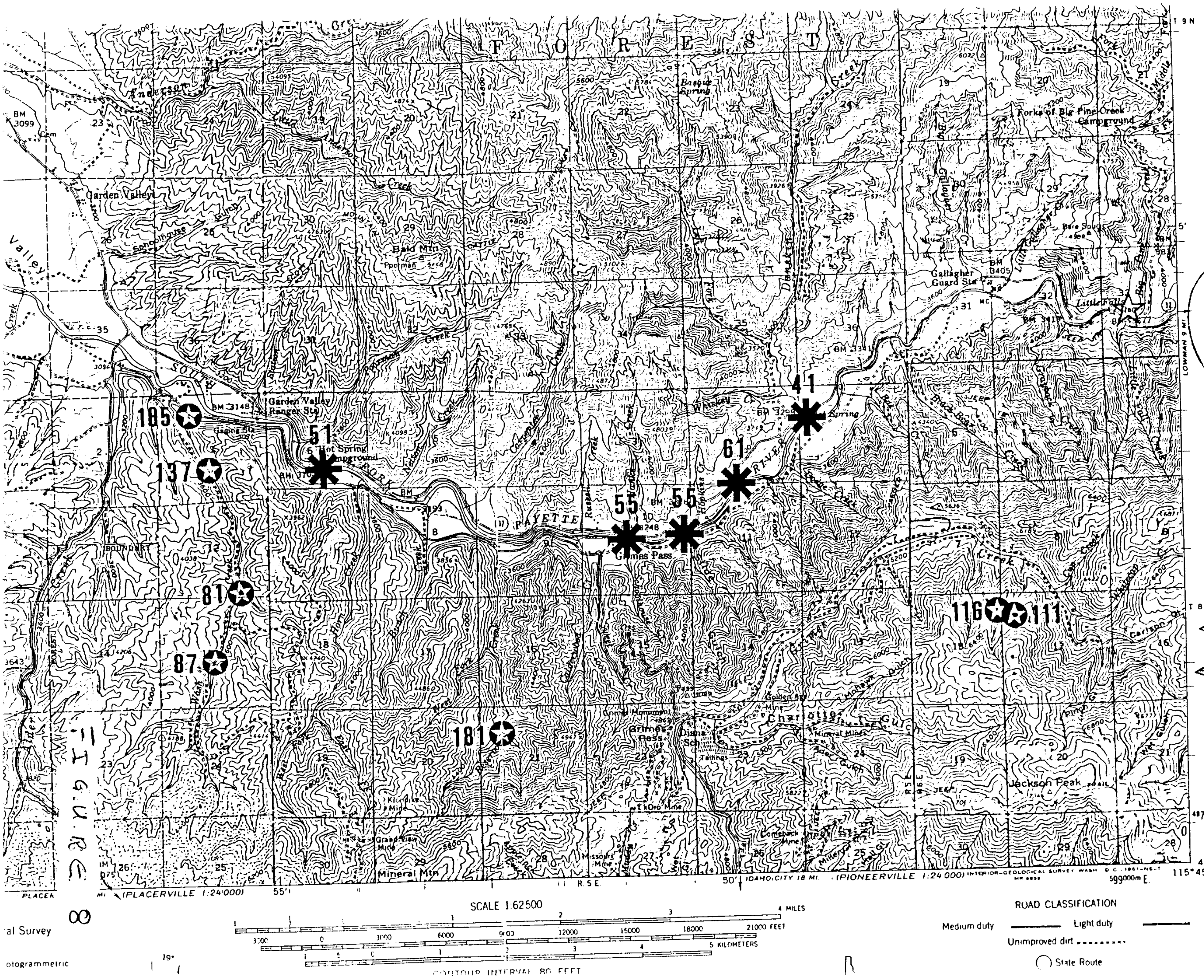
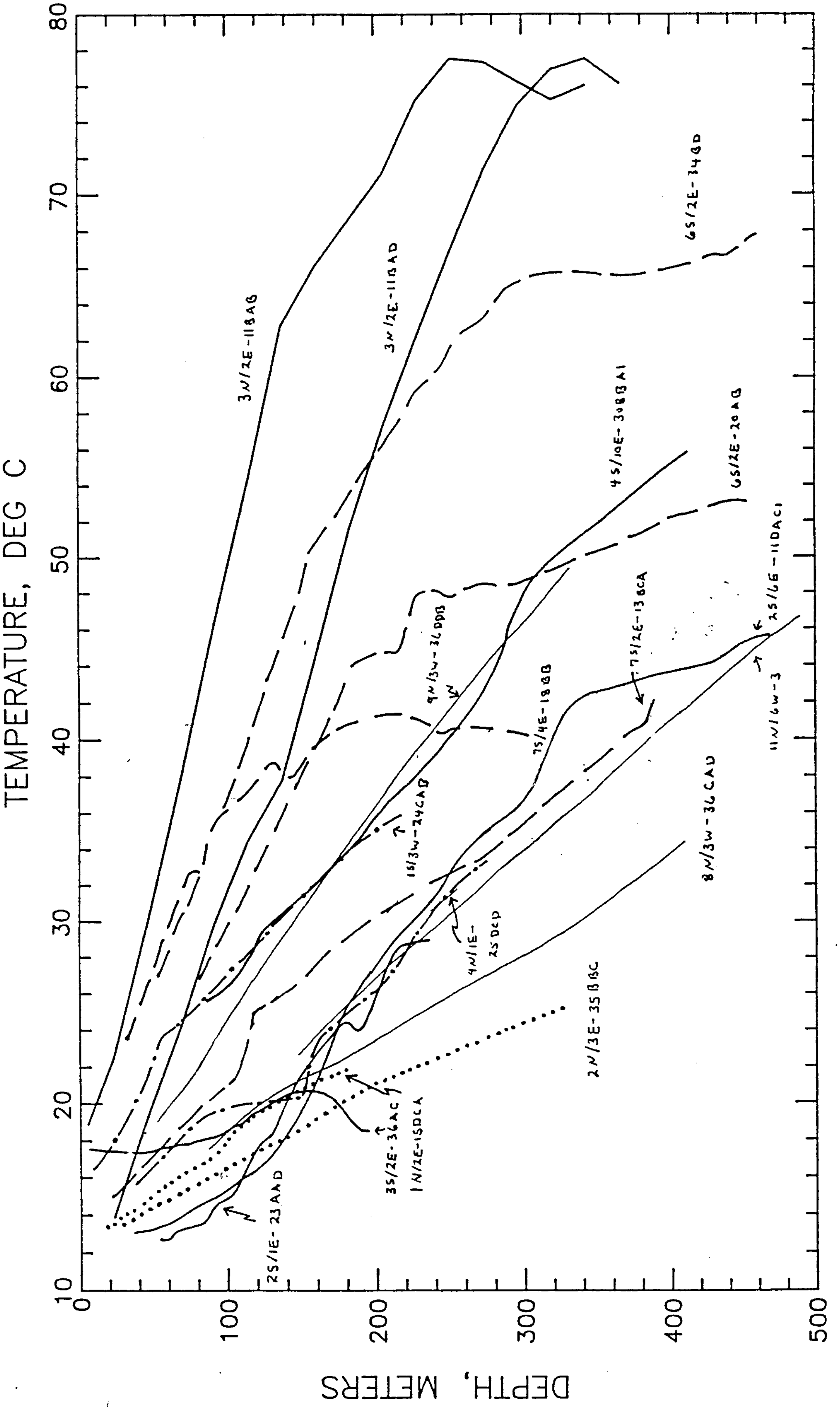


FIGURE 8

These
Tri
M
cop,
← #
← #


TEMPERATURE, DEG C
DEPTH, METERS
10
20
30
40
50
60
70
80
0
100
200
300
400
500
3N/2E-11BAB
3N/2E-11BAD
6S/2E-34BD
4S/10E-30BBA1
6S/2E-20AB
2S/6E-11DAC1
7S/2E-13BCA
11N/6W-3
9N/3W-36DDB
7S/4E-18BB
8N/3W-36CAD
1S/3W-24CAB
4N/1E-25DCD
2N/3E-35BBC
3S/2E-36AC
1N/2E-15DCA
2S/1E-23AAD

WESTERN SNAKE RIVER PLAIN

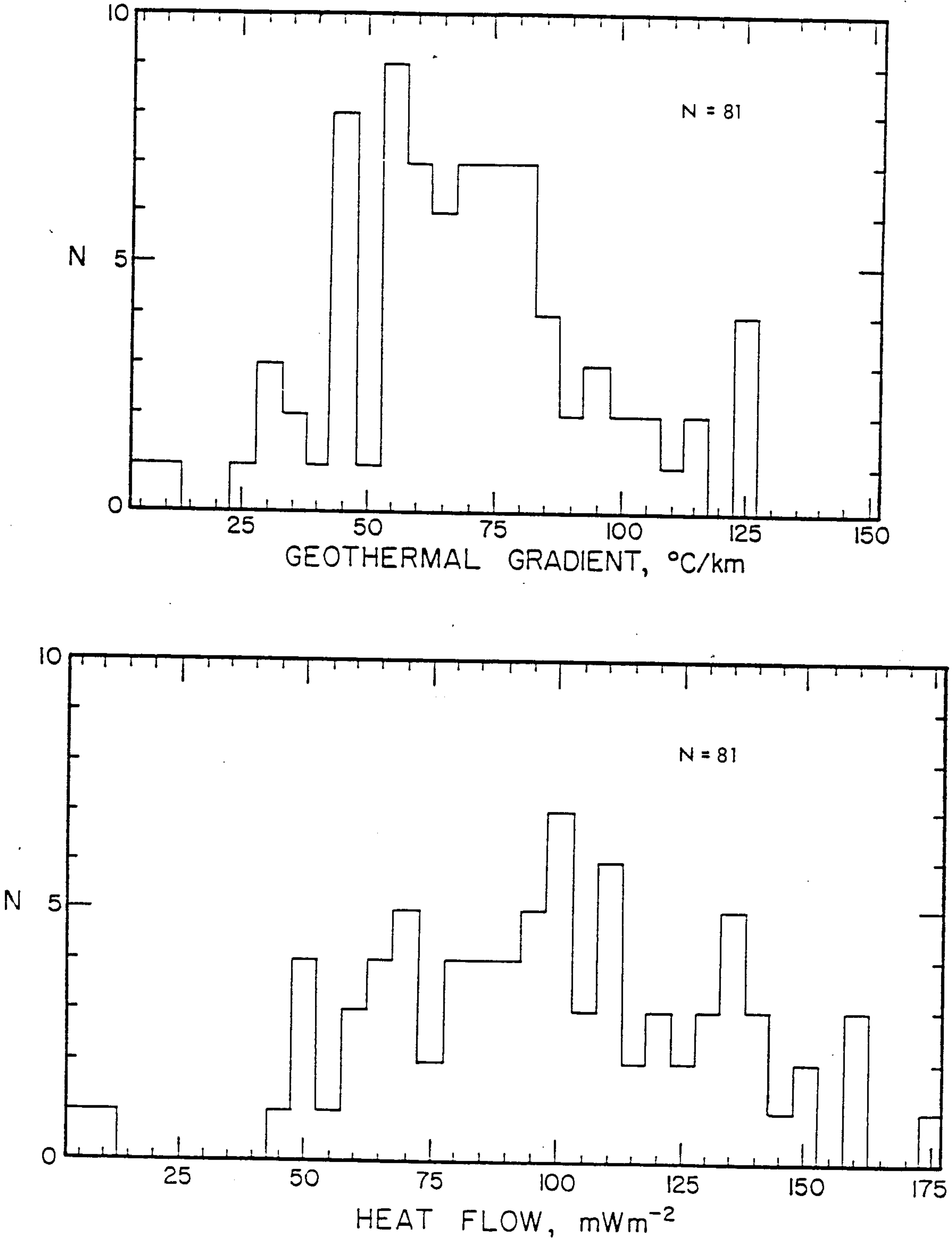
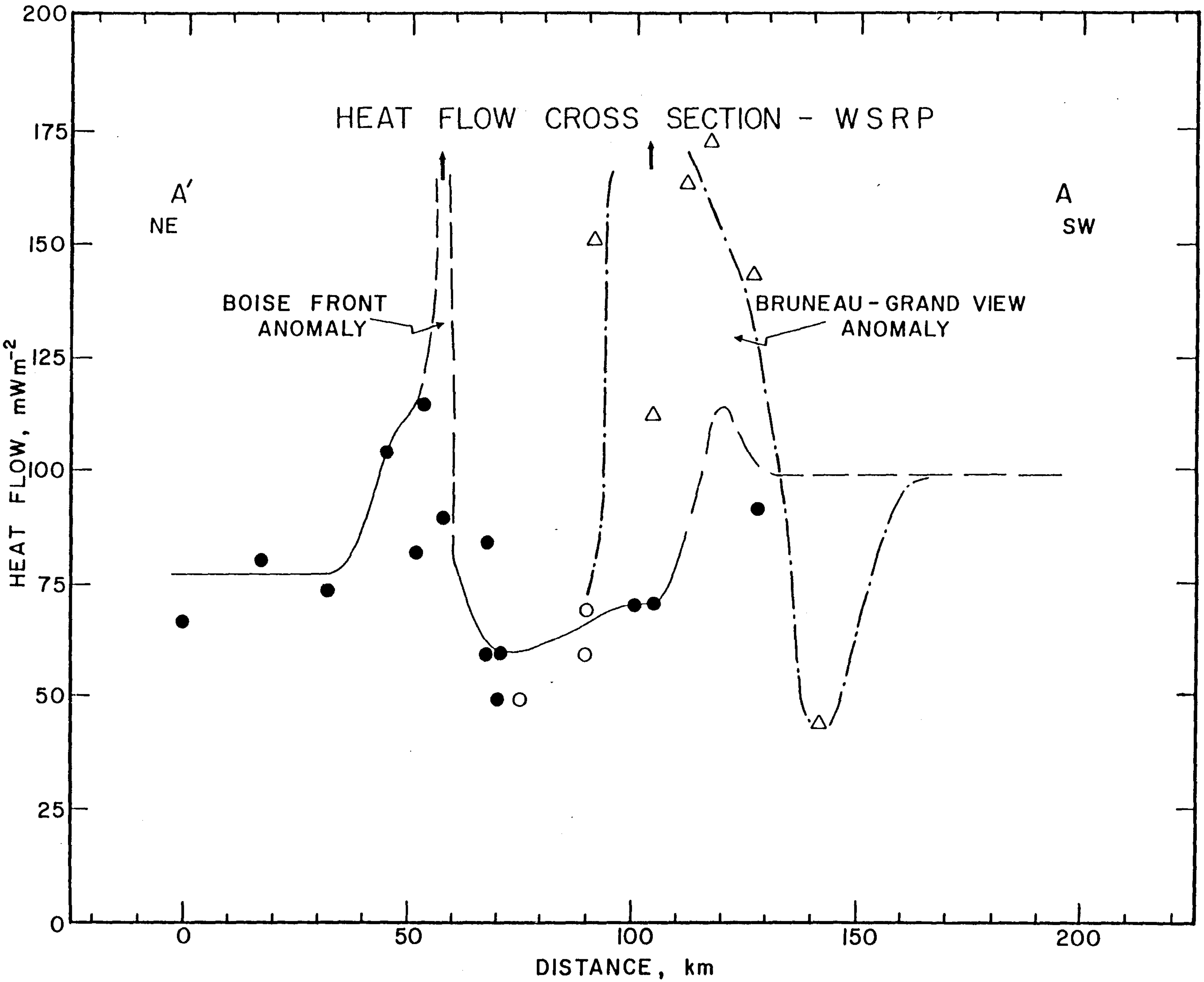
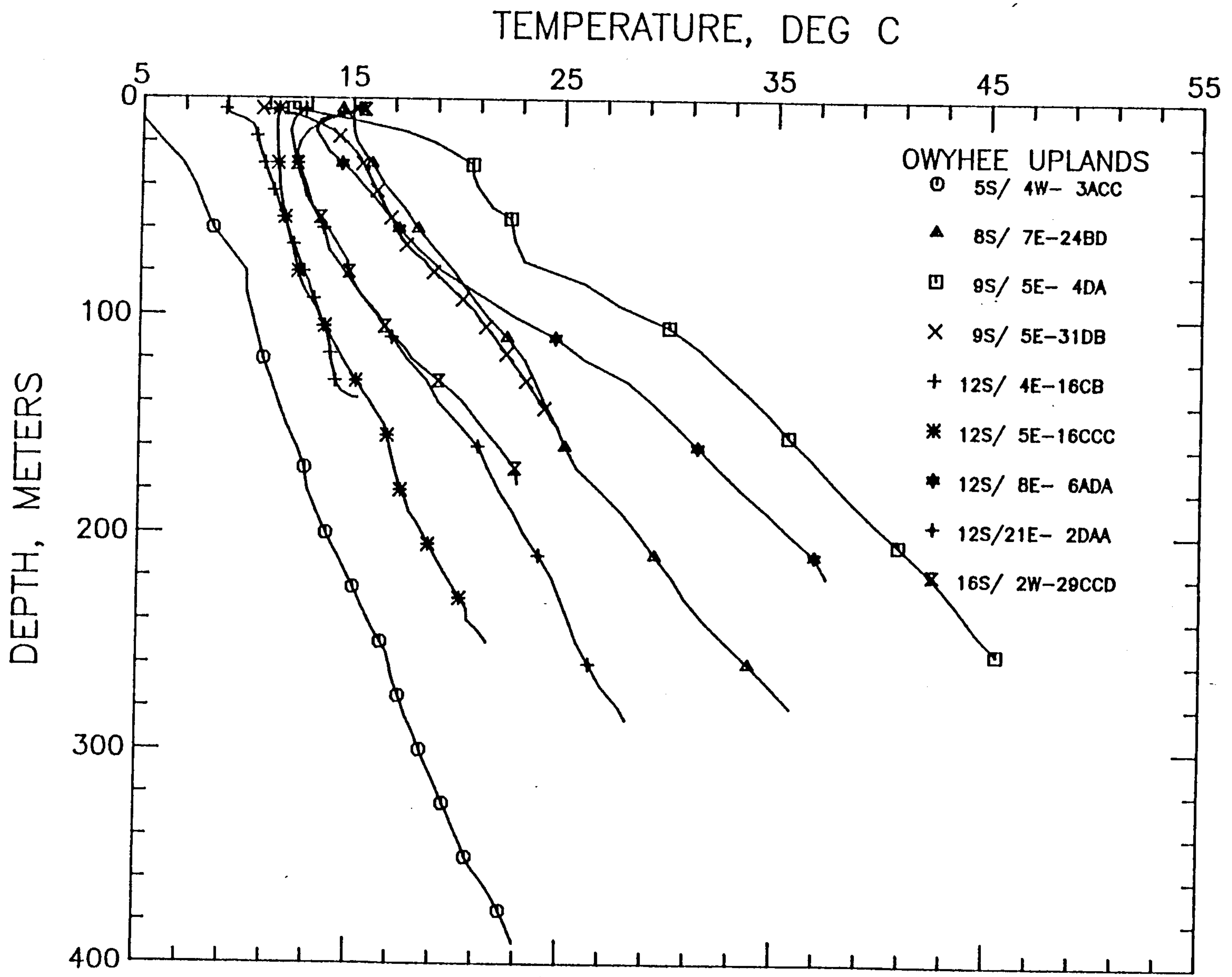
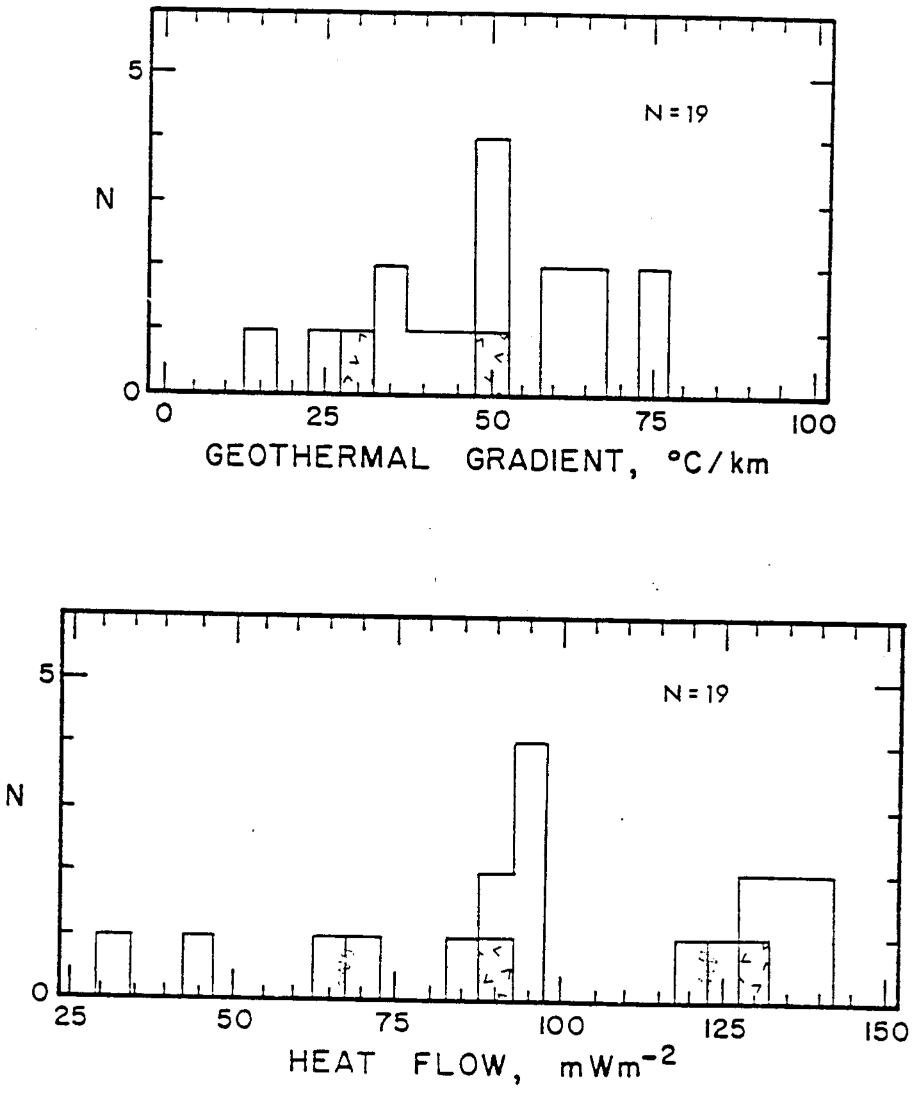


Figure 10

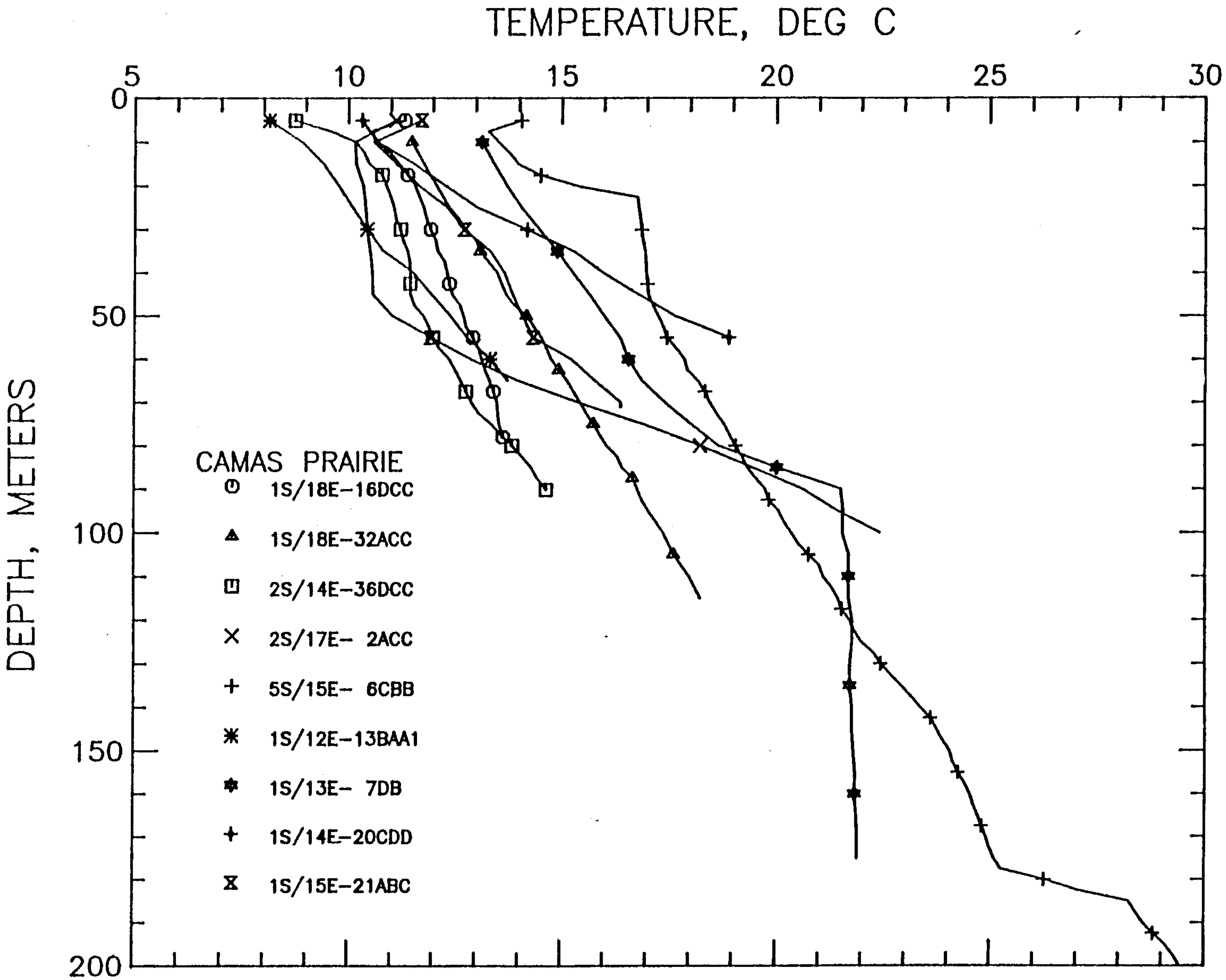

HEAT FLOW CROSS SECTION - WSRP
A′
NE
A
SW
BOISE FRONT ANOMALY
BRUNEAU-GRAND VIEW ANOMALY
HEAT FLOW, mWm⁻²
200
175
150
125
100
75
50
25
0
DISTANCE, km
0
50
100
150
200

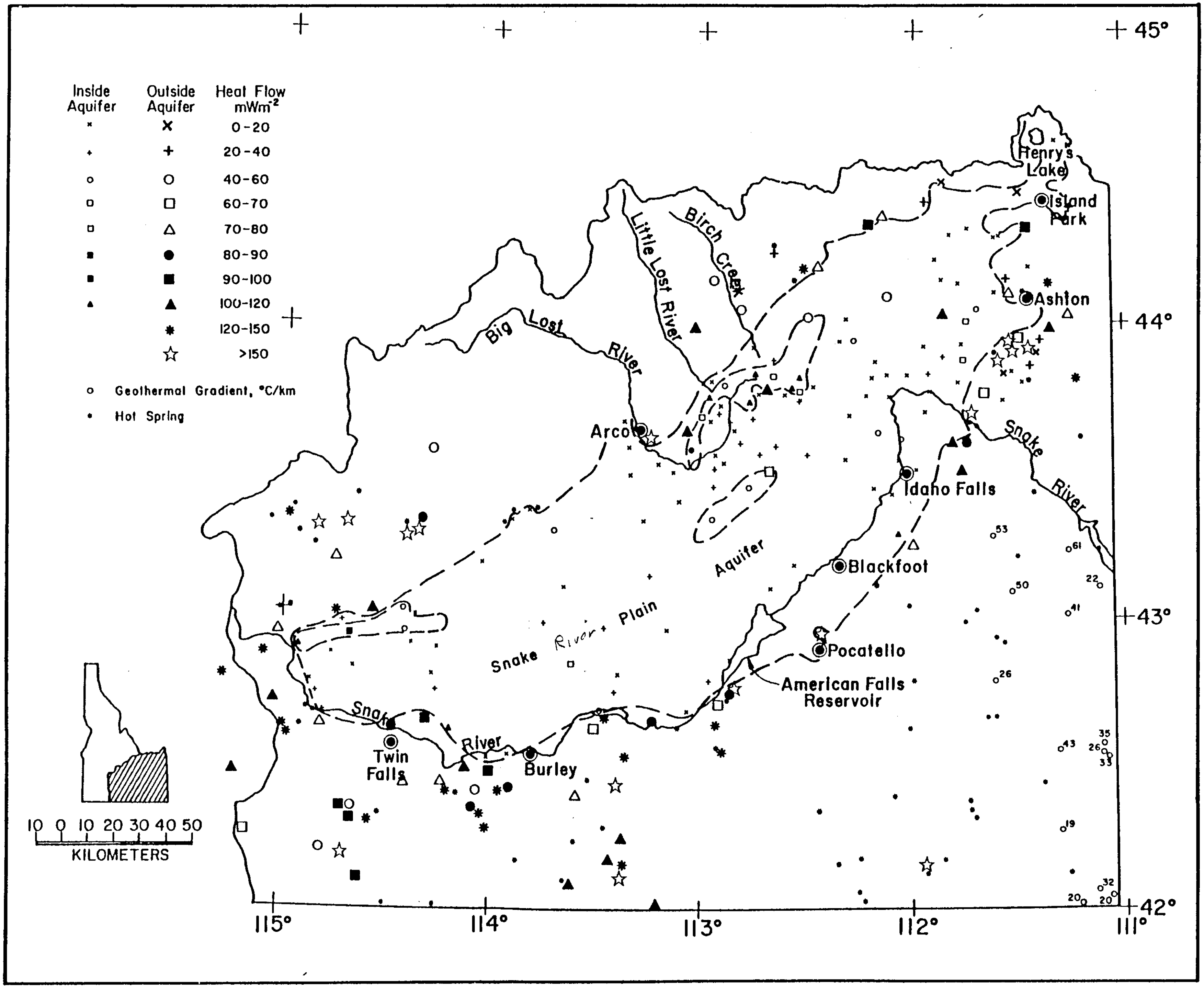

TEMPERATURE, DEG C
5
15
25
35
45
55
0
100
200
300
400
DEPTH, METERS
OWYHEE UPLANDS
5S/ 4W- 3ACC
8S/ 7E-24BD
9S/ 5E- 4DA
9S/ 5E-31DB
12S/ 4E-16CB
12S/ 5E-16CCC
12S/ 8E- 6ADA
12S/21E- 2DAA
16S/ 2W-29CCD

OWYHEE UPLANDS

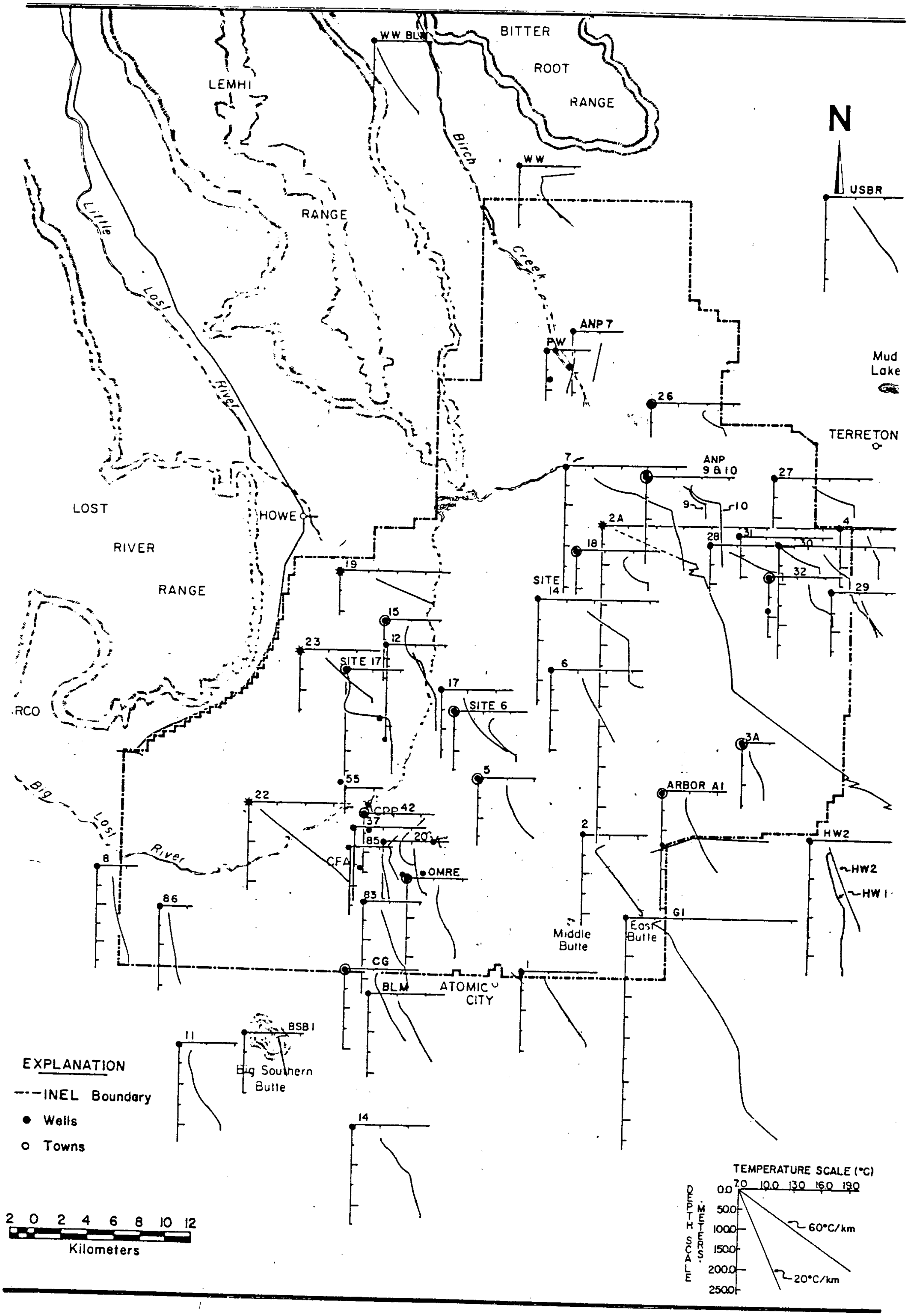


Fi [illegible]

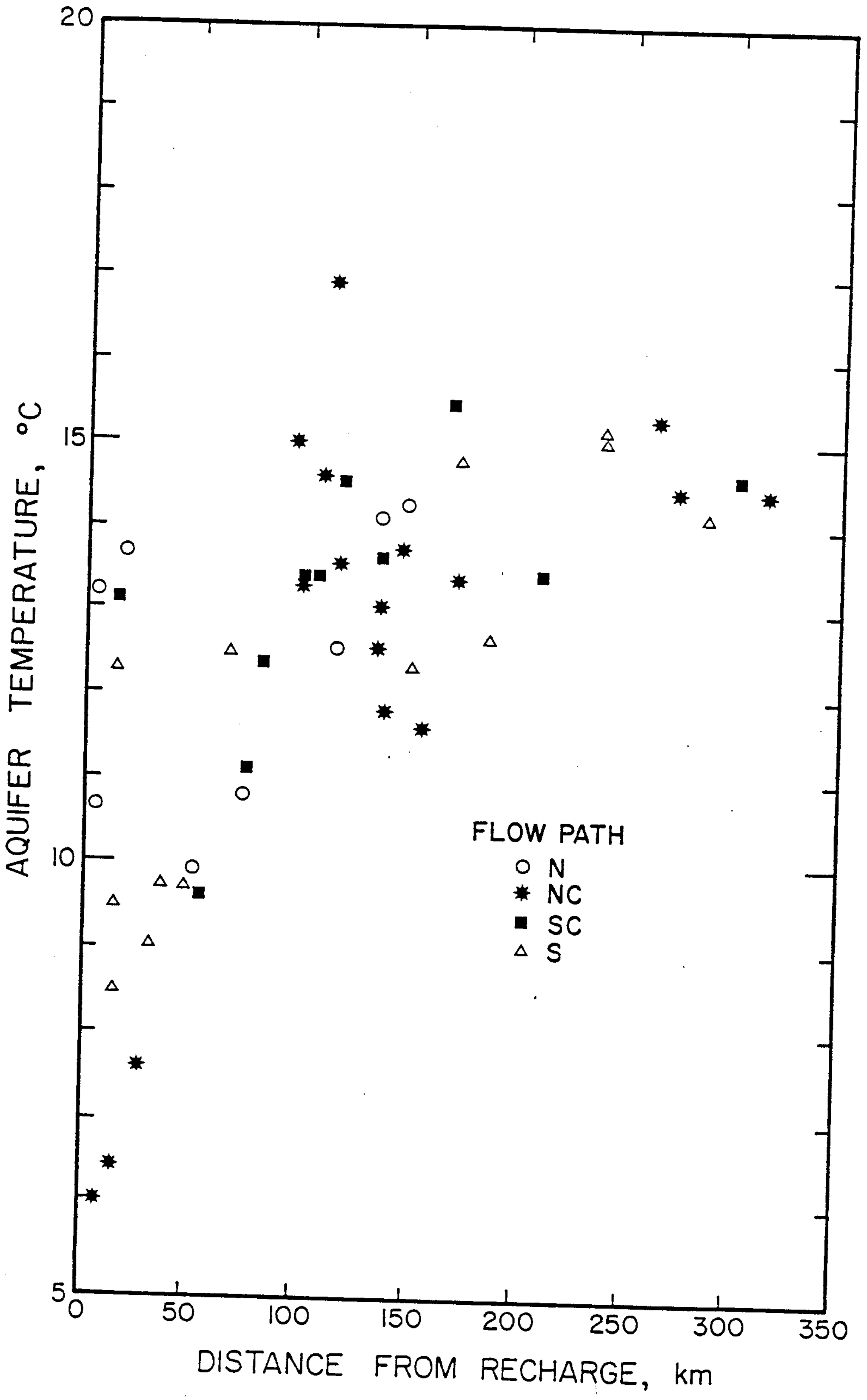

TEMPERATURE, DEG C
5
10
15
20
25
30
0
50
100
150
200
DEPTH, METERS
CAMAS PRAIRIE
○ 1S/18E-16DCC
△ 1S/18E-32ACC
□ 2S/14E-36DCC
× 2S/17E- 2ACC
+ 5S/15E- 6CBB
✳ 1S/12E-13BAA1
✶ 1S/13E- 7DB
+ 1S/14E-20CDD
⧗ 1S/15E-21ABC

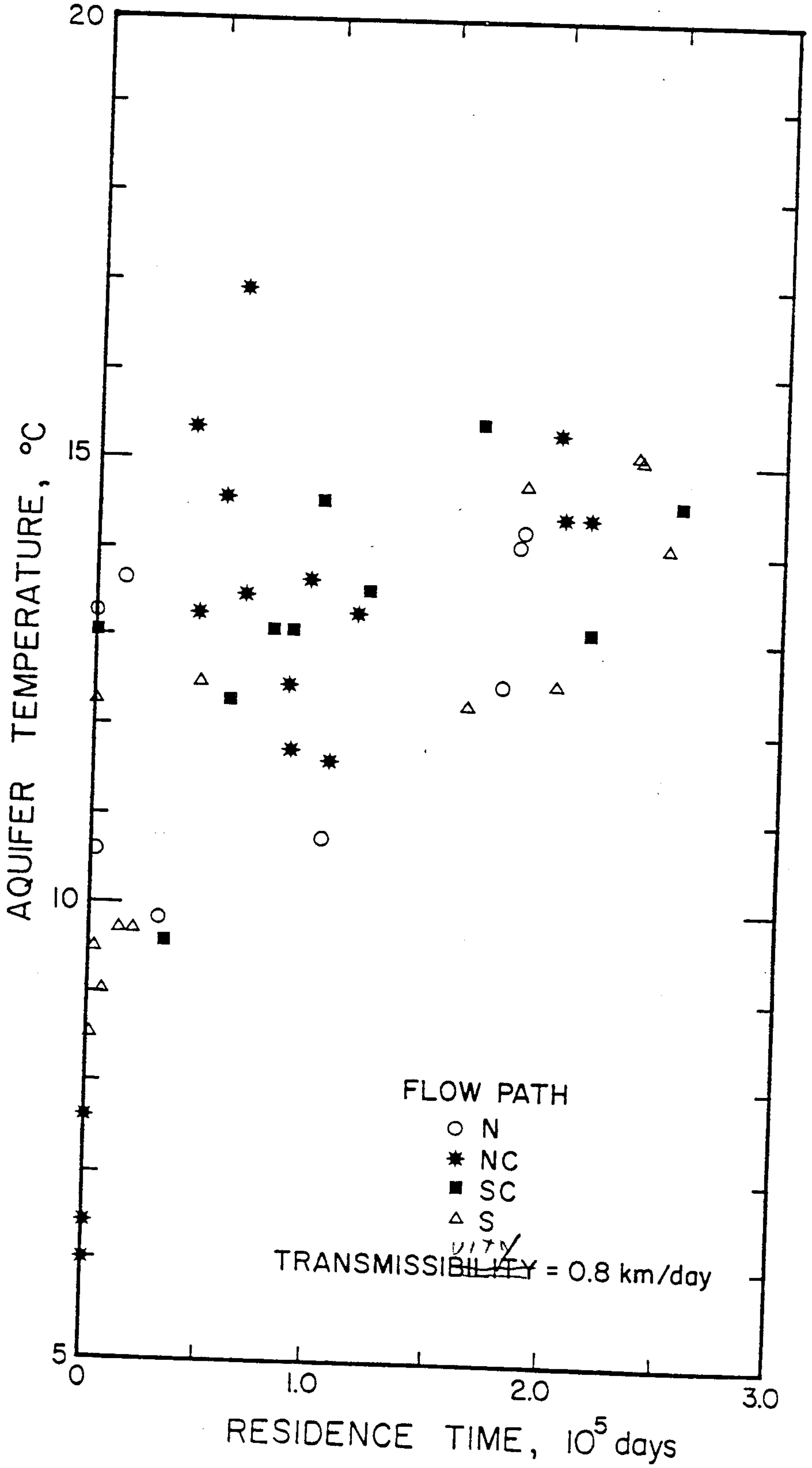


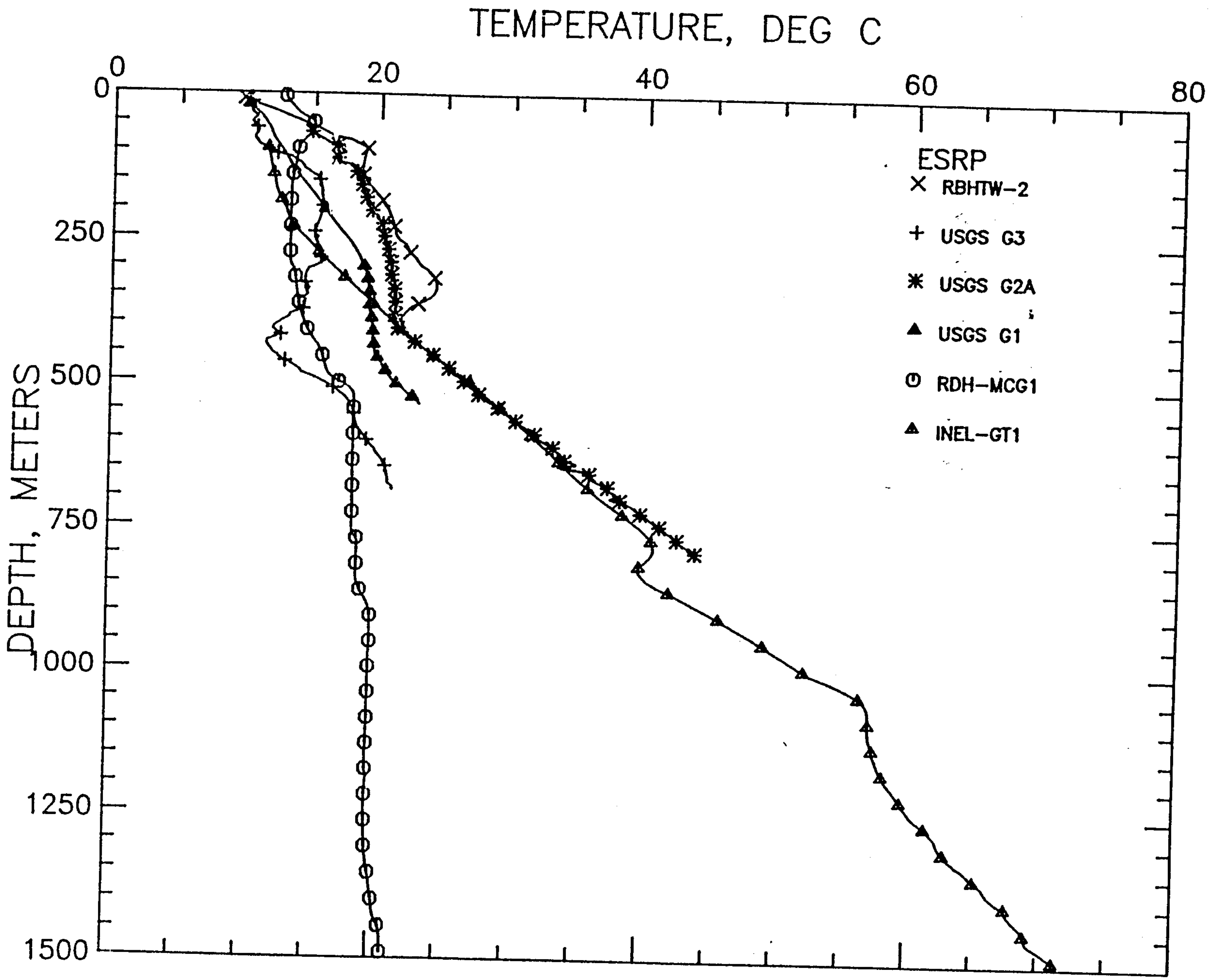
Inside Aquifer
Outside Aquifer
Heat Flow mWm^{-2}
0-20
20-40
40-60
60-70
70-80
80-90
90-100
100-120
120-150
>150
Geothermal Gradient, °C/km
Hot Spring
10 0 10 20 30 40 50
KILOMETERS
45°
44°
43°
42°
115°
114°
113°
112°
111°
Henry's Lake
Island Park
Ashton
Birch Creek
Little Lost River
Big Lost River
Arco
Snake River
Idaho Falls
Aquifer
Blackfoot
Pocatello
American Falls Reservoir
Snake River Plain
Twin Falls
Burley
53
61
22
50
41
26
35
43
26
33
19
32
20
20



BITTER
ROOT
RANGE
LEMHI
RANGE
WW BLM
WW
Birch
Creek
N
USBR
Little
Lost
River
ANP 7
PW
Mud
Lake
26
TERRETON
LOST
RIVER
RANGE
HOWE
7
ANP
9 & 10
9
10
27
2A
4
18
28
31
30
19
SITE
14
32
29
15
12
23
SITE 17
6
17
SITE 6
RCO
3A
55
5
ARBOR A1
22
CPP
42
37
Big
Lost
River
2
HW2
85
20
CFA
OMRE
HW2
HW1
8
86
83
G1
Middle
Butte
East
Butte
CG
BLM
ATOMIC
CITY
1
11
BSB1
Big Southern
Butte
EXPLANATION
INEL Boundary
Wells
Towns
14
TEMPERATURE SCALE (°C)
7.0
10.0
13.0
16.0
19.0
DEPTH SCALE
METERS
0.0
500
1000
1500
2000
2500
60°C/km
20°C/km
2 0 2 4 6 8 10 12
Kilometers

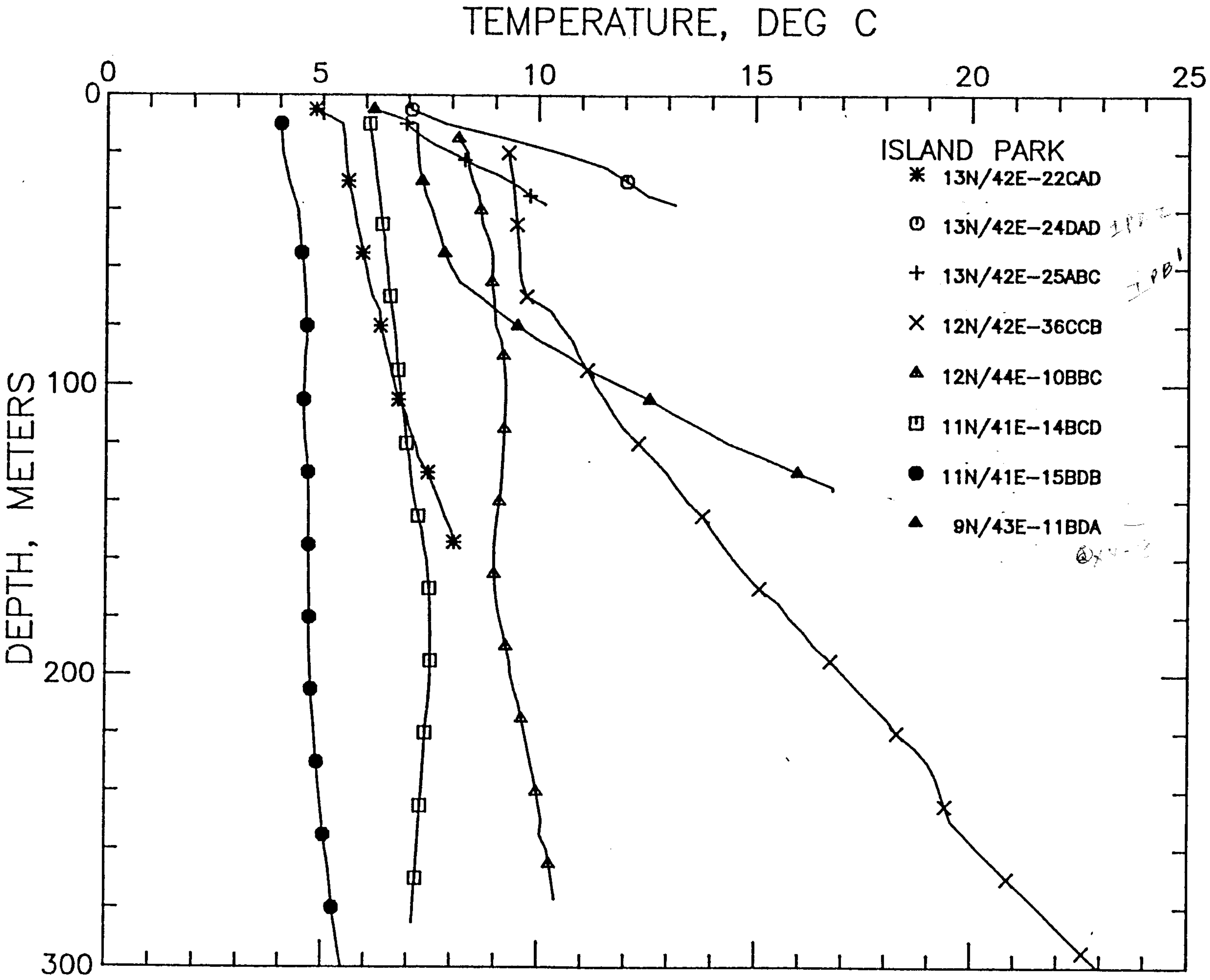

AQUIFER TEMPERATURE, °C
5
10
15
20
DISTANCE FROM RECHARGE, km
0
50
100
150
200
250
300
350
FLOW PATH
○ N
✱ NC
■ SC
△ S


AQUIFER TEMPERATURE, °C
20
15
10
5
0
1.0
2.0
3.0
RESIDENCE TIME, 10^5 days
FLOW PATH
○ N
✱ NC
■ SC
△ S
TRANSMISSIB~~ILITY~~ VITY = 0.8 km/day



TEMPERATURE, DEG C
0
20
40
60
80
DEPTH, METERS
0
250
500
750
1000
1250
1500
ESRP
× RBHTW-2
+ USGS G3
✳ USGS G2A
▲ USGS G1
○ RDH-MCG1
△ INEL-GT1

23.24.25


TEMPERATURE, DEG C
0
5
10
15
20
25
DEPTH, METERS
0
100
200
300
ISLAND PARK
✳ 13N/42E-22CAD
○ 13N/42E-24DAD
+ 13N/42E-25ABC
× 12N/42E-36CCB
△ 12N/44E-10BBC
□ 11N/41E-14BCD
● 11N/41E-15BDB
▲ 9N/43E-11BDA

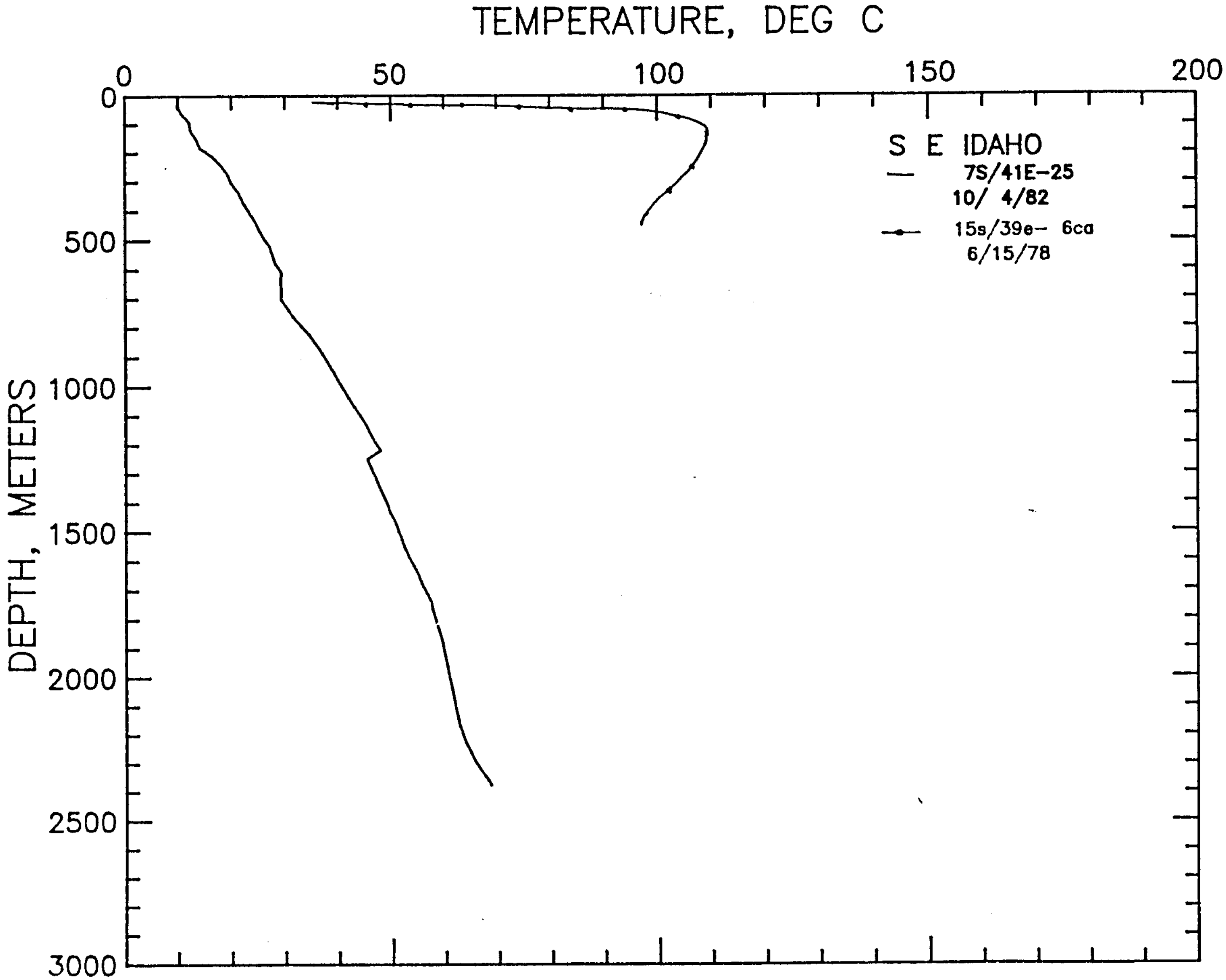
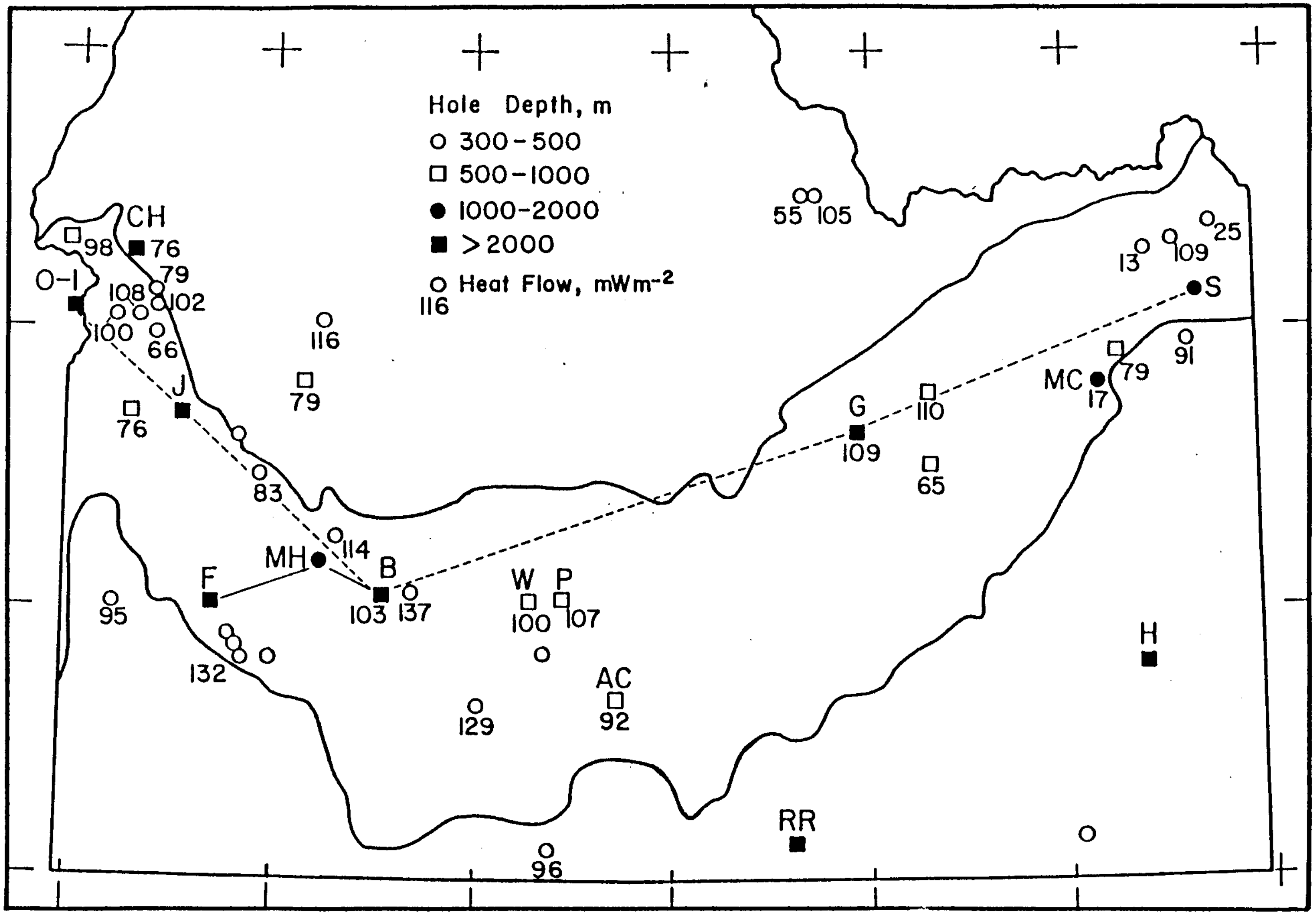
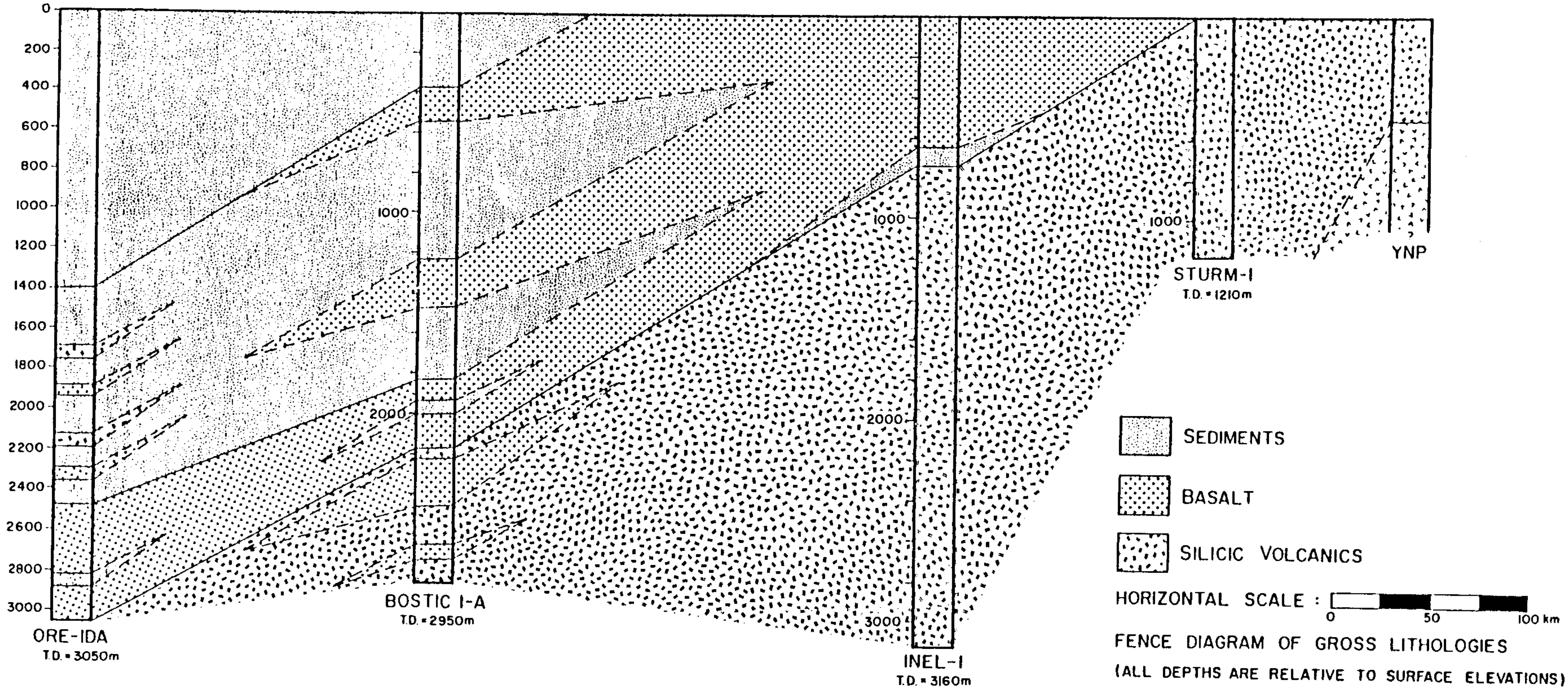

TEMPERATURE, DEG C
0
50
100
150
200
DEPTH, METERS
0
500
1000
1500
2000
2500
3000
S E IDAHO
7S/41E-25
10/ 4/82
15s/39e- 6ca
6/15/78

Figure 27


Hole Depth, m
○ 300-500
□ 500-1000
● 1000-2000
■ >2000
○ Heat Flow, mWm⁻²
116
CH
98
76
79
O-I
108
102
100
66
116
79
J
76
83
MH
114
F
B
103
137
95
132
W
P
100
107
AC
92
129
96
RR
55
105
13
109
25
S
91
79
MC
17
G
110
109
65
H



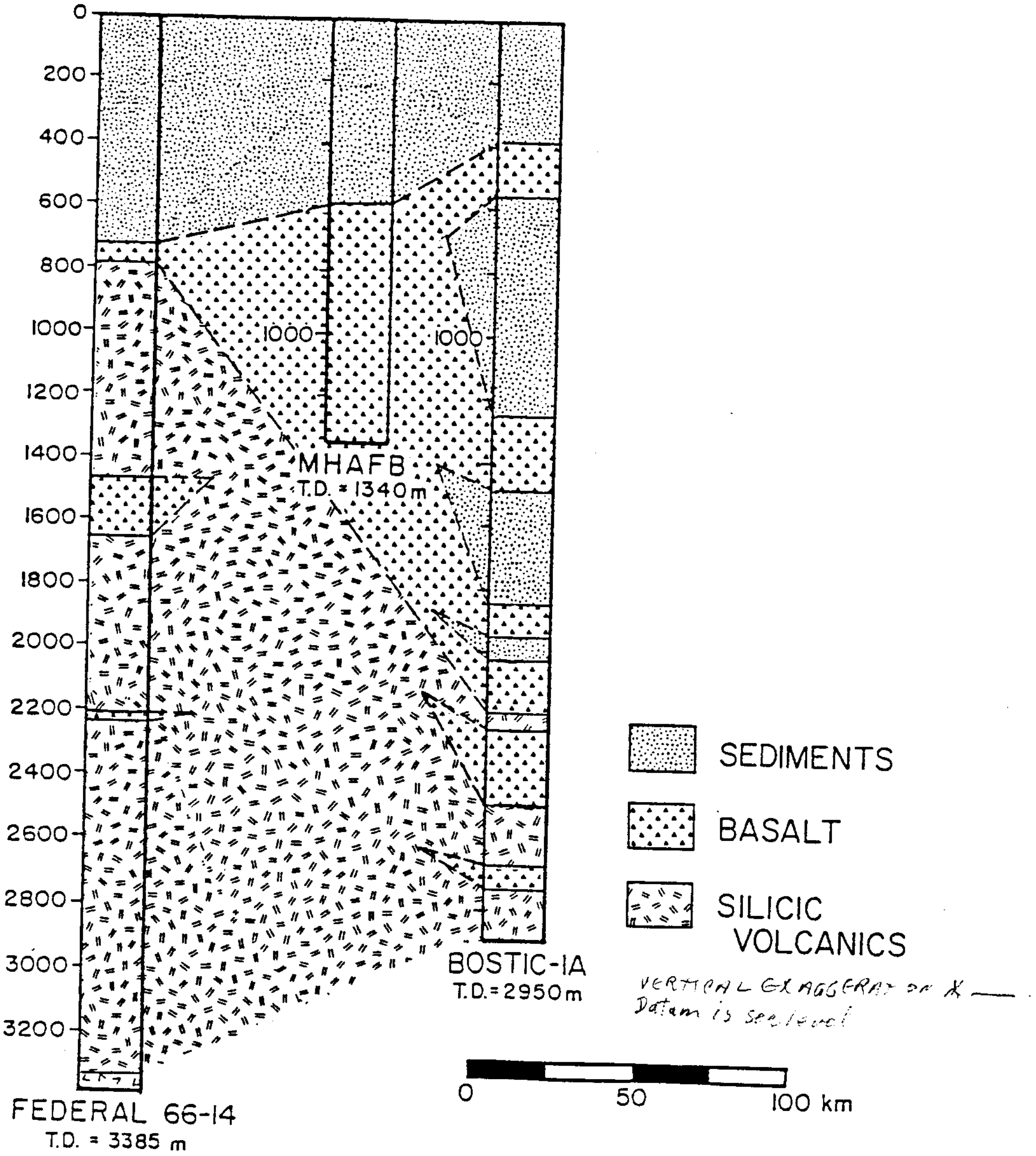
FENCE DIAGRAM OF GROSS LITHOLOGIES

(ALL DEPTHS ARE RELATIVE TO SURFACE ELEVATIONS)

VERTICAL EXAGGERATION [illegible]

Datum [illegible]

DIAGRAMMATIC LONGITUDINAL Geologic SECTION



VERTICAL EXAGGERATION X ——
Datum is sea level

DIAGRAMMATIC GEOLOGIC CROSS-SECTION

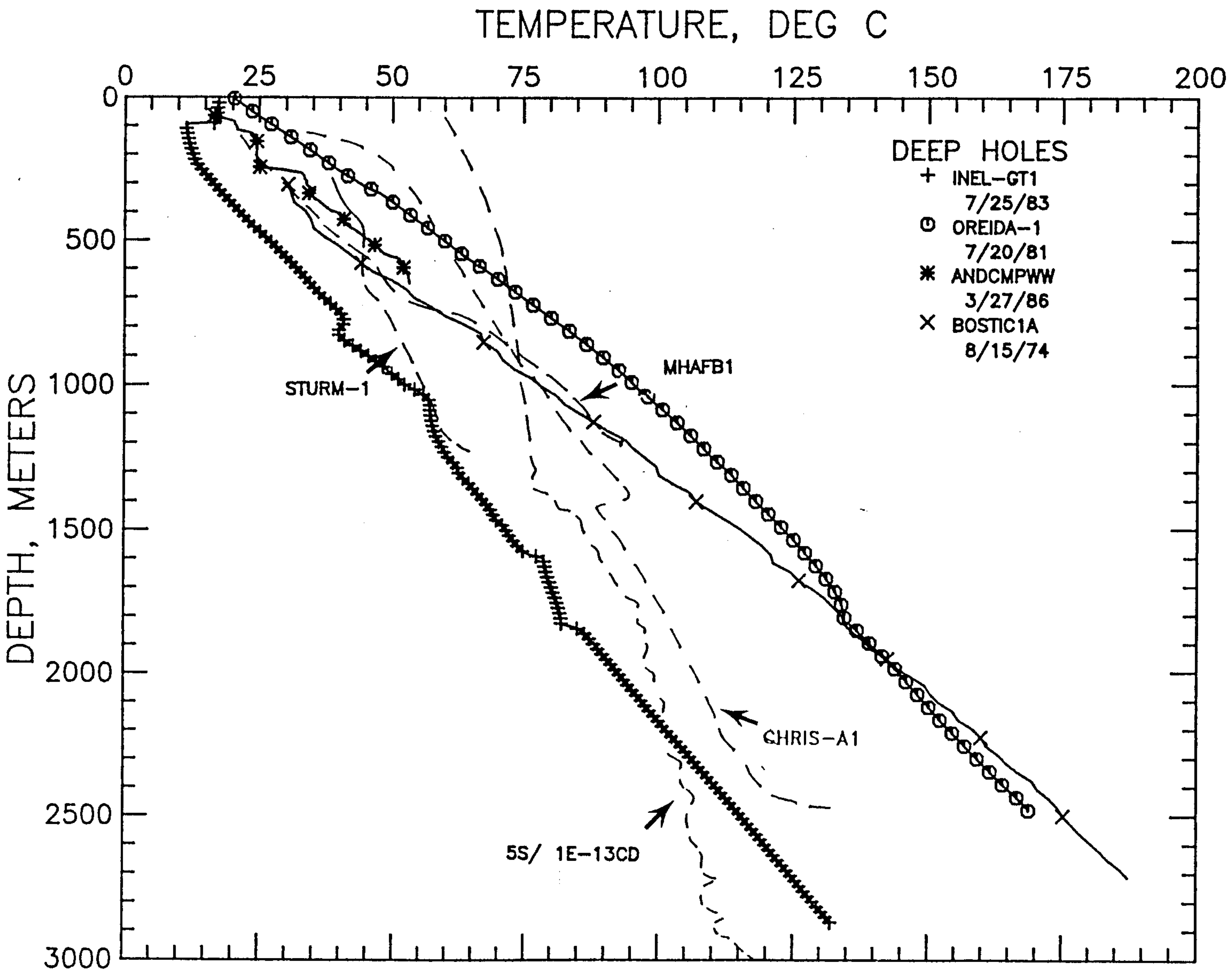

TEMPERATURE, DEG C
0
25
50
75
100
125
150
175
200
DEPTH, METERS
0
500
1000
1500
2000
2500
3000
DEEP HOLES
+ INEL-GT1 7/25/83
⊙ OREIDA-1 7/20/81
✱ ANDCMPWW 3/27/86
× BOSTIC1A 8/15/74
MHAFB1
STURM-1
CHRIS-A1
5S/ 1E-13CD

Figure 30

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
50N/ 5W 17BC	NR	47-40.91	116-59.82	MILLERWW 9/ 6/81	768	19.0 61.5			23.6 1.4			D	SCHIST OR GNEISS
46N/ 5W 7BBC	NR	47-21.00	117- 1.25	WW LWSN2 7/31/78	804	75.0 210.0						X	C P BASALT
39N/ 5W 4BAA	DU	46-45.42	116-58.29	WW HNGST 3/ 3/78	803	10.0 55.0	1.92 0.34	2	52.5 2.3	49.8	95	D	ARKOSE AND BASALT
35N/ 5W 22BAB	NR	46-22.07	116-57.04	WW LWSTN 2/14/78	468	200.0 300.0	1.72		33.9 3.0	33.9	58	D	C P BASALT
35N/ 4W 32BBA	NR	46-20.31	116-52.30	WW MCCNN 2/14/78	559	10.0 225.0						X	C P BASALT
35N/ 4E 15DCB	NR	46-20.06	115-56.39	WW WEIPP 3/ 1/78	915	10.0 45.0	1.67 0.08	2	40.6	40.6	68	D	C P BASALT
33N/ 4E 9BAB	NR	46-13.25	115-57.94	WW SNYDR 1/18/78	867	20.0 210.0	1.55	1	49.9 1.3	55.4	85	D	C P BASALT
31N/ 1E 5AAD	NR	46- 3.60	116-23.05	WW CTTNW 2/28/78	1089	10.0 60.0						X	C P BASALT
31N/ 1W 5CAD	NR	46- 3.26	116-29.07	WW ANDRS 2/28/78	1384	10.0 44.0	1.55	1				X	GRANITE
31N/ 1E 33CAB	NR	45-58.89	116-20.35	WW UHLEN 2/28/78	1012	20.0 165.0	1.61	1				X	C P BASALT
30N/ 2E 14ACD	NR	45-56.49	116- 9.90	WW BLWTT 2/21/78	1003	10.0 40.0						X	
30N/ 3E 27DCB	NR	45-54.30	116- 3.81	WW COVE 2/21/78	1120	10.0 55.0	1.41	1	33.7 3.2	37.4	53	D	META. SEDS.
29N/ 2E 1ADC	NR	45-52.97	116- 8.58	WW GREEN 7/26/78	1248	10.0 85.0	1.55	1				X	C P BASALT
18N/ 9E 14AAD	SI	44-54.11	115-18.74	RH-1-75 8/ 9/76	2355	10.0 32.0	3.05		37.4	37.4	124	D	IDAHO BATH. GRANITE
18N/ 3E 31DBA	CH	44-51.19	116- 7.82	WW 8/20/76	1536	10.0 40.0	1.80	1	37.4 3.9	37.4	67	D	ALLUVIUM
16N/ 4W 11DBB	WD	44-43.89	116-47.12	DDH-2 8/15/71	1987	100.0 310.0						X	DIORITE AND GRANODIORITE
16N/ 3E 33A	CH	44-41.03	116- 5.52	USBR 8/13/76	1478	10.0 30.0	3.05		33.8 13.9	33.8	103	D	IDAHO BATH. GRANITE
15N/ 3E 35DDB	CH	44-35.33	116- 3.15	USBR 8/31/76	1487	10.0 30.0						X	IDAHO BATH. GRANITE
14N/19E 33ABC	SI	44-30.14	114-14.25	DDH-13 8/17/70	1570	40.0 300.0	1.97		29.9 1.1	29.9	59	D	CHALLIS VOLCANICS

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
13N/18E 4AAB	SI	44-29.48	114-20.48	DDH 8/ 5/75	2073	45.0 250.0						X	CHALLIS VOLCANICS
13N/27E 5CA	IR	44-29.09	113-16.19	RDH-1 6/ 5/79	2087	0.0 110.0						X	ALLUVIUM AND VALLEY FILL
13N/26E 10CD	IR	44-28.87	113-18.01	DRH-B 8/19/71	2265	0.0 7.0						X	
13N/26E 12BAA	IR	44-28.76	113-18.37	RDH-A 8/18/71	2298	30.0 50.0	2.55		39.3 0.8	36.9 0.8	94	D	MONZONITE
13N/15E 20CC	SI	44-26.21	114-44.09	RDH 8/ 6/76	2317	20.0 90.0	1.34		11.6 0.1	8.5 0.1	11	D	CHALLIS VOLCANICS
13N/27E 29AAA	IR	44-26.21	113-15.38	WW CD 6/ 5/79	2219	30.0 100.0	2.59		11.7 0.3	11.0 0.3	28	D	
13N/27E 29AA 1	IR	44-26.10	113-15.27	M-EXP2 6/ 5/79	2164	10.0 60.0						X	IDAHO BATH. GRANITE
13N/27E 29AA 2	IR	44-26.10	113-15.27	M-EXP3 6/ 5/79	2164	40.0 80.0						X	IDAHO BATH. GRANITE
12N/ 4W 23CCA	WD	44-21.20	116-45.50	RNS-1	817	15.0 77.0	1.25 0.13	13	59.5	49.6	62	D	SANDY/CLAY/ BASALT
12N/ 8E 34BA	CH	44-20.09	115-29.30	SMU IB-5 9/22/76	2079	25.0 65.0	3.78 0.22	4				X	IDAHO BATH. GRANITE
11N/ 6W 30DB1	SW	44-18.30	117- 2.05	WW 9/25/75	695	20.0 90.0	1.46		53.3 8.0	52.2	77	D	CENOZOIC SEDIMENTS
11N/14E 4DAB	SI	44-18.61	114-48.18	RDH 8/ 7/76	2368	20.0 90.0	1.34	1	4.6 0.3	4.6 0.3	5	D	CHALLIS VOLCANICS
11N/ 6W 9DAB	SW	44-18.18	117- 3.36	WW 9/25/75	682	5.0 28.0	1.78 0.07	4	82.7 2.8	82.7	147	D	CENOZOIC SEDIMENTS
11N/14E 9BDD	SI	44-18.16	114-49.49	RDH 8/ 7/76	2365	10.0 110.0	1.34		7.4 0.6	7.4 0.6	10	D	CHALLIS VOLCANICS
11N/14E 9CBD	SI	44-17.75	114-49.76	RDH 8/ 7/76	2341	10.0 110.0	1.34		6.2 0.4	6.2 0.4	8	D	CHALLIS VOLCANICS
11N/14E 10DDA	CH	44-17.56	114-47.75	DDH-1 8/ 7/76	2292	10.0 185.0	2.93	1	15.7 0.3	14.9 0.3	44	D	IDAHO BATH. GRANITE
11N/14E 10DDB	CH	44-17.54	114-47.94	DDH-2 7/27/76	2317	20.0 45.0	2.93		30.8 0.5	29.3 0.5	86	D	IDAHO BATH. GRANITE
11N/14E 16ACD	SI	44-17.07	114-49.17	RDH 7/27/76	2091							X	CHALLIS VOLCANICS
11N/14E 16CAB	SI	44-16.94	114-49.76	RDH 8/ 7/76	2158	10.0 50.0	2.93		31.9 2.7	30.3 2.6	89	D	CHALLIS CHALLIS VOL

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
11N/ 5W 29BAD	SW	44-15.86	116-57.89	WW WSR 2 8/23/78	679	10.0 71.0	1.74	1				X	CENOZOIC SEDIMENTS
11N/ 2W 27ACD	WD	44-15.00	116-32.40	RNS-5	1037	20.0 55.0	1.33 0.04	13	47.5	45.2	60	D	CENOZOIC SEDIMENTS
10N/13E 3CAB	CH	44-13.45	114-55.70	HD-1 7/15/76	1896	4.0 8.0						X	IDAHO BATH GRANITE
10N/ 2W 1DDD	WD	44-13.40	116-30.75	RNS-15	1105	20.0 38.0	1.14 0.24	9	44.0	46.3	53	D	CZ BASALT CLAY/SAND
10N/ 5W 9BAD	SW	44-13.15	116-56.55	RNS-17	646	15.0 25.0	1.17		106.0	106.0	124	D	CENOZOIC CLAY
10N/ 4E 22DAA	CH	44-11.25	115-57.10	WW BROWN 7/15/78	1049	10.0 42.5	2.93		45.3 7.0	41.2	120	D	IDAHO BATH GRANITE
9N/ 6E 33CAB	CH	44- 4.75	115-45.55	DDH-A 7/21/69	1029	0.0 90.0						X	IDAHO BATH GRANITE
9N/ 6E 33CAA	CH	44- 4.56	115-45.40	DDH-C 7/21/69	1097	0.0 90.0						X	IDAHO BATH GRANITE
9N/ 6E 33CAC	CH	44- 4.41	115-45.50	DDH-B 7/21/69	1029	0.0 160.0						X	IDAHO BATH GRANITE
8N/ 5W 2BAD	SW	44- 3.88	116-54.19	RDH-OIL 8/10/78	754	30.0 54.0	1.09	1	51.8 2.7	51.8	69	D	CENOZOIC CLAY/SAND
9N/16E 34DCD2	SI	44- 3.53	114-33.47	DDH-2 6/26/70	2634	60.0 205.0						X	IDAHO BATH GRANITE
9N/16E 34DCD3	SI	44- 3.53	114-33.47	DDH-3 6/26/70	2634	30.0 185.0						X	IDAHO BATH GRANITE
9N/16E 34DCD1	SI	44- 3.53	114-33.47	DDH-1 8/14/69	2634	60.0 210.0						X	IDAHO BATH GRANITE
8N/ 5W 22ACA	SW	44- 1.28	116-55.10	WW FRUIT 8/ 2/73	673	35.0 45.0	1.58	2	38.0 1.2	38.0 1.2	60	D	CENOZOIC CLAY/SAND
7N/ 4W 9ACD	SW	43-57.62	116-46.87	WW PLYMH 7/27/78	595	10.0 31.1	1.97	1	41.4 5.1	41.4 5.1	82	D	CENOZOIC CLAY/SAND
7N/ 4W 14BCD	SW	43-56.80	116-47.24	WW 8/ 9/78	704	0.0 27.5						X	CENOZOIC CLAY/SAND
7N/ 4E 18DDC	CH	43-56.40	116- 1.36	DDH-BM 1 8/12/76	1881	15.0 120.0	2.93		26.9 0.6	37.1 0.8	109	D	IDAHO BATH GRANITE
7N/ 4E 18DCA	CH	43-56.39	116- 1.48	DDH-BM 2 8/12/76	1878	20.0 85.0	2.93		26.4 0.9	36.4 1.2	107	D	IDAHO BATH GRANITE
6N/ 5E 6CCA	CH	43-52.96	115-54.84	USBRDDH1 8/19/76	1256	20.0 50.0	2.44 0.18	5	40.2 0.4	(38.3) 0.4	93	D	IDAHO BATH GRANITE

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
6N/ 1W 7AAD	SW	43-52.62	116-29.63	WW EMMTT 7/ 5/78	725	0.0 72.0						X	CENOZOIC CLAY & SAND
6N/ 4W 18BBD	SW	43-51.77	116-52.27	RDH 7/26/74	759	10.0 40.0			96.1 13.4			D	CENOZOIC SEDIMENTS
6N/ 4W 17BDD	SW	43-51.52	116-50.49	RDH 7/26/74	826	10.0 20.0						X	CENOZOIC SEDIMENTS
6N/ 1E 15DDD	WD	43-51.13	116-18.76	DDH-AU 8/10/78	1344	10.0 33.2	2.93		62.4 4.5	48.0	141	D	IDAHO BATH GRANITE
6N/ 4E 24DBD	CH	43-50.44	115-55.48	USBR DH2 7/10/70	1213	60.0 88.0	3.31		36.6 1.7	26.2	84	D	IDAHO BATH GRANITE
6N/ 4W 31CDC	SW	43-48.50	116-52.04	RDH 7/36/74	759	10.0 40.0			92.3 15.5	100.6		D	CENOZOIC SEDIMENTS
5N/ 1W 3ABD	SW	43-48.25	116-26.38	WW HLMCK 8/15/78	838	15.0 32.0	1.42	1	77.4 7.4	75.0	106	D	CENOZOIC CLAY/SAND
5N/ 5W 9BDB	SW	43-47.23	116-56.68	WW PARMA 8/18/78	675	0.0 100.0	(1.56)	2	(61.0)	(61.0)	95	D	CENOZOIC SAND/CLAY
5N/ 3W 35BBB	SW	43-44.02	116-40.19	WW 7/27/78	762	15.0 56.6	1.62	1				X	CENOZOIC CLAY/SAND
4N/ 1E 2ADB	SW	43-43.02	116-17.86	WW BARTN 8/31/78	902	0.0 82.0						X	CENOZOIC SAND
4N/ 2W 6BCB	SW	43-42.91	116-37.81	WW MDDLT 7/29/78	739	0.0 30.0						X	CENOZOIC CLAY
4N/ 2E 7CAA	WD	43-41.89	116-15.84	WW TRRTL 8/ 2/78	902	10.0 30.0	1.17		96.2 7.2	80.0	94	D	CENOZOIC CLAY
4N/ 3W 27AAC	SW	43-39.58	116-40.53	WW CALDW 7/ 5/78	725	20.0 48.0	1.46		72.4 2.3	72.4	106	D	CENOZOIC CLAY
4N/ 1E 31CCC	SW	43-38.07	116-23.41	WW COPE 8/16/78	789	0.0 49.0	1.80	1				X	CENOZOIC CLAY/GRAVEL
3N/ 1E 5ABB	SW	43-37.99	116-21.72	USGS 7/25/78	797	0.0 25.0						X	CENOZOIC CLAY/SAND
3N/ 4W 6BCC	SW	43-37.60	116-52.16	WW MOULT 8/23/78	785	10.0 60.0						X	CENOZOIC CLAY/SAND
3N/ 5W 3DBC	SW	43-37.16	116-55.20	WW KNGHT 8/22/78	682	0.0 21.0						X	CENOZOIC CLAY
3N/ 1W 7BCB1	SW	43-36.97	116-30.67	USGS 7/25/78	797	0.0 14.0						X	CENOZOIC CLAY
3N/ 1W 23DBB	SW	43-34.96	116-25.36	WW TESTR 8/ 4/78	821	0.0 52.0						X	CENOZOIC SAND/CLAY

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
3N/ 1E 32AD	SW	43-33.37	116-21.24	WW 8/11/75	818	0.0 63.0						X	CENOZOIC BASALT
3N/ 1E 35DD	SW	43-32.82	116-17.84	BO 2 8/23/75	833	12.5 30.0	1.95 0.06	2	10.8 1.5	10.8	21	D	CENOZOIC BASALT
2N/ 1W 7BBC	SW	43-31.72	116-30.70	USGS 7/25/75	777	10.0 29.8	1.34		76.4 14.2	76.4	102	D	CENOZOIC CLAY/BASALT
1N/ 4W 13BAC	SW	43-25.66	116-45.91	WW FRMAN 6/25/78	777	5.0 25.0	1.17		111.0 8.0	111.0	130	D	CENOZOIC CLAY
1S/ 1E 6CCD	SW	43-21.45	116-23.28	WW 7/25/76	904	20.0 165.0	(1.42)	1	(93.0) 6.4	93.0	132	D	CENOZOIC SED./BASALT
2S/ 2W 4DAB	SW	43-16.65	116-34.47	WW 6/27/77	765	10.0 33.0	1.09		70.6 1.4	70.6	77	D	CENOZOIC SED./BASALT
2S/ 2W 4CBD	SW	43-16.55	116-35.18	WW 7/29/75	786	0.0 11.0						X	CENOZOIC BASALT
2S/ 5E 15CA	SW	43-14.98	115-50.88	WW 7/25/74	998	0.0 90.0	1.46		102.0	102.0	149	D	CENOZOIC BASALT
2S/ 5E 22BDA	SW	43-14.36	115-50.91	WW 7/11/77	989	30.0 95.0	1.34		59.6 1.0	59.6	80	D	CENOZOIC BASALT
2S/ 1E 23ADD	SW	43-14.07	116-17.63	WW LNDRF 7/21/78	962	160.0 230.0	1.17		84.3 6.3	84.3	99	C	CENOZOIC BASALT/CLAY
						30.0 235.0	1.38	1	60.0 3.1	60.0	83	D	
2S/ 4E 21DDD	SW	43-13.82	115-59.00	WW 7/20/78	940	0.0 42.0						X	CENOZOIC SED./BASALT?
2S/ 2W 36BA	SW	43-12.77	116-31.31	USGS 8/10/74	862	50.0 100.0	1.46	1	71.0	71.0	104	D	CENOZOIC BASALT
2S/ 5E 36BDC	SW	43-12.47	115-48.66	USGS 8/ 2/75	968	5.0 15.0						X	CENOZOIC BASALT
2S/ 2W 36CB	SW	43-12.29	116-31.64	WW 8/11/74	888	20.0 350.0	> 1.46		> 42.0	> 42.0	62	D	CENOZOIC BASALT
3S/ 5E 7930	SW	43-11.00	115-54.68	WW 1 7/22/76	939	0.0 80.0						X	CENOZOIC SED./BASALT
3S/ 5E 7A	SW	43-10.93	115-53.97	WW 8/24/75	939	20.0 80.0	1.09	1				X	CENOZOIC BASALT/SED.
3S/ 5E 7BDD	SW	43-10.75	115-54.41	WW 2 7/26/76	937	10.0 260.0						X	CENOZOIC BASALT/SED.
3S/ 7E 9AC	SW	43-10.67	115-37.49	MH 3 8/22/75	1048	7.5 27.5	1.76	1				X	CENOZOIC BASALT

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
3S/ 1E 18BAC	SW	43-10.02	116-23.24	WW 7/ 4/77	747	10.0 69.0	> 1.46	1	> 48.8 6.2	? 40.7	59	D	CENOZOIC SED./SIL.VOL
4S/ 7E 17CB	SW	43- 4.52	115-39.18	WW 7/30/75	942	0.0 79.0						X	BASALT (VB) CLAY
4S/ 2E 20BDA	SW	43- 3.93	116-14.72	WW 6/28/77	754	30.0 89.0						X	CENOZOIC CLAY/GRAVEL
4S/ 1E 35BBD	SW	43- 2.20	116-18.50	WW 6/24/77	771	70.0 278.0						X	CENOZOIC SEIDMENTS
4S/ 1E 35ACB	SW	43- 2.13	115-18.14	WW 6/26/77	774	10.0 30.0	1.13		74.6 3.6	74.6	84 4	D	CENOZOIC SEDIMENTS
4S/ 1E 35ACC	SW	43- 2.03	116-18.10	WW 6/29/77	777	40.0 85.0	1.17					X	CENOZOIC SEDIMENTS
5S/ 1E 2AAA	SW	43- 1.48	116-18.19	WW 6/25/77	795	0.0 15.0						X	CENOZOIC SEDIMENTS
5S/ 1E 10BDC	SW	43- 0.27	116-19.67	WW 6/25/77	807	0.0 105.0						X	CENOZOIC CLAY/SAND
5S/17E 10	EW	43- 0.15	114-25.35	WW 7/27/77		0.0 62.0						X	
5S/ 1E 9CCA	SW	43- 0.00	116-20.94	WW 7/ 4/77	838	20.0 119.0	> 1.63		> 38.9 1.4	> 38.9	64 2	D	CENOZOIC SEDIMENTS
5S/12E 16BCB1	SW	42-59.50	115- 2.70	USGS 7/18/74	974	0.0 30.0						X	
5S/ 3E 15CBB	SW	42-59.42	116- 5.76	WW 6/30/77	722	0.0 52.0						X	CENOZOIC SEDIMENTS
5S/ 3E 23CAA	SW	42-58.53	116- 4.03	WW 7/ 5/77	730	0.0 19.0						X	CENOZOIC SEDIMENTS
5S/ 2E 25AAD	SW	42-57.85	116- 9.35	WW 7/ 4/77	804	0.0 54.0						X	CENOZOIC SEDIMENTS
5S/ 2E 27DAA	SW	42-57.59	116-11.75	WW 7/ 2/77	865	0.0 19.0						X	CENOZOIC SEDIMENTS
5S/ 1E 29DA	SW	42-57.49	116-21.26	WW 6/30/77	861	0.0 47.0						X	CENOZOIC SEDIMENTS
6S/ 4E 4BDB	SW	42-56.09	115-59.42	WW 7/14/77	771	10.0 77.0	1.09	1	60.9 5.5	60.9	66	D	CENOZOIC SEDIMENTS
6S/ 3E 6CAB	SW	42-55.86	116-10.18	WW 7/ 8/77	846	5.0 35.0	1.51	1	42.4 8.8	42.4	64	D	CENOZOIC CLAY/SAND
6S/ 3E 40DB	SW	42-55.59	116- 6.02	WW 7/ 5/77	785	0.0 17.0						X	CENOZOIC SEDIMENTS

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
6S/ 3E 10BAC	SW	42-55.19	116- 5.42	WW 7/ 1/77	789	0.0 21.0						X	
6S/ 3E 10BDB	SW	42-55.15	116- 5.42	WW 7/ 1/77	791	0.0 11.0						X	
6S/ 3E 7CBD	SW	42-54.83	116-10.23	WW 7/ 8/77	853	5.0 78.0						X	
6S/ 4E 17BBB	SW	42-54.52	116- 0.88	WW 7/14/77	804	10.0 20.0	(1.46)	1	(126.0)	126.0	185	D	CENOZOIC SEDIMENTS
6S/ 3E 14BCB1	SW	42-54.23	116- 4.55	USGS 8/20/74	806	15.0 55.0	1.26	1	59.0 5.4	59.0	73 7	D	CENOZOIC SND CLAY & GRVL
6S/ 3E 13BDC	SW	42-54.14	116- 3.04	WW 6/21/77	798	10.0 60.0	1.26		18.4 0.8	18.4	23 1	D	CENOZOIC CLY SILT & SAND
6S/ 8E 18CDD	SW	42-53.68	115-32.93	WW 7/ 6/77	800	0.0 12.5						X	CENOZOIC SEDIMENTS
6S/ 3E 23BBB	SW	42-53.64	116- 4.54	WW 7/12/77	824	10.0 25.0	(1.51)		(82.0)	82.0	165	D	CENOZOIC CLY SAND & BASLT
6S/ 3E 22DDB	SW	42-53.00	116- 4.87	WW 6/ 9/77	830	0.0 46.0						X	CENOZOIC SEDIMENTS
7S/ 4E 2DBC	SW	42-50.46	115-56.56	WW 6/26/77	823	0.0 30.0						X	CENOZOIC SEDIMENTS
7S/ 5E 7DDC	SW	42-49.41	115-53.90	WW 6/26/77	798	0.0 13.0						X	CZ CLAY/SAND BASALT
7S/ 5E 19BCD	SW	42-48.26	115-54.63	WW 8/20/74	817	0.0 26.0						X	CENOZOIC SEDIMENTS
8S/ 1W 25DBC	OU	42-41.79	116-24.05	WW 6/ 9/77	1827	10.0 23.0	1.09		96.2 18.5	96.2	105	D	CENOZOIC SEDIMENTS
9S/13E 32CDC	EW	42-35.74	114-57.70	WW BLGUL 8/31/75	1160	10.0 135.0	2.03 0.10	8	92.7 1.7	92.7	188 3	D	CENOZOIC GRAVEL/RHY
10S/13E 5CB	EW	42-35.09	114-57.81	WW BLGUL 9/ 6/75	1162	30.0 195.0	< 2.03 0.10	8	< 86.3 3.3	< 86.3	175	D	CENOZOIC GRAVEL/RHY
10S/12E 1CD	SW	42-34.86	114-59.85	WW BLGUL 9/ 5/75	1152	10.0 105.0	2.03 0.10		58.9 1.9	58.9	120	X	CENOZOIC GRAVEL/RHY
						10.0 220.0	< 2.03 0.10	8	< 83.5 1.6	< 83.5	169	D	
10S/12E 12AB	SW	42-34.71	114-59.55	WW BLGUL 6/28/74	1150	0.0 127.0	< 2.03 0.10	8	<125.0	<125.0	254	D	CENOZOIC GRAV/BAS/RHY
10S/ 2E 9BBB1	OU	42-34.62	116-14.13	WW BLM 7/ 6/77	1710	20.0 47.0	1.80		21.6 1.0	21.6	39	D	CENOZOIC SIL VOL

APPENDIX A

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
10S/12E 10DAA	SW	42-34.23	115- 1.54	WW BLGUL 6/27/74	1158	35.0 240.0	2.03 0.10	8	61.2 5.7	61.2	124	D	CENOZOIC RHYOLITE
10S/12E 11DBD	SW	42-34.10	115- 0.57	USGS 7/ 7/74	1143	0.0 210.0	2.03 0.12	8	61.0	61.0	124	D	CENOZOIC GRAV/BAS/RHY
10S/11E 36BBD	SW	42-31.09	115- 7.10	WW 7/20/77	1231	12.5 45.0	1.80		26.6 7.4	26.6	48	D	CENOZOIC SIL VOL
13S/ 3E 31CBD	OU	42-15.00	116- 9.25	WW 6/15/77	1628	10.0 26.5	1.88		103.0 5.8	103.0	194	D	CENOZOIC SIL VOL
14S/ 4E 17AAB	OU	42-12.94	116- 0.33	SMU GM3 12/28/77	1801	10.0 38.0	1.38 0.27	3	37.8 2.0	37.8	51	D	CENOZOIC SIL VOL
14S/ 3E 16CD	OU	42-12.11	116- 6.53	WW 6/15/77	1636	0.0 11.0						X	
15S/ 6E 4DAA2	OU	42- 8.99	115-45.00	WW 6/19/77	1554	10.0 40.0	1.88		59.9 5.8	59.9	113	D	CENOZOIC SILICIC VOL
15S/ 6E 11DB	OU	42- 8.03	115-42.91	WW 6/21/77	1615	0.0 25.0						X	CENOZOIC SILICIC VOL
15S/16E 20BC	CH	42- 6.60	114-36.80	WW 7/21/77		0.0 334.0			44.8	44.8		D	
15S/ 2E 22DBB	OU	42- 6.27	116-12.28	WW 7/10/77	1615	0.0 10.0						X	CENOZOIC SEDIMENTS
15S/ 2E 34DAC	OU	42- 4.41	116-12.23	WW 7/10/77	1618	0.0 12.0						X	CENOZOIC SEDIMENTS
16S/ 2W 29CCD	OU	41-59.88	116-36.28	WW 7/20/77	1596	50.0 175.0	1.88		80.4 4.0	80.4	151	D	CENOZOIC SILICIC VOL
13N/18E	CH			WW 7/21/77		10.0 43.0						X	

TABLE 81. Geothermal Data for the Eastern Snake River Plain Inside Boundaries of the Snake Plain Aquifer

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
15N/43E-24AAB	44-37.00	111-19.04	WW IP 8/ 5/75	2024	5.0 30.0	(1.13)		53.3 5.5	-59 5	AB	
					40.0 62.0	(1.46)		4.0 5.3	5	IN	7.67
12N/44E-20ADB	44-21.21	111-16.57	WW IP 8/ 5/75	1914	22.5 32.5	(1.46)		8.0	11	IN	5.07
11N/39E-11CDA	44-17.57	111-49.38	WW BLACK 5/13/77	1916	20.0 50.0	(1.46)		9.1 1.3	13	IN	6.44
11N/40E-4ADA	44-18.86	111-44.25	WW BLACK 5/15/77	2032	20.0 80.0	(1.46)		5.9 .1	8	IN	6.01
10N/39E-5CCD	44-13.02	111-53.53	WW LUSK 7/25/77	1827	20.0 60.0	(1.46)		7.6 .6	11	AB	
					60.0 200.0	(1.46)		14.5 .7	21	IN	7.67
10N/42E-24ABA1	44-11.21	111-26.54	USGS 8/ 6/75	1887	20.0 50.0	(1.46)		-25.2 3.1	-36	AB	
					50.0 65.5	(1.46)		20.8 1.5	30	IN	3.38
9N/39E-4AAC	44- 8.49	111-51.65	WW BALL 5/19/77	1725	50.0 260.0	(1.46)		6.9 .2	10	AB	9.89
9N/40E-3DDD	44- 7.85	111-46.51	WW 5/22/77	1682	10.0 190.0	(1.46)		7.3 .3	10	AB	
					190.0 220.0	(1.46)		17.3 1.4	25	IN	10.07
9N/44E-21BAD1	44- 5.80	111-15.22	WW IP 8/ 5/75	1729	10.0 32.5	(1.51)		12.6 1.3	22	AB	5.56
9N/34E-17CCC3	44- .97	112-29.61	USBR 8/13/77	1465	25.0 120.0	(1.46)		30.2 .3	44	AB	
					120.0 182.0	(1.46)		28.8 1.8	42	IN	13.97
8N/40E-1CAD1	44- 2.78	111-41.36	USBR 7/12/77	1573	20.0 100.0	(1.46)		28.8 3.4	42	AB	
					105.0 114.0	(1.46)		21.4 4.4	31	IN	13.24
8N/40E-21DDD3	44- .00	111-44.25	USBR 7/12/77	1513	20.0 50.0	(1.46)		45.0 1.9	66	AB	
					50.0 114.0	(1.46)		21.0 1.7	31	IN	13.11
7N/31E-22BDD	43-55.37	112-44.71	NRTS AN7 6/27/77	1504	20.0 110.0	(1.46)		-10.8 .4	-15	AB	9.09
7N/31E-29CAC	43-54.27	112-46.07	NRTS PW1 6/29/77	1493	20.0 105.0	(1.46)		-9.0 .5	-13	AB	9.26
7N/35E-13AAD4	43-56.43	112-16.70	USBR 7/ 7/77	1460	15.0 80.0	(1.46)		28.2 1.6	41	AB	
					80.0 225.0	(1.46)		-.5 .1	-0	IN	11.73
7N/35E-16BDD	43-56.16	112-20.79	WW 7/15/77	1497	35.0 81.0	(1.46)		4.5 .4	6	IN	12.23
7N/38E-23DBA6	43-55.10	111-56.52	USBR 7/12/77	1479	70.0 150.0	(1.46)		1.9 .2	2	IN	11.26
7N/39E-34CCB1	43-53.21	111-51.41	USBR 8/14/74	1472	30.0 70.0	(1.46)		16.7 1.5	24	AB	10.84
7N/40E-16BCC1	43-56.13	111-45.29	USBR 8/15/74	1489	.0 40.0					IN	11.33
7N/40E-19AAD1	43-55.49	111-46.70	USBR 7/ 8/77	1480	.0 45.0					IN	11.53
7N/40E-20CDC3	43-54.84	111-46.25	USBR 7/ 8/77	1484	45.0 120.0	(1.46)		-7.1 2.0	-10	IN	11.21
6N/31E-27BAD1	43-49.43	112-44.70	NRTS 7 6/ 5/77	1460	70.0 105.0	(1.46)		100.1 3.3	146	AB	
					105.0 260.0	(1.46)		11.8 .5	17	IN	19.78

TABLE 2

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 1

IDAHO NORTH 5/26/87

IG N	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
W A	NR	48- 8.24	116-51.39	DDH-8 8/11/71	731	90.0 215.0	2.68 0.15	19	20.1 0.1	19.3	52	A	PC BELT SERIES
5W	NR	47-41.12	116-56.98	NEUSTEL 9/ 5/81	774	24.0 89.0	3.18	1	19.3 0.1	18.0	57	B	GRANITE
	NR	47-30.00	116- 5.00	CM-854 6/17/66	1341	1538.0 1604.0	5.27 0.08	12	17.6 0.2	17.7	93	B	BELT QUARTZITE
	NR	47-30.00	116- 5.00	CM-841 6/17/66	1341	1538.0 1597.0	5.23 0.13	9	17.7 0.3	17.8	93	B	BELT QUARTZITE
	NR	47-30.00	116- 2.00	SSM-3417 7/14/65	1189	1382.0 1435.0	4.90 0.13	9	18.8 0.2	18.8	94	B	BELT ARG. QUARTZITE
3E BD	NR	47-27.32	116- 4.04	DDH-2 8/ 9/70	951	180.0 540.0	3.63 0.12	38	24.8 0.3	21.9	79	A	PC BELT SERIES
/ 4E	NR	47-27.00	115-58.00	DDH-1 9/ 0/64	928	957.0 1201.0	4.98 0.75	30	21.4 0.1	19.3	96	B	BELT SERIES QUARTZITE
/ 5W CBB	NR	47-19.67	117- 1.33	WW LWSN1 7/30/78	817	20.0 290.0	1.59	1	42.4 1.3	42.4	67	C	C P BASALT
/ 5W DDB	DU	46-52.61	117- 0.22	WW CRKHL 3/ 2/78	885	15.0 90.0	3.08	1	22.3 0.8	22.8	70	C	GRANITE
/ 5W BCC	NR	46-51.32	116-57.18	WW PORTR 3/ 2/78	878	25.0 70.0	2.61	1	24.2 0.3	27.8	73	C	GRANITE
/ 5W 3CAD	DU	46-48.42	117- 0.79	WW CHIN 3/ 2/78	945	20.0 90.0	2.59		20.7 0.1	23.8	62	C	GRANITE ?
N/ 2W 28CC	NR	46-47.78	116-34.75	WW DEARY 3/ 2/78	830	50.0 105.0	1.59	1	34.6	34.6	54	C	BASALT AND SANDSTONE
N/ 3W 0DDD	NR	46-33.54	116-41.30	WW HMGRD 3/ 3/78	649	15.0 130.0	1.62 0.23	1	33.6 0.7	28.9	47	C	C P BASALT
N/ 2W 10DDD	NR	46-28.42	116-33.49	WW PEA 1/18/78	817	30.0 210.0	1.59	1	45.9 1.2	58.3	93	C	C P BASALT
5N/ 5W 20CD	NR	46-24.04	116-55.44	WW TAYLR 2/17/78	434	170.0 215.0	1.72	1	46.0 1.4	46.0	79	C	C P BASALT
5N/ 5W 17DDB	NR	46-22.30	116-58.94	WW NASH 2/15/78	420	95.0 190.0	1.72		47.0 1.0	47.0	81	C	C P BASALT
5N/ 5W 30BDD	NR	46-20.91	117- 0.80	WW LOWTH 2/17/78	439	110.0 190.0	1.72		30.9 0.5	38.6	66	C	C P BASALT
4N/ 2W 31DDC	NR	46-14.39	116-37.25	WW HNCHS 2/20/78	1214	15.0 165.0	2.51		23.8 0.2	23.8	60	C	GRANITE
31N/ 1W 13AAC	NR	46- 1.97	116-23.50	WW STGCN 2/28/78	1226	15.0 210.0	2.51		25.7 0.3	26.3	67	C	GRAYWACKE & GRANITE

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 2

IDAHO NORTH 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
30N/ 2E 6CAC	NR	45-58.02	116-15.32	WW FENN 2/28/78	998	65.0 140.0	1.59	1	24.3 0.5	24.3	39	C	C P BASALT
20N/ 3W 28BD	WD	45- 6.20	116-40.43	DDH-N2 8/12/71	1563	45.0 95.0	2.72 0.04	15	21.2 0.2	20.3	55	B	ANDESITE
20N/ 3W 3DB	WD	45- 5.79	116-41.18	DDH-A 8/31/71	1463	90.0 150.0	2.59	1	19.5 0.4	18.7	49	C	ANDESITE
18N/ 3E 22DAA	SI	44-52.90	116- 3.98	WW 8/13/76	1556	10.0 80.0	1.61	1	35.5 1.1	35.5	57	C	GLACIAL SEDIMENTS
16N/ 4W 118DA	WD	44-44.23	116-47.02	DDH-1 8/15/71	1756	100.0 295.0	2.83 0.11	16	22.9 0.1	21.6	61	A	DIORITE AND GRANODIORITE
15N/ 3E 5AAD	CH	44-40.15	116- 6.63	USBR 8/20/76	1475	10.0 50.0	1.55		234.7 1.9	215.8	334	G	ALLUV. OVER GRANITE
15N/ 8E 32CD	CH	44-35.26	115-30.92	SMU IB-6 9/18/77	2207	25.0 80.0	3.84 0.09	7	21.0 0.5	20.2	77	B	IDAHO BATH. GRANITE
14N/ 4E 21DB	CH	44-32.02	115-58.44	SMU IB-7 9/17/77	1536	20.0 85.0	3.79 0.07	7	12.6 0.4	12.4	47	B	IDAHO BATH. GRANITE
14N/18E 29AC	SI	44-31.04	114-21.68	DDH-17 9/20/76	2207	13.0 105.0	1.95 0.02	8	42.4 2.2	48.4	95	C	CHALLIS VOLCANICS
13N/27E 5CCA2	IR	44-29.05	113-16.32	RDH-2 7/15/79	2084	207.5 432.5	> 1.26	1	83.7 0.5	> 83.7 0.5	105	C	ALLUVIUM AND VALLEY FILL
13N/26E 12ABA	IR	44-28.76	113-18.12	DDH-W2 8/18/71	2268	10.0 440.0	$ 2.56 0.03	4	$ 18.2 26.1	$ 18.0 24.5	46 63	C	MONZONITE & GRANODIORITE
13N/27E 7BAD	IR	44-28.68	113-17.32	DDH-W3 8/18/71	2201	210.0 250.0	2.59 0.05	11	24.4 0.1	22.6 0.1	59	B	MONZONITE
13N/18E 16DBC	SI	44-27.29	114-20.50	WW 8/ 5/76	2173	45.0 115.0	1.85		43.8 3.6	43.8 3.6	81	C	CHALLIS VOLCANICS
13N/18E 32DCB	SI	44-24.53	114-21.84	DDH-38 6/27/76	2378	50.0 105.0	3.38 0.10	11	38.6 0.8	28.0 0.5	95	A	HORNBLENDE GNEISS
12N/18E 3ACB	SI	44-24.05	114-19.33	DDH-58 6/27/72	1975	70.0 170.0	4.08 0.27	25	66.1 3.0	44.9 2.0	183	G	SLATE
12N/18E 3ACC	SI	44-23.97	114-19.21	DDH-35 9/20/65	1914	100.0 295.0	4.28 0.04	9	24.6 0.9	19.0 0.7	81	G	SLATE
12N/18E 3ACD	SI	44-23.95	114-19.05	DDH-36 9/12/66	1902	150.0 270.0	4.27		81.2 14.7	62.8 11.3	268	G	SLATE
12N/18E 3DBB	SI	44-23.86	114-19.35	DDH-65 6/26/70	2048	50.0 85.0	3.96 0.19	5	61.9 4.5	49.2 2.9	155	G	SLATE
12N/ 4W 27DBC	WD	44-20.60	116-48.05	RNS-2	732	55.0 77.0	1.39 0.15	13	43.9	36.5	50	C	CLAY/BASALT

TABLE 2

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 3

IDAHO NORTH 5/26/87

G N	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
W	WD	44-19.50	116-47.10	RNS-3	744	40.0 77.0	1.53 0.33	13	59.6	54.2	83	B	CENOZOIC SAND/CLAY
1W	WD	44-18.75	116-47.35	RNS-12	718	20.0 55.0	1.33 0.04	13	47.5	45.2	60	C	SAND/CLAY/ BASALT
W A	WD	44-17.20	116-41.60	RNS-8	1113	50.0 77.0	1.57 0.39	13	44.0	44.0	69	C	SAND/CLAY/ BASALT (CZ)
3W B	WD	44-16.85	116-40.40	RNS-9	1113	40.0 77.0	1.36 0.08	13	28.0	29.4	40	C	SANDY/CLY/ BASALT (CZ)
2W B	WD	44-16.85	116-33.60	RNS-4	1037	15.0 77.0	1.21 0.11	13	92.8	84.0	102	B	CENOZOIC SEDIMENTS
3W 8D	WD	44-16.80	116-39.50	RNS-10	1152	30.0 77.0	1.56 0.13	13	18.4	20.4	32	B	CENOZOIC SAND/GRAVEL
3W BB	NR	44-16.02	116-43.82	RDH-CHA1 12/13/77	820	0.0 2438.0	(1.59)		(47.9)	(47.9)	76	C	CP BASALT TO K GRANITE
/14E CCD	CH	44-15.73	114-49.84	DDH-3 8/ 4/76	1926	20.0 40.0	> 2.93		>220.0	>169.0	496	G	IDAHO BATH GRANITE
/ 2W 8DD	WD	44-14.75	116-32.54	RNS-7	1064	10.0 77.0	1.22 0.22	13	38.6	35.1	43	B	CENOZOIC SEDIMENTS
/ 2W CCD	WD	44-14.40	116-34.25	RNS-6	1055	45.0 65.0	1.49 0.13	12	72.6	66.0	98	C	C. R. BASALT
/32E 50DC	IR	44-13.85	112-39.50	SMU LHS2 8/15/78	1868	12.5 142.5	2.22 0.18	18	17.8 0.5	17.8 ~~0.5~~	39	A	CLAY LS CIND RHYOLITE
N/ 2W 2CCD	WD	44-13.30	116-32.70	RNS-16	1079	20.0 65.0	1.45 0.24	13	31.6	30.1	44	B	CZ BASALT SAND/CLAY
N/ 4E 32CCB	CH	44- 9.24	116- 0.87	WW TERRA 9/11/77	1219	10.0 70.0	3.05	1	176.7 4.6	163.2	498	G	IDAHO BATH GRANITE
9N/29E 1CAA	IR	44- 8.33	112-56.68	WW BLM 8/21/77	1951	100.0 183.0	1.46		33.7 1.3	33.7 ~~1.3~~	49	B	BASALT AND SEDIMENTS
9N/30E 2CDD	IR	44- 7.95	112-50.75	RDH-U-LC 7/29/78	1987	15.0 100.0	2.43	1	38.3 1.8	27.4	67	B	LIMESTONE
9N/ 4E 19DC	CH	44- 5.62	116- 1.50	WW B 8/25/76	1000	10.0 40.0	2.80	1	44.7 2.0	36.7	103	G	IDAHO BATH GRANITE
8N/ 4E 18AC	CH	44- 3.66	115-55.85	SMU GV4 9/ 8/78	975	10.0 26.5	2.79	2	66.4 2.8	51.1	143	G	IDAHO BATH GRANITE
8N/ 4E 1CAD	CH	44- 3.26	115-55.64	SMU GV3 9/ 8/78	1000	12.5 90.0	2.80 0.05	13	54.3 0.8	48.9	137	G	IDAHO BATH GRANITE
8N/31E 7AB	IR	44- 2.57	112-48.02	WW BALL 8/19/77	1672	70.0 130.0	1.46	1	36.9 1.0	36.9 ~~1.0~~	54	B	BASALT

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 4

IDAHO NORTH 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
8N/ 4E 12DCD	CH	44- 2.32	115-55.33	SMU GV2 9/ 8/78	1073	10.0 122.5	2.85 0.04	19	33.1 0.2	28.1	80	B	IDAHO BATH GRANITE
8N/ 6E 16AAB	CH	44- 2.12	115-47.16	DDH-1 6/24/72	1835	20.0 100.0	2.79 0.10	8	24.2 0.5	29.3 0.8	82	B	IDAHO BATH GRANITE
8N/ 6E 16AAD	CH	44- 2.04	115-47.04	DDH-5 7/31/72	1891	200.0 400.0	2.80 0.08	4	38.4 0.3	41.5 0.3	116	A	IDAHO BATH GRANITE
8N/ 6E 17BB	CH	44- 1.99	115-46.62	DDH-11 8/ 1/77	1847	50.0 300.0	2.54 0.14	7	36.2 0.3	42.6 0.4	108	A	IDAHO BATH GRANITE
8N/ 5E 16BCC	CH	44- 1.84	115-52.61	USBRDDH3 6/28/70	1066	40.0 100.0	3.05 0.13	9	81.5 1.1	59.2 0.7	191	G	IDAHO BATH GRANITE
8N/ 4E 13CAA	CH	44- 1.75	115-55.64	SMU GV1 9/ 8/78	1091	47.5 129.0	2.72 0.08	10	37.9 0.2	32.2	87	B	IDAHO BATH GRANITE
8N/29E 32CCC1	IR	43-58.46	113- 1.89	RDH-P81 8/20/78	2121	17.5 59.0	3.22 0.17	2	24.3 0.2	33.3	107	C	QUARTZITE
7N/ 1E 10BCD	WD	43-57.53	116-19.74	WW DRAKE 8/25/78	780	15.0 64.0	1.07	1	145.1 4.7	145.1 4.7	155	G	CENOZOIC CLAY/SAND
7N/ 7E 10CB	CH	43-57.35	115-37.39	SMU IB-4 9/27/77	1628	15.0 55.0	3.56 0.09	5	20.6 0.5	21.1 0.5	75	B	IDAHO BATH GRANITE
6N/ 2E 29BA	WD	43-50.17	116-14.70	BO-1 8/13/76	1294	20.0 150.0	2.75 0.04	15	62.7 1.3	60.3	166	A	IDAHO BATH GRANITE
5N/ 5E 3CDD	CH	43-47.49	115-50.79	DDH-3 7/13/72	1451	120.0 590.0	3.03 0.09	6	26.0	26.2	79	A	IDAHO BATH GRANITE
5N/ 1E 26BAC	WD	43-44.80	116-18.46	WW CON 1 8/31/78	926	65.0 125.0	1.85	1	82.0 2.9	74.5	138	C	CENOZOIC CLAY
4N/ 6E 12BDC	CH	43-42.50	115-41.48	DDH QH-4 8/12/69	1500	190.0 245.0	3.63 0.04	8	19.4 1.0	25.1 1.1	78	B	IDAHO BATH GRANITE
4N/10E 29AD	CH	43-39.41	115-17.03	SMU IB 1 9/24/77	1682	20.0 85.0	3.03 0.10	7	22.6 0.3	22.2 0.3	67	B	IDAHO BATH GRANITE
3N/ 2E 2CAB	CH	43-37.57	116-11.22	WW 7/29/74	859	0.0 95.0	< 1.26		<380.0	<345.0	433	G	CENOZOIC SEDIMENTS
3N/ 2E 13ACC	WD	43-35.92	116- 9.63	WW STPEN 8/24/78	850	10.0 222.0	1.97	1	142.4 18.5	123.8	244	G	CENOZOIC CLAY
3N/ 3E 20BDB	WD	43-35.02	116- 7.64	WW HARRS 8/24/78	875	5.0 161.9	1.46	1	318.0	265.0	388	G	CENOZOIC CLAY/SAND
3N/ 3E 28BB	WD	43-34.45	116- 7.38	WW TRPLT 7/29/78	878	30.0 73.9	1.46		89.7 1.5	74.8	110	C	CENOZOIC CLAY/SAND
3N/18E 26ABC	CH	43-34.06	114-16.53	WW RONGR 8/ 4/78	1829	7.5 65.0	1.80	1	33.8 1.2	28.7 1.0	52	C	

TABLE 2

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                        GEOTHERMAL DATA PRINTOUT       S.I. UNITS                    PAGE   5
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                                          IDAHO NORTH 5/26/87
-----------------------------------------------------------------------------------------------
NG  TECT  N LAT     W LONG      HOLE     COLLAR   DEPTH   AVG TCU  NO  UN GRAD  CO GRAD  CO H.F.  Q    LITHOLOGY
ON  PROV DEG MIN   DEG MIN     (DATE)     ELEV    RANGE    <SE>   TCU   <SE>     <SE>     <SE>   HF    SUMMARY
-----------------------------------------------------------------------------------------------
8E   CH  43-32.42  115-26.60 SMU IB-2     1682     17.0    3.46   11    27.8     23.4      81    B   IDAHO BATH
                              9/24/77             117.0    0.08          0.4                          GRANITE
:
7E   SI  43-27.50  115-35.83 WW DOMNG     1432    145.0    1.59         43.9     46.1      73    C   CENOZOIC
                              7/23/78             200.0                  0.4                          BASALT
AA
6E   IR  43-23.01  115-43.05 SMU IB-3     1472     10.0    3.59   12    27.4     28.7     103    B   IDAHO BATH
                              7/14/77             118.0    0.03          0.9                          GRANITE
AD
9E   CH  43-19.08  115-21.64 MH 1         1561     95.0    2.64    5    47.2     46.7     123    A   IDAHO BATH
                              2/ 3/76             150.0    0.02          0.5                          GRANITE
BC
/ 8E IR  43-15.19  115-32.70 MH 2         1512     10.0    2.30    1    24.3     24.3      56    C   CENOZOIC
                              8/22/75              30.0                  0.6                          CLAY/RHY.
ABO
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TABLE 2

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 1

IDAHO WSRP 5/26/87

G N	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
W	SW	44-19.02	117- 2.68	WEISR 7/22/76	722	103.7 263.0			71.4 0.3				CENOZOIC SEDIMENTS
						359.8 603.7			59.9 0.4				
						97.6 603.7	1.46		67.9 0.4	67.0	98	C	
5W 3	SW	44-18.60	117- 3.46	WW 9/25/75	701	65.0 95.0	1.46		71.3	69.7	102	C	CENOZOIC SEDIMENTS
3W A	SW	44- 7.70	116-38.80	RNS-18	811	195.0 435.0	1.17		67.0	67.0	79	C	CENOZOIC CLAY
5W A	SW	44- 4.30	116-55.37	WW PAYTT 8/ 2/78	655	30.0 64.0	2.02	1	55.9 0.5	55.9 0.5	113	C	CENOZOIC SAND/GRAVEL
3W B	SW	44- 4.10	116-37.80	RNS-19	817	230.0 334.0	1.17		96.0	87.0	102	C	CENOZOIC CLAY
3W 8D	SW	44- 2.25	116-42.50	RNS-21	700	10.0 442.0	1.17		97.0	92.4	108	C	CENOZOIC CLAY
4W DA	SW	44- 2.13	116-49.55	RNS-23 0/ 0/78	678	25.0 295.0	1.17		89.3	85.0	100	C	CENOZOIC CLAY
3W AD	SW	43-58.60	116-37.60	RNS-22	841	140.0 335.0	1.46		45.0	45.0	66	C	CENOZOIC SAND/CLAY
/ 2W 3BA	SW	43-55.40	116-36.47	USGS 8/ 9/75	730	10.0 80.0	1.80		58.1 0.3	58.1 0.3	104	C	SEDIMENT
/ 4W AAD	SW	43-49.16	116-50.00	ROH 7/26/74	835	15.0 50.0	1.78 0.06	4	49.1 2.4	54.0	96	C	CENOZOIC SEDIMENTS
/ 4W DBD	SW	43-48.75	116-51.55	ROH 6/15/74	838	10.0 75.0	1.78 0.06	4	63.2 2.4	62.3	111	C	CENOZOIC SEDIMENTS
/ 2W 5AAA	SW	43-44.97	116-32.02	WW 8/15/78	777	45.0 70.0	1.77	1	57.0 2.5	55.0	97	C	CENOZOIC CLAY/SAND
N/ 1E 7BDB	SW	43-44.82	116-19.71	WW CON 2 9/ 1/78	902	55.0 99.0	1.62	1	85.7 3.8	81.6	133	C	CENOZOIC CLAY
N/ 1E 7DAA	SW	43-44.54	116-18.45	WW CON 3 8/31/78	850	35.0 69.0	1.44	1	89.0	77.4	111	C	CENOZOIC CLAY
4N/ 2E 19AAA	SW	43-40.64	116-15.28	WW 8/16/78	856	10.0 169.0	2.00	1	96.8 1.1	80.6	161	G	CENOZOIC SAND/CLAY
4N/ 3W 19ACD	SW	43-40.25	116-44.23	RNS-40	712	0.0 660.0	< 1.46		< 75.8	75.8	111	C	CENOZOIC CLAY/SAND
4N/ 3W 19ADC	SW	43-40.25	116-44.15	SIMP-WW 12/19/79	711	0.0 768.0	1.17		65.0	65.0	76	C	CENOZOIC CLAY

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 2

IDAHO WSRP 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
4N/ 2E 22BCD	SW	43-40.25	116-12.52	RNS-46	887	10.0 80.0	(1.46)		163.0	155.0	226	G	CENOZOIC CLAY/SAND
4N/ 2E 29ACC	SW	43-39.41	116-14.35	ROH EDWD 7/24/78	814	15.0 123.0	< 1.46		< 91.7	< 90.0	132	G	CENOZOIC CLAY/SAND
4N/ 1E 25DCD	SW	43-38.99	116-17.35	WW 7/20/77	814	10.0 280.0	1.80		70.9 1.7	70.9	127	G	CENOZOIC SILICIC VOL.
3N/ 2E 11BAB	SW	43-37.10	116-11.05	RNS-55	835	35.0 114.0	1.25 0.23	24	225.4	204.5	255	G	CENOZOIC CLAY/RHY.?
3N/ 2E 10ABA	SW	43-37.09	116-11.96	ISH-WW 12/20/79	824	0.0 242.5	(1.17)		(101.6)	(101.6)	119	G	CENOZOIC SED/RHY
3N/ 2E 11BAA	SW	43-37.08	116-11.07	BGL - 3 8/24/81	844	0.0 572.8	< 1.17		<102.8	<102.8	120	G	CZ SED, SIL VOL & BASALT
3N/ 2E 11BAD	SW	43-37.02	116-10.92	RNS-56	845	46.0 137.0	1.26		361.8	328.9	413	G	CENOZOIC CLAY/RHY.?
3N/ 4W 8CDC	SW	43-36.23	116-50.62	WW 8/22/78	731	40.0 60.0	1.95	1	81.8 3.1	81.8	160	C	CENOZOIC SAND
3N/ 1E 29BBB	SW	43-34.47	116-22.37	WW GALLW 9/14/78	807	10.0 65.0	1.59	1	30.9 0.8	30.9	49	C	CENOZOIC ,CLAY/SAND
3N/ 3E 33AAC	SW	43-33.44	116- 5.83	WW 7/14/77	864	25.0 110.0	1.46		79.3 4.0	69.0	101	C	CENOZOIC BASALT
3N/ 2E 36AC	SW	43-33.33	116- 9.27	RNS-58	884	90.0 140.0	1.46		83.0	83.0	122	G	CENOZOIC SAND
2N/ 3W 6DBD1	SW	43-32.13	116-44.25	USGS 8/ 8/74	796	10.0 70.0	1.34		95.4 0.9	95.4	128	C	CENOZOIC BASALT
2N/ 2E 33ABB	SW	43-28.39	116-13.29	WW STPEN 7/19/78	922	40.0 120.0	1.65	1	56.6 0.6	56.6	92	C	CENOZOIC CLAY/GRAVEL
2N/ 3E 35BBC	SW	43-28.24	116- 4.38	WW 7/24/76	1044	20.0 210.0	2.05	1	43.2 0.3	43.2	89	C	CENOZOIC SILICIC VOL.
						210.0 330.0	2.51		31.3 0.2	31.3	79	C	
1N/ 3W 1BDA	SW	43-27.30	116-38.58	WW 6/13/77	836	25.0 95.0	1.34		107.1 1.8	107.1	143	C	CENOZOIC SEDIMENTS
1N/ 2E 15DCA	SW	43-25.07	116-11.98	WW 7/25/76	905	10.0 175.0	1.42		56.1 1.0	56.1	79	C	CENOZOIC BASALT
1N/ 2E 29DD	SW	43-23.26	116-14.08	BO 3 8/23/75	888	12.5 30.0	1.42	1	33.2 1.4	33.2	47	C	CENOZOIC SAND/GRAVEL
1S/ 4E 10DAD	SW	43-20.92	115-57.30	WW 7/22/76	1006	10.0 130.0	1.46		47.9 1.4	47.9	70	C	CENOZOIC SEDIMENTS

TABLE 2

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 3

IDAHO WSRP 5/26/87

NG ON	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
3E	SW	43-20.25	116- 3.40	WW 8/ 7/74	962	20.0 110.0	1.42	1	34.6 2.1	34.6	49	C	CENOZOIC BASALT
3W \B	SW	43-19.27	116-38.56	WW 6/27/77	768	10.0 215.0	1.42		94.6 2.0	94.6	135	C	CENOZOIC SED./BASALT
6E DC	SW	43-18.47	115-44.44	WW 7/23/77	1100	20.0 90.0	1.26	1	65.8 3.0	65.8	82	C	CENOZOIC SED./BASALT
5E DB1	SW	43-17.78	115-49.80	USGS 7/22/74	1024	10.0 55.0	1.09	1	82.7 5.7	82.7	90	C	CENOZOIC SEDIMENTS
4E 3BD	SW	43-16.20	115-57.18	WW 8/26/75	961	25.0 145.0	1.34		44.3 1.4	44.3	59	C	CENOZOIC BASALT
/ 4E DDD	SW	43-15.57	115-58.59	WW NYBOR 8/27/75	951	10.0 160.0	1.34	1	44.9 0.7	44.9	60	B	CENOZOIC SED/BASALT
/ 6E DAC1	SW	43-15.45	115-42.15	USGS CC 7/23/76	1109	20.0 480.0	1.34		84.9 2.4	84.9	114	B	CENOZOIC BASALT
/ 2W D	SW	43-14.74	116-34.53	WW 7/16/75	853	45.0 125.0	1.21	1	56.0 0.7	56.0	72	C	CENOZOIC SED./BASALT
5/ 1E 1DD	SW	43-14.67	116-17.63	BO 4 8/23/74	963	15.0 30.0	2.01	1	62.0 1.3	62.0	123	C	CENOZOIC SAND/CLAY
5/ 1E 3ADD	SW	43-14.07	116-17.63	WW LNDRF 7/21/78	962	160.0 230.0	1.17		84.3 6.3	84.3	99	C	CENOZOIC BASALT/CLAY
						30.0 235.0	1.38	1	60.0 3.1	60.0	83	D	
2S/ 3W 22DBC	SW	43-13.88	116-40.61	WW 6/24/77	1292	10.0 44.0	1.09		77.8 1.1	77.8	85	C	CENOZOIC SED./BASALT?
2S/ 5E 30DCC	SW	43-13.14	115-54.37	WW 8/24/75	948	35.0 90.0	1.34	1	62.8 3.0	62.8	84	C	CENOZOIC BASALT
2S/ 2W 35AAA	SW	43-12.77	116-31.92	WW 6/22/77	875	20.0 135.0	1.13	1	93.5 5.4	93.5	106	C	CENOZOIC SED./BASALT
2S/ 4E 36DCC	SW	43-12.07	115-55.57	WW 8/23/75	938	5.0 80.0	1.46		33.6 2.1	33.6	49	C	CENOZOIC BASALT
3S/ 1W 8CBC	SW	43-10.47	116-29.52	USGS 6/19/77	969	30.0 125.0	1.38		97.6 0.6	97.6	135	C	CENOZOIC SILICIC VOL.
3S/ 1E 18BCB	SW	43- 9.88	116-23.50	WW 7/ 4/77	754	15.0 30.0	1.17		97.0 5.0	80.8	95	C	CENOZOIC CLAY
3S/ 6E 35BCC1	SW	43- 7.27	115-42.85	USGS 7/23/74	959	10.0 190.0	1.13	1	87.4 2.8	87.4	98	C	CENOZOIC CLAY
4S/ 2W 11ABA	SW	43- 5.78	116-32.27	WW 6/12/77	993	5.0 95.0	1.46		5.9 0.6	5.9	9	C	CENOZOIC SED./SIL.VOL

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 4

IDAHO WSRP 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
4S/ 6E 14BA	SW	43- 4.97	115-42.55	MH 4 8/22/75	942	15.0 30.0	1.86 0.06	2	34.1 1.5	34.1	64	C	CENOZOIC BASALT
4S/ 7E 18AD	SW	43- 4.66	115-39.63	WW 7/30/75	942	5.0 119.0	1.14	1	88.7	88.7	101	C	BASALT (VB) CLAY
4S/ 2E 20DBD	SW	43- 3.73	116-14.74	WW 6/28/77	762	25.0 63.0	1.55	1	63.1 2.0	63.1	98	C	CENOZOIC CLAY/GRAVEL
										63.1	71	C	
4S/ 5E 21CA	SW	43- 3.67	115-52.02	WW USAF 8/ 7/74	913	10.0 110.0	1.13		53.3 4.0	53.3	60 5	C	CENOZOIC BASALT/SED.
4S/ 3E 23CDD	SW	43- 3.37	116- 4.11	WW 7/27/76	829	20.0 105.0	1.09	1	63.9 4.8	63.9	69	C	CENOZOIC CLAY/GRAVEL
4S/10E 30BBA1	SW	43- 3.17	115-19.14	USGS 7/25/74	1051	100.0 270.0			88.1 1.3	88.1		D	CENOZOIC BASALT
						100.0 410.0	1.38	1	98.8 1.9	98.8	137	C	
4S/ 1W 29BDC	SW	43- 2.80	116-28.64	WW 7/ 1/77	990	15.0 85.0	1.46		0.7 0.1	0.7	1	C	CENOZOIC SED/SIL VOL
4S/ 8E 25CBB	SW	43- 2.45	115-27.55	BOSTICK1 8/15/74	972	500.0 2700.0	1.46		70.0	70.0	103	B	CZ SEDS BSLT SILIC VOL
4S/ 1E 36BA	SW	43- 2.37	116-17.18	BO 5 8/23/75	769	17.5 32.0	1.57	2	45.3 0.4	45.3	71	C	CENOZOIC CLAY
5S/ 3E 12BDA	SW	43- 0.45	116- 2.24	WW 7/ 2/77	792	30.0 105.0	1.38	1	130.7 3.1	108.0	149	G	CENOZOIC SEDIMENTS
5S/ 2E 22DCD	SW	42-58.11	116-12.06	WW 7/ 3/77	856	10.0 70.0	1.21	1	93.4 3.1	93.4	113	C	CENOZOIC SEDIMENTS
5S/12E 26CCB	SW	42-57.35	115- 0.33	BL 1 8/26/75	1019	15.0 30.0	1.54	1	50.0 1.2	50.0	77	C	BASALT
5S/ 3E 34DAA	SW	42-56.76	116- 5.20	WW 6/21/77	762	5.0 40.0			137.9 3.7			D	CENOZOIC CLAY/SHALE
						40.0 120.0	1.38		67.3 0.4	67.3	93	C	

TABLE 2

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 5

IDAHO WSRP 5/26/87

NG ON	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
1E C	SW	42-56.41	116-17.90	WW 6/ 8/77	929	10.0 45.0	1.30	1	88.9 1.1	88.9	115	B	CENOZOIC LS/SAND
						45.0 70.0	2.26	1	51.1 1.9	51.1	116	B	
						70.0 90.0	1.59	1	74.0 0.3	74.0	118	B	
						10.0 90.0				74.0	116	B	
3E D	SW	42-55.53	116-10.02	WW 6/26/77	838	35.0 85.0	1.51		48.8 1.1	48.8	74	C	CENOZOIC CLAY/SAND
/ 3E 3AB	SW	42-55.37	116- 5.42	WW 7/ 1/77	783	50.0 160.0	1.38		47.5 0.4	47.5	66	C	CENOZOIC CLAY/SAND
/ 3E CCB	SW	42-54.66	116- 4.54	WW 8/20/74	795	10.0 30.0	1.17		143.4 5.1	143.4	168	D	CENOZOIC SAND/CLAY
						30.0 60.0	1.51		58.4 3.1	58.4	88	C	
/ 6E BA	SW	42-54.52	115-47.27	MH 5 8/24/75	888	15.0 30.0	1.34	1	57.6 1.1	57.6	78	C	CENOZOIC SND /GRVL & CLAY
/ 2E AB	SW	42-53.63	116-14.50	RDH-104 8/ 5/78	1021	40.0 455.0			(87.0)	(87.0)	92	G	CENOZOIC VOL/SED
						40.0 180.0	1.05		155.4 2.1	155.4	163	G	
S/ 3E 3DDD	SW	42-52.84	116- 3.42	WW 6/19/77	844	30.0 105.0	1.09		125.0 5.3	125.0	136	G	CENOZOIC CLAY/SAND
S/12E 9CDD	SW	42-52.84	115- 4.63	BL2 8/26/75	983	15.0 30.0	1.21	1	113.0 2.0	113.0	137	B	SEDIMENTS
S/ 2E 30CB	SW	42-52.20	116-16.42	BO 6 8/23/75	1091	7.5 15.0	0.96	1	174.8 3.2	174.8	167	G	CENOZOIC SND CLAY & GRVL
						15.0 32.5	1.38	1	125.0 1.1	125.0	174	G	
6S/ 2E 34BD	SW	42-51.64	116-12.45	RDH-8 8/ 4/78	1044	50.0 454.0	(1.88)		(102.0)	(102.0)	192	G	CENOZOIC VOL/SED
						50.0 160.0	1.05		225.4 3.1	225.4	236	G	
						160.0 220.0	1.88		118.1 1.1	118.1	222	G	
7S/ 4E 6CDA	SW	42-50.38	116- 1.38	WW 7/12/77	891	5.0 83.0	1.26		127.3 2.6	127.3	159	C	CENOZOIC SEDIMENTS

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 6

IDAHO WSRP 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
7S/ 4E 9CCC	SW	42-49.43	115-59.46	MH 6 8/24/75	894	7.5 30.0	1.26 0.01	2	116.3 2.2	116.3	146	C	CENOZOIC GRAVEL /SAND
7S/ 4E 18BB	SW	42-49.25	116- 1.75	RDH-128 8/ 4/78	914	30.0 305.0	(1.88)		(59.0)	(59.0)	111	G	CENOZOIC VOL/SED
						30.0 80.0	1.05		198.6 9.7	198.6	208	G	
						80.0 130.0	1.88		10.8 9.0	107.6	203	G	
7S/ 5E 18ACC	SW	42-49.13	115-53.84	WW 6/26/77	807	20.0 115.0	(1.38)	1	(146.0)	(146.0)	202	G	CENOZOIC SAND/CLAY
7S/ 2E 13BCA	SW	42-49.07	116- 9.93	WW BLACK 6/24/78	995	30.0 60.0	1.17		139.6 1.8	139.6	164	D	CENOZOIC SILICIC VOL
						70.0 370.0	1.88		65.5 1.4	65.5	123	D	
						290.0 370.0	1.88		70.1 0.5	70.1	132	C	
7S/10E 22DDD	SW	42-47.85	115-15.53	RDH 8/ 5/77	962	30.0 100.0	1.17		104.4 3.1	104.4	122	C	CENOZOIC CLAY/SAND
						100.0 160.0	1.88		55.3 2.6	55.3	104	C	
						160.0 220.0	1.17		110.5 2.6	110.5	129	C	
8S/12E 23AAC	SW	42-43.40	115- 1.28	WW BLGUL 6/25/74	1064	95.0 165.0	2.05	8	55.0 1.1	55.0	112	B	BASALT RHYOLITE
8S/ 7E 24BD	SW	42-43.14	115-34.95	WW 7/12/77	1112	15.0 280.0	1.34		76.4 0.8	76.4	102	C	SEDIMENTS & SILICIC VOL.
9S/ 5E 4DA	SW	42-40.26	115-51.95	WW 6/29/77	1103	115.0 255.0	1.51		101.0 0.9	101.9	152	G	BASALT AND SILICIC VOL.
9S/13E 18CB	SW	42-38.52	114-59.02	WW BLGUL 9/ 1/75	1157	20.0 300.0	2.03 0.10	8	56.9 1.2	56.9	115	A	GRAV, BASALT RHYOLITE
9S/12E 24AD	SW	42-37.94	114-59.16	WW BLGUL 7/ 7/74	1159	70.0 425.0	2.03 0.10	8	63.6 2.4	63.6	129	C	CENOZOIC BASALT/RHY.
9S/ 6E 20DBC	SW	42-37.59	115-46.47	WW 6/28/77	1146	10.0 45.0	1.17	1	118.8 5.3	118.8	139	C	SEDIMENTS & BASALT
9S/13E 20CCD1	SW	42-37.40	114-57.91	USGS 7/ 7/74	1160	30.0 220.0	2.05	8	63.9 3.7	63.9	130	B	GRAV, BASALT RHYOLITE
9S/13E 31BD	SW	42-36.19	114-58.67	WW BLGUL 9/ 4/75	1158	20.0 175.0	2.03 0.10	8	69.6 1.9	69.6	141	C	GRAVEL BASALT/RHY.

TABLE 2

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                                GEOTHERMAL DATA PRINTOUT       S.I. UNITS                  PAGE  7
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                                          IDAHO WSRP 5/26/87
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THN/RNG  TECT  N LAT    W LONG     HOLE     COLLAR   DEPTH    AVG TCU  NO  UN GRAD  CO GRAD  CO H.F.  Q     LITHOLOGY
SECTION  PROV DEG MIN  DEG MIN    (DATE)     ELEV    RANGE     <SE>   TCU   <SE>     <SE>     <SE>   HF     SUMMARY
--------------------------------------------------------------------------------------------------------
11S/11E   SW  42-28.83  115-13.29 WW BLM     1387      20.0    1.38    1    73.6     73.6      101    C     CENOZOIC
 7CCA                              7/15/77             80.0                  3.2                           SEDIMENTS

11S/11E   SW  42-28.21  115-10.89 WW RR      1372      10.0    1.38         73.7     73.7      102    C     CENOZOIC
 16CCC                             7/19/77             65.0                  1.5                           SEDIMENTS

12S/ 8E   SW  42-24.86  115-33.12 AEC        1387      15.0    1.38        127.3    127.3      176    G     CENOZOIC
 6ADA                              7/13/77            220.0                  2.1                           BASALT

12S/20E   SW  42-24.61  114- 3.49 WW         1309      20.0    2.03    8    27.4     27.4       56    C     SEDIMENTS
 1ACC                              9/17/75            190.0    0.10          4.6

12S/21E   SW  42-24.57  113-57.03 USBR       1329      60.0    2.03    8    65.4     65.4      133    B     IDAVADA VOLC
 2DAA                              7/29/77            280.0    0.10          1.3                           ANICS

12S/20E   SW  42-24.40  114- 6.21 WW         1320      40.0    1.26    1    77.6     77.6       98    B     IDAVADA VOL
 3CBD                              8/ 1/76            100.0                  4.6

13S/15E   SW  42-18.82  114-39.35 WW         1395      10.0    1.34    1    68.2     68.2       90    B     BASALT
 11AAD                             9/12/75             95.0                  3.4

13S/16E   SW  42-18.64  114-33.94 WW         1410       5.0    1.34         94.9     94.9      128    B     BASALT, SEDS
 10DDB1                            9/ 9/75             70.0                  5.3                           RHYOLITE

13S/11E   SW  42-16.20  115- 8.77 WW         1608      10.0    1.55    1    44.3     44.3       68    C     CENOZOIC
 26BAA                             7/20/77            170.0                  1.4                           BASALT
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TABLE 2

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 1

IDAHO OWYHEE PLAT 5/26/87

N/RNG CTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
S/ 3W 3CCA	OU	43-11.30	116-41.10	USGSMUR1	1292	0.0 253.0	2.72			48.0	130	A	GRANITE
S/ 4W 5CCB	OU	43- 1.60	116-47.08	DDH-13 6/23/70	596	140.0 195.0	2.62 0.21	11	31.2 0.4	33.5	88	B	CENOZOIC VOLCANICS
S/ 4W 3ACC	OU	43- 1.08	116-47.78	DDH-14 8/28/74	1908	20.0 390.0	2.08 0.06	13	43.6 0.4	45.6	95	A	CENOZOIC VOLCANICS
S/ 1W 4BDA	OU	42-48.27	116-24.28	USGS-MA1 0/ 0/74	1625	0.0 248.0	2.93			31.0	92	B	GRANITE
S/ 1E 0DDA	OU	42-44.40	116-18.82	BO 7 8/23/75	1479	12.5 20.0	0.96	1	170.4 8.1	140.0	135	C	RHYOLITE
						20.0 31.3	1.80	1	94.8 1.7	78.6	142	C	
1S/ 5E 11DB	OU	42-35.94	115-57.37	SMU GM1 7/ 5/79	1372	65.0 97.5			106.0 1.0	106.0		A	CENOZOIC SILIC VOLC
						97.5 150.0	1.74 0.11	11	74.7 0.4	74.7	130	A	
S/ 2E 9BBB2	OU	42-34.62	116-14.13	WW BLM 7/ 6/77	1710	20.0 67.0	1.80		25.0 0.3	25.0	45	C	CENOZOIC SILIC VOLC
2S/ 4E 14BC	OU	42-25.19	115-57.85	SMU GM2 8/22/78	1647	10.0 96.5	2.05 0.14	9	15.8 0.4	15.8	32	B	CENOZOIC SIL VOL
2S/19E 2ADC	OU	42-24.62	114-11.64	WW 7/31/76	1304	30.0 100.0	2.05	8	66.4 2.3	66.4	135	B	SILICIC VOL
2S/ 4E 16CB	OU	42-22.91	115-59.46	SMU GM4 7/ 5/79	1786	10.0 138.0	1.72 0.07	21	37.3 0.5	37.3	64	A	CENOZOIC SIL VOL
2S/ 5E 16CCC	OU	42-22.57	115-52.97	WW 7/ 9/77	1545	85.0 250.0	1.34		51.0 0.8	51.0	68	C	CENOZOIC SEDIMENTS
2S/20E 25CBB	OU	42-21.04	114- 4.01	WW 9/18/75	1427	15.0 120.0	2.05	8	40.8 2.1	40.8	83	B	IDAVADA VOL
2S/21E 31BDB	OU	42-20.45	114- 2.63	WW 8/ 1/76	1396	40.0 95.0	2.03 0.10	8	68.6 2.9	68.6	139	B	IDAVADA VOL
12S/21E 31BCC	OU	42-20.29	114- 2.88	WW 9/11/75	1417	20.0 100.0	2.03 0.10	8	60.1 2.5	60.1	122	B	IDAVADA VOL
13S/21E 5CCD	OU	42-19.00	114- 1.45	WW 9/17/75	1426	10.0 110.0	2.05	8	60.7 2.2	60.7	123	B	IDAVADA VOL
13S/21E 20AD	OU	42-16.92	114- 0.62	WW 7/31/76	1695	30.0 115.0	2.05	8	59.6 4.1	66.2	136	B	IDAVADA VOL
14S/15E 23CD	OU	42-11.35	114-39.88	WW 7/12/74	1522	10.0 92.0	1.05	1	192.8 14.6	192.8 14.6	200	G	SEDIMENTS

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 2

IDAHO OWYHEE PLAT 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
14S/15E 26BB	OU	42-11.04	114-40.34	WW 7/12/74	1522	10.0 65.0	1.09	1	178.0 31.4	178.0 31.4	191	G	SEDIMENTS
14S/15E 28BAD2	OU	42-10.95	114-42.18	USGS 7/12/74	1516	20.0 52.0	1.09		223.6 33.7	223.6 33.7	240	G	BASALT, SEDS RHYOLITE
15S/ 6E 4DAA1	OU	42- 8.99	115-45.00	WW 6/19/77	1554	10.0 78.0	1.88		50.2 2.6	50.2	95	C	CENOZOIC SILICIC VOL
15S/16E 20BC	OU	42- 6.71	114-36.74	WW 7/17/77	1707	25.0 330.0	1.80	1	53.7 1.9	53.7 1.9	96	B	SILICIC VOL
15S/ 1W 32ADA	OU	42- 4.73	116-28.28	WW 7/20/77	1543	10.0 45.0	1.88		51.8 3.0	51.8	97	C	CENOZOIC SILICIC VOL

TABLE 3

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 1

IDAHO ESRP 5/28/87

N/RNG ECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
N/39E 9ACC	EW	44-28.38	111-51.85	OXY-58 0/ 0/77	2009	30.0 40.0	1.88		32.8 3.6	32.8	63	C	RHYOLITE
						60.0 82.0	1.88		9.1 5.6	9.1	17	C	
N/40E 10CAC	EW	44-27.82	111-43.93	SMU KG2 6/29/79	1987	27.5 65.0	1.88 0.03	2	81.4 3.2	77.5	146	B	CLAY, GRAVEL RHYOLITE
N/40E 10CDB	EW	44-27.80	111-43.90	OXY-68 0/ 0/77	1981	15.0 95.0	1.88		65.5 5.5	65.5	121	C	RHY 1-82 SED 82-136
						95.0 135.0	1.38		38.2	38.2	54	C	
N/42E 2CAD	EW	44-26.10	111-29.35	OXY-20 0/ 0/77	1951	10.0 100.0	1.63		14.6	14.6	25	D	BASALT 0-140 RHY 140-152
						100.0 150.0	1.63		25.5	25.5	42	C	
3N/42E 24DAD	YI	44-26.09	111-26.25	WW-IPB2 6/24/77	1923	10.0 38.0	1.88		189.3 36.4	189.3	310	G	BASALT
3N/42E 25ABC	YI	44-25.64	111-26.95	WW-IPB1 6/17/77	1926	15.0 38.0	1.88		121.9 9.1	121.9	201	G	SILICIC VOL
2N/38E 2ABB	EW	44-24.14	111-56.44	SMU KG1 9/29/79	1945	25.0 90.0	2.22 0.10	7	10.2 0.7	10.2 0.7	23	C	CLAY, GRAVEL AND SAND
2N/44E 10BBC	EW	44-23.00	111-15.00	OXY-18 0/ 0/77	1939	10.0 175.0	1.88					X	RHYOLITE
						175.0 280.0	1.88		12.7	12.7	25	C	
2N/37E 18CAA2	EW	44-22.07	112- 8.58	SMU SP2 8/15/78	1859	25.0 70.2	1.67 0.08	5	45.7 1.5	38.8	65	B	CLAY RHYOLITE
2N/38E 19DAC	EW	44-21.03	112- 0.92	OXY-4 0/ 0/77	1882	10.0 125.0	1.88		21.8	21.8	42	D	RHYOLITE
						125.0 143.0	1.88		67.3	67.3	126	D	
2N/36E 24BAD	EW	44-20.95	112- 9.20	OXY-2 0/ 0/77	1820	60.0 150.0	1.88		41.9 3.6	41.9	79	C	RHY 2-90 BASALT TO TD
2N/36E 34ABC	EW	44-19.75	112-12.13	OXY-1 0/ 0/77	1768	40.0 89.0	1.88		29.1	29.1	54	C	RHYOLITE
2N/36E 34BCB	EW	44-19.67	112-12.77	SMU SP3 6/29/79	1795	10.0 89.0	2.06 0.23	5	54.5 1.1	51.4	106	B	CLAY, RHY, GRAVEL

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 2

IDAHO ESRP 5/28/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
12N/42E 36CCB	EW	44-19.20	111-27.25	OXY-19 0/ 0/77	1867	100.0 180.0	1.63		52.8	52.8	88	B	BASALT 5-274 CLAY 274-303
						180.0 350.0	1.88		65.5 1.8	65.5	109	B	
11N/41E 14BAB	EW	44-17.30	111-35.35	OXY-15 0/ 0/77	2070	40.0 96.0	1.63		9.1	9.1	17	X	NO RETURNS
11N/41E 15DBD	EW	44-17.10	111-36.53	OXY-16 0/ 0/77	2060	20.0 205.0	1.88		-5.6	-5.6		X	BASALT 5-73 RHY 73-303
						205.0 305.0	1.88		7.3 1.8	7.3	13	X	
11N/41E 15BDB	EW	44-16.95	111-35.48	OXY-14 0/ 0/77	2062	20.0 200.0	1.88		14.6 7.3	14.6	29	X	BASALT 0-61 RHY 61-290
						200.0 290.0	1.88		-5.5	-5.5		X	
10N/34E 22B	EW	44-11.09	112-26.94	WW 8/19/77	1544	20.0 105.0	1.51		46.2 2.2	46.2 2.2	69	B	SANDSTONE LIMESTONE
						105.0 138.0	2.43		29.5 1.3	29.5 1.3	72	C	
10N/33E 24ACD	PH	44-10.85	112-31.28	SMU LHS1 6/29/79	1672	102.5 151.5	2.43 0.06	8	57.6 1.2	59.2	144	B	LAYERED CLAY RHYOLITE
9N/42E 6BDA1	YI	44- 8.38	111-32.80	WW NEVIL 7/27/77	1724	20.0 150.0	1.51		22.7 0.6	22.7 0.6	34	C	SILICIC VOL
9N/43E 11BDA	EW	44- 7.45	111-20.78	OXY-17 0/ 0/77	1695	20.0 60.0	1.88		12.7 1.8	12.7	17	X	RHYOLITE
						60.0 135.0	(1.88)		(155.0) 64.0	(155.0) 64.0	356 146	G	
9N/43E 11BDA	EW	44- 6.10	111-36.53	OXY-8 0/ 0/77	1515	30.0 133.0	1.88		10.9 1.8	10.9	13	X	BASALT 0-50 NO RET TO TD
9N/43E 19BDC	YI	44- 5.55	111-25.73	STRUM-1 8/29/79	1602	0.0 1200.0	1.88		40.0	40.0	75	C	SILICIC VOLCANICS
9N/42E 20CCD1	EW	44- 5.21	111-31.94	USGS 8/ 7/75	1582	20.0 53.5	1.88		40.0 2.6	40.0 2.6	75	C	VOLCANICS
9N/32E 30BCA	EW	44- 4.92	112- 7.62	RDH-U-RG 7/31/78	1926	15.0 65.0	2.38	1	20.3 1.7	16.7	40	C	LIMESTONE
9N/42E 25CDA	EW	44- 4.71	111-26.79	WW CITY2 6/13/78	1602	15.0 105.0	1.92	1	62.1 1.5	62.1 1.5	120	B	SILICIC VOL
9N/42E 25CCB	YI	44- 4.46	111-27.17	WW CITY 10/16/77	1599	25.0 175.0	1.92	1	78.3 2.6	78.3 2.6	151	B	SILICIC VOL

TABLE 3

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 3

IDAHO ESRP 5/28/87

N/RNG CTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
N/39E 48DC	EW	44- 1.35	111-49.76	SMU STA2 8/16/78	1602	7.5 123.5	1.84 0.07	18	58.8 0.9	61.6	113	B	RHYO, CLAY, BASALT, SEDS
N/39E 7DBD	EW	44- 1.09	111-52.94	SMU STA1 8/16/78	1684	12.5 59.0	1.80 0.09	6	46.7 0.9	42.3	76	B	CLAY, GRAVEL
N/34E 7CCC6	EW	44- 0.97	112-29.61	USBR 7/11/77	1465	20.0 78.0	1.46		31.0 0.8	31.0 0.8	46	C	BASALT AND SEDIMENTS
N/44E 5CDB	EW	44- 0.93	111-15.11	WW KANDL 6/ 4/77	1768	120.0 230.0	2.05		36.7 0.4	36.7 0.4	75	B	BASALT RHYOLITE
N/35E 2ADA	EW	44- 0.68	112-19.00	OXY-9 0/ 0/77	1487	30.0 157.0	1.63		3.6 7.2	3.6	4	X	BASALT 0-60 NO RET TO TD
N/40E 4CCC	EW	43-52.20	111-45.34	USGS G3 7/ 9/79	1489	425.0 687.5	1.79 0.25	6	44.3 1.0	44.3 1.0	79	C	
N/42E 0CAC	EW	43-49.85	111-31.88	OXY-10 0/ 0/77	1926	10.0 145.0	1.88		3.6	36.0	8	X	RHYOLITE TUFF
N/40E 1BBA2	EW	43-48.65	111-47.15	GT-MCG1 9/ 3/81	1511	0.0 1495.0	1.88		(8.7)	8.7	17	X	BASALT 0-296 RHY TO 957
N/40E 1BAC	EW	43-48.51	111-47.10	RBTW - 1 1/ 5/80	1211	100.0 250.0						G	SILICIC VOL
N/42E 5CCD	EW	43-47.85	111-28.40	OXY-11 0/ 0/77	1780	50.0 153.0	1.88		9.1	9.1	17	X	BASALT 0-79 RHY 79-152
N/40E 5CD	EW	43-47.18	111-46.63	RBTW-2 6/11/80	1566	10.0 95.0	1.88		99.0	99.0	188	G	SILICIC VOL
						95.0 393.0						G	
N/32E 5BAD	EW	43-45.95	112-41.34	USGS G2A 7/ 2/79	1459	10.0 95.0	1.46	1	75.4 10.0	75.4	110	X	
						95.0 407.5	1.33 0.13	6	16.1 0.4	16.1	21	X	
						407.5 789.5	1.34 0.06		59.8 1.0	59.8	110	A	
N/41E 7CCC	EW	43-45.38	111-39.85	OXY-12 0/ 0/77	1658	10.0 153.0	1.88		34.6	34.6	67	C	SEDIMENTS VOLCANICS
N/41E 5ACD	EW	43-44.05	111-34.45	OXY-13 0/ 0/77	1911	10.0 100.0	1.88		-7.3	-7.3		X	RHYOLITE
N/40E 0CAD	EW	43-41.39	111-44.23	WW 8/14/74	1554	10.0 80.0	1.80		94.9 10.4	94.9 10.4	171	B	BASALT RHY SEDIMENTS

GEOTHERMAL DATA PRINTOUT S.I. UNITS PAGE 4

IDAHO ESRP 5/28/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
3N/28E 1BAA	EW	43-37.41	113- 3.95	INEL-GT1 9/10/78	1561	87.5 230.0	1.42		15.5 0.4	15.5	22	X	BASAL SIL VOLCANIC
						230.0 550.0			45.1 0.3	45.1		X	
						550.0 750.0			47.1 0.3	47.1		X	
						750.0 1000.0			49.9 1.6	49.9		X	
						1000.0 3100.0	2.76	10	39.5	39.5	109	B	
2N/32E 22ABD	EW	43-29.44	112-41.05	USGS G1 7/ 2/79	1637	20.0 300.0	2.34 0.12	3	31.7 0.3	31.7	74	X	
						300.0 455.0	1.97 0.13	10	5.3	5.3	10	X	
						455.0 537.5	1.58 0.17	3	41.7 1.0	41.7	66	B	
1S/13E 7DCA	PH	43-20.72	114-57.28	WW 7/26/77	1551	10.0 60.0	1.38		72.9 4.0	72.9 4.0	101	B	SEDIMENTS
1S/12E 13BAA1	PH	43-20.33	114-58.78	USGS 7/19/74	1551	15.0 65.0	1.37 0.05	3	89.1 2.3	89.1 2.3	122	B	SEDIMENTS
1S/18E 16DCC	EW	43-19.93	114-19.49	SMU FF1 8/23/78	1524	20.0 78.0	2.43 0.05	9	37.0 0.6	37.0	89	B	GRANITE
1S/15E 21ABC	PH	43-19.50	114-41.48	WW FRSTS 8/ 6/78	1526	10.0 70.0	2.51		89.8 3.6	89.0	207	C	
1S/14E 20CDD	PH	43-18.83	114-49.37	WW T/S 8/ 6/78	1536	10.0 55.0	2.51	1	181.4 3.4	181.4	418	C	
1S/18E 32ACC	EW	43-17.70	114-20.53	SMU FF2 6/30/79	1579	10.0 110.0	2.44 0.07	17	65.7 0.5	64.0	156	B	GRANITE
2S/17E 2ACC	EW	43-16.77	114-24.11	WW CROFT 8/ 3/78	1474	5.0 100.0	1.26		136.2 13.6	136.2 13.6	172	C	RHYOLITE
2S/14E 36DCC	PH	43-11.96	114-44.35	SMU MBH1 7/ 7/79	1609	10.0 90.2	1.41 0.05	10	51.4 2.0	51.4	70	B	SED 0-43 RHY 43-91
4S/16E 33DA	EW	43- 1.90	114-33.35	PALACIO1 6/ 9/80	1015	0.0 610.0	(1.46)		(73.2)	(73.2)	107	C	BASALT AND RHY TUFF
5S/15E 6BBC	EW	43- 1.39	114-43.85	WW BSSM1 8/31/78	1109	45.0 104.0	2.05	1	61.8 0.5	61.8	126	B	BASALT AND S EDIMENTS
						105.0 220.0	1.55	1	94.9 2.8	94.9	147	B	

TABLE 3

IDAHO ESRP 5/28/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
5S/14E 12AAA	EW	43- 0.70	114-44.00	RWINK1 5/15/80	1098	0.0 610.0	(1.46)		(68.4)	(68.4)	100	C	BASALT
7S/15E 12CBA1	EW	42-49.95	114-39.03	USGS-WTW 0/ 0/84	1097							X	BASALT
9S/18E 1DD	EW	42-39.90	114-17.30	ANDCMPWW 3/27/86	1194	65.0 650.0	1.46		62.5	62.5	92	C	BASALT 0-237 RHY&CLAY TD
9S/26E 7AAB	EW	42-39.72	113-27.33	USBR 7/12/74	1280	10.0 236.0	1.42	1	93.1 4.4	93.1	133	B	BASALT AND S EDIMENTS
9S/28E 18BAD	EW	42-38.56	113-13.75	BLM 6/16/79	1292	10.0 110.0	1.51	1	58.2 0.5	58.2	87	B	
9S/14E 23ABA	EW	42-38.20	114-47.98	WW 9/ 2/78	1012	20.0 61.5	1.59	1	45.1 2.1	45.1	72	B	
9S/17E 22BCB	EW	42-37.99	114-27.68	WW LCKLY 9/ 3/78	1112	27.5 119.0	1.63	1	53.1 0.5	53.1	87	B	
9S/17E 20BCC	EW	42-37.85	114-30.00	WW AMBRS 9/ 3/78	1100	35.0 95.0	1.63	1	39.4 3.0	39.4	57	C	
9S/25E 23CDA	EW	42-37.34	113-30.02	WW 8/ 4/77	1304	15.0 58.0	1.38	1	49.5 5.3	49.5	68	C	BASALT AND SEDIMENTS
S/13E 33CB	EW	42-35.98	114-56.74	WW BLGUL 6/27/74	1169	50.0 146.0	2.05	8	71.4 9.5	71.4	145	B	GRAVEL RHYOLITE
S/13E 33CA	EW	42-35.98	114-56.47	WW BLGUL 6/27/74	1170	35.0 175.0	2.05	8	60.7 1.6	60.7	123	B	GRAVEL RHYOLITE
S/13E 2CDD	EW	42-35.74	114-57.56	WW BLGUL 8/31/75	1158	50.0 210.0	2.03 0.10	8	62.4 3.0	62.4	127	C	CENOZOIC GRAVEL/RHY
S/13E 2CDD	EW	42-35.70	114-57.53	WW BLGUL 8/31/75	1170	90.0 210.0	2.05 0.10	8	72.5 2.6	72.5	147	B	GRAV, BASALT RHYOLITE
S/26E 5DCC	EW	42-31.07	113-21.77	WW 8/ 4/77	1346	20.0 290.0	1.76	1	79.9 4.9	79.9	141	B	SILICIC VOL
S/21E 9DDA	EW	42-28.67	113-59.40	WW 9/18/75	1318	75.0 145.0	2.05	8	48.7 3.3	48.7	99	B	BASALT
S/19E 7CAD1	EW	42-26.17	114-13.36	WW 7/31/76	1276	10.0 115.0	1.63	1	48.4 1.9	48.4	79	B	BASALT
S/17E 5DDD1	EW	42-25.98	114-24.09	WW BLM 6/13/79	1261	10.0 105.0	1.46	1	54.1 3.5	54.1	79	B	BASALT AND SEDIMENTS
S/20E 3DAD1	EW	42-25.30	114- 6.45	WW 8/ 2/76	1293	10.0 120.0	1.63		88.0	88.0	130	C	BASALT
S/22E 2CCC	EW	42-25.05	113-54.61	WW 7/29/77	1313	10.0 140.0	1.88	1	43.7 4.3	43.7	82	B	BASALT AND S EDIMENTS

IDAHO ESRP 5/28/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
12S/15E 27BAA	EW	42-21.58	114-40.98	WW 9/13/75	1377	25.0 155.0	2.01	1	44.6 0.4	44.6 0.4	90	C	BASALT
12S/15E 26ADD	EW	42-21.25	114-39.19	WW 9/13/75	1380	30.0 230.0	1.46		39.2 0.5	39.2	57	B	BASALT
14S/14E 14BBB	EW	42-12.73	114-47.31	WW 7/15/77	1585	15.0 140.0	1.38		40.8 0.9	40.8 0.9	56	B	BASALT

TABLE 3

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SOUTHEAST IDAHO B&R 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
8N/43E 26DDA	BR	43-59.18	111-20.49	WW 8/22/77	1740	20.0 80.0	1.34		85.7 2.5	85.7 2.5	115	B	BASALT RHYOLITE
						90.0 190.0	2.05		53.6 1.2	53.6 1.2	110	B	
8N/43E 35AAA	BR	43-57.56	111-20.49	WW HRSGB 6/ 5/77	1740	10.0 70.0	1.51		76.2 2.3	76.2 2.3	115	B	BASALT RHYOLITE
						80.0 180.0	2.05		58.2 0.8	58.2 0.8	119	B	
7N/43E 10ABB	BR	43-57.27	111-22.09	WW KERBS 6/28/78	1719	10.0 345.0	2.05 0.08	18	44.5 1.9	44.5 1.9	91	C	SIL VOLCAN CLAY
7N/43E 12BCA	BR	43-57.02	111-20.11	USBR 8/16/75	1743	50.0 110.0	1.46		14.7 0.4	14.7 0.4	21	C	BASALT AND SEDIMENTS
7N/42E 17AB	BR	43-56.35	111-31.54	WW 8/17/75	1626	35.0 105.0	2.05 0.08	18	118.8 2.8	118.8 2.8	244	A	RHYOLITE
7N/42E 15AB	BR	43-56.34	111-29.01	USBR 8/14/75	1646	10.0 85.0	1.92	1	24.0 1.1	32.6 1.5	62	B	RHYOLITE
7N/42E 17BA	BR	43-56.33	111-31.74	USBR A 8/15/74	1615	20.0 100.0	2.05 0.08	18	99.4 3.5	99.4 3.5	204	B	RHYOLITE
7N/43E 21AA	BR	43-55.57	111-22.75	USBR 8/12/75	1727	45.0 215.0	1.46		19.7 0.8	19.7 0.8	29	C	RHYOLITE
7N/42E 19AB	BR	43-55.53	111-32.67	USBR C 8/ 2/74	1594	10.0 150.0	2.05 0.08	18	87.8 2.2	87.8 2.2	180	B	RHYOLITE
7N/42E 23DCB	BR	43-54.84	111-28.06	WW NEDR3 9/ 2/77	1678	110.0 253.0	1.55	1	36.7 9.0	32.0 7.9	50	B	RHYOLITE AND SEDIMENT
7N/42E 19CD	BR	43-54.81	111-32.68	USBR DH6 8/ 9/75	1628	95.0 130.0	2.05 0.08	18	57.0 2.5	57.0 2.5	117	B	RHYOLITE
7N/42E 19DC	BR	43-54.80	111-32.88	USBR 8/ 9/75	1629	15.0 170.0	2.05 0.08	18	92.0 0.7	92.0 0.7	189	A	RHYOLITE TUFF CONGL
						170.0 195.0	0.96	1	213.2 9.3	213.2 9.3	208	B	
7N/42E 29BD 1	BR	43-54.48	111-31.93	USBR 8/ 8/75	1634	10.0 60.0	2.05 0.08	18	122.4 3.2	122.4 3.2	251	A	SILT, PHY, A SH, SEDS
						60.0 100.0	1.76	1	133.9 2.2	133.9 2.2	235	A	
7N/42E 30AD 1	BR	43-54.42	111-32.24	USBR 8/ 9/75	1536	20.0 105.0	2.05 0.08	18	131.3 1.1	114.5 1.0	235	A	RHYOLITE TUFF CONGL
7N/42E 27DCB	BR	43-53.99	111-29.21	WW SCHWN 9/ 5/77	1735	85.0 225.0	2.05 0.08	18	74.2 1.6	74.2 1.6	152	B	RHYOLITE

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SOUTHEAST IDAHO B&R 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
7N/43E 30CCC	BR	43-53.87	111-26.27	WW 8/14/75	1732	10.0 255.0	2.05 0.08	18	107.5 3.6	107.5 3.6	220	A	RHYOLITE
7N/42E 32BB	BR	43-53.68	111-32.11	USBR D 7/31/74	1631	20.0 140.0	2.05 0.08	18	177.6 3.5	177.6 3.5	364	A	RHYOLITE
7N/42E 33BD 1	BR	43-53.49	111-30.98	USBR B 8/18/75	1649	10.0 130.0	2.05 0.08	18	107.9 5.7	107.9 5.7	221	A	RHYOLITE VITROPHYRE
7N/43E 32BC 1	BR	43-53.45	111-24.95	WW LINDM 8/21/73	1745	50.0 240.0	1.51		12.0 0.5	12.0 0.5	18	B	RHYOLITE SED, QTZT
6N/41E 11CDB2	BR	43-51.47	111-35.57	USGS 8/15/74	1591	30.0 100.0	2.05 0.08	18	110.4 5.3	110.4 5.3	226	B	BASALT RHY SEDIMENT
6N/43E 18CCD	BR	43-50.45	111-26.29	WW NEELY 4/20/77	1771	20.0 100.0	1.51		17.4 0.9	17.4 0.9	26	B	LOESS AND BASALT
6N/41E 25ABC	BR	43-49.39	111-34.00	WW NEDR2 7/10/77	1687	40.0 180.0	1.51		6.1 4.1	6.1 4.1	9	C	BASALT
6N/41E 25ADC	BR	43-49.15	111-33.72	WW NEDR1 7/ 7/77	1713	10.0 215.0	1.51		8.6 1.1	8.6 1.1	13	B	BASALT
6N/44E 35DAD	BR	43-48.01	111-13.26	COAL BKR 8/11/78	1812	10.0 135.0	1.92 0.22	5	79.3 5.5	79.3 5.5	153	C	
4N/40E 13CAB	BR	43-40.54	111-41.88	WW GROVR 6/27/77	1707	10.0 195.0	1.80		96.7 4.4	96.7	174	B	RHYOLITE
3N/40E 15DA	BR	43-35.32	111-43.64	WW SIMMN 6/16/77	1609	30.0 110.0	1.80		49.1 2.6	49.1 2.6	88	B	RHYOLITE
3N/39E 13DAD	BR	43-35.27	111-48.53	A1 7/15/77	1561	10.0 45.0	1.80	1	63.3 2.3	63.3 2.3	114	C	RHYOLITE
3N/40E 15CCB	BR	43-35.11	111-44.61	P-41-X 6/28/77	1570	10.0 69.0	1.80		45.0 3.4	45.0 3.4	81	B	SEDIMENTS RHYOLITE
2N/40E 20ABD	BR	43-29.64	111-46.01	WW BROWN 6/14/77	1669	20.0 95.0	1.80	1	41.8 7.4	41.8 7.4	75	C	RHYOLITE
2N/40E 21CDB	BR	43-29.16	111-45.56	WW CMBLL 7/12/77	1699	20.0 225.0	1.80		72.6 2.5	72.6 2.5	131	C	RHYOLITE
2S/41E 2ACA	BR	43-16.65	111-37.05	KING-2-1 0/ 0/78	2012	0.0 3810.0				53.0		C	PAL AND MEZ SEDIMENTS
2S/38E 16DAA	BR	43-14.67	112- 0.00	WW COX 7/ 5/78	1585	117.5 280.0	1.88	1	38.0 0.2	38.0	72	B	
2S/44E 23DB	BR	43-13.80	111-15.75	BEMTN 1 0/ 0/50	2473	0.0 1545.0				61.0		C	PAL AND MEZ SEDIMENTS
3S/45E 36CC	BR	43- 6.30	111- 7.05	BMFED-1 0/ 0/77	2693	0.0 4158.0				22.0		C	PAL AND MEZ SEDIMENTS

TABLE 3

GEOTHERMAL DATA PRINTOUT   S.I. UNITS   PAGE 3

SOUTHEAST IDAHO B&R 5/26/87

/RNG TION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
5/42E 3AAC	BR	43- 5.40	111-31.80	GENVAL-1 0/ 0/78	2080	0.0 3008.0				50.0		C	PAL AND MEZ SEDIMENTS
5/44E 2CAC	BR	43- 0.75	111-15.90	STOOR-A1 11/27/80	2059	0.0 4483.0				40.7		C	PAL AND MEZ SEDIMENTS
5/41E 5	BR	42-47.25	111-36.60	HUBBARD 10/ 4/82	1890							C	
5/31E 4CBB1	BR	42-45.20	112-50.87	WW BRCKR 6/18/78	1392	10.0 70.0	1.55	1	140.6 4.1	140.6	218	B	
5/31E 3CAC	BR	42-44.24	112-52.05	WW 8/ 9/77	1386	20.0 230.0	1.42	1	60.5 2.2	60.5	86	B	BASALT
5/30E 3DCD	BR	42-42.35	112-54.77	USGS 8/ 9/77	1375	40.0 84.0	1.63	1	42.6 1.2	42.6	69	B	BASALT
5/30E 5DDD	BR	42-37.96	112-55.59	WW-NELSN 6/ 3/79	1371	0.0 215.0	1.51		85.6	85.0	129	C	
5/46E 3BDA	BR	42-34.20	111- 6.08	FED-1-8 0/ 0/78	2337	0.0 5105.0				35.0		C	PAL AND MEZ SEDIMENT
5/43E 3DCD	BR	42-32.85	111-18.46	BCF-1-13 0/ 0/79	2070	0.0 3551.0				43.0		C	PAL AND MEZ SEDIMENT
5/31E 3BCC1	BR	42-32.37	112-53.14	WW-WSTN2 6/ 2/79	1478	10.0 240.0	1.51		81.4 3.8	81.4	123	B	
5/46E 3DD	BR	42-32.10	111- 5.55	FEV-1 0/ 0/76	2294	0.0 1194.0				26.0		C	PAL AND MEZ SEDIMENT
5/30E 1CDD	BR	42-31.91	112-53.86	WW-WSTN1 6/ 3/79	1513	25.0 205.0	1.51		121.3 10.5	121.3	183	C	
5/46E 3BDD	BR	42-31.65	111- 5.10	AM-T1-W1 0/ 0/63	2286	0.0 1219.0				33.0		C	PAL AND MEZ SEDIMENT
5/26E ADC	BR	42-25.37	113-23.87	WW 8/ 3/77	1344	10.0 120.0	1.09	1	155.2 6.8	155.2	169	B	SEDIMENTS
5/25E 7CCC	BR	42-23.21	113-35.26	WW 8/ 3/77	1504	10.0 177.0	1.30		60.3 27.4	60.3	78	C	SEDIMENTS AND BASALT
5/44E 2CCD	BR	42-16.35	111-18.00	JEN21-11 0/ 0/78	1806	0.0 3500.0				19.0		C	PAL AND MEZ SEDIMENT
	BR	42-14.25	113-22.10	ROH G-W 12/18/76	1350	200.0 1498.0	2.09		54.0	54.0	113	C	
	BR	42-10.10	113-25.75	USGS-ID5 8/ 6/76	1650	76.0 128.0	1.97	46	63.0	61.0	120	A /	
						140.0 216.0	2.38	46	45.0	43.0	103	A	

GEOTHERMAL DATA PRINTOUT   S.I. UNITS   PAGE 4

SOUTHEAST IDAHO B&R 5/26/87

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
15S/39E 6CA	BR	42- 8.75	111-56.71	SUN-1001 6/15/78	1446	0.0 110.0	1.46		857.0	857.0	1255	G	PHYLLITE AND SCHIST
15S/26E 12ACC	BR	42- 8.00	113-21.85	USGS-ID1 0/ 0/76	1478	50.0 260.0	1.09	72	120.0	120.0	131	A	CENOZOIC SEDIMENTS
15S/26E 12ACC	BR	42- 8.00	113-21.70	RR-1B 5/ 3/75	1478		1.05	1	130.0	130.0	126	B	QUATERNARY SEDIMENTS
15S/26E 23AAA1	BR	42- 6.60	113-22.50	RRGE-2 8/10/76	1475							G	CENO. SEDS. & QTZ. MONZ.
15S/26E	BR	42- 6.50	113-23.50	SCHMITT	1500	0.0 126.0	1.05		63.5	> 63.5	106	G	CENOZOIC SEDIMENTS
15S/26E 23CAA	BR	42- 6.20	113-23.00	RRGE-1B 5/ 3/75	1475		1.67		200.0	200.0	335	? B	QUATERNARY SEDIMENTS
~~15S/26E 23CAA~~	~~BR~~	~~42- 6.15~~	~~113-23.00~~	~~RRGE-1 10/16/75~~	~~1475~~	~~0.0 1100.0~~						~~G~~	~~CENO. VOLC. & QUARTZITE~~
15S/26E 22DDD	BR	42- 5.85	113-23.61	USGS-ID3 8/11/76	1487	20.0 330.0	1.67	89	200.0	200.0	335	G	CENOZOIC SEDIMENTS
15S/26E 22DDD	BR	42- 5.80	113-23.60	RR-3B 5/ 3/75	1485		1.67		180.0	180.0	293	B	QUATERNARY SEDIMENTS
? → 15S/26E 23DD01	BR	42- 5.80	113-22.65	CRANKWW	1469							G	CENOZOIC SEDIMENTS
15S/26E 25ABC	BR	42- 5.60	113-21.70	RR-2B 5/ 3/75	1472		1.26		200.0	200.0	251	B	QUATERNARY SEDIMENTS
15S/26E 25ABC	BR	42- 5.55	113-21.75	USGS-ID2 1/15/76	1475	20.0 190.0	1.30	23	210.0	210.0	335	G	CENOZOIC SEDIMENTS
15S/26E 25BD1	BR	42- 5.50	113-21.95	RRGE-3 8/12/76	1478							G	CZ. VOLC/SED & QTZ MONZ
? →	BR	42- 5.10	113-33.60	USGSALM1 8/ 7/76								G	
	BR	42- 4.95	113-36.60	USGSALM2 8/ 8/76	1700	50.0 200.0	2.09		52.0	52.0	109	C	
15S/26E	BR	42- 4.00	113-26.85	USGE-ID4 8/ 8/76	1515							G	
16S/46E 6BBA	BR	42- 3.90	111- 7.50	NRCF6-21 0/ 0/80	2055	0.0 3537.0				32.0		C	PAL AND MEZ SEDIMENTS
16S/46E 10BC	BR	42- 2.85	111- 4.05	GRF-10-1 0/ 0/78	2323	0.0 3615.0				20.0		C	PAL AND MEZ SEDIMENTS
16S/45E 21BBC	BR	42- 1.20	111-12.15	NEF22-11 0/ 0/80	2103	0.0 2618.0				20.0		C	PAL AND MEZ SEDIMENTS

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                                              APPENDIX A
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TWN/RNG   TECT  N LAT    W LONG    HOLE   COLLAR     DEPTH  AVG TCU   NO UN GRAD  CO GRAD CO H.F.    Q    LITHOLOGY
SECTION   PROV DEG MIN  DEG MIN   (DATE)    ELEV     RANGE     <SE>  TCU    <SE>     <SE>    <SE>   HF    SUMMARY
----------------------------------------------------------------------------------------------------------------------
50N/ 5W   NR  47-40.91  116-59.82 MILLERWW   768      19.0                  23.6                     D    SCHIST OR
 17BC                              9/ 6/81            61.5                   1.4                          GNEISS

46N/ 5W   NR  47-21.00  117- 1.25 WW LWSN2   804      75.0                                           X    C P BASALT
 7BBC                              1/31/78           210.0

39N/ 5W   DU  46-45.42  116-58.29 WW HNGST   803      10.0     1.92    2    52.5     49.8      95    D    ARKOSE AND
 4BAA                              3/ 3/78            55.0     0.34          2.3                          BASALT

35N/ 5W   NR  46-22.07  116-57.04 WW LWSTN   468     200.0     1.72         33.9     33.9      58    D    C P  BASALT
 22BAB                             2/14/78           300.0                   3.0

35N/ 4W   NR  46-20.31  116-52.30 WW MCCNN   559      10.0                                           X    C P BASALT
 32BBA                             2/14/78           225.0

35N/ 4E   NR  46-20.06  115-56.39 WW WEIPP   915      10.0     1.67    2    40.6     40.6      68    D    C P BASALT
 15DCB                             3/ 1/78            45.0     0.08

33N/ 4E   NR  46-13.25  115-57.94 WW SNYDR   867      20.0     1.55    1    49.9     55.4      85    D    C P BASALT
 9BAB                              1/18/78           210.0                   1.3

31N/ 1E   NR  46- 3.60  116-23.05 WW CTTNW  1089      10.0                                           X    C P BASALT
 5AAD                              2/28/78            60.0

31N/ 1W   NR  46- 3.26  116-29.07 WW ANDRS  1384      10.0     1.55    1                             X    GRANITE
 5CAD                              2/28/78            44.0

31N/ 1E   NR  45-58.89  116-20.35 WW UHLEN  1012      20.0     1.61    1                             X    C P BASALT
 33CAB                             2/28/78           165.0

30N/ 2E   NR  45-56.49  116- 9.90 WW BLWTT  1003      10.0                                           X
 14ACD                             2/21/78            40.0

30N/ 3E   NR  45-54.30  116- 3.81 WW COVE   1120      10.0     1.41    1    33.7     37.4      53    D    META. SEDS.
 27DCB                             2/21/78            55.0                   3.2

29N/ 2E   NR  45-52.97  116- 8.58 WW GREEN  1248      10.0     1.55    1                             X    C P BASALT
 1ADC                              7/26/78            85.0

18N/ 9E   SI  44-54.11  115-18.74 RH-1-75   2355      10.0     3.05         37.4     37.4     124    D    IDAHO BATH.
 14AAD                             8/ 9/76            32.0                                                GRANITE

18N/ 3E   CH  44-51.19  116- 7.82 WW        1536      10.0     1.80    1    37.4     37.4      67    D    ALLUVIUM
 31DBA                             8/20/76            40.0                   3.9

16N/ 4W   WO  44-43.89  116-47.12 DDH-2     1987     100.0                                           X    DIORITE AND
 11DBB                             8/15/71           310.0                                                GRANODIORITE

16N/ 3E   CH  44-41.03  116- 5.52 USBR      1478      10.0     3.05         33.8     33.8     103    D    IDAHO BATH.
 33A                               8/13/76            30.0                  13.9                          GRANITE

15N/ 3E   CH  44-35.33  116- 3.15 USBR      1487      10.0                                           X    IDAHO BATH.
 35DDB                             8/31/76            30.0                                                GRANITE

14N/19E   SI  44-30.14  114-14.25 DDH-13    1570      40.0     1.97         29.9     29.9      59    D    CHALLIS
 33ABC                             8/17/70           300.0                   1.1                          VOLCANICS
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                              GEOTHERMAL DATA PRINTOUT      S.I. UNITS                 PAGE  2
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                                              APPENDIX A
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TWN/RNG   TECT  N LAT    W LONG    HOLE   COLLAR     DEPTH  AVG TCU   NO UN GRAD  CO GRAD CO H.F.    Q    LITHOLOGY
SECTION   PROV DEG MIN  DEG MIN   (DATE)    ELEV     RANGE     <SE>  TCU    <SE>     <SE>    <SE>   HF    SUMMARY
----------------------------------------------------------------------------------------------------------------------
13N/18E   SI  44-29.48  114-20.48 DDH       2073      45.0                                           X    CHALLIS
 4AAB                              8/ 5/76           250.0                                                VOLCANICS

13N/27E   IR  44-29.09  113-16.19 RDH-1     2087       0.0                                           X    ALLUVIUM AND
 5CA                               6/ 5/79           110.0                                                VALLEY FILL

13N/26E   IR  44-28.87  113-18.01 DRH-B     2265       0.0                                           X
 10CD                              8/19/71             7.0

13N/26E   IR  44-28.76  113-18.37 RDH-A     2298      30.0     2.55         39.3     36.9      94    D    MONZONITE
 12BAA                             8/18/71            50.0                   0.8      0.8

13N/15E   SI  44-26.21  114-44.09 RDH       2317      20.0     1.34         11.6      8.5      11    D    CHALLIS
 20CC                              8/ 6/76            90.0                   0.1      0.1                 VOLCANICS

13N/27E   IR  44-26.21  113-15.38 WW CD     2219      30.0     2.59         11.7     11.0      28    D
 29AAA                             6/ 5/79           100.0                   0.3      0.3

13N/27E   IR  44-26.10  113-15.27 M-EXP2    2164      10.0                                           X    IDAHO BATH.
 29AA 1                            6/ 5/79            60.0                                                GRANITE

13N/27E   IR  44-26.10  113-15.27 M-EXP3    2164      40.0                                           X    IDAHO BATH.
 29AA 2                            6/ 5/79            80.0                                                GRANITE

12N/ 4W   WO  44-21.20  116-45.50 RNS-1      817      15.0     1.25   13    59.5     49.6      62    D    SANDY/CLAY/
 23CCA                                                77.0     0.13                                       BASALT

12N/ 8E   CH  44-20.09  115-29.30 SMU IB-5  2079      25.0     3.78    4                             X    IDAHO BATH.
 34BA                              9/22/76            65.0     0.22                                       GRANITE

11N/ 6W   SW  44-18.80  117- 2.05 WW         695      20.0     1.46         53.3     52.2      77    D    CENOZOIC
 30DB1                             9/25/75            90.0                   8.0                          SEDIMENTS

11N/14E   SI  44-18.61  114-48.18 RDH       2368      20.0     1.34    1     4.6      4.6       6    D    CHALLIS
 4DAB                              8/ 7/76            90.0                   0.3      0.3                 VOLCANICS

11N/ 6W   SW  44-18.18  117- 3.36 WW         682       5.0     1.78    4    82.7     82.7     147    D    CENOZOIC
 9DAB                              9/25/75            28.0     0.07          2.8                          SEDIMENTS

11N/14E   SI  44-18.16  114-49.49 RDH       2365      10.0     1.34          7.4      7.4      10    D    CHALLIS
 9BDD                              8/ 7/76           110.0                   0.6      0.6                 VOLCANICS

11N/14E   SI  44-17.75  114-49.76 RDH       2341      10.0     1.34          6.2      6.2       8    D    CHALLIS
 9CBD                              8/ 7/76           110.0                   0.4      0.4                 VOLCANICS

11N/14E   CH  44-17.56  114-47.75 DDH-1     2292      10.0     2.93    1    15.7     14.9      44    D    IDAHO BATH.
 10DDA                             8/ 7/76           185.0                   0.3      0.3                 GRANITE

11N/14E   CH  44-17.54  114-47.84 DDH-2     2317      20.0     2.93         30.8     29.3      86    D    IDAHO BATH.
 10DDB                             7/27/76            45.0                   0.5      0.5                 GRANITE

11N/14E   SI  44-17.07  114-49.17 RDH       2091                                                     X    CHALLIS
 16ACD                             7/27/76                                                                VOLCANICS

11N/14E   SI  44-16.94  114-49.76 RDH       2158      10.0     2.93         31.9     30.3      89    D    CHALLIS
 16CAB                             8/ 7/76            50.0                   2.7      2.6                 CHALLIS VOL
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TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
11N/ 5W 29BAD	SW	44-15.86	116-57.89	WW WSR 2 8/23/78	679	10.0 71.0	1.74	1				X	CENOZOIC SEDIMENTS
11N/ 2W 27ACD	WO	44-15.00	116-32.40	RNS-5	1037	20.0 55.0	1.33 0.04	13	47.5	45.2	60	D	CENOZOIC SEDIMENTS
10N/13E 3CAB	CH	44-13.45	114-55.70	HD-1 7/15/76	1896	4.0 8.0						X	IDAHO BATH GRANITE
10N/ 2W 1DDD	WO	44-13.40	116-30.75	RNS-15	1105	20.0 38.0	1.14 0.24	9	44.0	46.3	53	D	CZ BASALT CLAY/SAND
10N/ 5W 9BAD	SW	44-13.15	116-56.55	RNS-17	646	15.0 25.0	1.17		106.0	106.0	124	D	CENOZOIC CLAY
10N/ 4E 22DAA	CH	44-11.25	115-57.10	WW BROWN 7/15/78	1049	10.0 42.5	2.93		45.3 7.0	41.2	120	D	IDAHO BATH GRANITE
9N/ 6E 33CAB	CH	44- 4.75	115-45.55	DDH-A 7/21/69	1029	0.0 90.0						X	IDAHO BATH GRANITE
9N/ 6E 33CAA	CH	44- 4.56	115-45.40	DDH-C 7/21/69	1097	0.0 90.0						X	IDAHO BATH GRANITE
9N/ 6E 33CAC	CH	44- 4.41	115-45.50	DDH-B 7/21/69	1029	0.0 160.0						X	IDAHO BATH GRANITE
8N/ 5W 28AD	SW	44- 3.88	116-54.19	ROH-OIL 8/10/78	754	30.0 54.0	1.09	1	51.8 2.7	51.8	69	D	CENOZOIC CLAY/SAND
9N/16E 34DCD2	SI	44- 3.53	114-33.47	DDH-2 6/26/70	2634	60.0 205.0						X	IDAHO BATH GRANITE
9N/16E 34DCD3	SI	44- 3.53	114-33.47	DDH-3 6/26/70	2634	30.0 185.0						X	IDAHO BATH GRANITE
9N/16E 34DCD1	SI	44- 3.53	114-33.47	DDH-1 8/14/69	2634	60.0 210.0						X	IDAHO BATH GRANITE
8N/ 5W 22ACA	SW	44- 1.28	116-55.10	WW FRUIT 8/ 2/73	673	35.0 45.0	1.58	2	38.0 1.2	38.0 1.2	60	D	CENOZOIC CLAY/SAND
7N/ 4W 9ACD	SW	43-57.62	116-46.87	WW PLYMH 7/27/78	595	10.0 31.1	1.97	1	41.4 5.1	41.4 5.1	82	D	CENOZOIC CLAY/SAND
7N/ 4W 14BCD	SW	43-56.80	116-47.24	WW 8/ 9/78	704	0.0 27.5						X	CENOZOIC CLAY/SAND
7N/ 4E 18DDC	CH	43-56.40	116- 1.36	DDH-BM 1 8/12/76	1881	15.0 120.0	2.93		26.9 0.6	37.1 0.8	109	D	IDAHO BATH GRANITE
7N/ 4E 18DCA	CH	43-56.39	116- 1.48	DDH-BM 2 8/12/76	1878	20.0 85.0	2.93		26.4 0.9	36.4 1.2	107	D	IDAHO BATH GRANITE
6N/ 5E 5CCA	CH	43-52.96	115-54.84	USBRDDH1 8/19/76	1256	20.0 50.0	2.44 0.18	5	40.2 0.4	(38.3) 0.4	93	D	IDAHO BATH GRANITE

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
6N/ 1W 7AAD	SW	43-52.62	116-29.63	WW EMMTT 7/ 5/78	725	0.0 72.0						X	CENOZOIC CLAY & SAND
6N/ 4W 18BBD	SW	43-51.77	116-52.27	RDH 7/26/74	759	10.0 40.0			96.1 13.4			D	CENOZOIC SEDIMENTS
6N/ 4W 17BDD	SW	43-51.52	116-50.49	RDH 7/26/74	826	10.0 20.0						X	CENOZOIC SEDIMENTS
6N/ 1E 15DDD	WO	43-51.13	116-18.76	DDH-AU 8/10/78	1344	10.0 33.2	2.93		62.4 4.5	48.0	141	D	IDAHO BATH GRANITE
6N/ 4E 24DBD	CH	43-50.44	115-55.48	USBR DH2 7/10/70	1213	60.0 88.0	3.31		36.6 1.7	26.2	84	D	IDAHO BATH GRANITE
6N/ 4W 31CDC	SW	43-48.50	116-52.04	RDH 7/36/74	759	10.0 40.0			92.3 15.5	100.6		D	CENOZOIC SEDIMENTS
5N/ 1W 3ABD	SW	43-48.25	116-26.38	WW HLMCK 8/15/78	838	15.0 32.0	1.42	1	77.4 7.4	75.0	106	D	CENOZOIC CLAY/SAND
5N/ 5W 9BDB	SW	43-47.23	116-56.68	WW PARMA 8/18/78	675	0.0 100.0	(1.56)	2	(61.0)	(61.0)	95	D	CENOZOIC SAND/CLAY
5N/ 3W 35BBB	SW	43-44.02	116-40.19	WW 7/21/78	762	15.0 56.6	1.62	1				X	CENOZOIC CLAY/SAND
4N/ 1E 2ADB	SW	43-43.02	116-17.86	WW BARTN 8/31/78	902	0.0 82.0						X	CENOZOIC SAND
4N/ 2W 6BCB	SW	43-42.91	116-37.81	WW MODLT 7/29/78	739	0.0 30.0						X	CENOZOIC CLAY
4N/ 2E 7CAA	WO	43-41.89	116-15.84	WW TRRTL 8/ 2/78	902	10.0 30.0	1.17		96.2 7.2	80.0	94	D	CENOZOIC CLAY
4N/ 3W 27AAC	SW	43-39.58	116-40.53	WW CALDW 7/ 5/78	725	20.0 48.0	1.46		72.4 2.3	72.4	106	D	CENOZOIC CLAY
4N/ 1E 31CCC	SW	43-38.07	116-23.41	WW COPE 8/16/78	789	0.0 49.0	1.80	1				X	CENOZOIC CLAY/GRAVEL
3N/ 1E 5ABB	SW	43-37.99	116-21.72	USGS 7/25/78	797	0.0 25.0						X	CENOZOIC CLAY/SAND
3N/ 4W 6BCC	SW	43-37.60	116-52.16	WW MOULT 8/23/78	785	10.0 60.0						X	CENOZOIC CLAY/SAND
3N/ 5W 3DBC	SW	43-37.16	116-55.20	WW KNGHT 8/22/78	682	0.0 21.0						X	CENOZOIC CLAY
3N/ 1W 7BCB1	SW	43-36.97	116-30.67	USGS 7/25/78	797	0.0 14.0						X	CENOZOIC CLAY
3N/ 1W 23DBB	SW	43-34.96	116-25.36	WW TESTR 8/ 4/78	821	0.0 52.0						X	CENOZOIC SAND/CLAY

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
3N/ 1E 32AD	SW	43-33.37	116-21.24	WW 8/11/75	818	0.0 63.0						X	CENOZOIC BASALT
3N/ 1E 35DD	SW	43-32.82	116-17.84	BO 2 8/23/75	833	12.5 30.0	1.95 0.06	2	10.8 1.5	10.8	21	D	CENOZOIC BASALT
2N/ 1W 7BBC	SW	43-31.72	116-30.70	USGS 7/25/75	777	10.0 29.8	1.34		76.4 14.2	76.4	102	D	CENOZOIC CLAY/BASALT
1N/ 4W 13BAC	SW	43-25.66	116-45.91	WW FRMAN 6/25/78	777	5.0 25.0	1.17		111.0 8.0	111.0	130	D	CENOZOIC CLAY
1S/ 1E 6CCD	SW	43-21.45	116-23.28	WW 7/25/76	904	20.0 165.0	(1.42)	1	(93.0) 6.4	93.0	132	D	CENOZOIC SED./BASALT
2S/ 2W 4DAB	SW	43-16.65	116-34.47	WW 6/27/77	765	10.0 33.0	1.09		70.6 1.4	70.6	77	D	CENOZOIC SED./BASALT
2S/ 2W 4CBD	SW	43-16.55	116-35.18	WW 7/29/75	786	0.0 11.0						X	CENOZOIC BASALT
2S/ 5E 15CA	SW	43-14.98	115-50.88	WW 7/25/74	998	0.0 90.0	1.46		102.0	102.0	149	D	CENOZOIC BASALT
2S/ 5E 22BDA	SW	43-14.36	115-50.91	WW 7/11/77	989	30.0 95.0	1.34		59.6 1.0	59.6	80	D	CENOZOIC BASALT
2S/ 1E 23ADD	SW	43-14.07	116-17.63	WW LNDRF 7/21/78	962	160.0 230.0	1.17		84.3 6.3	84.3	99	C	CENOZOIC BASALT/CLAY
						30.0 235.0	1.38	1	60.0 3.1	60.0	83	D	
2S/ 4E 21DDD	SW	43-13.82	115-59.00	WW 7/20/78	940	0.0 42.0						X	CENOZOIC SED./BASALT?
2S/ 2W 36BA	SW	43-12.77	116-31.31	USGS 8/10/74	862	50.0 100.0	1.46	1	71.0	71.0	104	D	CENOZOIC BASALT
2S/ 5E 36BDC	SW	43-12.47	115-48.66	USGS 8/ 2/75	968	5.0 15.0						X	CENOZOIC BASALT
2S/ 2W 36CB	SW	43-12.29	116-31.64	WW 8/11/74	888	20.0 350.0	> 1.46		> 42.0	> 42.0	62	D	CENOZOIC BASALT
3S/ 5E 7BBD	SW	43-11.00	115-54.68	WW 1 7/22/76	939	0.0 80.0						X	CENOZOIC SED./BASALT
3S/ 5E 7A	SW	43-10.93	115-53.97	WW 8/24/75	939	20.0 80.0	1.09	1				X	CENOZOIC BASALT/SED.
3S/ 5E 7BDD	SW	43-10.75	115-54.41	WW 2 7/26/76	937	10.0 260.0						X	CENOZOIC BASALT/SED.
3S/ 7E 9AC	SW	43-10.67	115-37.49	MH 3 8/22/75	1048	7.5 27.5	1.76	1				X	CENOZOIC BASALT

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
3S/ 1E 18BAC	SW	43-10.02	116-23.24	WW 7/ 4/77	747	10.0 69.0	> 1.46	1	> 48.8 6.2	? 40.7	58	D	CENOZOIC SEC./SIL.VOL
4S/ 7E 17CB	SW	43- 4.52	115-39.18	WW 7/30/75	942	0.0 79.0						X	BASALT (V8) CLAY
4S/ 2E 20BDA	SW	43- 3.93	116-14.72	WW 6/28/77	754	30.0 89.0						X	CENOZOIC CLAY/GRAVEL
4S/ 1E 35BBD	SW	43- 2.20	116-18.50	WW 6/24/77	771	70.0 278.0						X	CENOZOIC SEIDMENTS
4S/ 1E 35ACB	SW	43- 2.13	116-18.14	WW 6/26/77	774	10.0 30.0	1.13		74.6 3.6	74.6	84 4	D	CENOZOIC SEDIMENTS
4S/ 1E 35ACC	SW	43- 2.03	116-18.10	WW 6/29/77	777	40.0 85.0	1.17					X	CENOZOIC SEDIMENTS
5S/ 1E 2AAA	SW	43- 1.48	116-18.19	WW 6/25/77	795	0.0 15.0						X	CENOZOIC SEDIMENTS
5S/ 1E 10BDC	SW	43- 0.27	116-19.67	WW 6/25/77	807	0.0 105.0						X	CENOZOIC CLAY/SAND
5S/17E 10	EW	43- 0.15	114-25.35	WW 7/27/77		0.0 62.0						X	
5S/ 1E 9CCA	SW	43- 0.00	116-20.94	WW 7/ 4/77	838	20.0 119.0	> 1.63		> 38.9 1.4	> 38.9	64 2	D	CENOZOIC SEDIMENTS
5S/12E 16BCB1	SW	42-59.50	115- 2.70	USGS 7/18/74	974	0.0 30.0						X	
5S/ 3E 15CBB	SW	42-59.42	116- 5.76	WW 6/30/77	722	0.0 52.0						X	CENOZOIC SEDIMENTS
5S/ 3E 23CAA	SW	42-58.53	116- 4.03	WW 7/ 5/77	730	0.0 19.0						X	CENOZOIC SEDIMENTS
5S/ 2E 25AAD	SW	42-57.85	116- 9.35	WW 7/ 4/77	804	0.0 54.0						X	CENOZOIC SEDIMENTS
5S/ 2E 27DAA	SW	42-57.59	116-11.75	WW 7/ 2/77	865	0.0 19.0						X	CENOZOIC SEDIMENTS
5S/ 1E 29DA	SW	42-57.49	116-21.26	WW 6/30/77	861	0.0 47.0						X	CENOZOIC SEDIMENTS
6S/ 4E 4BDB	SW	42-56.09	115-59.42	WW 7/14/77	771	10.0 77.0	1.09	1	60.9 5.5	60.9	66	D	CENOZOIC SEDIMENTS
6S/ 3E 6CAB	SW	42-55.86	116-10.18	WW 7/ 8/77	846	5.0 35.0	1.51	1	42.4 8.8	42.4	64	D	CENOZOIC CLAY/SAND
6S/ 3E 4DDB	SW	42-55.59	116- 6.02	WW 7/ 5/77	785	0.0 17.0						X	CENOZOIC SEDIMENTS

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
6S/ 3E 10BAC	SW	42-55.19	116- 5.42	WW 7/ 1/77	789	0.0 21.0						X	
6S/ 3E 10BDB	SW	42-55.15	116- 5.42	WW 7/ 1/77	791	0.0 11.0						X	
6S/ 3E 7CBD	SW	42-54.83	116-10.23	WW 7/ 8/77	853	5.0 78.0						X	
6S/ 4E 17BBB	SW	42-54.52	116- 0.88	WW 7/14/77	804	10.0 20.0	(1.46)	1	(126.0)	126.0	185	D	CENOZOIC SEDIMENTS
6S/ 3E 14BCB1	SW	42-54.23	116- 4.55	USGS 8/20/74	806	15.0 55.0	1.26	1	59.0 5.4	59.0	73 7	D	CENOZOIC SND CLAY & GRVL
6S/ 3E 13BDC	SW	42-54.14	116- 3.04	WW 6/21/77	798	10.0 60.0	1.26		18.4 0.8	18.4	23 1	D	CENOZOIC CLY SILT & SAND
6S/ 8E 18CDD	SW	42-53.68	115-32.93	WW 7/ 6/77	800	0.0 12.5						X	CENOZOIC SEDIMENTS
6S/ 3E 23BBB	SW	42-53.64	116- 4.54	WW 7/12/77	824	10.0 25.0	(1.51)		(82.0)	82.0	165	D	CENOZOIC CLY SAND & BASLT
6S/ 3E 22DDB	SW	42-53.00	116- 4.87	WW 6/ 9/77	830	0.0 46.0						X	CENOZOIC SEDIMENTS
7S/ 4E 2DBC	SW	42-50.46	115-56.56	WW 6/26/77	823	0.0 30.0						X	CENOZOIC SEDIMENTS
7S/ 5E 7DDC	SW	42-49.41	115-53.90	WW 6/26/77	798	0.0 13.0						X	CZ CLAY/SAND BASALT
7S/ 5E 19BCD	SW	42-48.26	115-54.63	WW 8/20/74	817	0.0 26.0						X	CENOZOIC SEDIMENTS
8S/ 1W 25DBC	OU	42-41.79	116-24.05	WW 6/ 9/77	1827	10.0 23.0	1.09		96.2 18.5	96.2	105	D	CENOZOIC SEDIMENTS
9S/13E 32CDC	EW	42-35.74	114-57.70	WW BLGUL 8/31/75	1160	10.0 135.0	2.03 0.10	8	92.7 1.7	92.7	188 3	D	CENOZOIC GRAVEL/RHY
10S/13E 5CB	EW	42-35.09	114-57.81	WW BLGUL 9/ 6/75	1162	30.0 195.0	< 2.03 0.10	8	< 86.3 3.3	< 86.3	175	D	CENOZOIC GRAVEL/RHY
10S/12E 1CD	SW	42-34.86	114-59.85	WW BLGUL 9/ 5/75	1152	10.0 105.0	2.03 0.10		58.9 1.9	58.9	120	X	CENOZOIC GRAVEL/RHY
						10.0 220.0	< 2.03 0.10	8	< 83.5 1.6	< 83.5	169	D	
10S/12E 12AB	SW	42-34.71	114-59.55	WW BLGUL 6/28/74	1150	0.0 127.0	< 2.03 0.10	8	<125.0	<125.0	254	D	CENOZOIC GRAV/BAS/RHY
10S/ 2E 9BBB1	OU	42-34.62	116-14.13	WW BLM 7/ 6/77	1710	20.0 47.0	1.80		21.6 1.0	21.6	39	D	CENOZOIC SIL VOL

TWN/RNG SECTION	TECT PROV	N LAT DEG MIN	W LONG DEG MIN	HOLE (DATE)	COLLAR ELEV	DEPTH RANGE	AVG TCU <SE>	NO TCU	UN GRAD <SE>	CO GRAD <SE>	CO H.F. <SE>	Q HF	LITHOLOGY SUMMARY
10S/12E 10DAA	SW	42-34.23	115- 1.54	WW BLGUL 6/27/74	1158	35.0 240.0	2.03 0.10	8	61.2 5.7	61.2	124	D	CENOZOIC RHYOLITE
10S/12E 11DBD	SW	42-34.10	115- 0.57	USGS 7/ 7/74	1143	0.0 210.0	2.03 0.12	8	61.0	61.0	124	D	CENOZOIC GRAV/BAS/RHY
10S/11E 36BBD	SW	42-31.09	115- 7.10	WW 7/20/77	1231	12.5 45.0	1.80		26.6 7.4	26.6	48	D	CENOZOIC SIL VOL
13S/ 3E 31CBD	OU	42-15.00	116- 9.25	WW 6/15/77	1628	10.0 26.5	1.88		103.0 5.8	103.0	194	D	CENOZOIC SIL VOL
14S/ 4E 17AAB	OU	42-12.94	116- 0.33	SMU GM3 12/28/77	1801	10.0 38.0	1.38 0.27	3	37.8 2.0	37.8	51	D	CENOZOIC SIL VOL
14S/ 3E 16CD	OU	42-12.11	116- 6.53	WW 6/15/77	1636	0.0 11.0						X	
15S/ 6E 4DAA2	OU	42- 8.99	115-45.00	WW 6/19/77	1554	10.0 40.0	1.88		59.9 5.8	59.9	113	D	CENOZOIC SILICIC VOL
15S/ 6E 11DB	OU	42- 8.03	115-42.91	WW 6/21/77	1615	0.0 25.0						X	CENOZOIC SILICIC VOL
15S/16E 20BC	CH	42- 6.60	114-36.80	WW 7/21/77		0.0 334.0			44.8	44.8		D	
15S/ 2E 22DBB	OU	42- 6.27	116-12.28	WW 7/10/77	1615	0.0 10.0						X	CENOZOIC SEDIMENTS
15S/ 2E 34DAC	OU	42- 4.41	116-12.23	WW 7/10/77	1618	0.0 12.0						X	CENOZOIC SEDIMENTS
16S/ 2W 29CCD	OU	41-59.88	116-36.28	WW 7/20/77	1596	50.0 175.0	1.88		80.4 4.0	80.4	151	D	CENOZOIC SILICIC VOL
13N/18E	CH			WW 7/21/77		10.0 43.0						X	

Appendix B

Thermal data from holes bottoming in, or above Snake River Plain Aquifer

Explaination

Similar data for each hole that bottoms in or above the Snake Plain aquifer to that shown in Tables 2 and 3 are shown in this appendix except that no uncorrected gradient values are shown and there is a gradient status column instead of a heat flow quality column. The "aquifer status" column is explained in the text and replaces heat flow quality. No "above" values are shown for holes which have a vesicular basalt disturbance. No terrain correlations are needed for any of the holes shown in this appendix.

TABLE 81. Geothermal Data for the Eastern Snake River Plain Inside Boundaries of the Snake Plain Aquifer

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC Wm^{-1}K^{-1}	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
15N/43E-24AAB	44-37.00	111-19.04	WW IP 8/ 5/75	2024	5.0 30.0	(1.13)		53.3 5.5	-59 5	AB	
					40.0 62.0	(1.46)		4.0 5.3	5	IN	7.67
13N/44E-20ADB	44-21.21	111-16.57	WW IP 8/ 5/75	1914	22.5 32.5	(1.46)		8.0	11	IN	5.07
11N/39E-11CDA	44-17.57	111-49.38	WW BLACK 5/12/77	1916	20.0 50.0	(1.46)		9.1 1.3	13	IN	6.44
11N/40E-4ADA	44-18.86	111-44.25	WW BLACK 5/15/77	2032	20.0 80.0	(1.46)		5.9 .1	8	IN	6.01
10N/39E-5CCD	44-13.02	111-53.53	WW LUSK 7/25/77	1827	20.0 60.0	(1.46)		7.6 .6	11	AB	
					60.0 200.0	(1.46)		14.5 .7	21	IN	7.67
10N/42E-24ABA1	44-11.21	111-26.54	USGS 8/ 6/75	1887	20.0 50.0	(1.46)		-25.2 3.1	-36	AB	
					50.0 65.5	(1.46)		20.8 1.5	30	IN	3.88
9N/39E-4AAC	44- 8.49	111-51.65	WW BALL 5/19/77	1725	50.0 260.0	(1.46)		6.9 .2	10	AB	9.89
9N/40E-5DDD	44- 7.85	111-46.51	WW 5/22/77	1682	10.0 190.0	(1.46)		7.3 .3	10	AB	
					190.0 220.0	(1.46)		17.3 1.4	25	IN	10.07
9N/44E-21AAD1	44- 5.80	111-15.22	WW IP 8/ 5/75	1729	10.0 32.5	(1.51)		12.6 1.3	22	AB	5.56
9N/34E-17CCC3	44- .97	112-29.61	USBR 8/13/77	1465	25.0 120.0	(1.46)		30.2 .3	44	AB	
					120.0 182.0	(1.46)		28.8 1.8	42	IN	13.97
8N/40E-1CAD1	44- 2.78	111-41.36	USBR 7/12/77	1573	20.0 100.0	(1.46)		28.8 3.4	42	AB	
					105.0 114.0	(1.46)		21.4 4.4	31	IN	13.24
8N/40E-21DDD3	44- .00	111-44.25	USBR 7/12/77	1513	20.0 50.0	(1.46)		45.0 1.9	66	AB	
					50.0 114.0	(1.46)		21.0 1.7	31	IN	13.11
7N/31E-22BDD	43-55.37	112-44.71	NRTS AN7 6/27/77	1504	20.0 110.0	(1.46)		-10.8 .4	-15	AB	9.09
7N/31E-23CAC	43-54.27	112-46.07	NRTS PW1 6/29/77	1493	20.0 105.0	(1.46)		-9.0 .5	-13	AB	9.26
7N/35E-13AAD4	43-56.43	112-16.70	USBR 7/ 7/77	1460	15.0 80.0	(1.46)		28.2 1.6	41	AB	
					80.0 225.0	(1.46)		-.5 .1	-0	IN	11.73
7N/35E-16BDD	43-56.16	112-20.79	WW 7/15/77	1497	35.0 81.0	(1.46)		4.5 .4	6	IN	12.23
7N/38E-23DBA6	43-55.10	111-56.52	USBR 7/12/77	1479	70.0 150.0	(1.46)		1.9 .2	2	IN	11.25
7N/39E-34CCB1	43-53.21	111-51.41	USBR 8/14/74	1472	30.0 70.0	(1.46)		16.7 1.5	24	AB	10.84
7N/40E-16BCC1	43-56.13	111-45.29	USBR 8/15/74	1489	.0 40.0					IN	11.33
7N/40E-19AAD1	43-55.49	111-46.70	USBR 7/ 8/77	1480	.0 46.0					IN	11.53
7N/40E-20CDC3	43-54.84	111-46.25	USBR 7/ 8/77	1484	45.0 120.0	(1.46)		-7.1 2.0	-10	IN	11.21
6N/31E-27BAD1	43-49.43	112-44.70	NRTS 7 6/ 5/77	1460	70.0 105.0	(1.46)		100.1 3.3	146	AB	
					105.0 260.0	(1.46)		11.8 .5	17	IN	19.78

TABLE B1 (continued)

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
6N/32E-11ABA	43-52.20	112-39.57	NRTS 26 6/13/78	1460	65.0 80.0	(1.46)		15.0 2.3	21	IN	15.04
6N/32E-26CAB2	43-49.12	112-40.07	NR ANP10 6/14/78	1459	65.0 220.0	(1.46)		2.1 .4	3	IN	15.35
6N/32E-26CAC2	43-49.02	112-40.02	NR ANP 9 6/14/78	1459	20.0 70.0	(1.46)		41.3 7.9	60	AB	
					70.0 100.0	1.46		-.2 .4	-0	IN	13.35
6N/33E-26DDB1	43-48.82	112-32.30	NRTS 27 6/11/78	1458	20.0 70.0	(1.46)		90.4 5.7	132	AB	
					70.0 90.0	(1.46)		1.4 .4	2	IN	15.55
6N/36E-11ABA4	43-52.18	112-10.81	USBR 7/ 9/77	1468	105.0 215.0	(1.46)		-21.8 2.6	-31	IN	9.68
6N/36E-23CCC	43-49.67	112-11.68	BLM 6/21/79	1488	20.0 40.0	(1.38)		7.0 1.6	9	IN	10.61
6N/37E-29AC 1	43-49.31	112- 7.19	USBR 9 7/ 1/74	1480	30.0 110.0	(1.46)		-21.3 1.3	-31	AB	
					110.0 160.0	(1.46)		.8 .2	1	IN	8.10
6N/38E-25AC 1	43-49.31	111-55.54	USBR 8/ 1/74	1474	50.0 160.0	(1.46)		20.5 1.0	30	IN	8.50
6N/38E-30BAD4	43-49.40	112- 1.64	USBR 7/ 9/77	1485	30.0 135.0	(1.46)		-14.8 .5	-21	AB	
					135.0 177.0	(1.46)		8.0 .1	11	IN	8.14
6N/39E-10BBB4	43-52.15	111-51.36	USBR 7/ 8/77	1473	40.0 80.0	(1.46)		-4.1 1.1	-6	AB	
					80.0 178.0	(1.46)		45.3 5.0	66	IN	12.00
6N/39E-29ACC3	43-49.18	111-53.16	USBR 7/ 8/77	1470	20.0 75.0	(1.51)		31.4 5.8	47	AB	12.28
6N/39E-30ADC3	43-49.25	111-54.09	USBR 7/ 8/77	1468	10.0 85.0	(1.46)		-19.3 1.9	-28	AB	
					85.0 132.0	(1.46)		18.8 .9	27	IN	9.51
6N/40E-4CCC	43-52.20	111-45.34	USGS G3 7/ 9/79	1489	425.0 687.5	1.79 .25	6	44.3 1.0	79	BL	10.22
5N/29E-1BBB	43-47.87	112-57.30	WW SMPT2 8/ 8/78	1464	40.0 170.0	(1.46)		.1	0	IN	9.47
5N/29E-23CDA1	43-44.50	112-57.98	NRTS 19 7/ 6/77	1463	20.0 85.0	(1.46)		97.6 2.0	143	AB	16.98
5N/30E-4BCC	43-47.50	112-53.61	WW SMPT1 8/ 1/78	1461	15.0 155.0	(1.46)		33.5 1.6	49	AB	
					155.0 335.0	(1.46)		.2	0	IN	13.37
5N/31E-14CAD1	43-45.47	112-43.60	NRTS 18 6/12/78	1496	85.0 102.0	(1.46)		1.7 1.4	2	IN	14.63
5N/31E-28CCC1	43-43.57	112-46.52	NRTS S14 7/21/77	1461	30.0 90.0	(1.46)		77.8 4.2	113	AB	
					90.0 215.0	(1.46)		5.5 1.7	7	IN	16.91
5N/32E-15BAD	43-45.95	112-41.34	USGS G2A 7/ 2/79	1459	10.0 95.0	1.46	1	75.4 10.0	109	AB	
					95.0 407.5	1.33 .13	6	16.1 .4	21	IN	20.01
					407.5 789.5	1.84 .06		59.8 1.0	110	BL	

TABLE 3 (continued)

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
5N/33E-10CDC1	43-46.42	112-34.33	NRTS 31 7/21/77	1453	20.0 80.0	(1.46)		76.1 6.2	111	AB	
					80.0 90.0	(1.34)				IN	15.50
5N/33E-13BDC1	43-46.08	112-31.95	NRTS 30 6/24/77	1458	20.0 85.0	(1.46)		44.4 4.1	64	AB	
					85.0 160.0	(1.34)		13.0 1.4	17	IN	15.82
					160.0 216.0	(1.84)		28.2 2.9	51	BL	
5N/33E-17ADD	43-45.48	112-36.48	NRTS 28 6/ 9/78	1455	20.0 73.0	(1.38)		101.3 7.4	140	AB	
					20.0 73.0	(1.38)				IN	14.64
5N/33E-23DDD1	43-44.73	112-32.35	NRTS 32 6/11/78	1468	80.0 120.0	(1.34)		22.9 7.9	30	IN	13.69
5N/34E-9BDA1	43-46.94	112-28.35	NRTS 4 6/10/78	1461	20.0 85.0	(1.46)		19.9 .8	8	AB	
					85.0 128.0	(1.34)		.2 .4	0	IN	11.10
5N/34E-29DAA1	43-44.12	112-28.85	NRTS 29 7/21/77	1486	20.0 100.0	(1.46)		22.0 1.0	32	AB	12.36
5N/36E-2BDA3	43-47.80	112-11.60	USBR 7/ 9/77	1451	5.0 115.0	(1.46)		.7 .2	0	IN	
					120.0 230.0	(1.34)		8.1 .5	10	IN	9.95
5N/36E-22BBA	43-45.35	112-13.02	WW 8/13/77	1452	5.0 95.0	(1.46)		6.4 2.5	9	IN	
					100.0 180.0	(1.34)		17.1 1.6	23	IN	9.75
5N/37E-21DB	43-44.88	112- 6.65	USBR 8/13/75	1454	25.0 70.0	(1.46)		-8.0 1.4	-11	AB	
					70.0 145.0	(1.34)		1.5 .3	2	IN	9.06
5N/39E-18CAC1	43-45.77	111-55.05	USBR 7/13/77	1470	40.0 80.0	(1.46)		-2.2 3.0	-3	IN	7.00
5N/40E-8CBB	43-46.70	111-47.16	WW RICKS 5/11/78	1556	85.0 100.0	(1.34)		-1.6 1.0	-2	IN	20.40
5N/40E-17ABA	43-46.27	111-46.23	USGS 8/14/74	1580	50.0 145.0	1.80	1	47.4 2.7	85	AB	
4N/25E-21ABB1	43-40.07	113-22.02	USGS 9/19/75	1643	120.0 175.0	1.42	1	5.1 .2	7	IN	9.83
4N/29E-9DCD1	43-40.93	113- .02	NRTS 23 7/ 6/77	1488	20.0 120.0	1.46	1	49.8 1.1	72	AB	
					120.0 130.0	(1.34)		1.0 .6	1	IN	14.70
4N/29E-14CAA	43-40.47	112-57.95	NRTS S17 6/14/78	1487	120.0 257.0	1.38	1	1.7 .4	2	IN	11.97
4N/30E-6ABB1	43-42.58	112-55.28	NRTS 15 6/28/77	1467	100.0 160.0	(1.34)		.9 1.2	11	IN	11.43
4N/30E-7ADB1	43-41.40	112-55.12	NRTS 12 6/10/78	1469	20.0 120.0	1.51	1	24.7 .8	37	AB	
					120.0 215.0	1.30	1	.1 .1	0	IN	12.07
4N/30E-22BDD1	43-39.63	112-52.00	NRTS 17 6/22/77	1473	30.0 100.0	1.42	1	24.0 1.2	34	AB	
					100.0 150.0	(1.34)		58.1 1.8	43	IN	12.79
4N/30E-26CCA1	43-38.47	112-51.13	NRTS S6 6/16/78	1337	110.0 125.0	(1.34)				IN	13.58

TABLE B1 (continued)

Twn/Rng- Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
4N/31E- 16ADD1	43-40.52	112-45.45	NRTS 6 6/29/77	1493	20.0 120.0	1.46	1	22.0 .8	32	AB	
					130.0 177.0	1.38	1	22.7 .3	31	IN	13.51
4N/35E- 14AAA1	43-41.03	112-18.12	USBR 15 8/18/71	1505	25.0 115.0	1.51	1	.7 .1	1	IN	
					130.0 230.0	(1.38)		7.5 .5	10	IN	9.75
4N/37E- 36CCC1	43-37.77	112- 9.93	USGS 6/21/79	1810	5.0 45.0	(1.38)		36.0 2.9	49	AB	
					45.0 60.0	(1.34)		3.4 1.0	4	IN	10.61
4N/38E- 12BBB5	43-41.88	111-56.54	USGS 7/ 8/77	1472	60.0 275.0	1.38	1	1.1 .5	1	IN	9.10
3N/26E- 22ABA1	43-34.75	113-20.57	USGS 7/31/77	1619	190.0 229.0	(1.34)				IN	13.29
3N/28E- 1BAA	43-37.41	113- 3.95	INEL-GT1 9/10/78	1561	87.5 230.0	(1.42)		15.5 .4	22	IN	14.55
					230.0 550.0			45.1 .3		BL	
					550.0 750.0			47.1 .3		BL	
					750.0 1000.0			49.9 1.6		BL	
					1000.0 3100.0	2.76	10	39.5	109	BL	
3N/29E- 19CBB1	43-34.38	113- 3.33	NRTS 22 6/25/77	1539	20.0 199.0	1.51	1	54.3 .3	81	AB	
					20.0 199.0	1.51				IN	17.77
3N/29E- 25CAA3	43-33.38	112-56.77	NRTS 37 6/21/78	1503	20.0 145.0	(1.51)		7.6- 2.7	-11	AB	12.56
3N/29E- 36BCB1	43-32.75	112-57.18	NRTS 85 6/21/78	1506	20.0 145.0	(1.51)		9.7 .3	14	AB	>11.54
3N/30E- 12CDD1	43-35.67	112-49.15	NRTS 5 6/14/78	1505	20.0 150.0	1.51	1	23.3 1.7	35	AB	>12.88
3N/30E- 31AAD1	43-32.88	112-55.00	NRTS 20 6/15/78	1498	20.0 141.0	(1.51)		9.1 1.0	13	AB	>11.56
3N/32E- 13DCB1	43-35.17	112-38.80	ARBOR A1 6/26/78	1574	20.0 205.0	(1.51)		19.7 .8	29	AB	
					205.0 237.0	1.38	1	.2 .1	0	IN	13.16
3N/32E- 29DCC1	43-33.33	112-43.38	NRTS 2 6/21/77	1562	40.0 205.0	(1.51)		23.5 .3	35	AB	13.15
3N/34E- 32BBC1	43-33.12	112-30.00	NRTS HW2 6/20/77	1590	20.0 220.0	1.46	1	17.6 .2	25	AB	
					220.0 240.0	(1.38)				IN	12.53
3N/37E- 2CBD1	43-36.93	112- 4.65	USGS 7/16/77	1467	50.0 110.0	(1.38)		-1.9 .7	-2	IN	10.94
3N/37E- 12BDB	43-36.38	112- 3.30	USBR 6/20/79	1449	5.0 50.0	1.38	1	28.9 7.4	39	AB	
					50.0 95.0	(1.34)		-4.3 .9	-5	IN	9.23
2N/26E- 22DDA1	43-28.88	113-20.20	USGS 8/ 1/77	1634	10.0 310.0					IN	13.72
2N/27E- 2DDC1	43-31.37	113-12.05	NRTS 8 6/26/77	1583	20.0 230.0	(1.51)		9.5 .4	14	AB	
					230.0 245.0	(1.38)		3.4 1.0	4	IN	10.67

TABLE 61 (continued)

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
2N/29E- 21BBB1	43-29.58	113- 8.02	NRTS 86 6/20/78	1547	20.0 197.0	(1.51)		7.8 .2	11	AB	9.44
2N/29E- 13AAA1	43-30.38	112-56.26	NRTS 83 6/18/77	1506	20.0 160.0	(1.51)		16.1 .2	24	AB	
					165.0 220.0	(1.38)		8.1 .3	11	IN	11.78
2N/29E- 36CC	43-27.09	112-57.15	NRTS CG 7/ 7/77	1530	30.0 170.0	1.46	1	25.0 .4	36	AB	13.74
2N/30E- 8AAA1	43-31.27	112-53.78	AEC OMRE 6/30/77	1506	170.0 205.0	(1.34)		1.1 .2	1	IN	13.14
2N/31E- 35DCC1	43-27.00	112-46.58	NRTS 1 7/ 1/77	1531	20.0 185.0	1.51	1	29.5 .4	44	AB	14.15
2N/32E- 22ABD	43-29.44	112-41.06	USGS G1 7/ 2/79	1637	20.0 300.0	2.34 .12	3	31.7 .3	74	AB	
					300.0 455.0	1.97 .13	10	5.3	10	IN	19.43
					455.0 537.5	1.58 .17	3	41.7 1.0	65	BL	
2N/35E- 2BBC1	43-32.30	112-19.27	NRTS HW1 6/15/77	1551	220.0 345.0	(1.34)		.1 .2	0	IN	10.01
2N/37E- 2AB	43-32.23	112- 4.23	BLM 6/19/79	1444	25.0	(1.34)		4.8 .5	6	IN	10.38
2N/38E- 16ADD	43-30.31	111-59.03	WW 7/18/77	1444	20.0 70.0	1.51	1	-25.0 .9	-37	IN	<10.87
1N/29E- 21DCC	43-23.81	113- 3.79	SMU BSB1 8/25/78	1585	7.5 106.0	2.76 .06	16	9.3 .2	25	AB	
1N/29E- 30BBD1	43-23.65	113- 6.75	NRTS 11 6/30/77	1544	200.0 212.0	(1.34)		.8 .4	1	IN	11.64
1N/30E- 10BBA1	43-26.32	112-55.97	WW BLM 6/25/78	1518	10.0 179.0	1.46	1	20.5 .8	30	AB	13.57
1N/36E- 1CCB1	43-26.55	112-10.88	USBR 6/11/78	1424	10.0 61.0	1.46	1	-9.1 9.8	-13	AB	11.00
1N/37E- 15BBA3	43-25.47	112- 5.95	USBR 6/10/78	1416	35.0 95.0	1.46	1	7.2 .9	10	IN	11.38
1S/21E- 13DB	43-19.98	113-54.00	WW SLLSW 8/ 7/78	1457	5.0 80.0					IN	11.05
1S/22E- 3AA	43-22.03	113-48.93	WW 8/ 7/77	1493	.0 52.0					IN	17.33
1S/23E- 26CCC	43-18.15	113-41.64	USGS 5/26/79	1532	10.0 300.0	1.26	1	.5 .3	1	IN	9.86
1S/27E- 14DCC	43-19.80	113-16.30	USGS 8/ 1/77	1572	150.0 310.0	(1.46)				IN	13.33
1S/30E- 15BCA1	43-20.32	112-56.85	NRTS 14 6/29/77	1564	30.0 120.0	(1.46)		34.8 1.0	51	AB	
					120.0 210.0	(1.38)		10.9 .9	15	IN	13.67
1S/37E- 36DCB	43-17.08	112- 4.17	WW FLDG1 6/13/78	1464	10.0 80.0	1.55	1	112.0 6.7	173	AB	18.60
2S/20E- 1ACC2	43-16.70	114- 1.50	USGS 7/27/74	1460	20.0 50.0	1.37 .06	3	54.3 1.5	74	AB	
3S/20E- 2DDA1	43-11.27	114- 2.15	USGS 8/ 2/78	1403	10.0 90.0	(1.46)		2.0 .3	7	AB	10.72
3S/27E- 24DDA	43- 8.67	113-14.55	USGS 5/28/79	1518	250.0 275.0	(1.38)		15.0 .5	20	IN	15.45
3S/33E- 2DC	43-11.09	112-33.87	USBR 6/29/79	1359	10.0 205.0	1.42	1	-7.3 .9	-10	IN	11.10
4S/17E- 24CDD	43- 3.36	114-23.05	WW 8/23/77	1311	20.0 57.0	1.51	1	31.8 .8	47	AB	

TABLE 81 (continued)

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
4S/17E- 35DA 1	43- 2.09	114-24.49	BLM R27S 6/24/78	1341	20.0 70.0	1.51	1	30.2 2.2	45	AB	
					70.0 110.0	(1.38)		.2 1.1	0	IN	12.70
4S/24E- 6BBC	43- 6.59	113-39.02	USGS 7/ 3/79	1377	10.0 105.0	(1.38)		5.4 .3	7	AB	>11.41
4S/32E- 1CBA3	43- 6.11	112-40.07	USGS 8/10/78	1356	40.0 109.3	(1.51)		-6.7 .7	-9	IN	10.09
5S/15E- 17BCB	42-59.56	114-42.61	WW 8/31/78	1103	37.5 62.5	(1.38)		16.0 2.7	22	IN	12.77
5S/15E- 34ACC	42-56.84	114-39.74	WW MUFFY 8/28/78	1105	7.5 53.5	1.88	1	44.5 5.7	84	IN	14.14
5S/17E- 26ACA1	42-57.70	114-24.07	USBR 7/ 9/78	1210	10.0 62.5	1.51	1	35.0 2.6	52	AB	12.53
5S/18E- 6ACC	43- 1.15	114-21.74	WW 7/26/77	1301	70.0 121.0	(1.51)		.1 .1	0	IN	13.19
5S/23E- 17CAA	42-59.20	113-44.63	USGS 7/ 3/79	1341	15.0 90.0	(1.38)		17.7 .3	24	AB	13.20
5S/25E- 22DAD1	42-58.18	113-27.27	USGS 5/31/79	1396	15.0 150.0	(1.42)		23.7 .4	33	AB	
					155.0 175.0	(1.34)		24.0 2.1	32	IN	14.78
5S/28E- 26BBD1	42-57.77	113- 9.65	USGS 7/28/78	1506	20.0 215.0	1.51	1	9.5 .9	14	AB	
					215.0 225.0	1.42	1	-1.0 .3	-1	IN	12.32
6S/13E- 16AAD1	42-54.42	114-54.58	USGS 7/18/74	1000	10.0 50.0	(1.42)		102.0	146	AB	
					50.0 100.0	(1.38)		.9	1	IN	16.93
6S/14E- 23DDA	42-52.99	114-46.11	WW 8/30/78	1070	67.5 77.5	1.46	1	3.6 .6	5	IN	14.30
6S/18E- 7BCB1	42-55.10	114-22.34	USBR 6/24/78	1213	20.0 70.0	1.55 .00	3	4.9 2.2	7	AB	14.45
6S/19E- 18BCD	42-54.11	114-14.83	WW 7/27/77	1234	75.0 140.0	1.37 .08	2	9.8 2.3	13	IN	15.33
6S/32E- 31CAB	42-51.34	112-51.59	W YOUNG 8/ 6/78	1342	15.0 35.0	(1.46)		.1 .4	-1	AB	
					15.0 35.0	(1.46)				IN	9.74
7S/14E- 30DCC	42-46.99	114-51.39	WW HSCVR 9/ 3/78	978	15.0 98.5					IN	14.47
7S/19E- 19AA 1	42-48.48	114-16.09	USGS 6/11/79	1237	5.0 75.0	1.34	1	3.2 .3	4	AB	15.09
7S/24E- 2ADD1	42-50.62	113-36.54	USBR 8/ 6/78	1306	10.0 72.0	(1.51)		48.8 4.2	73	AB	12.65
7S/25E- 14CCC1	42-48.45	113-23.55	USBR 7/14/78	1342	20.0 120.0	1.51	1	9.7 1.4	14	AB	12.21
7S/30E- 28BBC	42-47.25	112-57.66	WW ALLEN 8/10/78	1381	10.0 70.0	(1.51)		18.1 1.6	27	AB	
					70.0 89.0	1.42	1	.6 .2	0	IN	10.42
8S/14E- 8AAA	42-45.22	114-49.81	WW 9/ 2/78	976	10.0 36.5	(1.38)		26.5 1.6	36	IN	14.58
8S/14E- 16CBB1	42-43.88	114-49.78	USGS 9/ 1/78	967	.0 16.2					IN	14.30
8S/19E- 5DAB1	42-45.40	114-15.15	USBR 6/27/78	1242	10.0 95.0	(1.51)		18.4 2.9	27	AB	15.16

TABLE 81 (continued)

Twn/Rng-Section	N Lat. Deg.Min.	W Long. Deg.Min.	Hole ID Date Logged	Collar Elev. m	Depth Interval m	Avg. TC $Wm^{-1}K^{-1}$	No. TC	Corr. Gradient °C/km	Corr. HF mWm^{-2}	Aqu. Status	Aqu. Temp. °C
8S/24E-2ABB1			USBR 7/19/78	1303	10.0 70.0	(1.51)		31.0 2.1	46	AB	
					70.0 88.0	(1.38)		.9 .4	1	IN	12.48
8S/25E-36DAA1	42-41.03	113-28.23	USBR 7/27/78	1282	10.0 35.0	(1.51)		29.6 1.1	44	AB	
					35.0 50.0	(1.38)		1.4 .3	2	IN	12.89
8S/26E-3CDD1	42-44.90	113-24.27	USBR 7/16/78	1320	10.0 110.0	1.51	1	25.4 2.3	38	AB	
					110.0 145.0	1.38	1	12.4 3.7	17	IN	13.86
8S/29E-34CBC3	42-40.78	113- 3.62	USBR 7/26/78	1337	20.0 60.0	(1.38)		10.1	13	IN	11.85
					60.0 119.8	1.59	1	53.4 1.3	84	BL	
9S/14E-2ACC	42-40.46	114-46.79	THOUS SP 9/ 1/78	908	.0					IN	14.44
9S/14E-3ABB1	42-40.88	114-48.05	USGS 9/ 1/78	976	22.5 28.0	(1.38)		19.0	26	IN	14.15
9S/17E-19ABA1	42-38.20	114-30.45	USGS JCC 6/22/78	1091	45.0 52.0	(1.38)		1.3 .5	1	IN	13.61
9S/19E-25BBC1	42-36.98	114-11.27	USBR 7/10/78	1198	10.0 40.0	1.51	1	68.3 10.0	102	AB	
					40.0 47.5	(1.38)				IN	15.23
10S/21E-28BC	42-31.24	114- .40	USBR 7/28/77	1265	20.0 120.0	(1.55)		-8.7 2.3	-13	IN	13.80
10S/22E-20CD	42-32.04	113-54.34	USBR 7/27/77	1266	25.0 129.0	(1.55)		-7.1 1.0	-10	IN	13.50

The abbreviations in the aquifer status column (Aqu. Status) are AB, gradient above Snake River ~~Plain~~ aquifer; IN, gradient in Snake River ~~Plain~~ aquifer; BL, gradient below Snake River ~~Plain~~ aquifer. Aquifer temperatures (Aqu. Temp.) are the observed temperatures within the Snake River ~~Plain~~ aquifer. Blanks in a particular column signify that measurements were not made or calculated. Brackets around the thermal conductivity values signify that the value is from surrounding well or wells.

TABLE 3

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                              GEOTHERMAL DATA PRINTOUT       S.I. UNITS                    PAGE   5
----------------------------------------------------------------------------------------------------
                                     SOUTHEAST IDAHO B&R 5/26/87
----------------------------------------------------------------------------------------------------
WN/RNG  TECT  N LAT     W LONG     HOLE     COLLAR    DEPTH    AVG TCU   NO  UN GRAD   CO GRAD   CO H.F.   Q       LITHOLOGY
ECTION  PROV DEG MIN   DEG MIN    (DATE)     ELEV     RANGE      <SE>   TCU    <SE>      <SE>      <SE>    HF       SUMMARY
----------------------------------------------------------------------------------------------------
         BR  42- 0.75  113-12.30 STREVELL    1675       75.0     2.09           56.0      56.0      117     C
                                 10/17/75              220.0
```

TABLE 4. Summary of Deep Wells

Well Name	Location	Depth Meters	Symbol on Figure 28
Sturm-1	9N/43E-19	1210	S
Madison County	6N/40E-31bba2	1495	MC
INEL-GT1	3N/28E-1baa	3160	G
Anderson Camp	9S/18E-1dd	650	AC
Bostic 1-A	4S/8E-25cbb	2950	B
Federal 60-13-1	5S/1E-13cd	3385	F
Mt. Home AFB	4S/5E-27aab	1372	MH
James #1	4N/1W-27dd	4232	J
Christiansen A1	11N/3W-29bbb	2438	CH
Ore-Ida-1	18S/47E-3*	3050	O-I

*Oregon

TABLE 5. Average geothermal gradient and heat flow values for the various provinces.
areas

~~Province~~ Area	Geothermal Gradient °C/km	Heat Flow mWm^{-2}	Number
Northern Idaho batholith	22±1	65±3	23
Granite (14)	40±10		
Basalt (9)			
Southern Idaho batholith (Excluding SRP Margin and Geothermal Systems)	27±3	77±4	12
Wieser Area	56±5	79±7	19
Western Snake River Plain Camas Prairie + MT Bennett [illegible] ?	69+3	99±4	80
Owyhee ~~Plateau~~ Uplands	51±4	98±7	23
Eastern Snake River Plain*			
Northern Margin	55±9	93±13	23
Southern Margin	71±7	113±11	80
Above Snake River Aquifer	18±2	27±4	125

*Brott and others (1981)