HEAT FLOW AND SUBSURFACE TEMPERATURE DISTRIBUTIONS IN CENTRAL AND WESTERN NEW YORK

Final Report

Prepared for

NEW YORK STATE
ENERGY RESEARCH AND DEVELOPMENT AUTHORITY

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405-ET-AES-82

NYSERDA Report 84-8

January 1984

NOTICE

First Printing: January 1986

ABSTRACT

Initiation of a geothermal energy program in western and central New York requires knowledge of subsurface temperatures for targeting areas of potential resources. The temperature distribution in possible geothermal reservoirs, calculated from heat flow measurements and modeling techniques, shows that a large area of New York can be considered for exploitation of geothermal resources. Though the temperatures at currently accessible depths show the availability of only a low-temperature (less than 100°C), direct-use resource, this can be considered as an alternative for the future energy needs of New York State.

From analysis of bottom-hole-temperature data and direct heat flow measurements, estimates of temperatures in the Cambrian Sandstones provide the basis of the economic evaluation of the reservoir. This reservoir contains the extractable fluids needed for targeting a potential geothermal well site in the low-temperature geothermal target zone. In the northern section of the Appalachian basin, reservoir temperatures in the Cambrian are below 50°C but may be over 80°C in the deeper parts of the basin in southern New York State. Using a minimum of 50°C as a useful reservoir temperature, temperatures in excess of this value are encountered in the Theresa Formation at depths in excess of 1300 meters. Considering a maximum depth for economical drilling to be 2500 meters with present technology, the 2500 meters to the Theresa (sea level datum) forms the lower limit of the geothermal resource. Temperatures in the range of 70°C to 80°C are predicted for the southern portion of New York State.

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SUMMARY

Low-temperature geothermal resources, defined to be usable concentrations of geothermal energy with a temperature less than 100°C, are becoming increasingly attractive as conventional energy supplies become scarcer and more costly. Although New York has areas of abundant gas and minor oil resources, energy needs of the future demand the development of alternative energy sources. Geothermal data indicate the possibility of direct-use geothermal resources in the sedimentary basins of central and western New York.

The geology of western and central New York, located in the northern portion of the Appalachian Basin, consists of Cambrian through Devonian sedimentary units which unconformably overlie the crystalline Precambrian basement. Regional geologic structure is simple; the units dip to the south approximately 10 m/km in the north increasing to 20 m/km in the south of New York. Overall, stratigraphic thickness also increases from about 900 meters in the north to 3400 meters in the south as a result of erosion of overlying strata in the north and a general thickening of individual stratigraphic units toward the south. It can be expected that the primary geothermal targets will be at the base of the sedimentary sequence in the Cambrian formations.

Heat flow studies in New York by Birch et al. (1968) showed measured values ranging from 33 to 50 mW/m^2 in eastern New York and the Adirondacks. Urban (1970 reported a heat flow value of 63 mW/m^2 near Balmat, New York and values of 63 and 80 mW/m^2 in the Finger Lakes region with estimated values ranging from 50 to 54 mW/m^2 in western New York.Hodge et al. (1979, 1980, 1981) identified areas of higher-than-normal temperature gradients in western, near East Aurora, and central New York, near Auburn, using bottom-hole temperatures recorded during logging operations of gas wells.

Changes in geothermal gradients observed in detailed temperature logs indicate that vertical thermal conductivity changes must be considered if heat flow and temperature-at-depth estimates in the region of central and western New York are to be made. The measurement of conductivity of rock samples from wells in several locations supports this conclusion. In order to obtain temperatures at depth maps, the horizontal extent of these vertical conductivity changes were considered; the change of conductivity was based on the observation that gradient changes correlate with lithology changes encountered in the stratigraphic section. Average geothermal gradients were obtained from mean annual surface temperature and bottom-hole temperatures, and in conjunction with the thermal conductivity variation for the region, the resulting distribution of heat flow indicates that central and western New York is an area of generally uniform heat flow (40 to 50 mW/m^2) with a distinct increase in the north-central part of this area. This anomaly, which centers near Auburn, reaches a maximum amplitude of approximately 90 mW/m^2.

Estimates of the reliability of predicted subsurface temperature from our maps are evaluated from the comparison of temperatures extrapolated from shallow BHT readings to deep temperature measurements in areas where both are available. An accuracy of ±5° is indicated by these comparisons. Where only shallow temperatures are available, and in areas of sparse BHT data, the accuracy of the predicted temperature

at deeper levels is dependent on the sample accuracy and distribution of the available data. The formulation of a conductivity model for central and western New York is the only means to extrapolate average geothermal gradients. Investigations show that the BHT data must be corrected for possible disturbances (e.g., drilling gas expulsion, water circulation). Application of a unique correction for drilling disturbances at each borehole cannot be made for the available bottom-hole temperatures. The variability of the drilling and logging conditions of the wells prevents this. An empirical relationship was used to estimate the undisturbed BHT at each borehole.

Calculations from the basal Cambrian sandstone, the primary geothermal target, indicate that a significant area of potential low-temperature geothermal energy exists. Using the limit of a minimum 50°C temperature, the minus 1300 meter depth to Theresa (sea level datum) generally defines the northern extent of the area. Considering a maximum depth for economical drilling to be 3000 meters with present technology, the minus 2500 meter depth to the Theresa (sea level datum) form the boundary to the south. Temperatures in the range of 70 to 80°C are predicted for the southern portion of the area. The presence of extractable fluids is an important consideration in targeting a potential geothermal site.

SECTION 1

INTRODUCTION

Low-temperature geothermal resources, defined to be usable concentrations of geothermal energy with a temperature less than 100°C (Reed and Sorey, 1982), are becoming increasingly attractive as conventional energy supplies become scarcer and more costly. Although New York has areas of abundant gas and minor oil resources, energy needs of the future demand the development of alternative energy sources. Low-temperature geothermal energy is one possibility for augmenting the energy resources of New York State.

Geothermal energy is typically associated with areas where the increase of temperature with depth is greater than normal. This is usually the result of localized increases in conductive heat flow from recent near-surface magmatic activity or the upward transfer of heat by water along dipping rock units or along fracture zones. The presence of granitic plutons containing radiogenic elements in crystalline basement covered by low thermal conductivity sedimentary rock also causes above-average temperature gradients. It is also possible for near-average temperature gradients in deep sedimentary basins to achieve sufficient temperatures for potential geothermal resources. Naturally occurring or injected water in permeable sedimentary rock layers provides a medium to transfer thermal energy at depth to the surface where it may either be converted to electricity (if the temperature is high enough) or used directly in space heating and agricultural or industrial processing.

Existing data in western and central New York indicates the possibility of a low-temperature, direct-use geothermal resource. Direct-use applications generally require a minimum temperature of 45°C (Tillman, 1980); presently the federal government provides incentives for developing geothermal resources which are 50°C or greater at the well-head. Therefore, the evaluation of a potential low-temperature resource area requires the consideration of temperatures which can be expected at depth as well as the presence of extractable geothermally heated fluids. The purpose of this report is to evaluate the heat flow and provide a representation of temperatures at depth in this area. This has been done by: (1) analyzing known temperature distributions, and (2) measuring the thermal conductivity of sedimentary rock units. Based on this information, areas of higher-than-normal heat flow and temperatures in possible geothermal source reservoirs are described to aid in targeting areas for the exploitation of geothermal energy in New York.

SECTION 2

GEOLOGIC SETTING - GEOTHERMAL ENERGY IN A SEDIMENTARY BASIN

The basic geology of western and central New York, located in the northern portion of the Appalachian Basin (Figure 2-1), consists of Cambrian through Devonian sedimentary units which unconformably overlie crystalline Precambrian basement. Regional geologic structure is fairly simple (Figure 2-2); the units dip to the south approximately 10 m/km in the north increasing to 20 m/km in the south of New York. Overall, stratigraphic thickness also increases from about 900 meters in the north to 3400 meters in the south as the result of erosion of overlying strata in the north and a general thickening of individual stratigraphic units toward the south.

It can be expected that the primary geothermal targets will be at the base of the sedimentary sequence; indications of small-scale hydrothermal convection are limited. These targets are primarily the lower Cambrian units, though, if connate waters are found, there is potential geothermal reservoirs from the Precambrian through the Middle Ordovician Trenton Group (especially to the south).

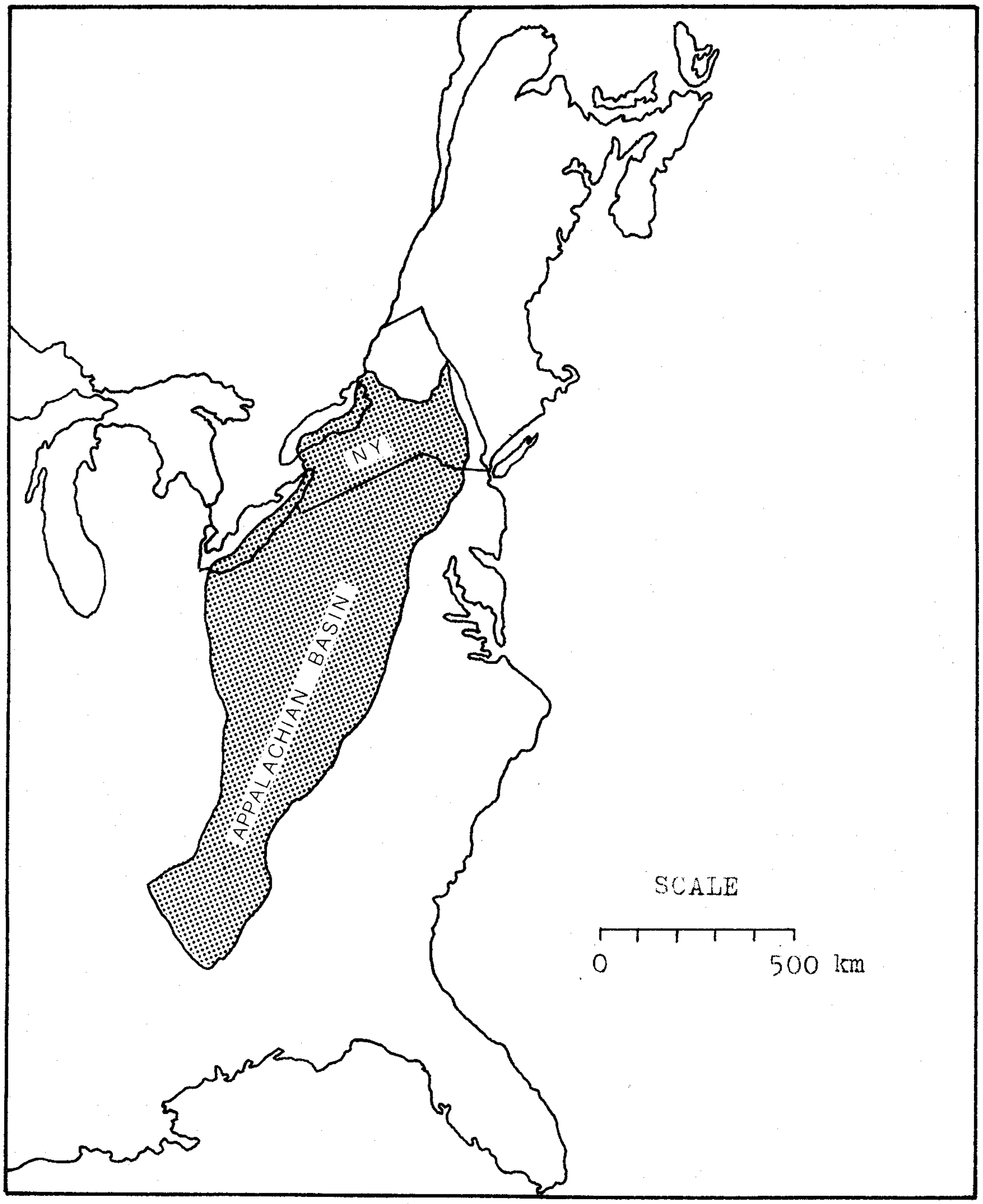


Figure 2-1 - Map of eastern North America showing the position of N.Y. in the Appalachian Basin in the eastern United States (after Colton, 1970).

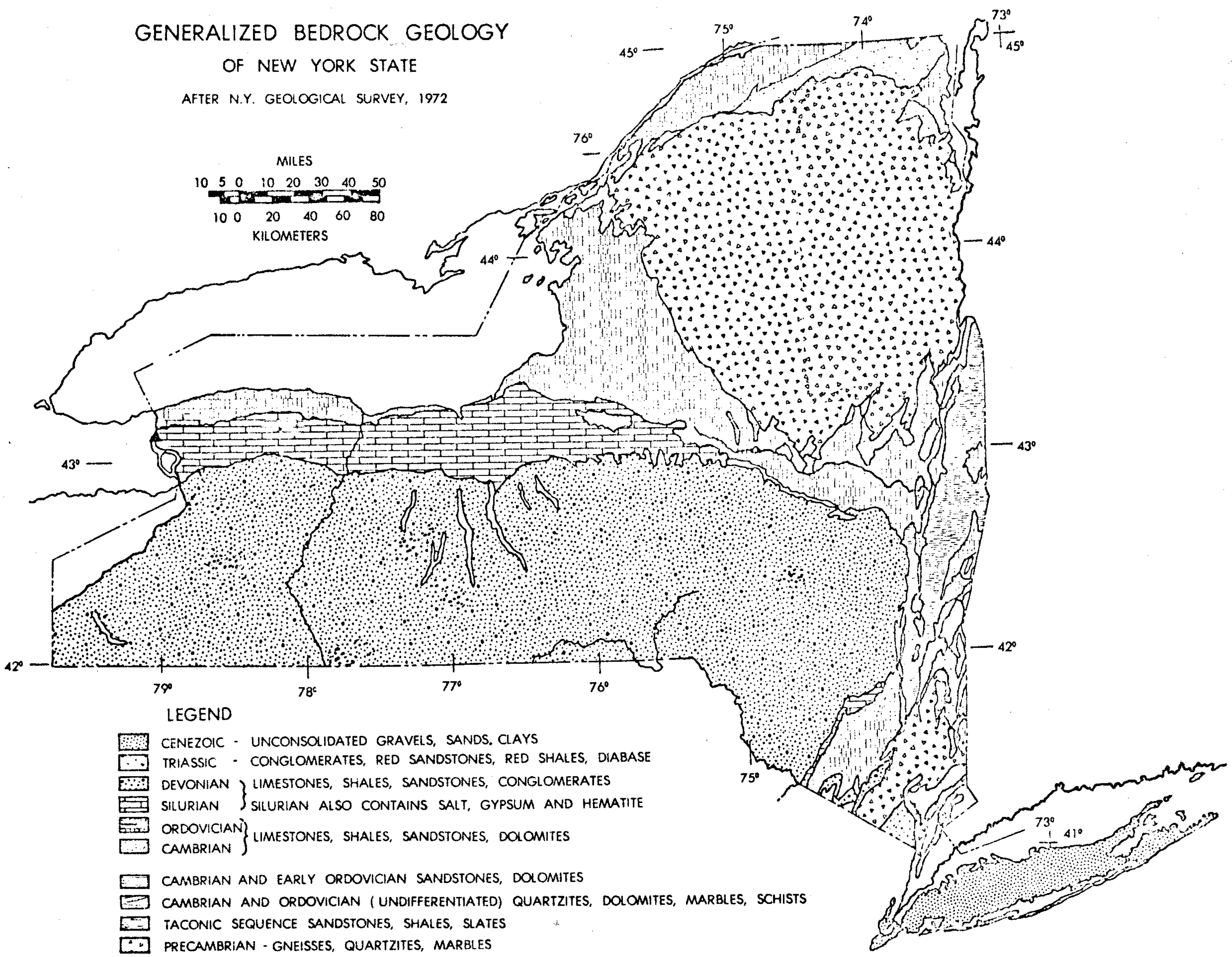


Figure 2-2 - General geologic map of New York.

The lowest unit in the Cambrian stratigraphic sequence is the Potsdam Formation which consists mainly of sandstone. Though the geologic boundary is not clearly defined, the Theresa (Galway) Formation overlies the Potsdam; there is a gradational increase of quartzosic dolostones to dolostones from the basal sandstones. The Theresa is of particular interest for the development of geothermal energy in New York as it is found at considerable depth which generally assures the temperatures required for direct-use applications. Connate water is reported in many of the wells which have penetrated the Theresa (Kreidler, 1975) and could provide the heat transport medium when adequate flow rates exist. Above the Theresa is the Little Falls Formation composed primarily of dolostones which are of late Cambrian to early Ordovician age.

Overlying the Little Falls Formation, except to the north and west, is the Beekmantown Group which consists of Lower Ordovician quartzosic dolostones, dolostones, and dolomitic limestones (Rickard, 1973). The top of the Beekmantown is eroded throughout the area (i.e., the Knox Unconformity) and is overlain by Black River or Trenton Group carbonates. The Black River Group, which overlies the Little Falls Formation to the north and west, is mostly dolostones with some sandstone and shales at its base. Limestones are the predominant lithology toward the top (Rickard, 1973). The Trenton Group is primarily limestone which thins toward the east and changes facies to calcareous shales, overlying shales and sandstones which are often included in the Trenton Group (Rickard, 1973).

There is little potential for geothermal reservoirs above the Trenton in western and central New York. The low permeability of the predominantly shale units of the Upper Ordovician (i.e., Lorraine and Queenston Formation) precludes their utility as reservoirs. The limestones and sandstones which occur in the Lower Silurian would possibly have high enough temperatures in the south of the area, but there is little evidence to indicate the presence of connate water in extractable quantities. The Upper Silurian and Devonian sequences should be rejected as geothermal targets unless a convective system is found.

The exploitation of low-temperature geothermal energy in sedimentary basins with normal temperature gradients has been shown to be economically feasible in several areas of the world. Perhaps the best example is in France where there has been development of geothermal resources in the Paris Basin. Five levels within the Paris basin have been found to be useful geothermal reservoirs. Water at temperatures from 30° to 50°C is extracted for heating purposes from two levels of Lower Cretaceous sandstones approximately 800 to 900 meters deep. Upper Jurassic limestones and sandstones at about 1200 meters provide water temperatures greater than 60°C and Middle Jurassic limestones at 1800 meters with water temperatures greater than 80°C are also extensively exploited. The deepest level consisting of Triassic sandstones with water temperatures above 100°C at about 2200 meters depth is used to a lesser extent (Lejune and Varet, 1981).

The Appalachian Basin in New York can be compared to the Paris Basin in a general way. It will be shown that the higher gradient areas in New York are in the low to intermediate range of gradients, 20° to 50°C/km, found in the Paris Basin. Information on flow rates of formation fluids in New York is scarce, but recent pump tests at the New York State Energy Research and Development Authority (NYSERDA) geothermal test well in Auburn, New York, produced a sustained flow of 100 to 150 gallons per minute (gpm). Spinner logs indicated that one-tenth of this water was from the Black River Formation and the remainder was from the Theresa and Potsdam (Burton Krakow, personal communication). Flow rates obtained in the Paris Basin, ranging from 220 to 1100 gpm, are greater than those that can be expected in New York, but the flow rates obtained at Auburn are sufficient for geothermal purposes. Enhancement of reservoir permeability by hydrofracturing or acidification could possibly produce flow comparable to the lower French values.

SECTION 3

PREVIOUS HEAT FLOW STUDIES

The work of Birch et al. (1968) and Lachenbruch and Sass (1977) has established that the eastern United States is a region of lower heat flow compared to the western United States. Birch et al. (1968) found a linear relation between heat production and heat flow and showed that there are heat flow provinces with distinctly different heat flow from deep sources, and the depth of significant heat production also varies. In the general sense, local variation in heat flow is interpreted to be the result of different heat production within the upper crust (Birch et al., 1968). Using this empirical linear relation, Birch et al. found that the heat flow from deep sources was 33 mW/M for the Eastern United States.

Several studies have reported heat flow values in New York. Birch et al. (1968) gave measured values ranging from 33 to 50 mW/m^2 in eastern New York and the Adirondacks (Figure 3-1). Urban (1970) reported a heat flow value of 63 mW/m^2 near Balmat, New York and values of 67 and 80 mW/m^2 in the Finger Lakes region. He also estimated values ranging from 50 to 54 mW/m^2 in western New York (Figure

3-1).

Hodge et al. (1979, 1980, 1981) identified areas of higher-than-normal temperature gradients in western and central New York using bottom-hole temperatures recorded during logging operations of gas wells (Figure 3-2). Apparent correlations of thermal conductivity with lithologic stratigraphy were used to model thermal conductivity distributions in the area, and then with calculated temperature gradients a heat flow map (Hilfiker, 1981) was produced.

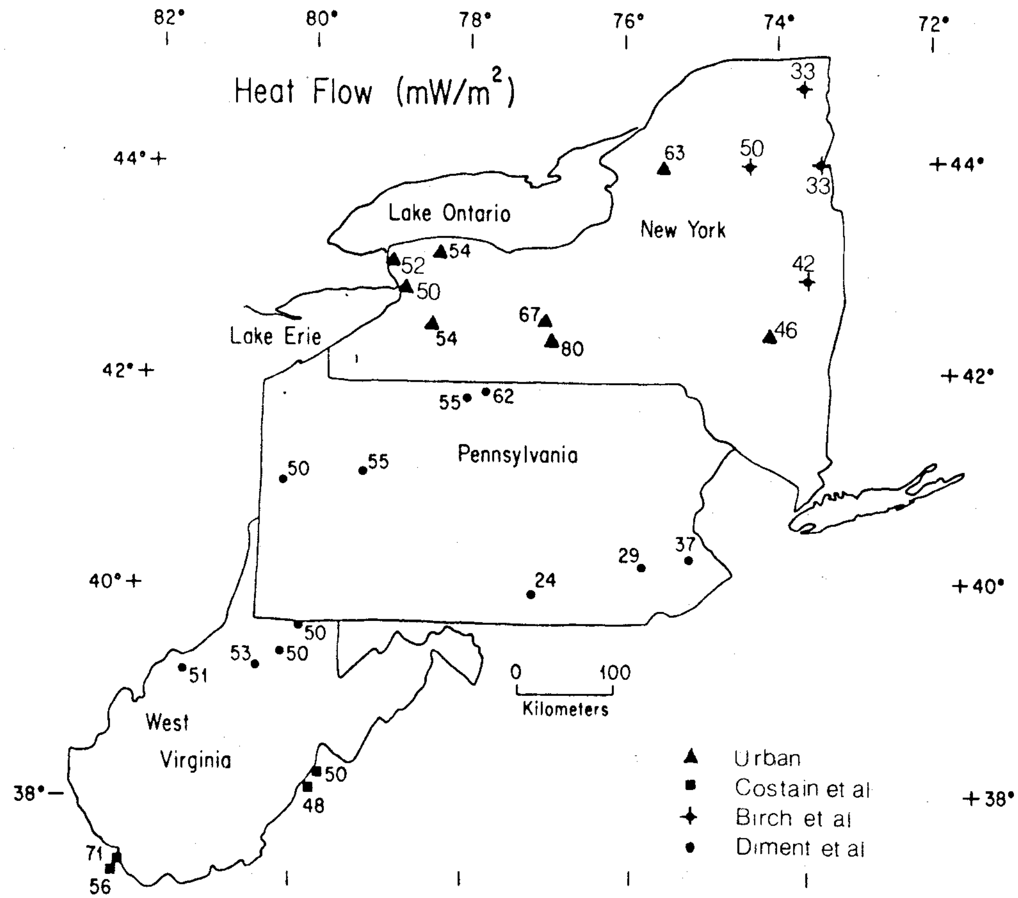


Figure 3-1 - Heat flow values (mW/m^2).

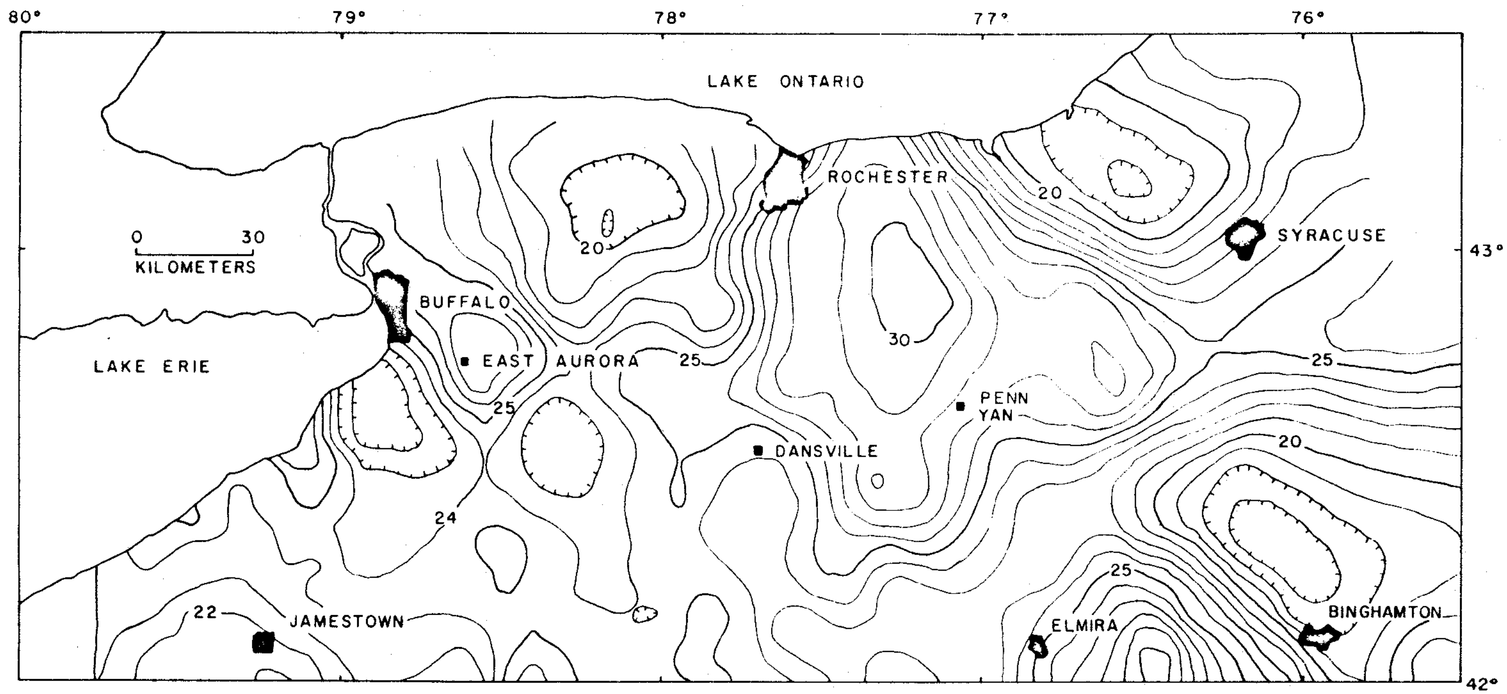


Figure 3-2 - Contoured temperature gradients (°C/km) for wells greater than 500 meters deep assuming no drilling disturbance correction (from Hodge et al, 1981).

SECTION 4

CONDUCTIVE HEAT FLOW - GENERAL THEORY

Heat flow at the earth's surface can be calculated using the equation for the steady-state flow of heat in one-dimension in a thermally conducting, isotropic body. The heat flow equation is

$$Q = K\,(\partial T/\partial z) \qquad (4\text{-}1)$$

where Q is the heat flux in units of mW/m^2, K is the thermal conductivity in units of $W/m^{o}C$, and $\partial T/\partial z$ is the thermal gradient where z is distance measured vertically downward and T is temperature in units of $^{o}C/km$ (Jaeger, 1965). It is assumed that there are no internal sources of heat (e.g., radioactive elements or chemical reactions) and therefore the heat flow is constant over the measured interval. If the rocks composing the outer layers of the earth were of a constant conductivity, then heat flow could be calculated simply by measuring the temperature at any two depths and the thermal conductivity of the rock. This simplification is usually not the case.

If the average geothermal gradient (G) is measured using the temperature obtained at two depth, and this gradient is taken in an area of horizontally layered rocks, the heat flow can then be calculated if the K of each layer is known. Consider the case where there are n discrete layers of conductivity $K_1, \ldots, K_n$ and thickness $t_1, \ldots, t_n$. Then a weighted mean harmonic conductivity (K_{mh}) of the layered section is given by

$$K_{mh} = (t_1 + \ldots + t_n)\left(\frac{t_1}{K_1} + \cdots + \frac{t_n}{K_n}\right)^{-1} \qquad (4\text{-}2)$$

(Jaeger, 1965), and the heat flow is calculated by

$$Q = K_{mh}\, G \qquad (4\text{-}3)$$

When continuous measurements of temperature at depth are available over the section containing these layers, the gradient in each layer should be linear (i.e., $\partial T/\partial z$ is constant) and the heat flow calculated from successive layers should be constant. The ratio of one measured layer gradient to another will be inversely proportional to the ratio of their respective thermal conductivities, as required by the assumption of steady-state heat flow.

SECTION 5

HEAT FLOW DETERMINATIONS

Temperature logs and conductivity samples for several boreholes (Figure 5-1) in the study area were available for the calculation of heat flow. Two of these boreholes were gas wells in which equilibrium temperatures were measured using a hand-operated portable temperature probe consisting of a linearly responding thermistor and 300 meters of coaxial cable in combination with a digital multimeter.

Wells of this type are typically drilled using air percussion drills for most of their length. This drilling disturbs the actual temperatures by the circulation of air and formation fluid from different levels which is not at the same temperature as the rock. These wells are then often cased, plugged at the bottom, and may be left standing for a period of time before they are completed. During this time equilibrium temperatures are reestablished; logging of these wells was done at least three days after drilling and cementing of the casing took place.

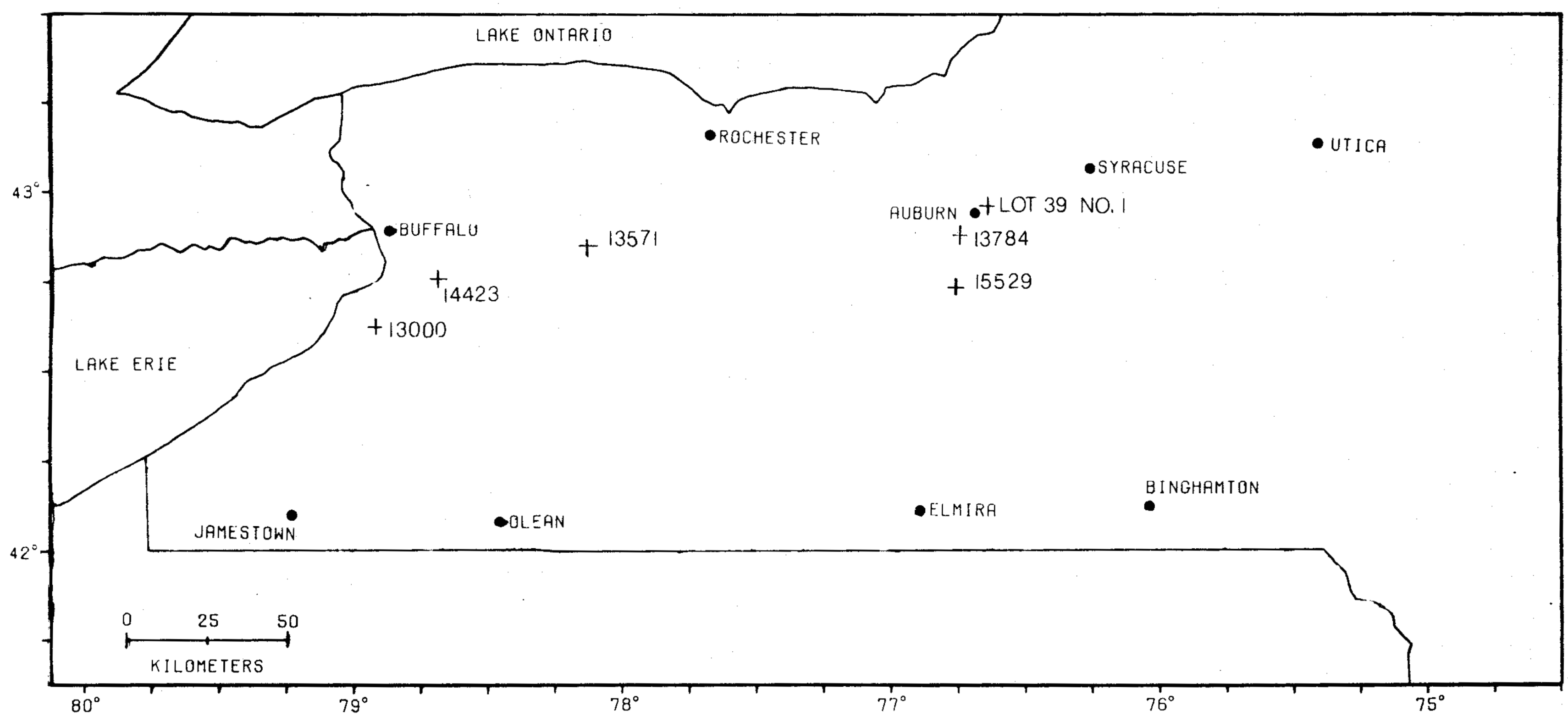


Figure 5-1 - Location of wells used for heat flow determination and temperature at depth analysis.

Another borehole used was the geothermal test well in Auburn, New York which was drilled in February 1982. An industrial temperature log was taken soon after drilling operations ceased. The utility of this log is highly questionable. Formation fluids with a very high salinity were circulated from a holding pond in which they were accumulated. The surface temperature during the drilling was well below $0^{o}C$ and the circulated brines were below $0^{o}C$ also. This has created noticeable disturbances in the temperature log. Repeated attempts to log this hole several months after drilling with the hand-operated probe (with 600 meters of cable) were foiled by equipment failure, though there are indications that these logs may be of some use. A detailed equilibrium log was finally completed to a depth of 2000 feet.

Thermal conductivity of rock chips collected during drilling operations was measured using a needle probe apparatus constructed at State University of New York at Buffalo from specifications provided by V. Vacquier (personal communication). The details of the apparatus and the measuring technique are described in Appendix B. Geophysical logs were available for porosity estimation to correct the bulk rock conductivity measured to the actual in situ conductivities.

WELL #13571 - (WINSPEAR #1)

The Winspear #1 well is located in the Middlebury Township in Wyoming County, New York, (8375' south of 42° 52' 30" latitude and 3330' west of 78° 05' 00" longitude). The temperature-depth data (Table C-1) plotted in Figure 5-2 shows a distinct change in gradient at a depth of 232.5 m. This corresponds to the change in lithology from the shales of the Middle Devonian Hamilton Group to the Middle to Lower Devonian Onondaga Limestone. Below this depth, the least squares gradient is 15.3°C/km which contrasts sharply with the gradient of 31.2°C/km over 130.6 - 232.5 m and 24.9°C/km over 86.0 - 130.6 m. Thermal conductivity measurement (Table C-2) in smaller intervals selected on the basis of uniformity of lithology show a definite inverse relation to gamma-ray activity and gradient; low conductivity sedimentary rocks, typically shales, display high gamma-ray activity (an indicator of relative shaleness) and relatively high gradients (Figure 5-3). The values for the gradients, mean harmonic conductivity (K_{mh}), and calculated heat flow (Table C-3) in the major intervals are shown in Figure 5-4. The K_{mh} for the deepest interval is 2.7 W/m°C; and the calculated heat flow is 41.3 mW/m^2. The shale interval directly overlying the Onondaga has a K_{mh} of 1.49 W/m°C and a heat flow value of 46.4 mW/m^2. In the shallowest interval, K_{mh} is 1.84 W/m°C and the heat flow is 45.7 mW/m^2. It would seem that the contradiction between the similar heat flow values obtained in the shale units and the lower limestone value indicated an error in measurement of either the gradient or conductivity (or both) in the limestone. If this is not true, then the heat flow could be different due to the presence of heat producing elements or fluid motions. When the heat flow value obtained in the deep interval is used in conjunction with the measured conductivities of the predominantly limestone sequence below to project temperatures (Table C-2 and Figure 5-5), the

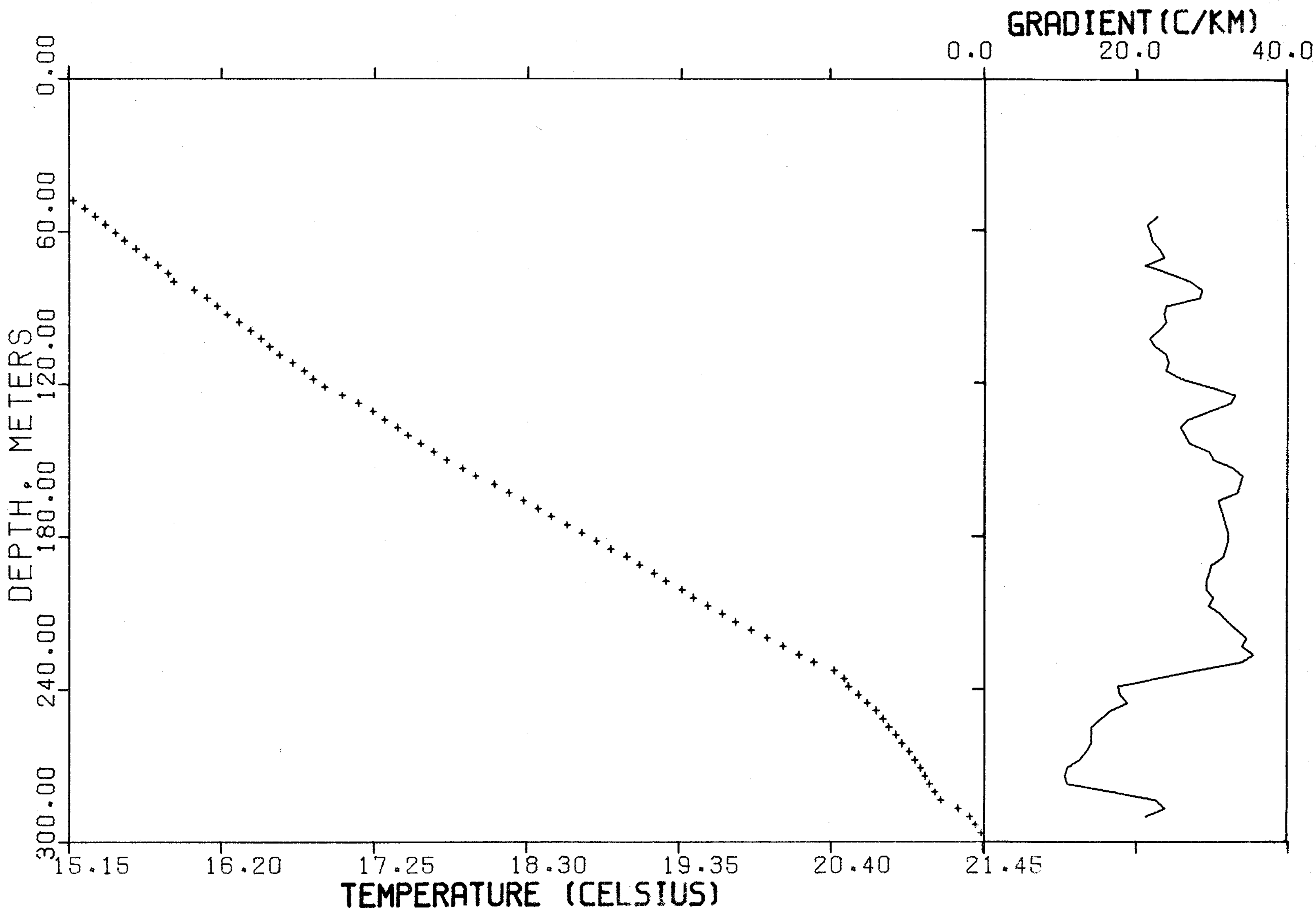


Figure 5-2 - Temperature versus depth and gradients (calculated by least squares regression over 12.5 meter running average intervals) for well #13571.

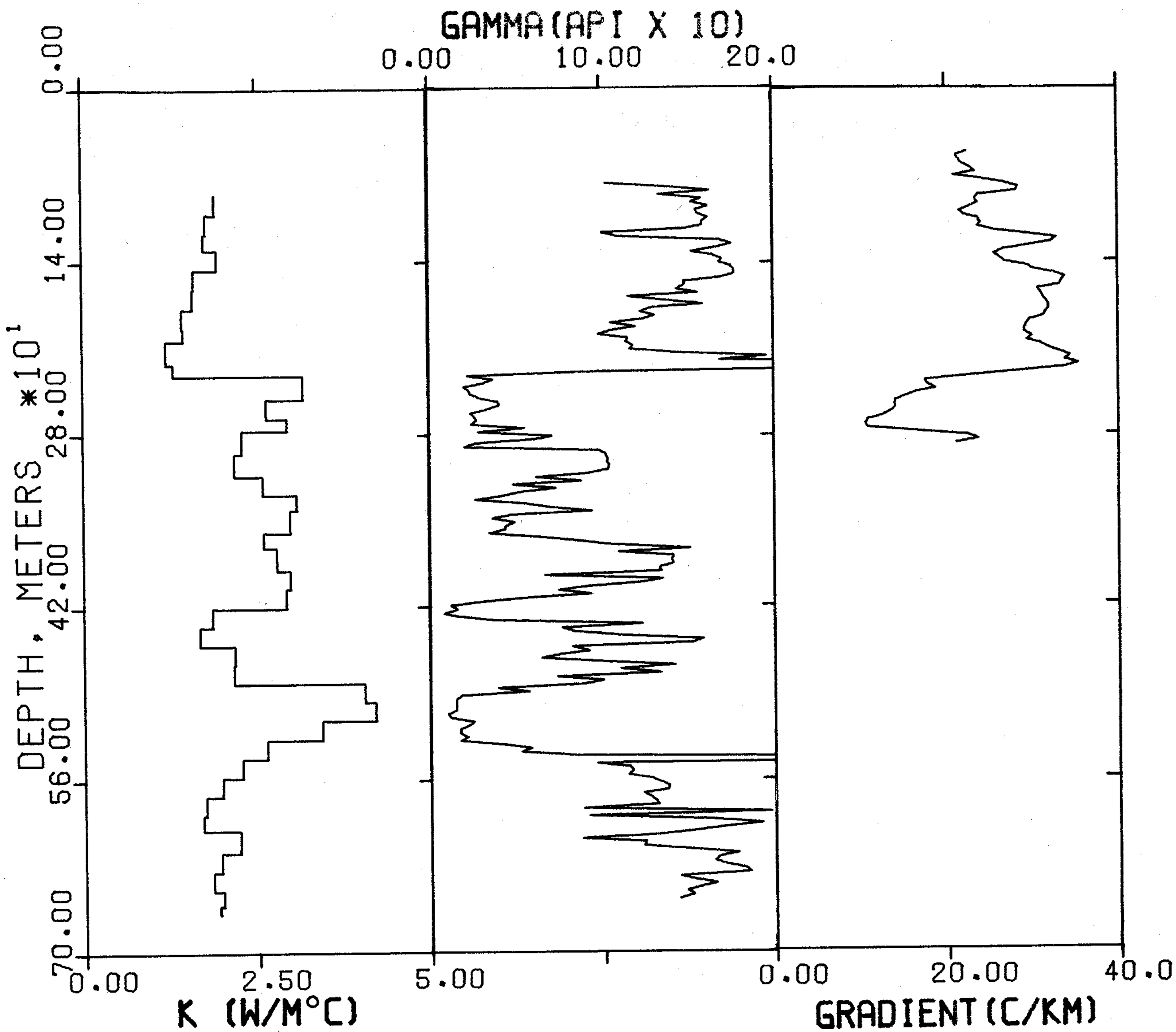


Figure 5-3 - Comparison of thermal conductivity, gamma-ray activity, and temperature gradients for well #13571. Gamma-ray data is from a well log digitized at 3.05 m intervals smoothed by 5 point averages. Gradient values are 12.5 m running average intervals.

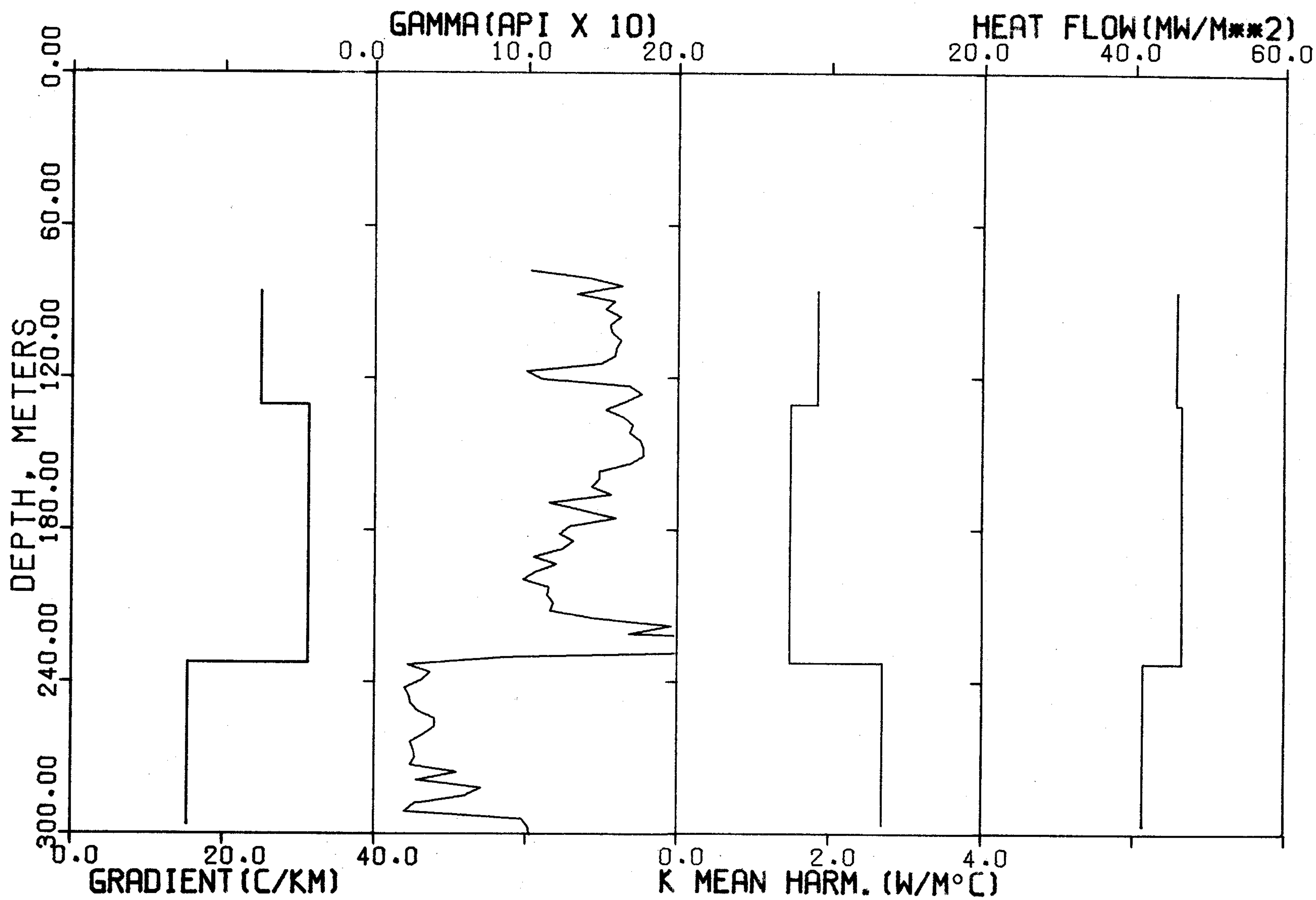


Figure 5-4 Comparison of interval gradients, gamma-ray activity, mean harmonic conductivity, and heat flow for well #13571. Gamma-ray data calculated as in Figure 5-3. Gradients calculated by least squares regression over the entire interval.

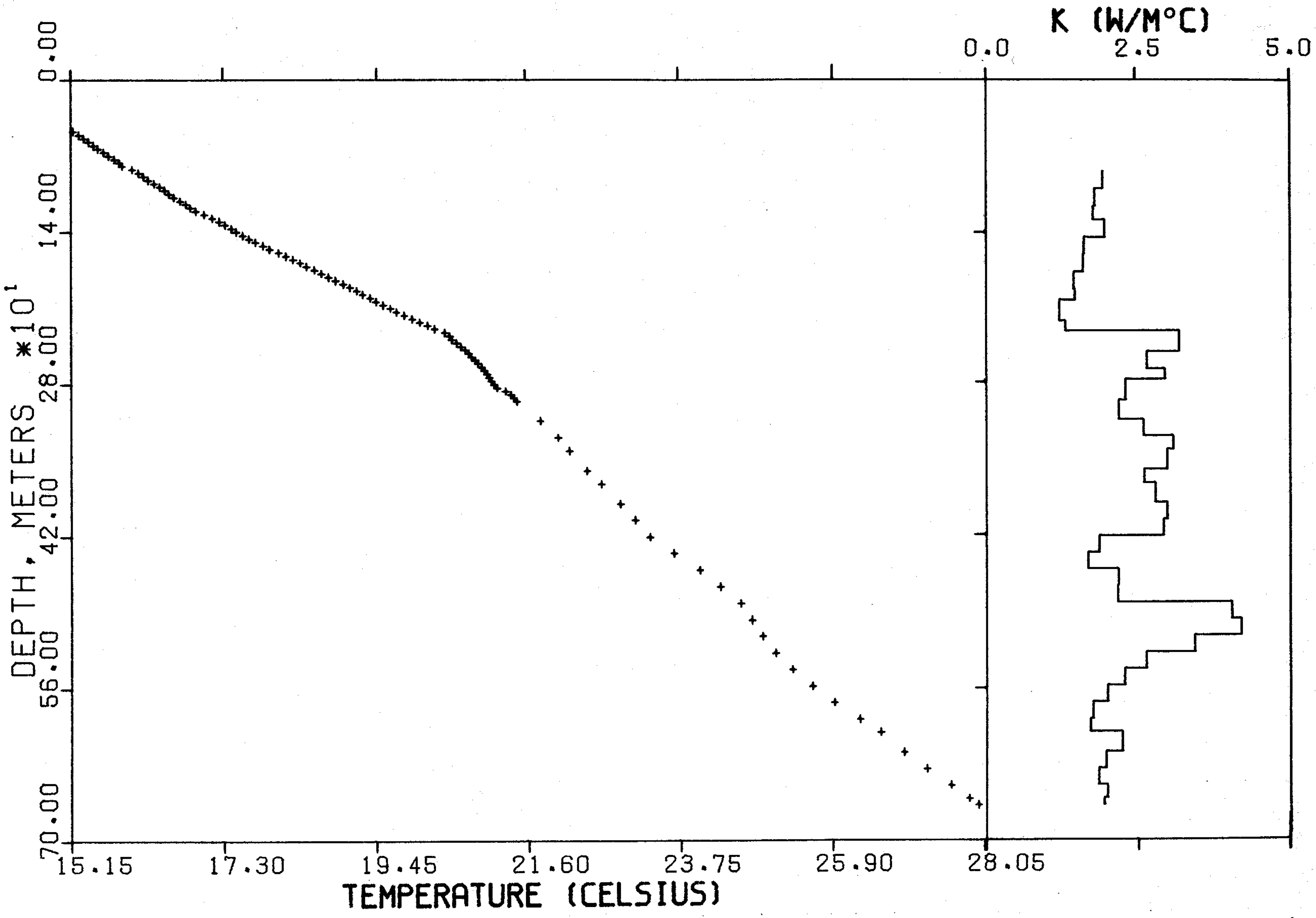


Figure 5-5 Temperature versus depth data and temperature-depth projected values (below 296.2 meters) with measured conductivities for well #13571. Projected temperatures based on 41.3 mW/m² heat flow.

deepest values obtained correlate very well with observed bottom-hole temperatures in this area (Figure 5-6). Unfortunately the interval of projected temperatures is not very great and using the shale heat flow value only elevates the final projected temperature by 0.75°C. Therefore, it is impossible to determine by this extrapolation whether the heat flow value in the Onondaga is accurate.

A consideration that must be made is the chip technique of thermal conductivity measurement. Blackwell and Steele (1981) report that conductivities of shales measured by this technique are likely to be too high because of the anisotropic conduction of heat in the predominantly clay minerals which constitute the shale. In the measuring cell, the random orientation of the shale chips allows for conduction along both high and low conductivity directions; the measured conductivity is then intermediate to these extremes. Although their results (using a divided-bar apparatus) show much greater differences in the heat flow measured in the shales compared to that in the carbonate sections, the calcareous nature of the Hamilton shales may cause this effect to be less noticeable than in the purer shales they measured (D. Blackwell, personal communication). Therefore, 41.3 mW/m^2 has been chosen as the best value for heat flow measured at this site.

WELL #15529 - (WELLS COLLEGE #1)

Wells College #1 is located in Ledyard in Cayuga County, New York (12000' north of 42° 42' 30" latitude and 19500' west of 76° 37' 30" longitude).
Temperature-depth data for this well (Figure 5-7 and Table C-4) was obtained using the hand-operated temperature probe to 302.6 m; deeper measurements are from a

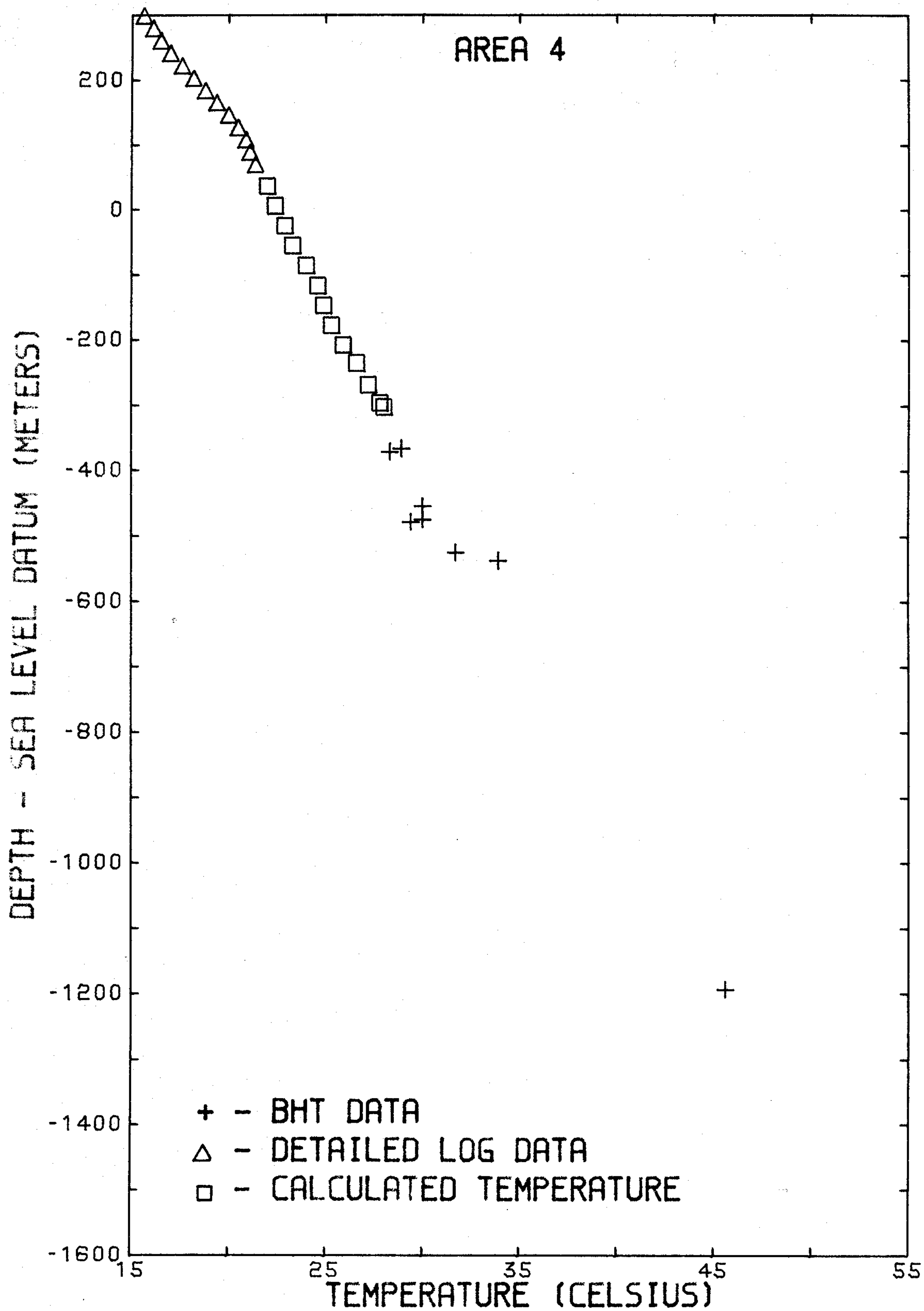


Figure 5-6 - Plot of bottom-hole temperatures versus depth and temperature-depth data and calculations for well #13571 (see Figure 7-9 for area location and extent).

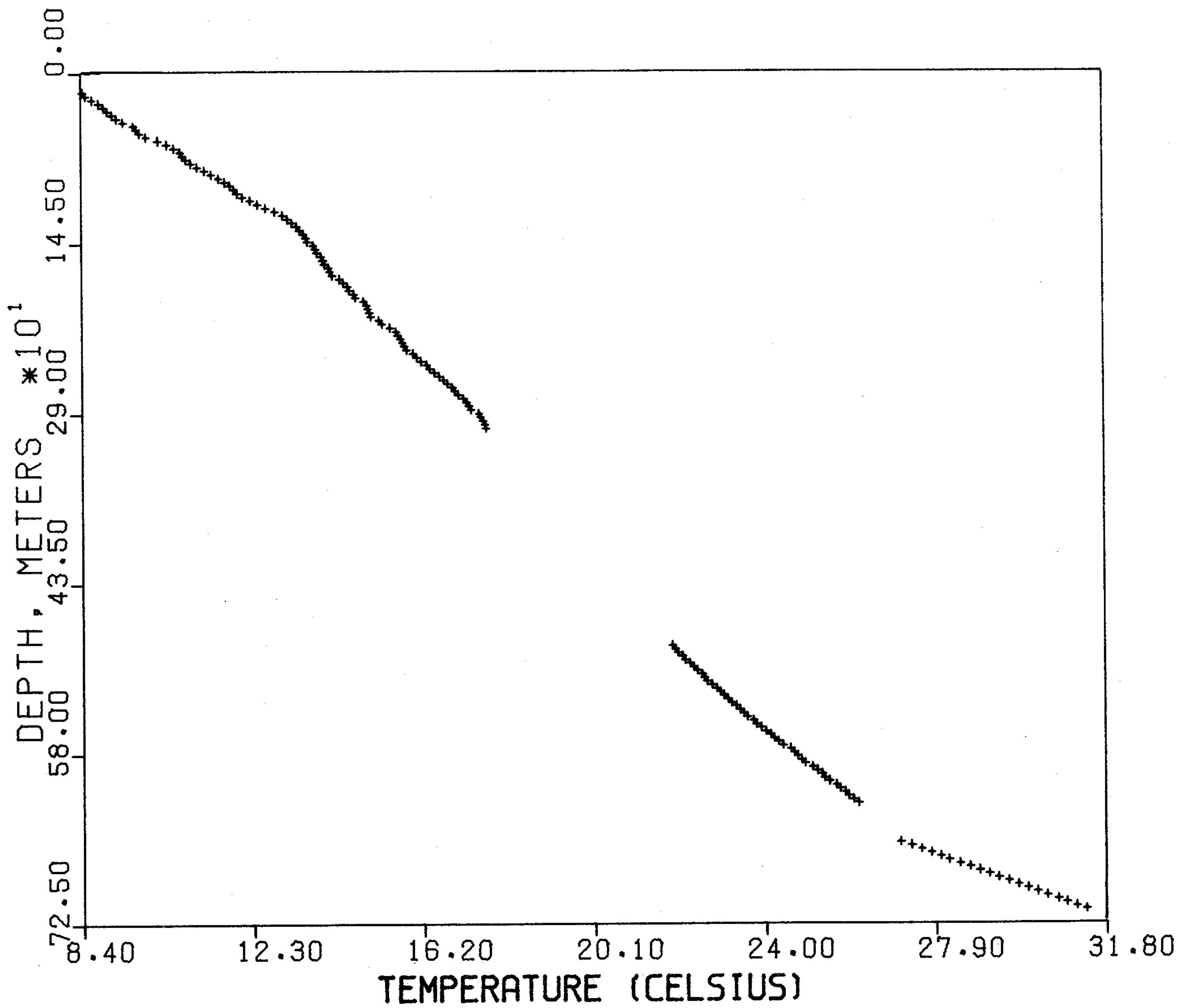


Figure 5-7 - Temperature versus depth for well #15529.

digitized industrial temperature log. The change in gradient at 130 m from 43.8°C/km in the overlying Hamilton Group shales to 26.4°C/km in the Onondaga Limestone Helderberg Group limestones and dolostones, is distinctive of this lithologic change. Since the conductivity of shales tends to be overestimated by the chip technique, only samples below the Onondaga top (limestone and dolostones) were measured (Table C-5). The K_{mh} determined for the interval from 130.6 to 302.6 meters is 2.42 W/m°C. The heat flow determined for this site is then 63.8 mW/m^2 (Table C-6). This is significantly greater than the heat flow determined at the Winspear #1 well. Though the conductivity of the limestones is somewhat lower here, the much higher gradients (approximately 10°C/km greater) are indicative of higher than normal heat flow for this area.

AUBURN LOT 39 #1

The Auburn well was drilled as a geothermal test well by NYSERDA, in cooperation with the DOE, in the town of Auburn in Cayuga County, New York (4950 ft. south of 42°57' 30" latitude and 800 ft. west of 76°32' 30" longitude). The temperature data was digitized from the industrial log (Table C-7) that was measured approximately 12 hours after drilling ceased (Figure 5-8). Disturbances in the gradient are present above 425 m and below 1200 m. The shallower disturbances are probably due to the circulation of groundwater in addition to temperature effects due to drilling while the deeper disturbances are likely due to circulation of the cold fluids from the holding pond. Negative gradients encountered toward the bottom of the profile are identified by the USGS from a borehole televiewer log as sections of high fracture density. The gradients may

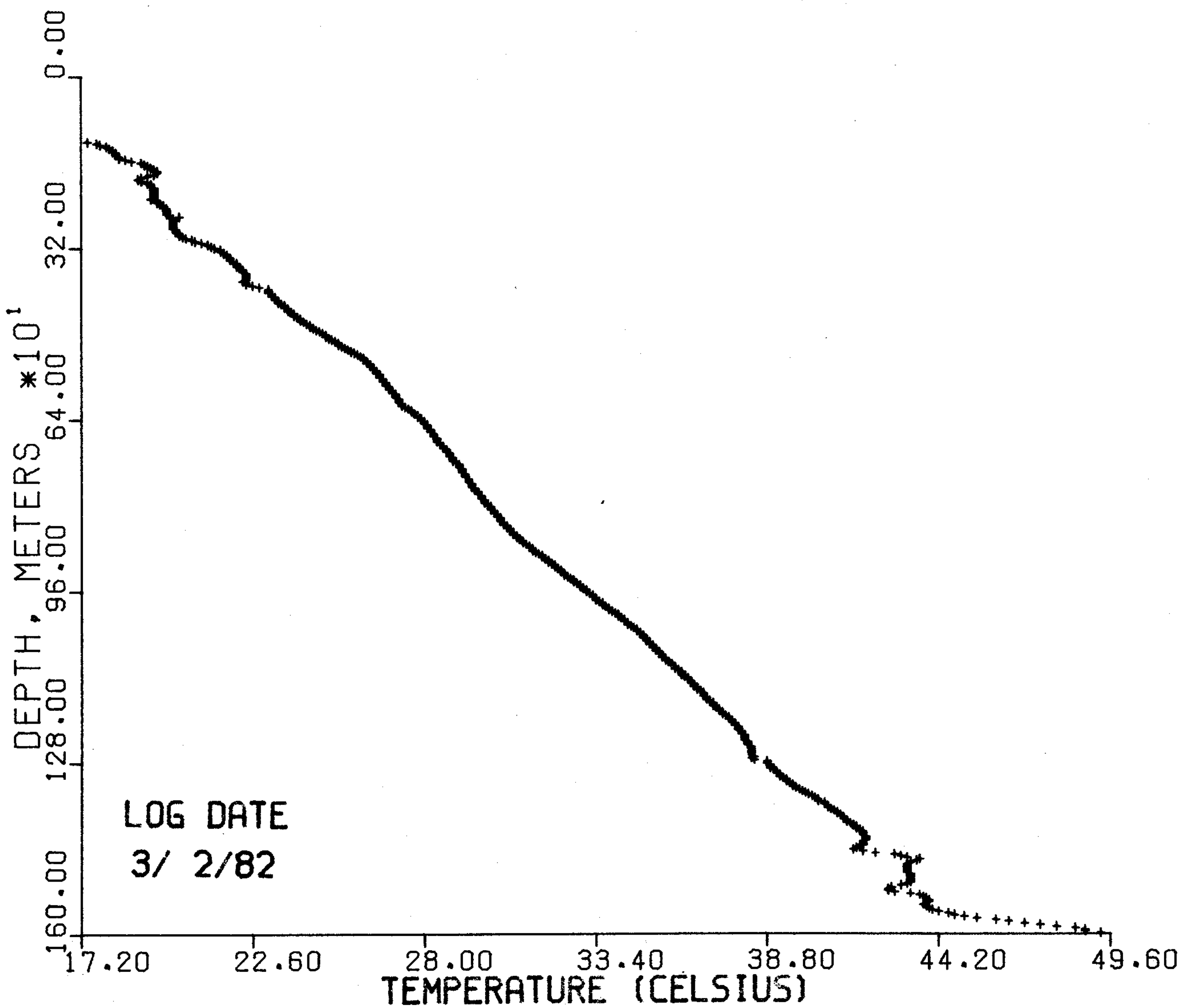


Figure 5-8 - Temperature versus depth for Auburn Lot 39 #1 geothermal test well (data digitized from industrial log at 3.05 m intervals).

be due to extensive drilling fluid invasion as well as cooling effects due to expanding gas (gas flow in the well is minor).

Since the recording of the industrial log, three separate temperature logs were recorded using a portable temperature probe which was eased to 650 meters in the hole. The temperature was measured on May 21, 1982, a second on May 30, 1982, and a third on May 13, 1983. Equipment problems were encountered during the first two logging sessions and are manifested in the abbreviated first log (Table C-8) and by data gaps in the second log (Table C-9). Temperature versus depth plots for these two logs appear in figure 5-9. Gas pressure buildup was also a problem during these first two logging runs with two to three minutes of flow after the initial opening of the valve and up to eight hours of slow bubbling afterwards. The well was allowed to stand open five hours and three hours, respectively, before the temperature logs were performed. Gas buildup was also apparent during the logging session of May 13, 1983.

Temperature versus depth plots resulting from all three of the individual logs are shown in Figure 5-10. A comparison of the plots indicates that temperatures on the industrial log were elevated twelve hours after drilling ceased and above a depth of about 500 meters. Above a depth of 300 meters, temperatures in this log are disturbed for reasons previously mentioned. Disturbances are apparent in the other logs, however, they occur much higher in the section. Below a depth of 400 meters, gradients appear to stabilize on all the logs reaching that depth. Plots of the logs from May 30, 1982, and May 13, 1983, appear to have similar gradients below 400 meters while lesser temperature gradients are indicated by the industrial log for the same zone. It is this zone (400 to 600 meters) that is

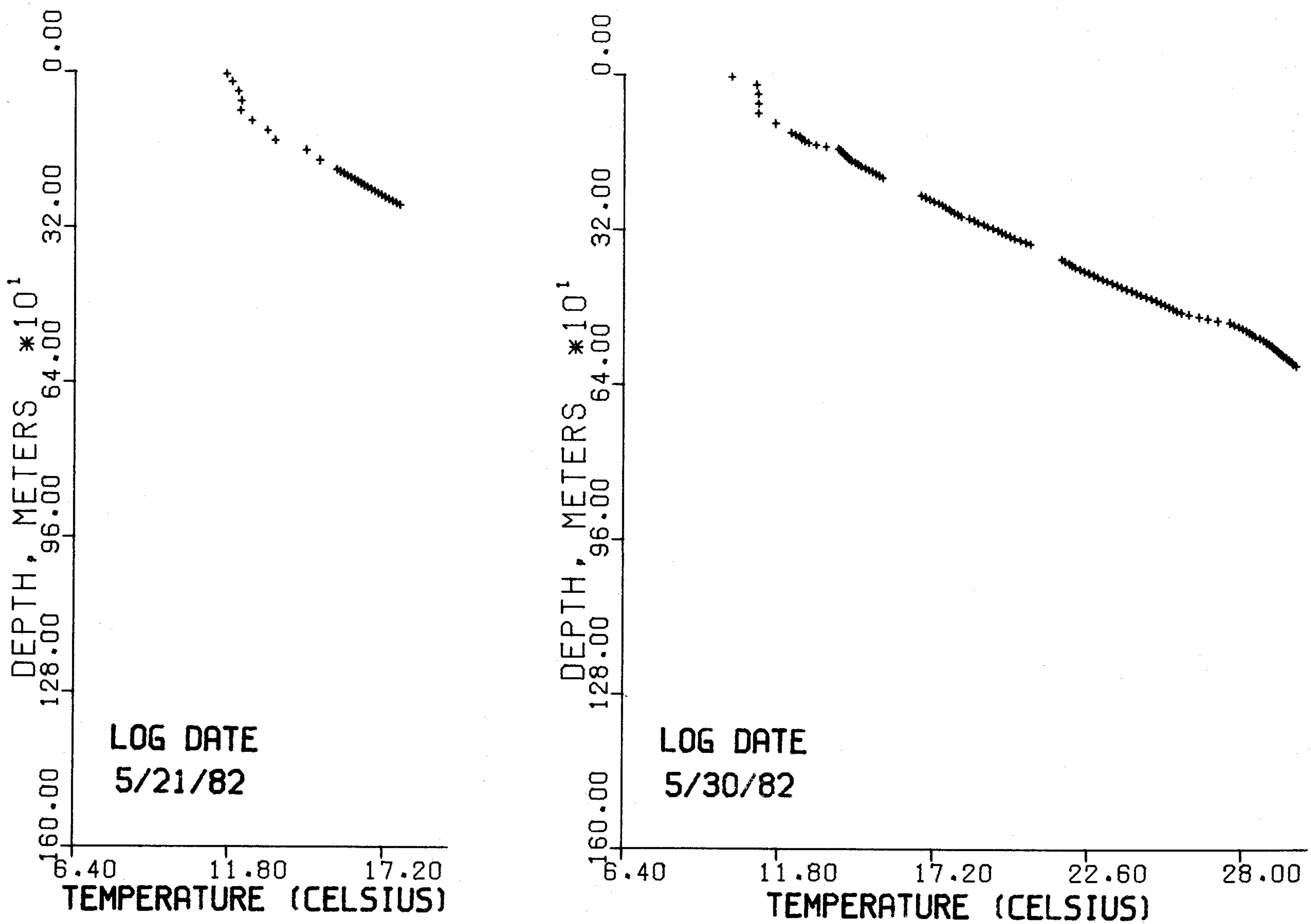


Figure 5-9 . - Temperature versus depth for Auburn Lot 39 #1 obtained using portable temperature probe.

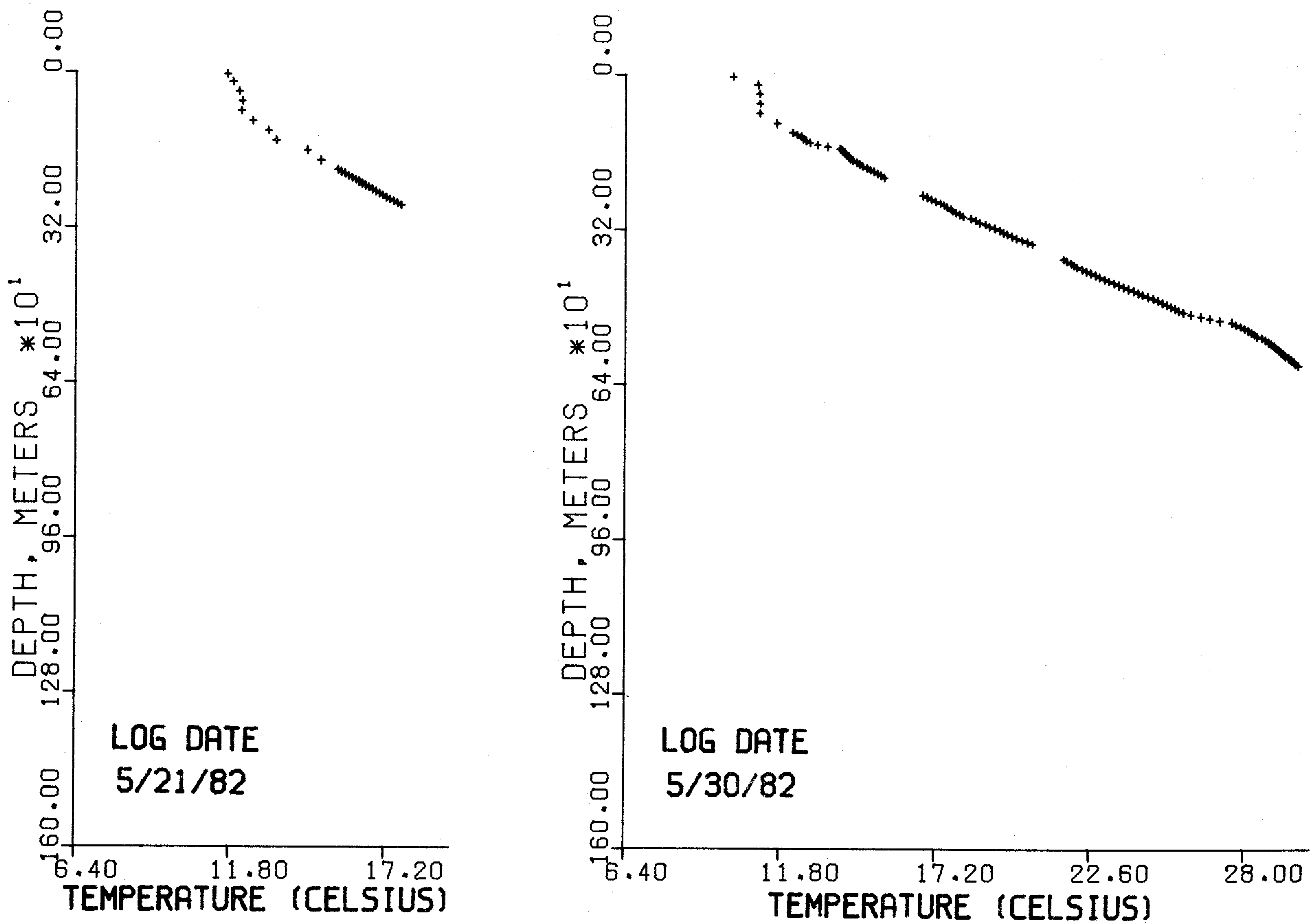


Figure 5-9 . - Temperature versus depth for Auburn Lot 39 #1 obtained using portable temperature probe.

most favorable for heat flow calculations because of the apparent stability of the temperature gradients. Since thermal conductivity measurements were lacking between depths of 546 and 600 meters, a zone extending from 413 to 488 meters was chosen for heat flow determinations. Heat flow values were determined by multiplying the average gradient over the interval times the mean harmonic thermal conductivity (2.31 W/m^{o}C). A heat flow value of 54.2 mW/m^2 was determined from the industrial log while heat flow values of 94.1 and 90.1 mW/m^2 were determined for the logs of May 30, 1982, and May 13, 1983, respectively. The value determined from the industrial log is lower and its value becomes even less as the borehole temperature changes toward equilibrium temperature gradients. The heat flow values determined from the other two logs are higher than those from nearby wells, i.e., 63.8 mW/m^2 at Wells College #1.

Thermal conductivity measurements were made on the samples available from this well (Table C-10) in the belief that an equilibrium log would be obtained and heat flow determined. These values are compared to the gamma-ray activity, P-wave velocity, and temperature gradients (from the industrial log) in Figure 5-11. The measured conductivity values show a distinct inverse relation to gamma-ray activity and gradient as was demonstrated for the Winspear #1 well. A direct relation to the P-wave velocity is also evident, although the correlation is not as obvious. The rapid change from the shales of the Lorraine Group to the limestones of the Trenton Group at 1060 m produces an apparent decrease in gamma-ray activity and increase in P-wave velocity. Here thermal conductivity changes from 2.31 W/m^{o}C in the shale to 3.21 W/m^{o}C upper Trenton limestone. At 1525 m, however, high gamma-ray signature and very low seismic velocities correspond to the highest thermal conductivity value (5.8 W/m^{o}C) measured. This

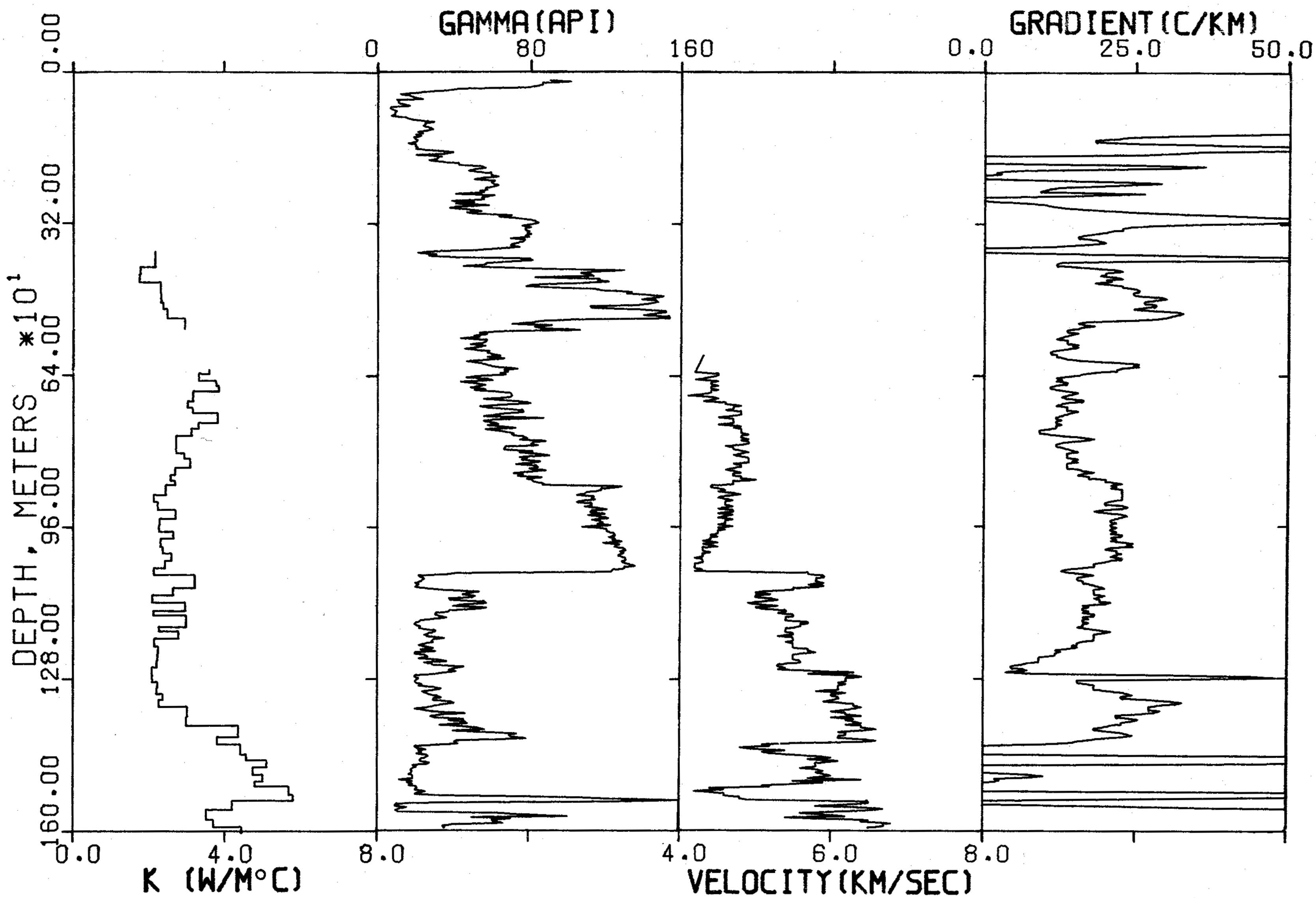


Figure 5-11 - Comparison of thermal conductivity, gamma-ray activity, p-wave velocity and temperature gradients for Auburn Lot 39 #1. (Gamma-ray activity and p-wave velocity and gradient data are from well logs calculated as in Figure 5-3.)

depth corresponds to the top of the Potsdam Sandstone which typically displays a strong gamma "kick". The televiewer log (Figure 5-12) shows that this is an area of high fracture density which could account for the low P-wave velocities encountered. Therefore, any attempts made to develop empirical relations of thermal conductivity with other physical properties which are more easily measured in boreholes must consider other effects which may be responsible for the observed measurements.

An estimate for heat flow was made based on equilibrium temperatures obtained a year after the cessation of drilling. The bottom-hole temperature recorded in early April, 1982, was 52.2°C at a depth of 1587.7 meters. The average gradient from the deepest temperature recorded late in May, 1982, (29.9°C at 596.0 meters) is 22.5°C/km. The K_{mh} over this interval is 2.9 W/m$^{\circ}$C. Therefore, a heat flow value at least 65 mW/m^2 is calculated for the Auburn well. This value is consistent with the heat flow obtained approximately 20 kilometers to the south in the Wells College #1 well.

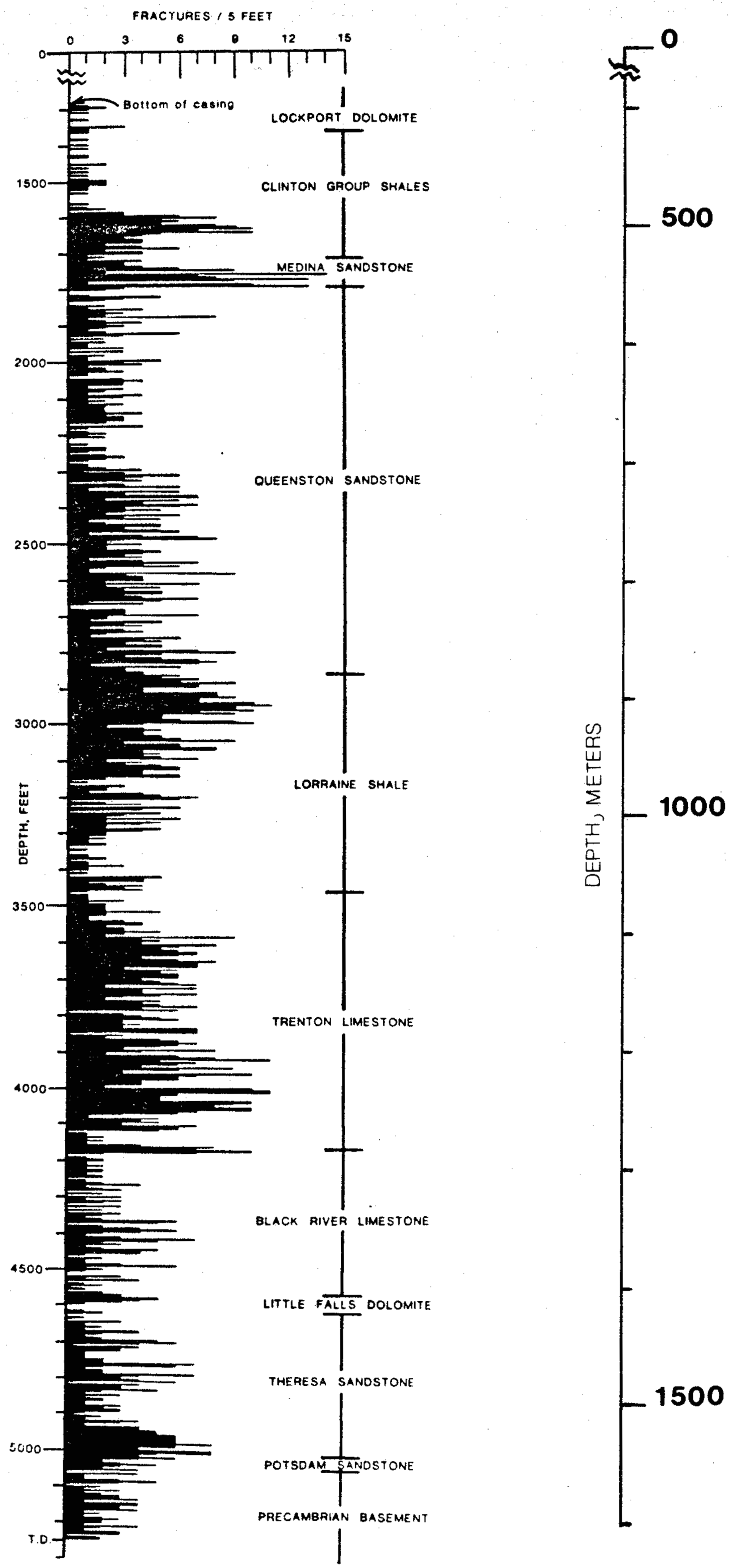


Figure 5-12 - Fracture density plot from televiewer logging by the U.S.G.S. of Auburn Lot 39 #1.

SECTION 6

THERMAL CONDUCTIVITY AND HEAT FLOW MODEL FOR NEW YORK

The limited availability of sites for the direct measurement of heat flow makes it desirable to develop a technique for predicting heat flow based on other data sources. This is necessary if temperature-at-depth distributions are to be determined on a regional scale. A large source of data for estimation of temperatures at depth is available from bottom-hole temperatures (BHT) recorded during routine electrical logging of gas wells. These BHTs can be used in conjunction with the mean annual surface temperature to estimate average geothermal gradients. The presence of stratigraphic layers with differing conductivities precludes, however, the simple projection of these gradients to predict temperatures. The heat flow and the vertical conductivity distribution must be determined if temperatures other than the BHT are desired. High temperature gradients may only be the result of the low conductivity of the layers, as conductivity changes inversely with the gradient. Assuming incorrect conductivity zones at depth will result in erroneous temperature determinations.

In order to determine the geothermal gradient at distributed sites across the study area from BHTs and surface temperatures, a data set of 1066 bottom-hole temperatures (Table C-11 and Figure 6-1) and 41 mean annual surface temperatures recorded at National Oceanographic and Aeronautical Administration (NOAA) weather stations in western and central New York and northern Pennsylvania (Table C-12) were assembled. The NOAA mean annual surface temperature data were reduced to temperatures at a sea level datum using an adiabatic lapse rate of 9.8^{o}C/km (Jaeger, 1965). Trend analysis of this temperature distribution throughout New York and Pennsylvania resulted in a second-order trend surface as a best-fit model (Figure 6-2). The mean annual temperature at each well site to be used for gradient determination was then estimated by solving the polynomial equation for the temperature at that location. The temperature was further corrected to correspond to the mean annual value at the drill floor or Kelly bushing elevation (from which the depth to BHT is typically measured). The average geothermal gradient is then determined by subtracting the BHT from the surface temperature and dividing by the depth of the BHT.

In local regions, the gradient calculations and the temperature-depth data show generally a consistent gradient and temperature-at-depth distribution. However, there are also selective gradients that display much higher or lower gradients, even for temperatures obtained at similar depths. There are many factors which could be responsible for these deviations, most of which are very difficult to determine for a specific borehole. The presence of expanding gas (either natural or H_2) causes very noticeable depressions in temperatures. Compressed air, formation fluids, water, or sometimes mud (for deeper wells) are circulated within wells during rotary drilling to cool and lubricate the drill bit and flush the chips from the well. This drilling disturbance is also responsible for

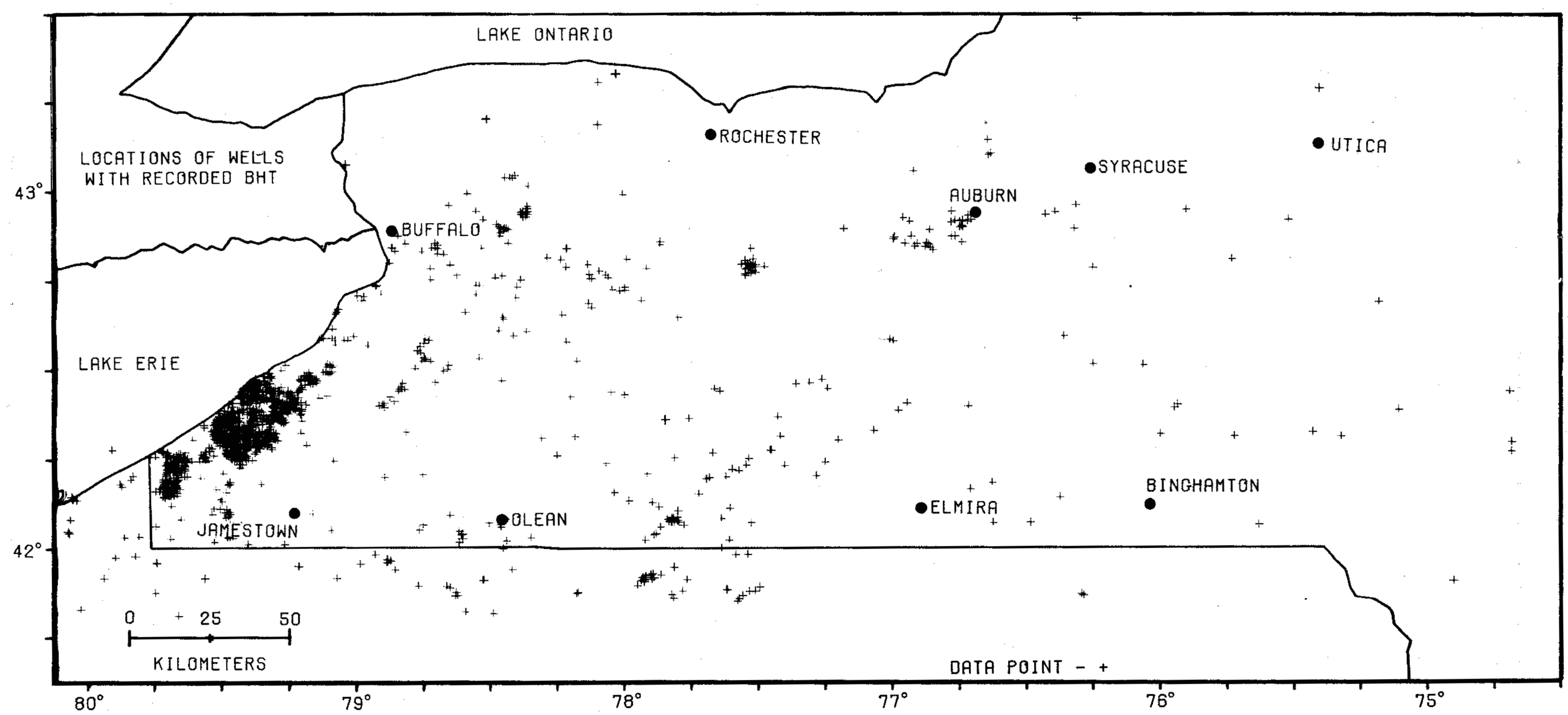


Figure 6-1 - Locations of wells with available bottom-hole temperatures.

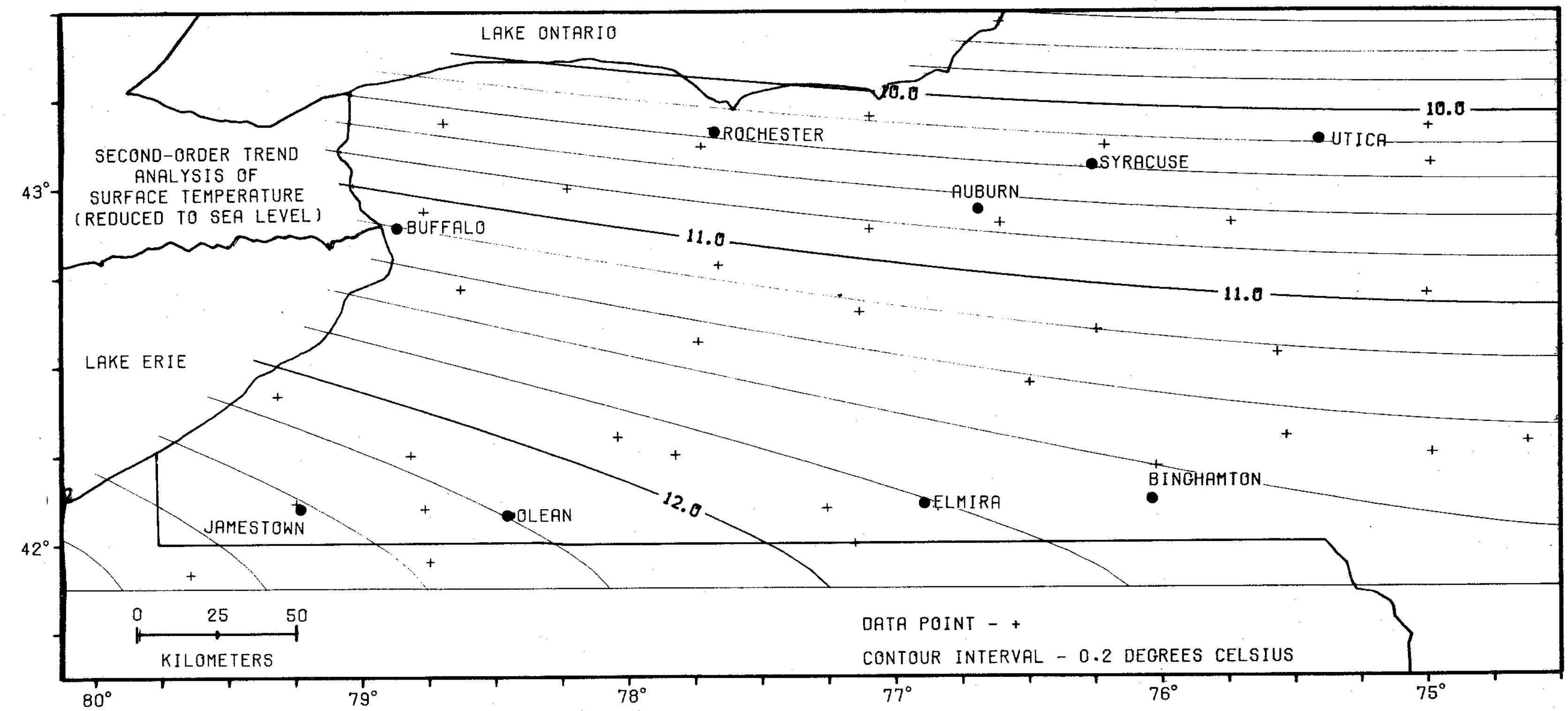


Figure 6-2 - Second-order trend analysis of surface temperature (°C) reduced to sea level datum.

disequilibrium in BHTs. After drilling is completed, casing is sometimes cemented into place to seal zones of gas production, eliminate losses of gas into fractured formations, and prevent pollution of groundwater. The reaction heat of cement hardening can elevate temperatures in selected zones in the wells. This factor was more of a concern for the subsequent detailed logs which were run because the cementing usually takes place after initial logging operations. Other chemical reactions, such as formation fluids from one zone reacting with fluids or rock in another zone, are also a possible disturbance which would elevate the temperature encountered. Water movement along fractures encountered in the sedimentary section may also disturb the temperature. Fluids which may be traveling up joint or fault planes could elevate the temperature, while groundwater entering the well can depress it. Finally, the accuracy of the BHT measurement itself is unknown. All of these factors must be considered when BHT data is used in the estimation of heat flow and temperatures.

Analysis of regional trends in the BHT and derived gradients was performed to locate data which was probably disturbed, and eliminate it from the final calculations. For example, well #6918 in western Erie County has a reported natural flow of 40 thousand cubic feet a day (Kreidler et al., 1972). The gradient calculated for this well is 19.8°C/km; gradients in this area are generally much higher (26°C/km) so this point was deleted. Four wells in northern Cattaraugus County (#10577, #11066, #11147, #11148) are located within a five-square-kilometer area. Well #10577 has a calculated gradient of 17.2°C/km, while the gradients in the others are 24.0, 23.3, and 23.9 respectively. The probability of a disturbance in #10577 is obvious and, therefore it was deleted.

It was noticed that sometimes wells with higher-than-normal gradients are associated with linear topographic features which may be surface expressions of possible faulting in the sedimentary section. Figure 6-3 shows the distribution of wells in southern Chemung and Tioga Counties. Linear topographic features from the Preliminary Brittle Structures Map of New York (Isachsen and McKendree, 1977) are also shown. Well #10335 has a calculated gradient of 24.0^{o}C/km with a reported BHT of 47.8^{o}C at a depth of 1678.8 m. Approximately seven kilometers to the east, well #4350 has a reported BHT of 45.6^{o}C at a depth of 1039.4 m. The calculated gradient here is 36.7^{o}C/km. Taking into account the fact that #10335 goes through higher conductivity layers (ie., Onondaga and below) does not reconcile the sharp increase in temperature gradient in #4350. When the gradient of #10335 is adjusted to the depth of #4350 using assumed conductivities of 1.67 W/m^{o}C for the Devonian shales and 2.2 W/m^{o}C for the deeper sequence, the calculated gradient is 26.2^{o}C/km. Well #11931, approximately 12 kilometers to the south, has a calculated gradient of 25.2^{o}C/km. The BHT is 40.6^{o}C at a depth of 1297.2 m which is at the same stratigraphic horizon as #4350. The proximity of #4350 to a linear topographic feature may indicate that upwelling fluids along a possible fracture has elevated the temperature. This correlation was seen in other wells in the study area, and these were deleted from further calculations. The resulting BHT data set was considered to be the best possible representation of temperature at depth for determining average geothermal gradient distributions throughout the study area.

The presence of distinctive changes in gradient (and therefore conductivity) with lithostratigraphic layers (Figure 6-4) suggests that the vertical distribution of

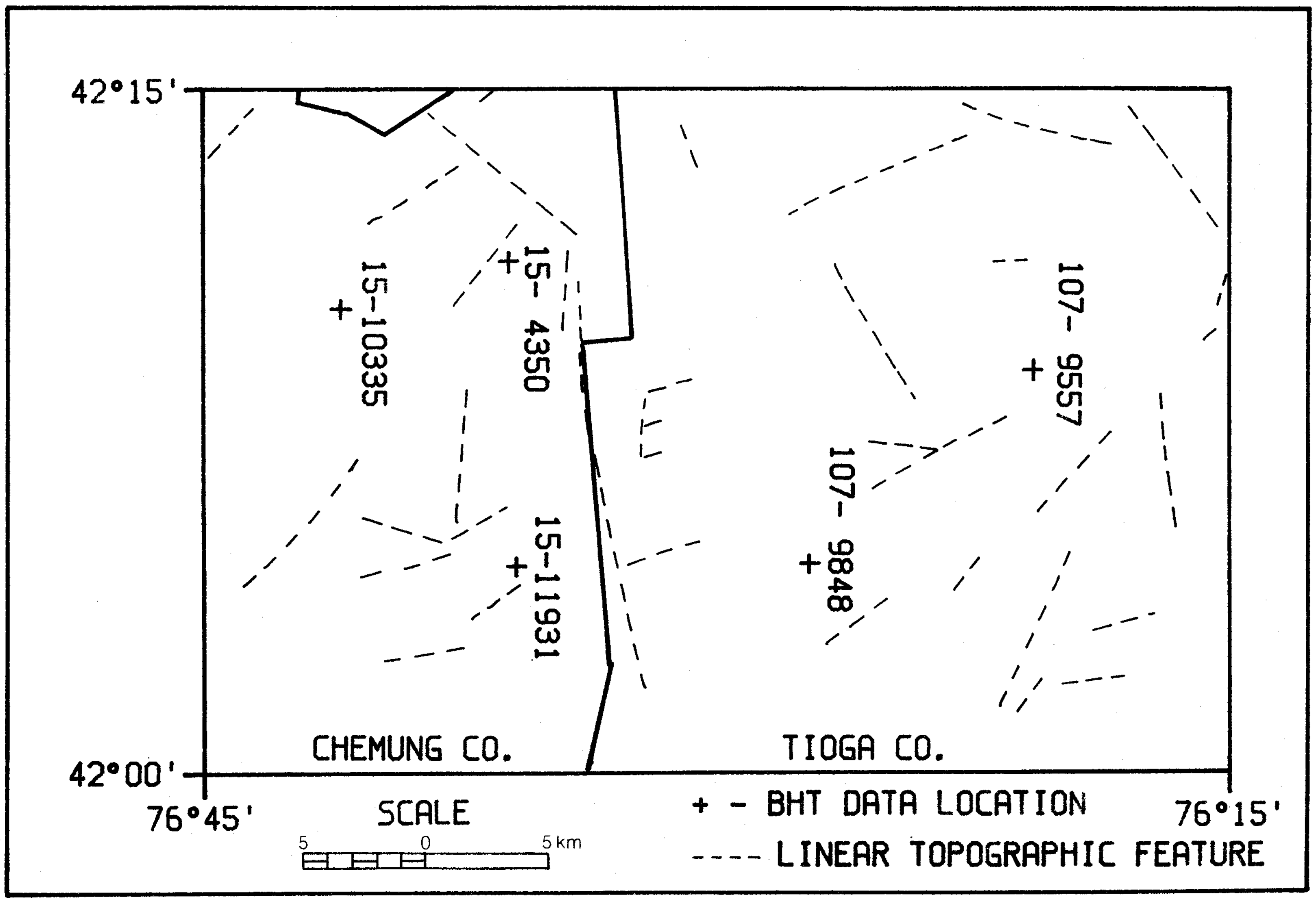


Figure 6-3 - Location of BHT and linear topographic features in Chemung and Tioga Counties (after Isachsen and McKendree, 1977).

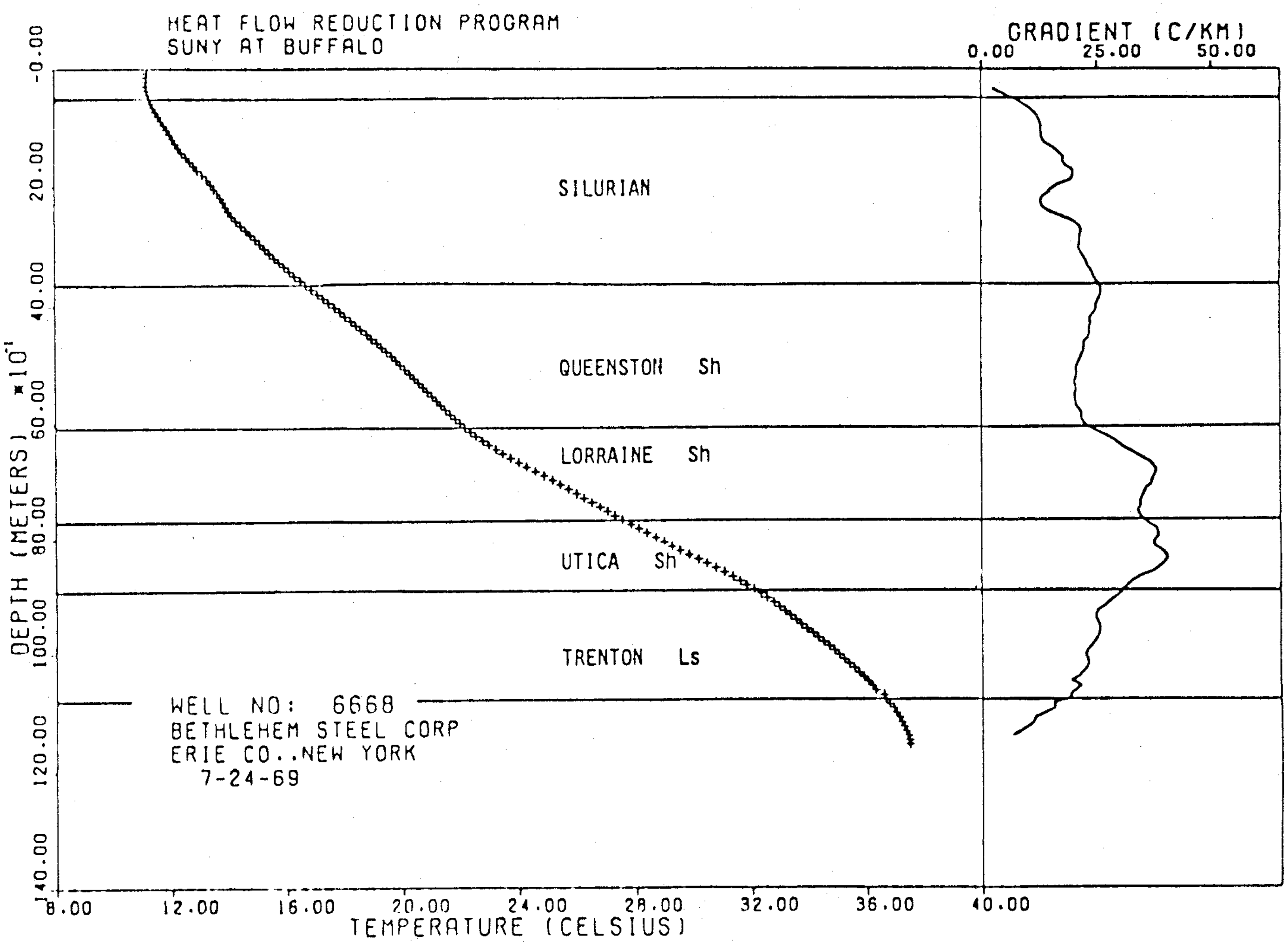


Figure 6-4 - Temperature-depth plot and correlation of temperature gradients with stratigraphic formations for well #6668.

conductivity in the study area can be modeled based on well records of the depths to the layer horizons. If the conductivity and thickness of the layers is known for the location of a gradient estimate, then the mean harmonic conductivity of the interval the gradient passes through can be determined. Heat flow can then be estimated based on this gradient and conductivity. The following discussion of the method is illustrated in Figure 6-5.

The average geothermal gradient (G) is calculated by

$$G = \frac{T_{BHT} - T_S}{Z_{BHT}} \tag{6-1}$$

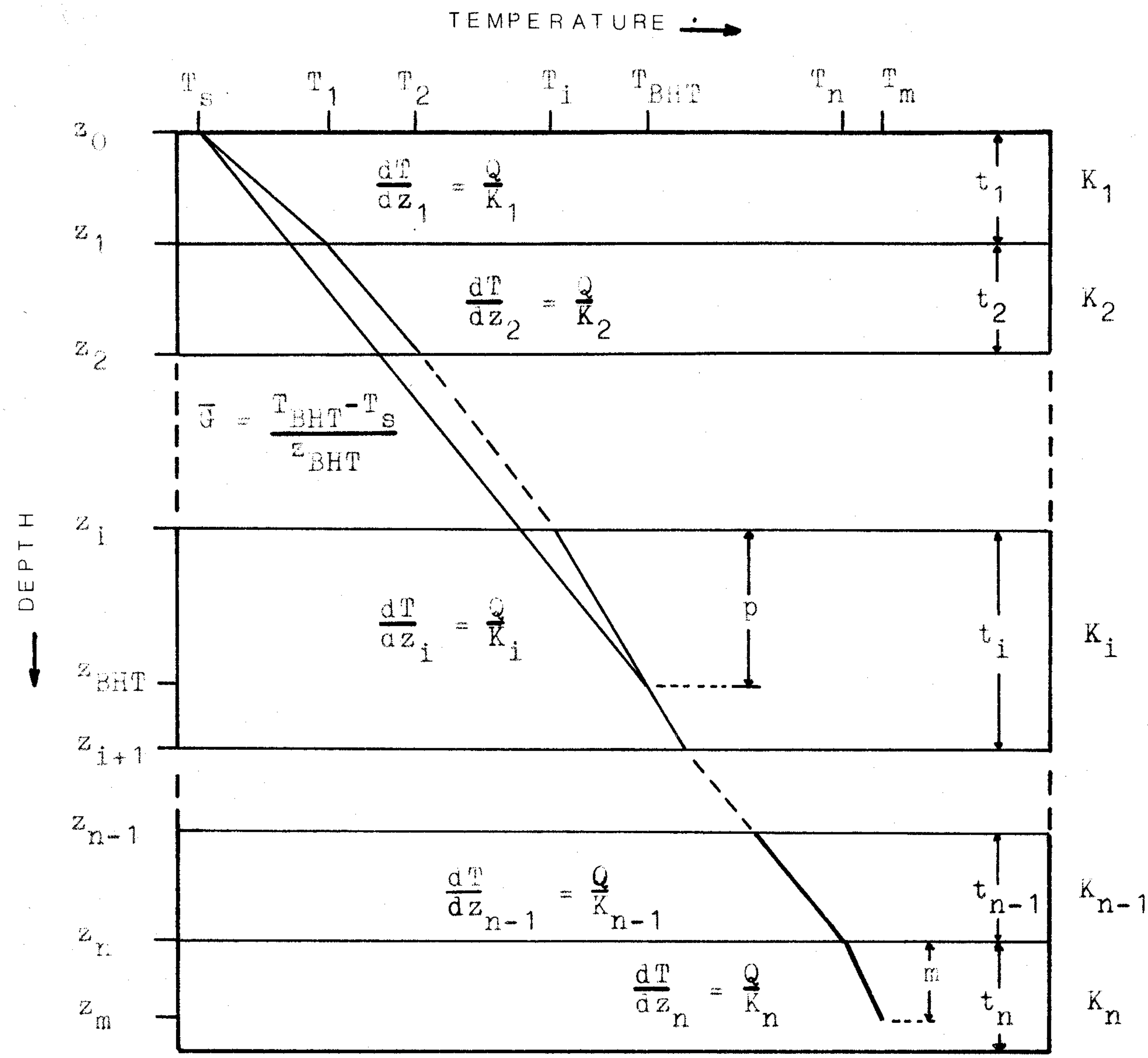
where T_{BHT} is the bottom-hole temperature, T_S is the surface temperature, and z_{BHT} is the depth of the BHT. The mean harmonic conductivity (K_{mh}) is calculated as in Equation 4-2. If the z_{BHT} is located some depth p below the top of the i^{th} conductivity layer then the K_{mh} is given by

$$K_{mh} = (t_1 + \ldots + t_{i-1} + p)\left(\frac{t_1}{K_1} + \ldots + \frac{t_{i-1}}{K_{i-1}} + \frac{p}{K_i}\right)^{-1} \tag{6-2}$$

where $t_1,\ldots,t_{i-1}$ are the thicknesses of the overlying conductivity layers and $K_1,\ldots, K_i$ are the conductivities of each layer. Then heat flow can be calculated as in Equation 4-3, $Q = K_{mh}$ G. For the i^{th} layer the gradient is

$$\left(\frac{dT}{dZ}\right)_i = \frac{Q}{K_i} \tag{6-3}$$

and the temperature at the top of the n^{th} layer (T_n) is



$$Q = (t_1 + \ldots + p)\left(\frac{t_1}{K_1} + \ldots + \frac{p}{K_i}\right)^{-1} (\bar{G})$$

Figure 6-5 - Thermal conductivity layer model for heat flow and temperature at depth determinations (see text for symbol descriptions).

$$T_n = \sum_{i=1}^{n-1} t_i \left(\frac{dt}{dz}\right)_i + T_S \qquad (6\text{-}4)$$

The temperature at a depth (m) below the top of the n^{th} layer is given by

$$T_m = \sum_{i=1}^{n-1} t_i \left(\frac{dt}{dz}\right)_i + m \left(\frac{dt}{dz}\right)_n + T_S \qquad (6\text{-}5)$$

The depth (d_x) to a particular temperature (T_x) can then be found, if $T_n \leq T_x \leq T_{n+1}$ by

$$d_x = \sum_{i=1}^{i=n} t_i + \frac{(T_x - T_n)}{(dT / dz)_n} \qquad (6\text{-}6)$$

A five-layer conductivity model was chosen based on observed major gradient changes in temperature logs which correlate with the tops of stratigraphic units in western and central New York. These layers are: 1) the Devonian shales which outcrop at the surface to the south of approximately 43° latitude, 2) the Onondaga Limestone through the top of the Queenston Formation comprised mostly of limestones and dolostones with minor shale beds, 3) the Queenston Formation through the Lorraine Group which is composed primarily of shales in the west but becomes predominantly sandstone in the upper part of the section in the east of the study area, 4) the Trenton Group through the Potsdam Formation including interlayered limestone and shales near the top and sandstones toward the base, 5) the crystalline Precambrian basement. Data for the tops of the Onondaga, Queenston, Trenton and basement were compiled from various publications (Commonwealth of Pennsylvania, 1960-1977; Flagler, 1966; Kreidler, 1959; Kreidler, 1963; Kreidler et al., 1972; Kreidler, 1975) and directly from drilling logs (Table C-13). Structure contour maps of the depth below sea level to the tops of these formations were prepared from this data set, and trend surface analysis to predict the depth of these formations was performed.

The thermal conductivity value used for the Devonian shales was chosen based on the measurements made for the Winspear #1 well and the work of Urban (1970). Urban reported a value of 1.67 W/m^{o}C for the Devonian section encountered in Himrod, New York. This is intermediate to the values of 1.84 and 1.49 W/m^{o}C which were obtained for the Winspear #1 well. These values were considered to be greater than the actual in situ conductivity because of anisotropic conduction effects in the chip technique. Since Urban used cored samples measured on a divided-bar apparatus, his value was considered to be a better overall conductivity to assign to this layer.

A structure contour map of the top of the Onondaga Limestone was computer generated from 572 data points in the study area (Figure 6-6a and Figure 6-6b). This defines the base of the Devonian and the top of the Onondaga-Medina conductivity layers. Trend surface analysis showed that sixth-order polynomial provided a best-fit model for this horizon (Figure 6-6c). Each BHT well to the north of the Onondaga outcrop (approximately 200 m above sea level along 43^{o} latitude) was checked individually to make sure the absence of control in the trend surface did not allow for prediction of an Onondaga horizon when it did not actually exist. The thermal conductivity for this sequence from the Winspear #1 well is 2.33 W/m^{o}C. Examination of the ratio of gradients between the Devonian shales and this layer indicated that this may be slightly high, probably because of the variability of shale thicknesses, to apply to the entire area. A value of

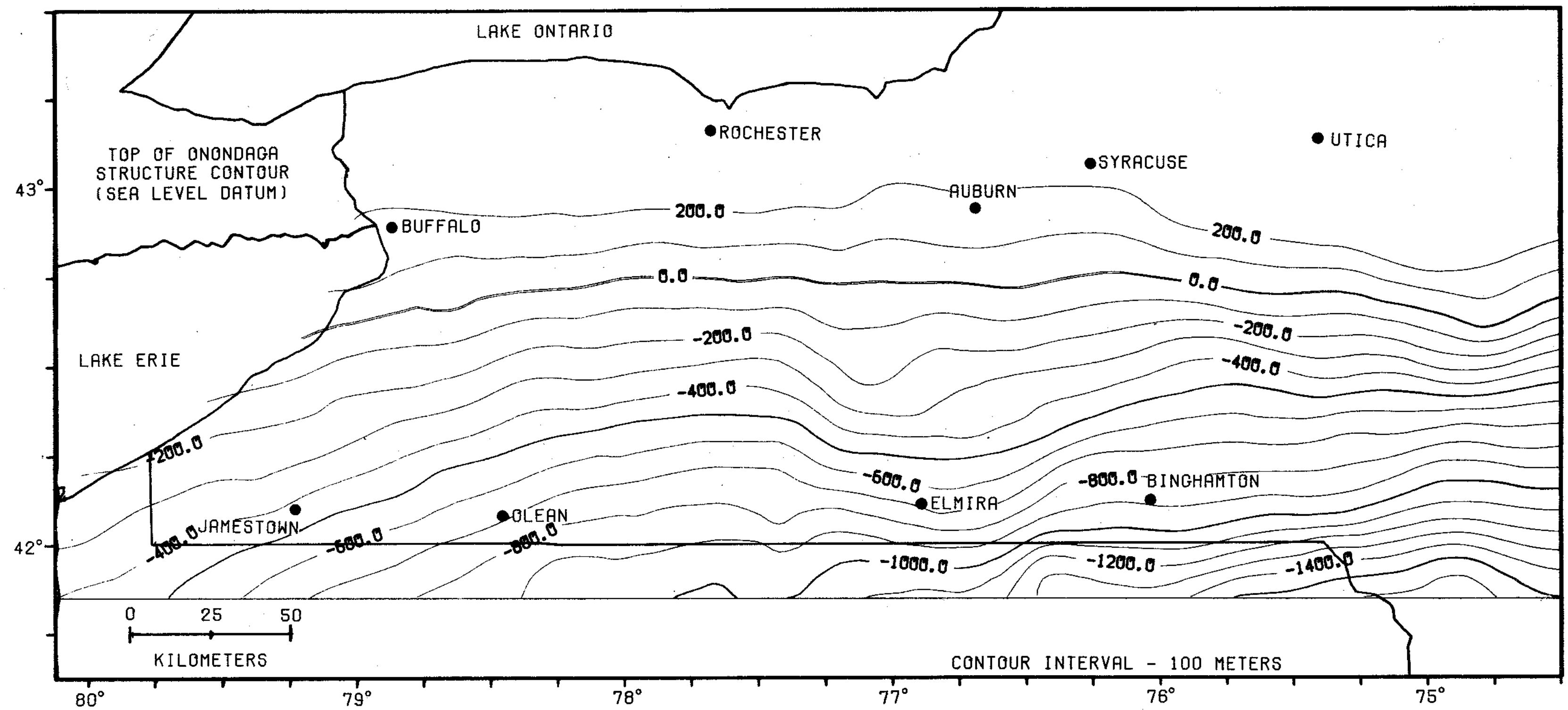


Figure 6-6a - Structure contour map of the depth in meters (sea level datum) to the top of the Onondaga Limestone.

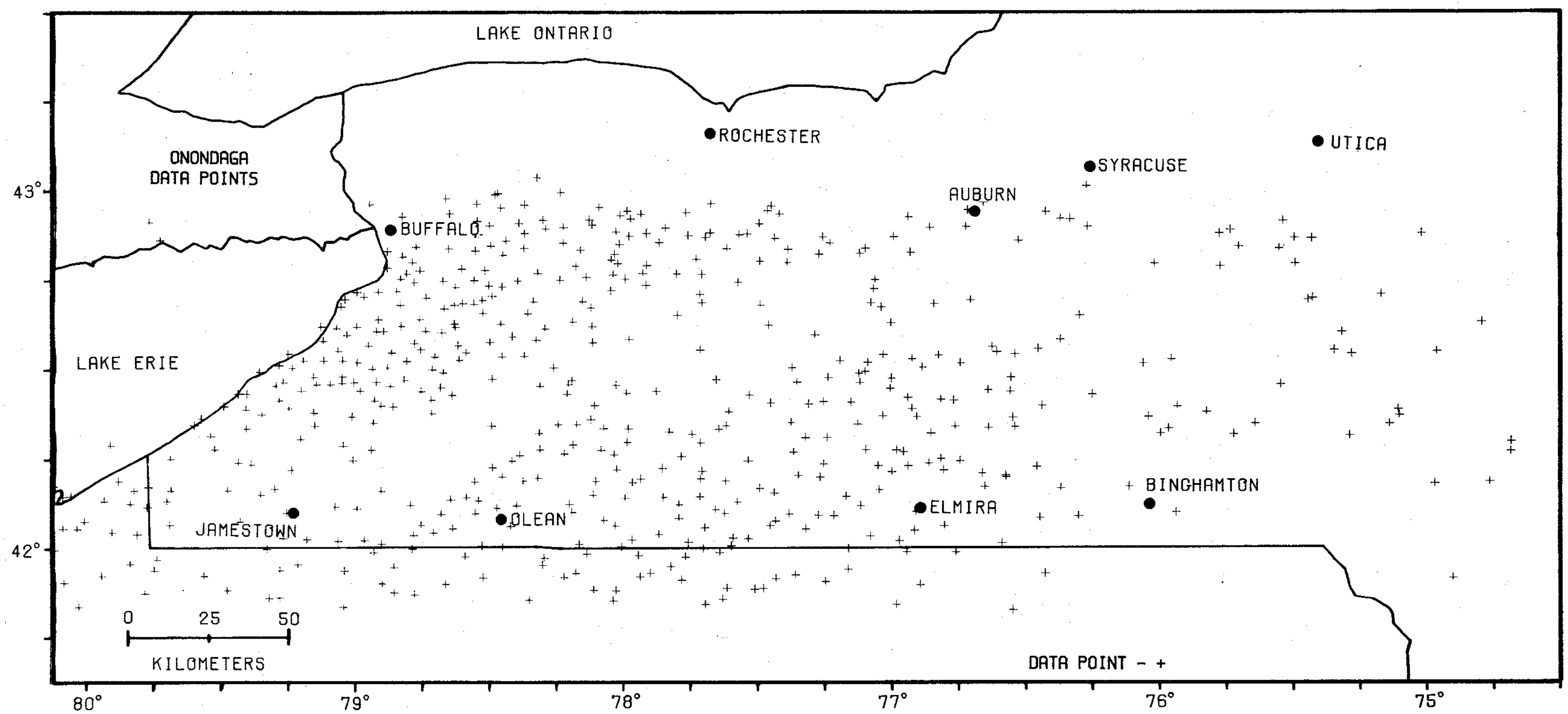


Figure 6-6b - Location of wells with depth to the Onondaga data used for structure contour map and trend surface analysis.

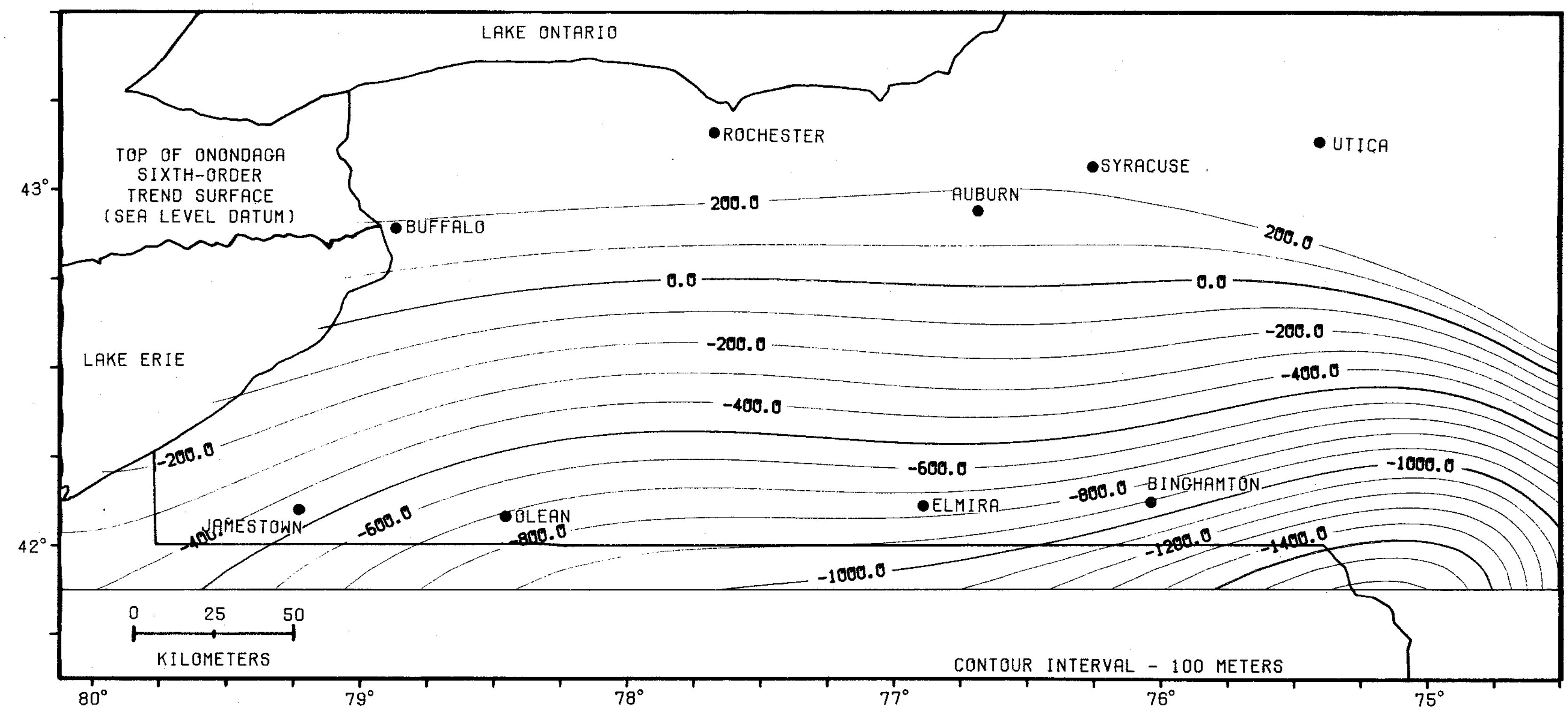


Figure 6-6c - Sixth-order trend surface of the depth in meters (sea level datum) to the top of the Onondaga Limestone.

2.2 W/m^{o}C was chosen based on these gradient ratios and the Devonian shale value.

The structure contour map of the Queenston formation was prepared from a data set of 311 points (Figure 6-7a and Figure 6-7b). From the work of Urban (1970) the mean harmonic conductivity of the sequence from the top of the Queenston Formation to the top of the Trenton group is estimated to be 1.64 W/m^{o}C for well #6668 in western Niagara County. The measurements from the Auburn Lot 39 #1 well yielded a value of 2.65 W/m^{o}C. The conductivity is much higher here because the Queenston Formation undergoes a facies change and contains more sandstone beds to the east than in the west. Since evaluating the nature of this facies change would require an extensive study in itself, a simple linear increase in conductivity from 1.64 W/m^{o}C in the west to 2.65 W/m^{o}C in the east was assumed for this conductivity layer. A fourth-order polynomial was calculated to predict the top of the Queenston horizon (Figure 6-7c).

The final conductivity layer in the sedimentary sequence is marked by the top of the Trenton Group. A structure contour map of the top of the Trenton was prepared from 152 available data points (Figure 6-8a and Figure 6-8b), and trend analysis produced a third-order polynomial as a best-fit model (Figure 6-8c). The Trenton Group is predominantly limestone at the top and contains interlayered limestones and shales throughout the sequence. Below the Trenton and intermingled with minor shale layers are limestones and dolostones which are present down to the basal sandstones of the Theresa and Potsdam Formations. Below this, the crystalline Precambrian basement is present. Though the relatively higher conductivity of the

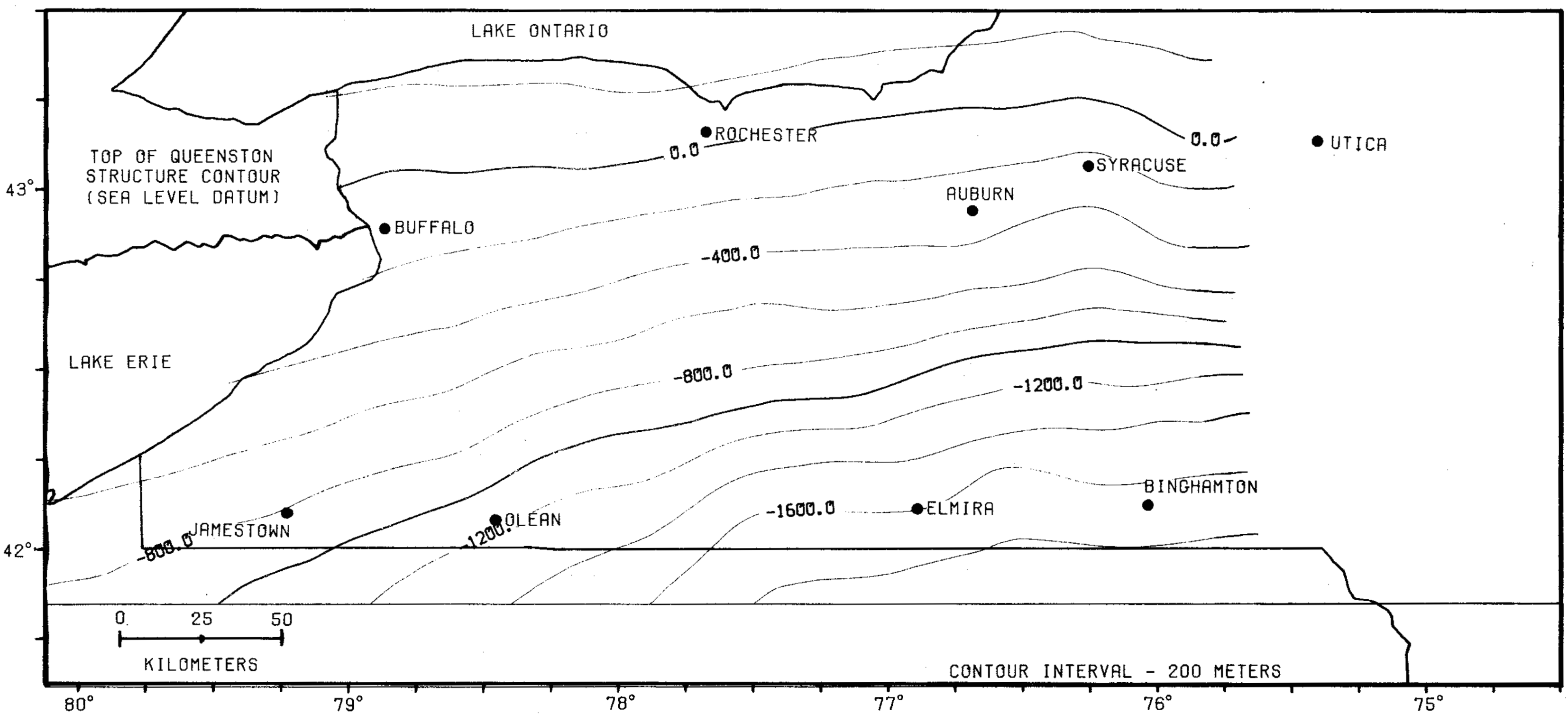


Figure 6-7a - Structure contour map of the depth in meters (sea level datum) to the top of the Queenston Formation.

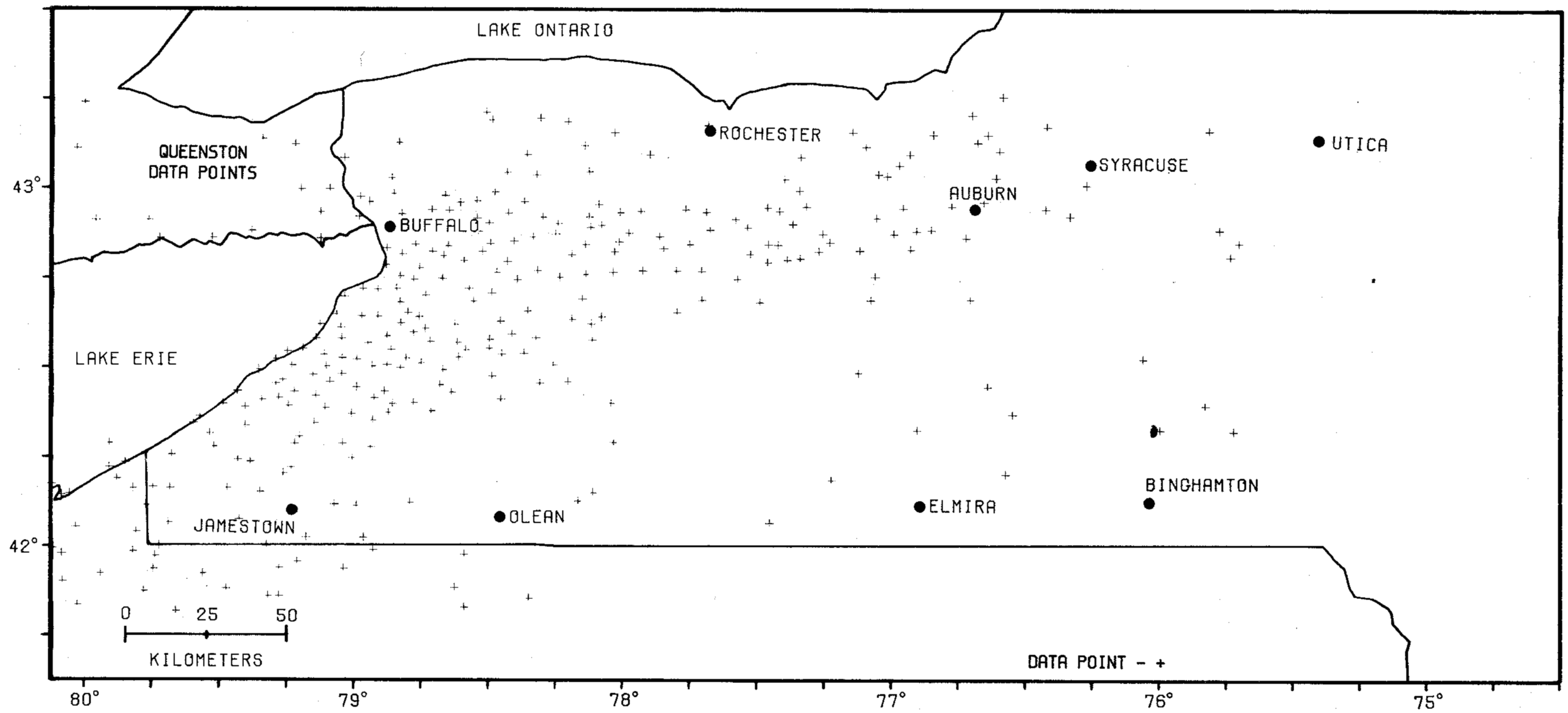


Figure 6-7b - Location of wells with depth to the Queenston data used for structure contour map and trend surface analysis.

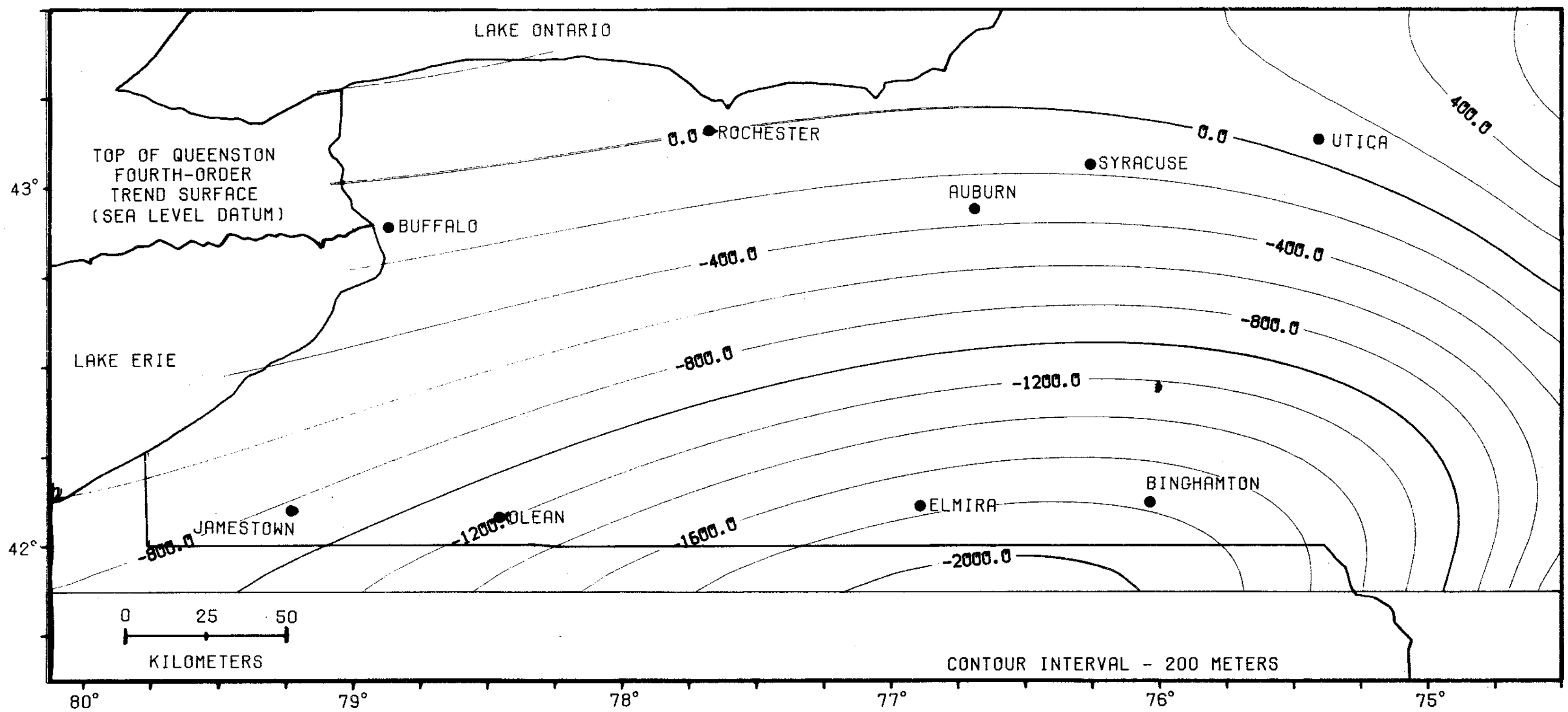


Figure 6-7c - Fourth-order trend surface of the depth in meters (sea level datum) to the top of the Queenston Formation.

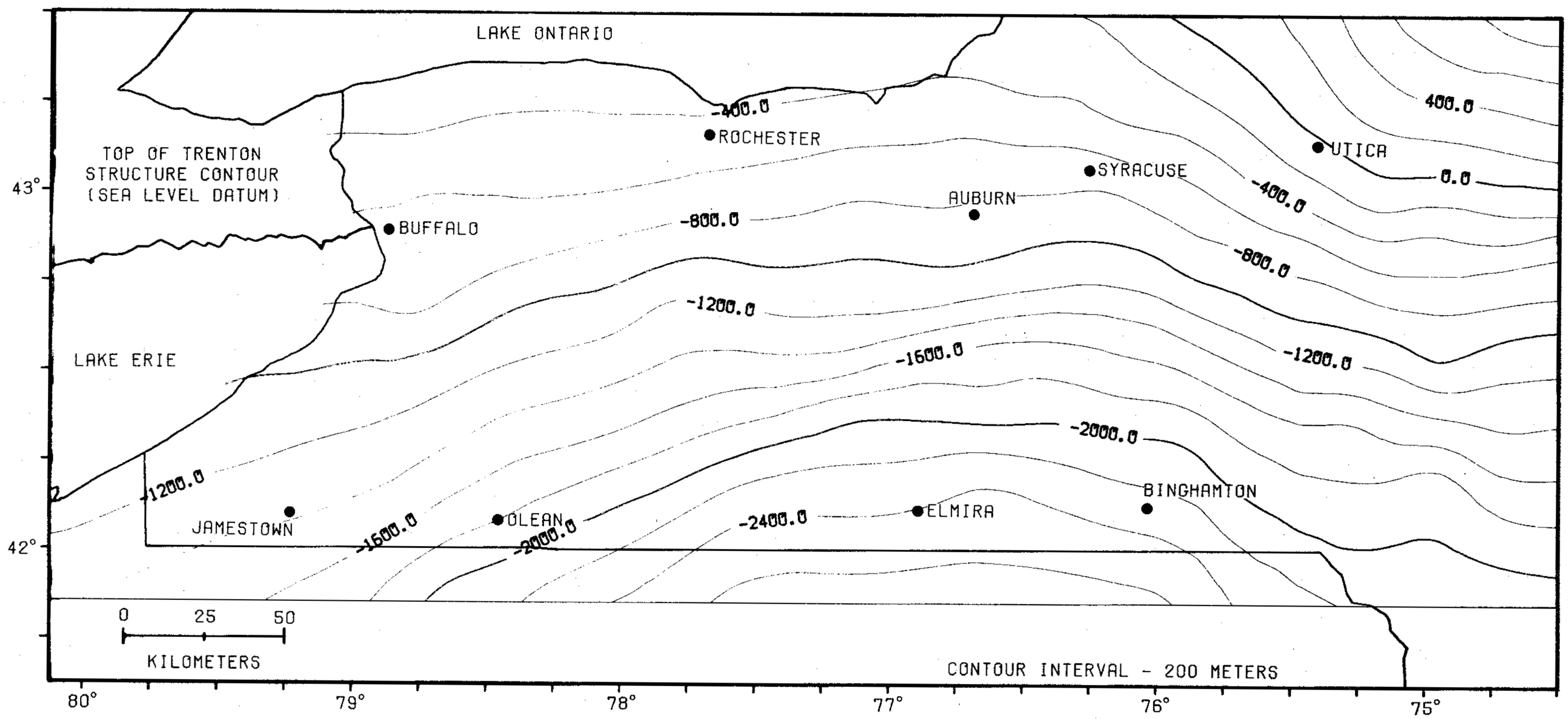


Figure 6-8a - Structure contour map of the depth in meters (sea level datum) to the top of the Trenton Group.

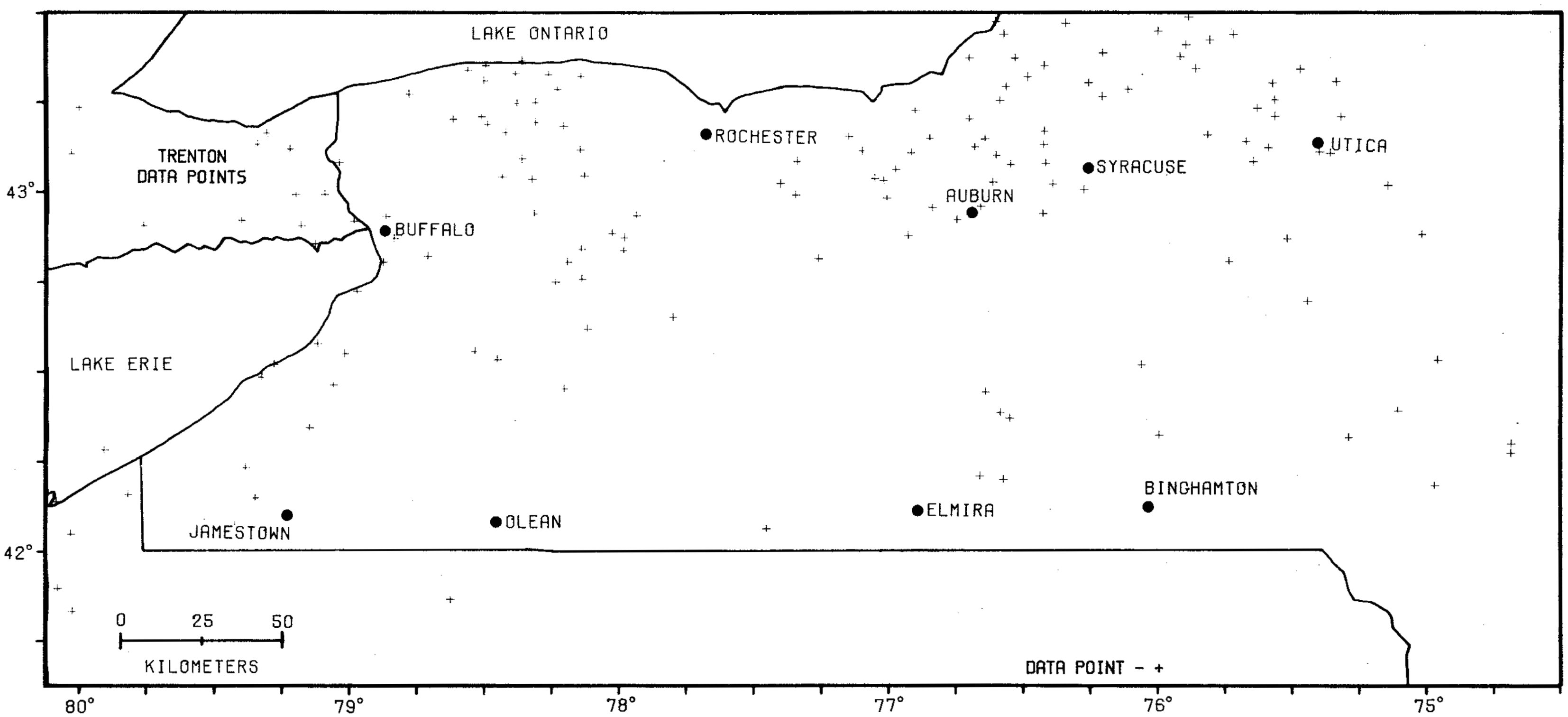


Figure 6-8b - Location of wells with depth to the Trenton data used for structure contour map and trend surface analysis.

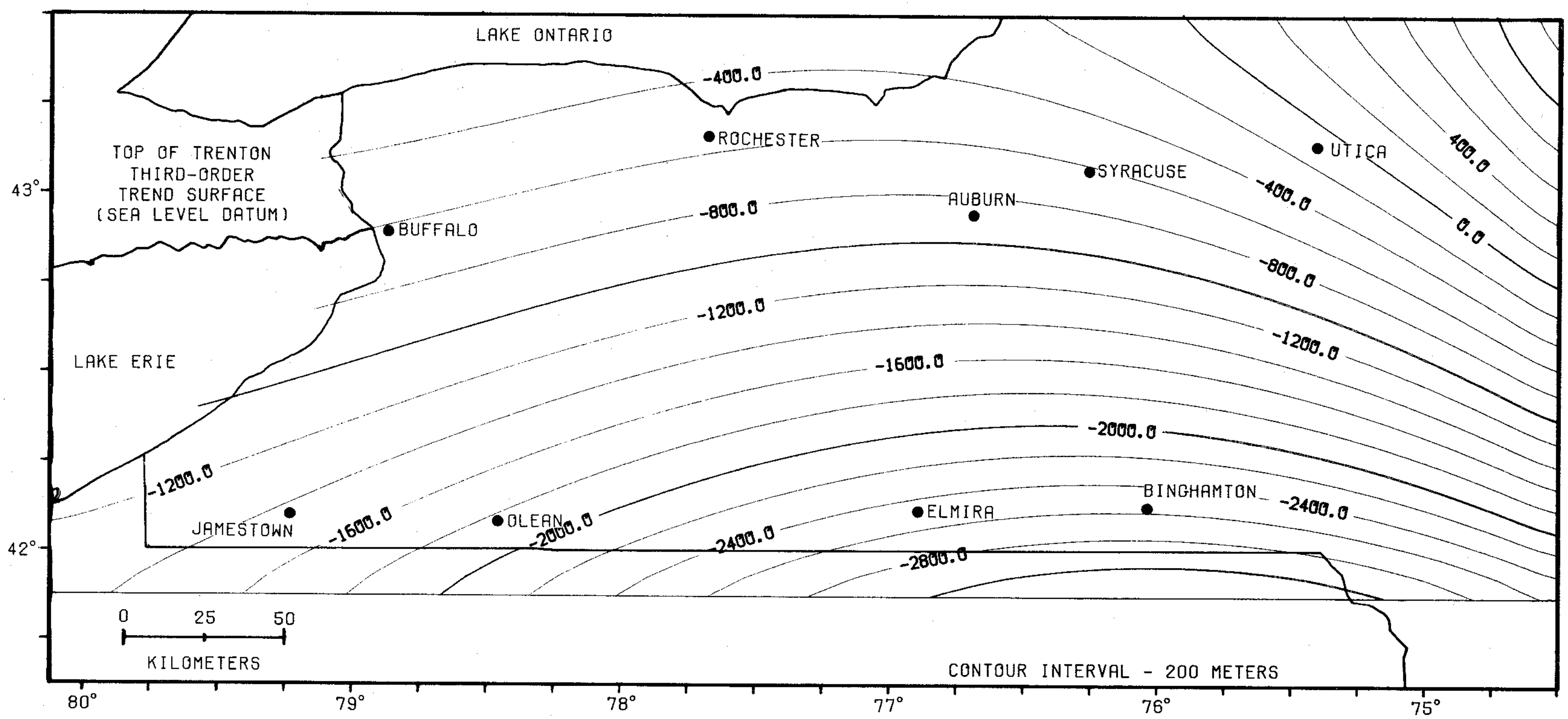


Figure 6-8c Third-order trend surface of the depth in meters (sea level datum) to the top of the Trenton Group.

Theresa and Potsdam (see Table C-10) suggests that another layer should be included, the absence of control for trend analysis of the Theresa top prevented this because only 52 data locations were available for this structure contour map (Figure 6-9a and Figure 6-9b). Inclusion of the Theresa and Potsdam units in the final sedimentary conductivity layer was not significant to the determinations of heat flow as few of the BHT wells penetrated to this depth. The increase in the mean harmonic conductivity of this layer due to their inclusion was unavoidable but, since they generally comprise less than one fifth of the entire sequence, this was seen to produce only a minor effect in the model. The thermal conductivity value used for this layer was 2.95 W/m^{o}C based on the measurement of the samples from the Auburn well. The isopach map of the Lower Ordovician and Cambrian units, which are potential geothermal reservoir rocks, shows an increase in thickness to the south of the state in figure 6-9c.

The structure contour map of the Precambrian basement was prepared from 94 data points (Figure 6-10a and Figure 6-10b). The probable variability of the basement prevented the use of actual thermal conductivity measurements to apply a conductivity value in this case. A value of 2.93 W/m^{o}C, typical of gneissic rock, was assumed. The effect of this in the model is generally seen only to the north of 43^{o} latitude in the determination of the depth to 50^{o}C; it was necessary to project the temperature-at-depth calculation past the basement top to obtain 50^{o}C here. A third-order trend surface was determined to be a best-fit model for the basement top (Figure 6-10c).

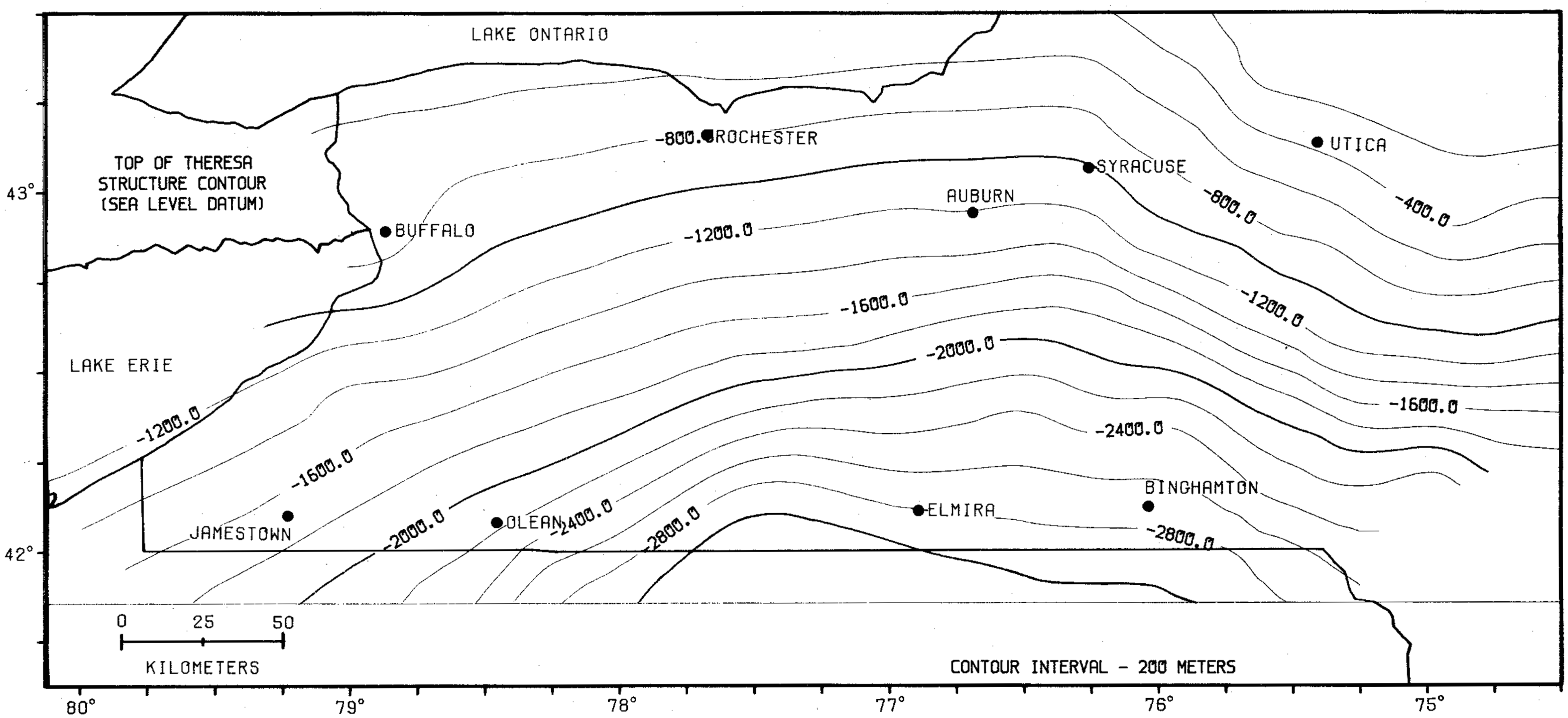


Figure 6-9a - Structure contour map of the depth in meters (sea level datum) to the top of the Theresa Formation.

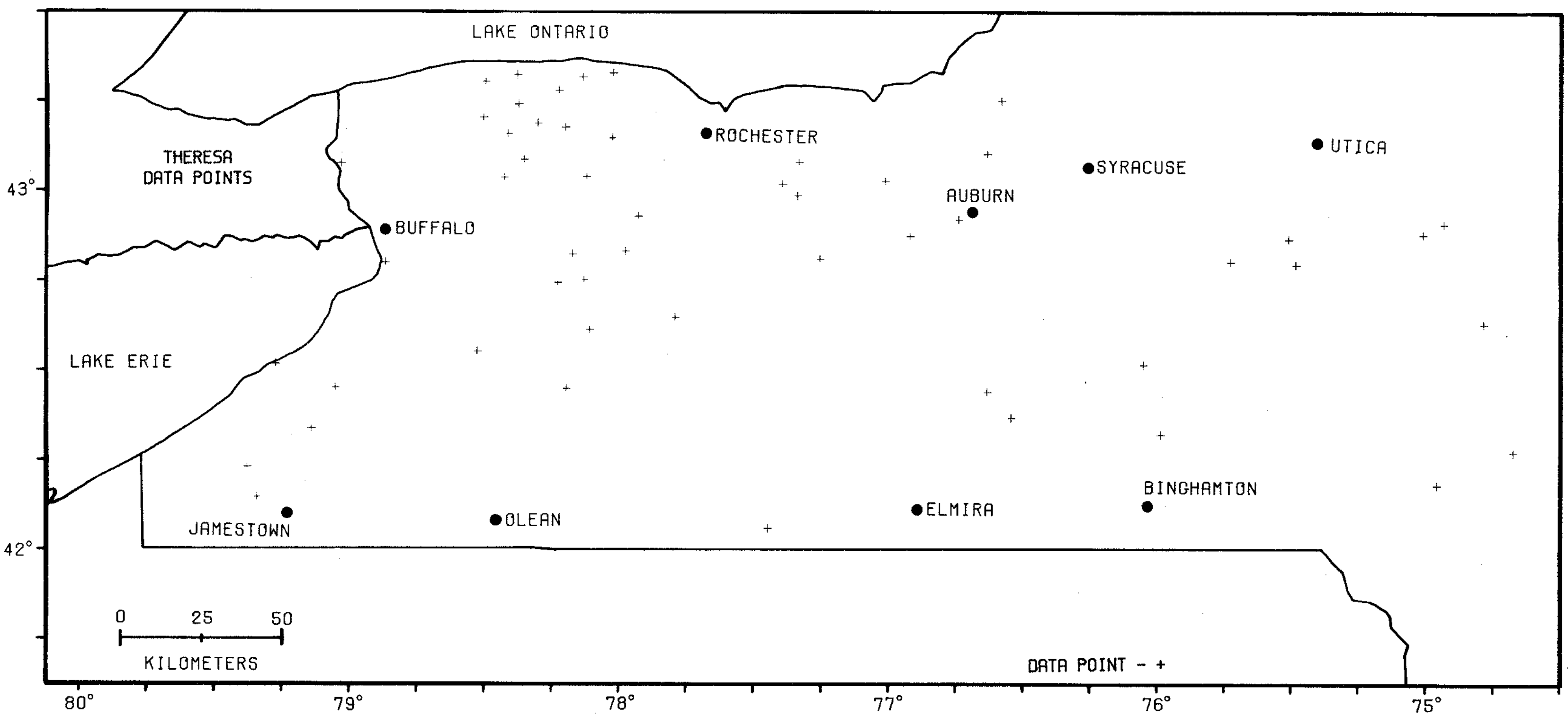


Figure 6-9b - Location of wells with depth to the Theresa data used for structure contour map.

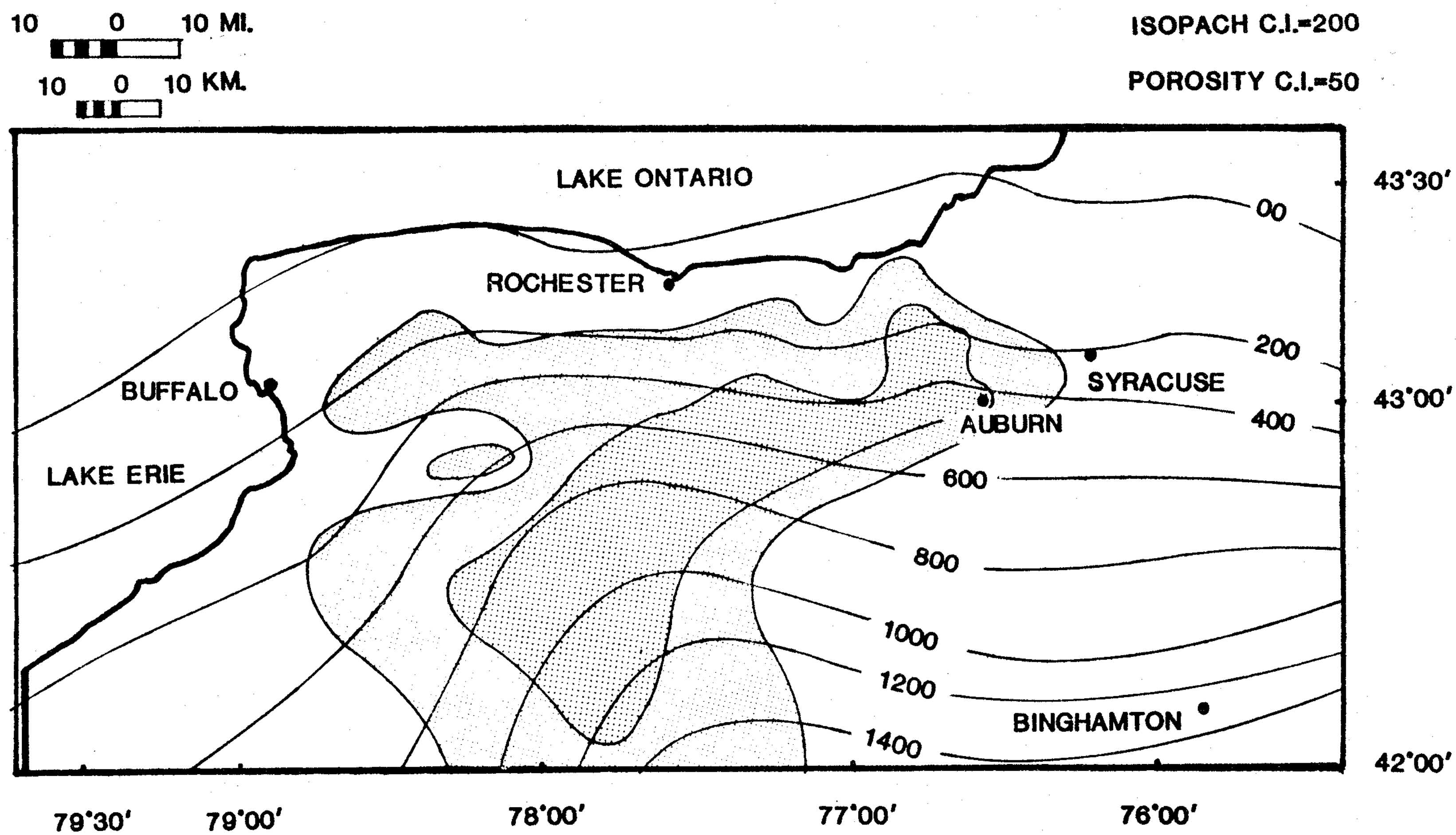


Figure 6-9c Isopach map of the lower Ordovician and Cambrian hydrothermal reservoir rocks. The lighter shaded pattern represents areas where the net thickness of greater than 10 percent porosity is in excess of 50 feet (Robinson, 1982). The darker shaded pattern represents areas where the net thickness of reservoir rocks with greater than 10 percent porosity exceeds 100 feet. The areas that show thick accumulations of reservoir rocks with high porosity are prime locations for potential low temperature geothermal sites.

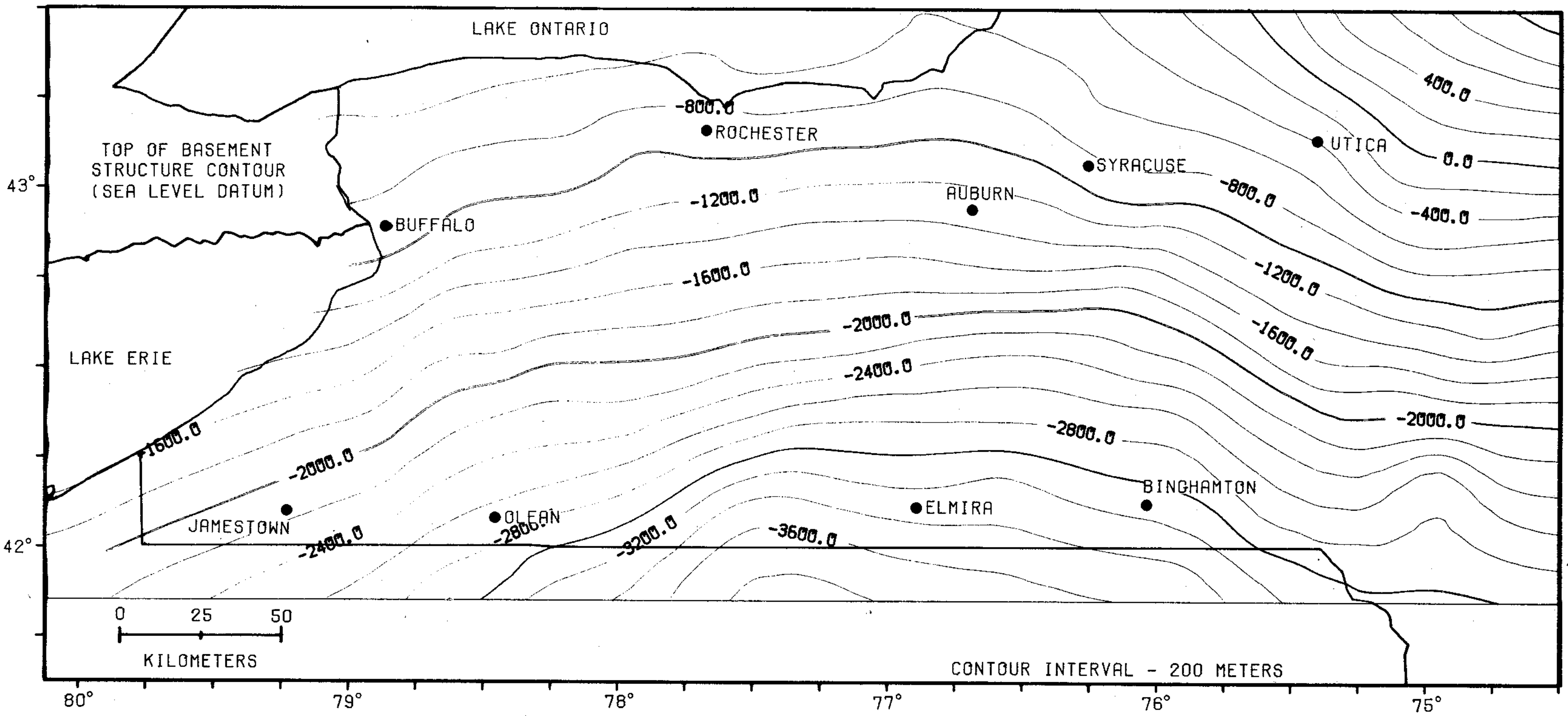


Figure 6-10a - Structure contour map of the depth in meters (sea level datum) to the top of the basement.

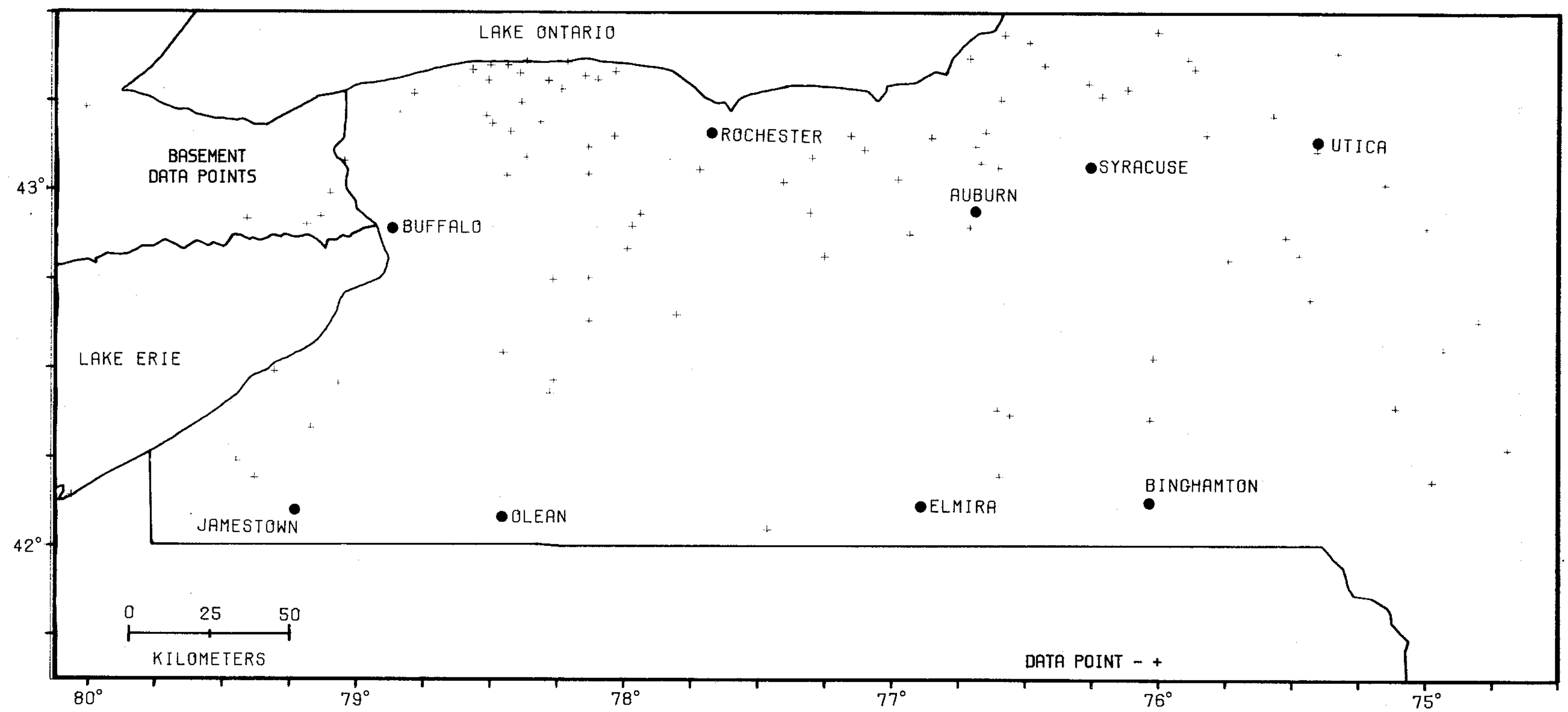


Figure 6-10b - Location of wells with depth to basement data used for structure contour map and trend surface analysis.

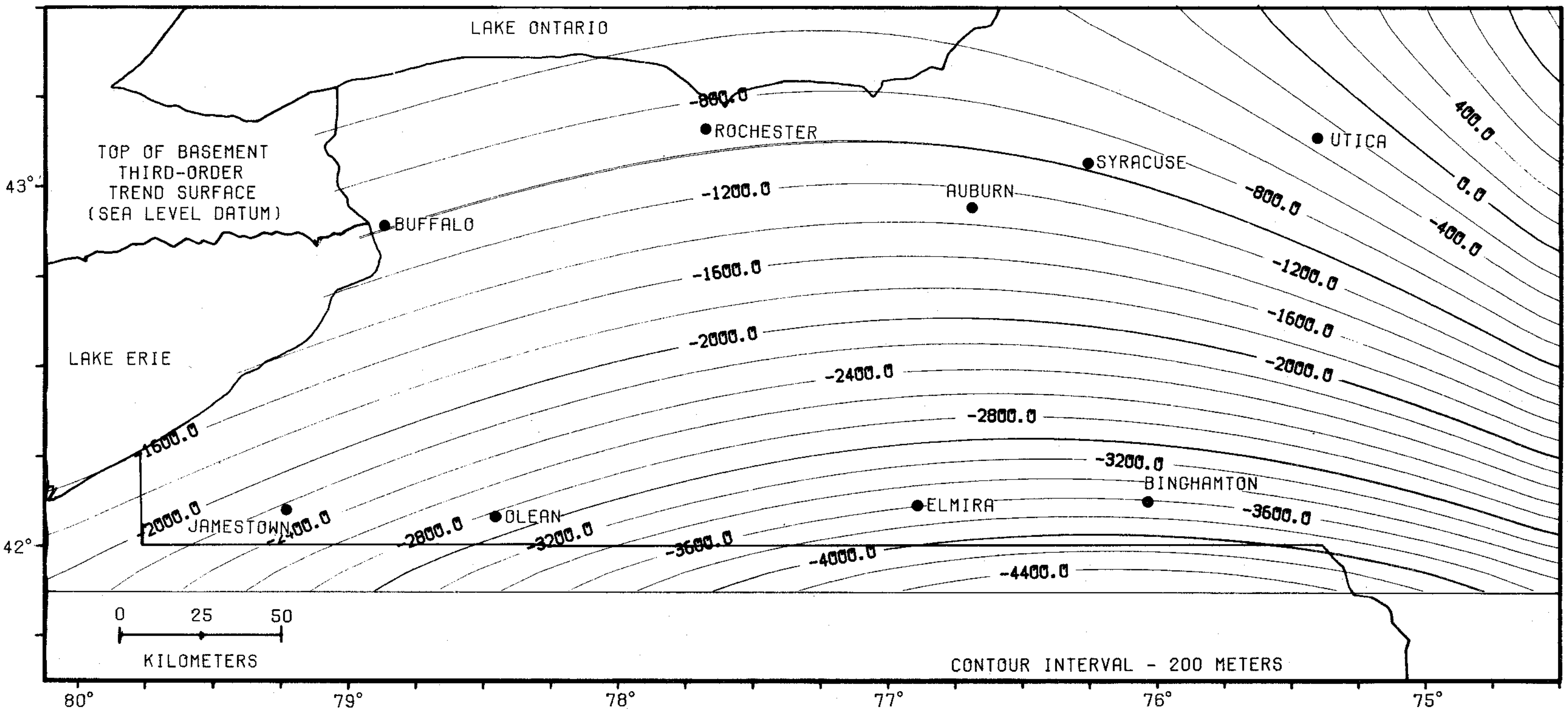


Figure 6-10c - Third-order trend surface of the depth in meters (sea level datum) to the top of the basement.

SECTION 7

HEAT FLOW AND SUBSURFACE TEMPERATURE DISTRIBUTIONS

The mean harmonic conductivity from the surface to the bottom of each BHT well was calculated by solving the trend surface equations for the depth to each layer at the well site, determining which layer the BHT was in, and applying this information along with the conductivity data in Table 7-1 to Equation 6-2. The heat flow then is the average geothermal gradient times the mean harmonic conductivity. The calculated heat flow was then computer contoured at 2 mW/m^2 intervals (Figure 7-1). Values in the data set ranged from 34.3 to 83.1 mW/m^2. The Appalacian basin region generally displays heat flow in the range of 40 to 50 mW/m^2, typical for the northeastern United States, with a distinct positive anomaly in the Auburn area. Very little correlation to gravity (Figure 7-2) or magnetic (Figure 7-3) trends is observed. Comparison with the site-specific heat flow measurement shows that values obtained from the model are in excellent agreement with the Wells College #1 value and the Auburn Lot 39 #1 estimate. Slightly higher heat flow for the Winspear #1 area is predicted by the model.

The heat flow values were then used in conjunction with the conductivity model to

Table 7-1

THERMAL CONDUCTIVITY MODEL FOR WESTERN AND CENTRAL NEW YORK

LAYER #	STRATIGRAPHY: LITHOLOGY	CONDUCTIVITY (W/m°C)
1	Upper-Middle Devonian: Shale with limestone interbeds	1.67
2	Onondaga Limestone-Medina Group: Limestone with interbedded shale, some sandstone	2.2
3	Queenston Formation-Lorraine Group: Predominantly shales in the west, more sandstone in upper section to the east	variable 1.64 - 2.65
4	Trenton Group-Potsdam Formation: Limestone with interbedded shales, dolostone, sandstone	2.95
5	Precambrian: Crystalline basement	2.93

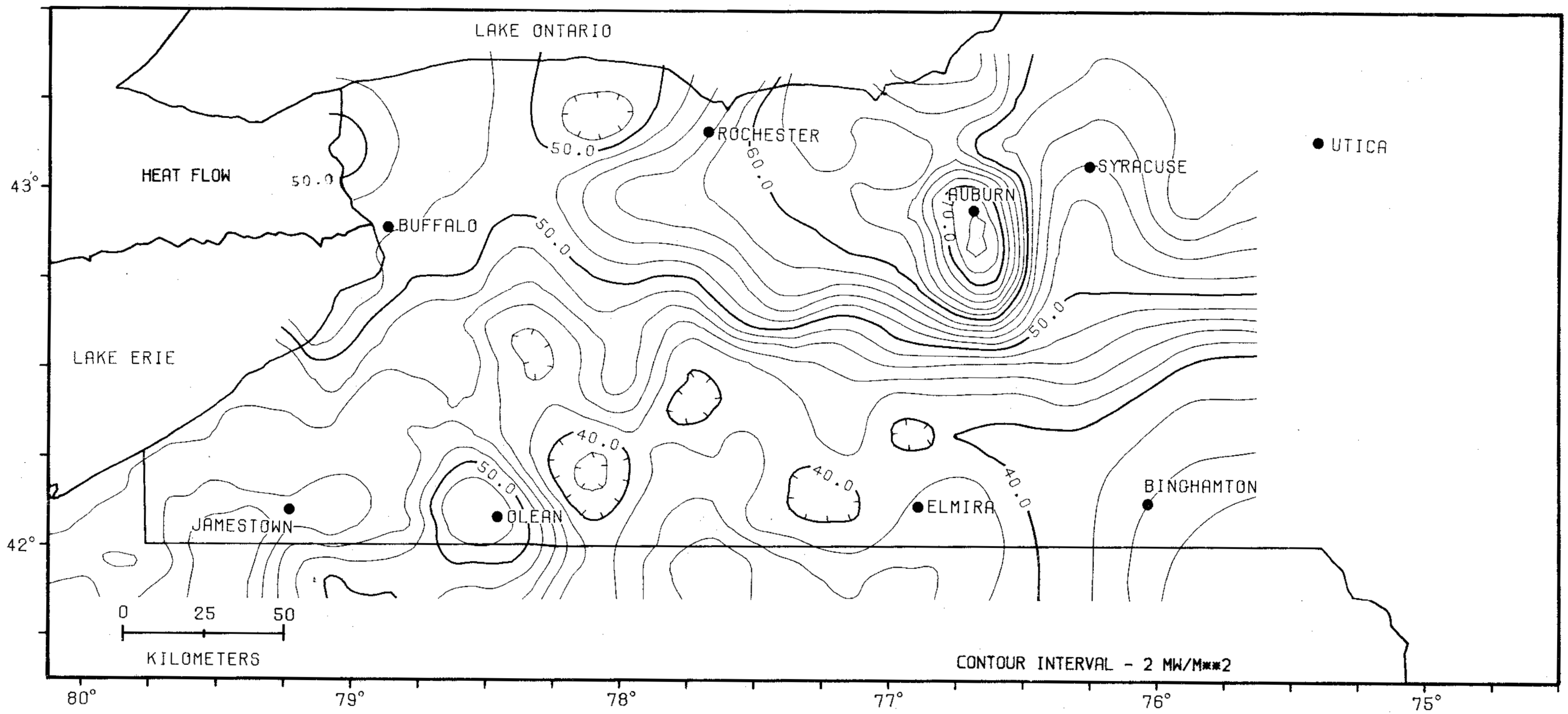


Figure 7-1 - Heat flow in New York based on average geothermal gradient from surface temperature - BHT and thermal conductivity model.

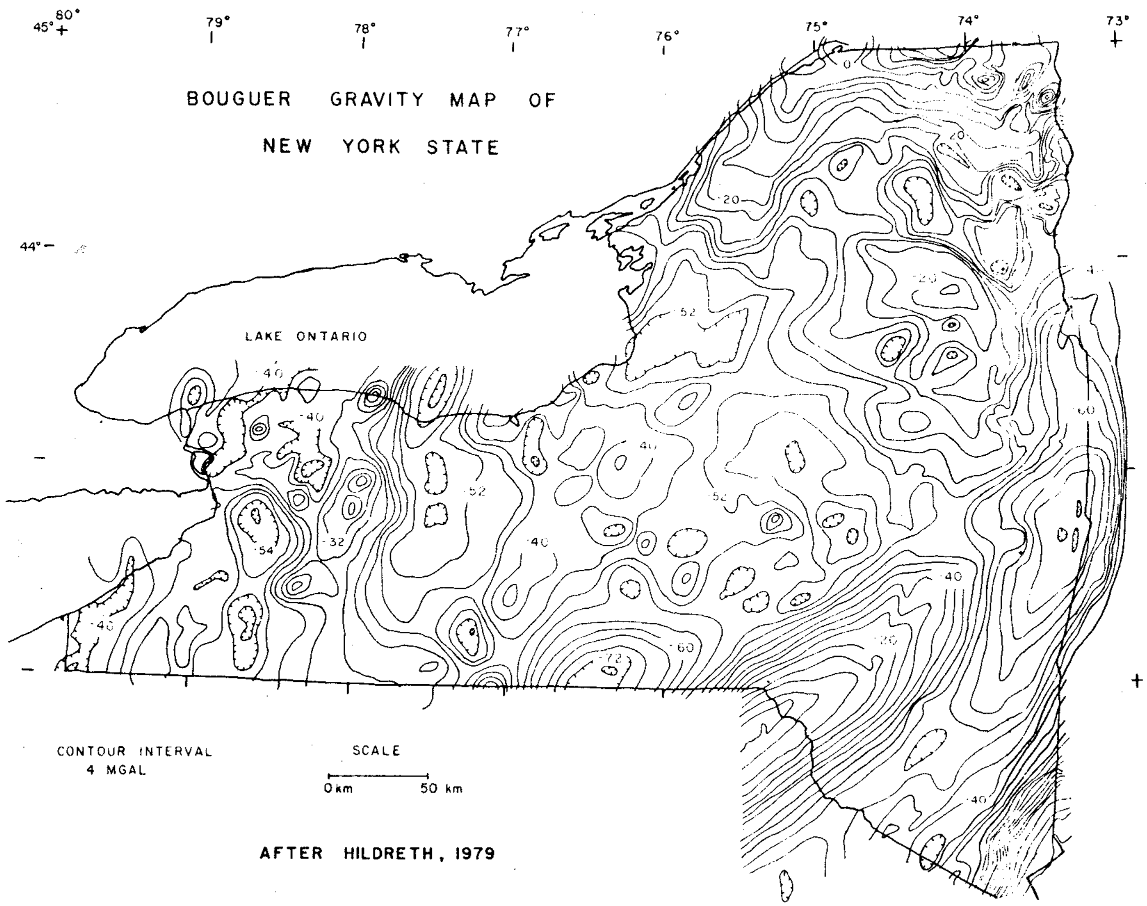
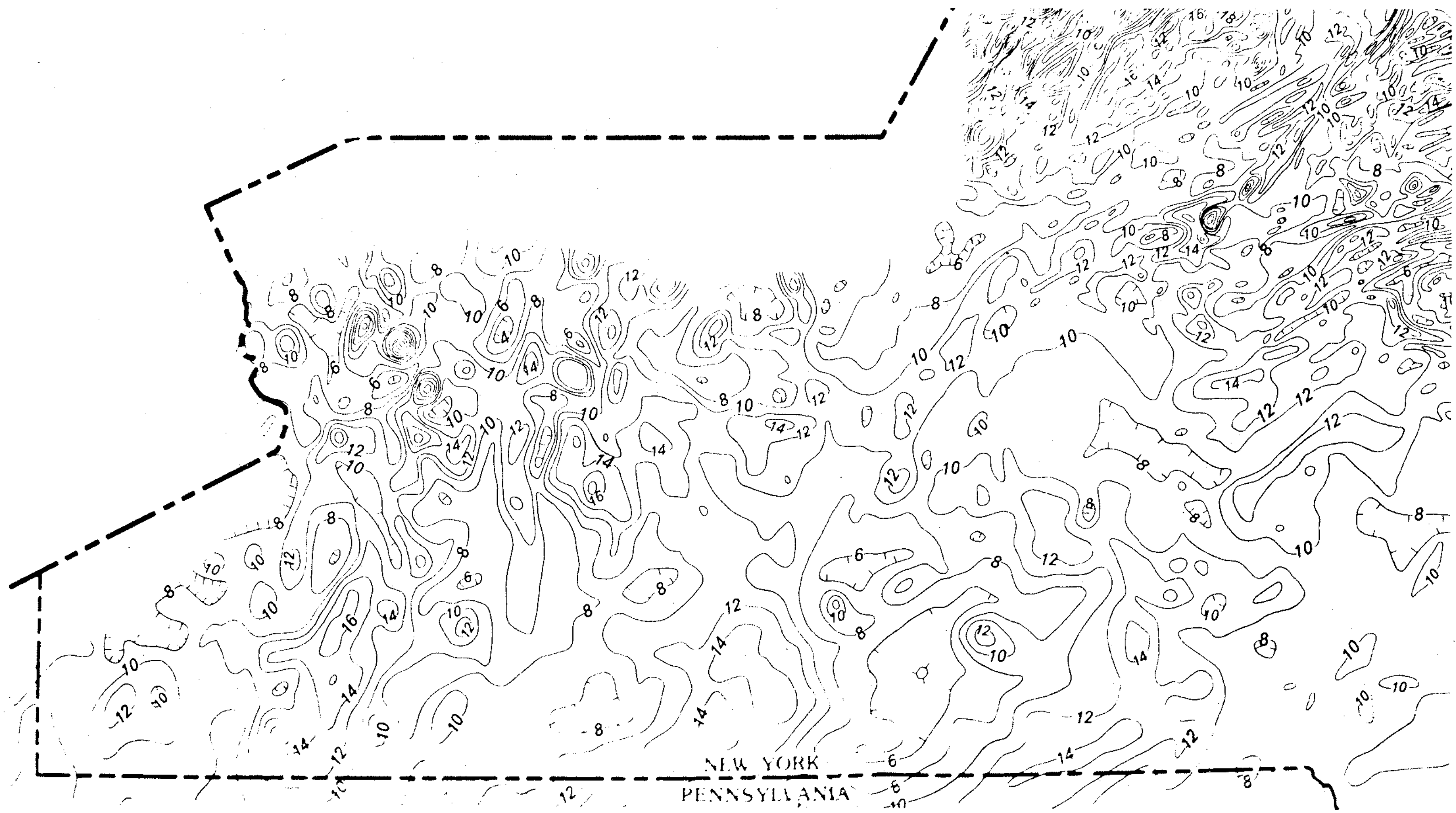


Figure 7-2 - Bouguer Gravity map of New York State.



MAGNETIC CONTOURS

Showing total intensity magnetic field of the earth in hundreds of gammas relative to arbitrary datum. Dashed where inferred; hachured to indicate areas of lower magnetic intensity. Main magnetic field of the earth from Barraclough and Fabiano (1975) has been removed from areas 12, Y2, U2, Y2, S3, and V3; main magnetic field of the earth from Fabiano and Peddie (1969) has been removed from all remaining areas. Contour interval 200 gammas.

Figure 7-3 - Magnetic map of New York (from Zietz and Gilbert, 1981).

extrapolate the subsurface temperatures (Figure 7-4 through 7-8b). Based on the possibility of a drilling disturbance depressing the observed bottom-hole temperatures, temperature distributions were also analyzed using a correction factor to bottom-hole temperature developed by the American Association of Petroleum Geologists during their geothermal survey of North America (A.A.P.G., 1971). Their study statistically derived a correction factor to apply to bottom-hole temperatures which are logged soon after cessation of drilling. The correction was derived from equilibrium temperatures in 602 wells in west Texas and southern Louisiana. The wells were reentered long after the drilling disturbance had dissipated, and the BHT was measured. These temperatures were then compared with the original BHT recorded, and an empirical relation of the drilling disturbance to the depth of the BHT was established. The equation derived to simulate the A.A.P.G. correction is:

$$\begin{aligned} \text{BHTCOR} = & -1.055\ (^{\circ}\text{F}) + ((0.4485 \times 10^{-2}\ (^{\circ}\text{F/ft})) \times (\text{DEPTH})) - \\ & ((0.1903 \times 10^{-7}\ (^{\circ}\text{F/ft}^{2})) \times (\text{DEPTH}^{2})) - \\ & ((0.9250 \times 10^{-11}\ (^{\circ}\text{F/ft}^{3})) \times (\text{DEPTH}^{3})) \end{aligned} \quad (7\text{-}1)$$

where BHTCOR is the correction factor in degrees Fahrenheit and DEPTH is the depth to the BHT in feet. The problem with this relation is it was derived from wells in an area where drilling mud is employed for most of the drilling operation. The wells drilled in New York, except for very deep ones, are drilled primarily with compressed air. It cannot be expected that the transfer of heat from the borehole will be as effective with air as with mud; the conductivity of air is generally several orders of magnitude less. Therefore, this correction must be considered to overestimate the boundary of the correction which should be made. Actual determination of an empirical corrective factor for air-drilled wells would require logging the BHT in many wells at different depths over time. Additionally, much of the information which would be necessary to properly apply a correction (eg., length of actual drilling time, presence of formation fluids in the well during drilling, time after cessation of drilling that the BHT was recorded) is commonly not available. A theoretical study of a corrective factor for the wells in New York to determine the precision of the A.A.P.G. correction is presented in the next section.

The depths (sea level datum) to 30°C (Figure 7-4a) and 50°C (Figures 7-5a, b) were calculated from Equation 6-6. Similarly, the depths below the surface to these temperatures were also mapped (Figure 7-4b and Figures 7-5c, d respectively) as a general guideline for the drilling depth to these temperatures; a considerable topographic effect may exist in areas of these maps. Temperatures at the top of the Trenton Group (Figures 7-6a, b), the top of the Theresa Formation (Figures 7-7a, b), and the top of the basement (Figures 7-8a, b) were calculated based on Equation 7-1. The depth that the temperature gradients had to be extrapolated from was determined from the trend surfaces and structure contour maps of these horizons (see Figures 6-8a through 6-10c). The general character of all the maps, especially the depths to 30 and 50°C, mimics the heat flow map as expected. Thirty and 50°C are encountered at shallower depths over areas of higher heat flow. The temperature maps of the horizons show the additional effect of increasing depth toward the south superimposed upon the elevated temperatures in areas of relatively higher heat flow. It can also be seen that the increase in temperature along the horizons toward the south becomes more rapid as a result of increased dip of the horizons in that area.

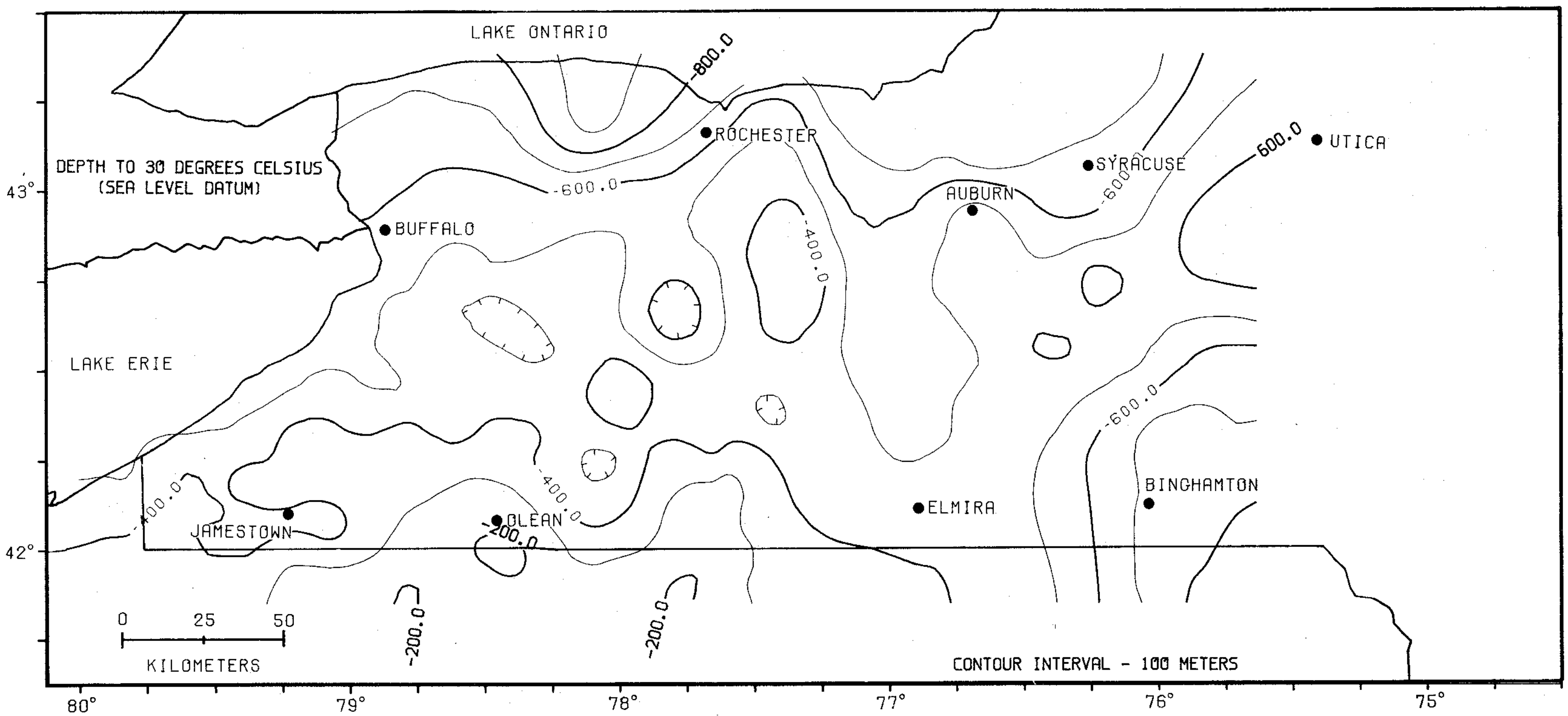


Figure 7-4a Depth to 30° C (sea level datum).

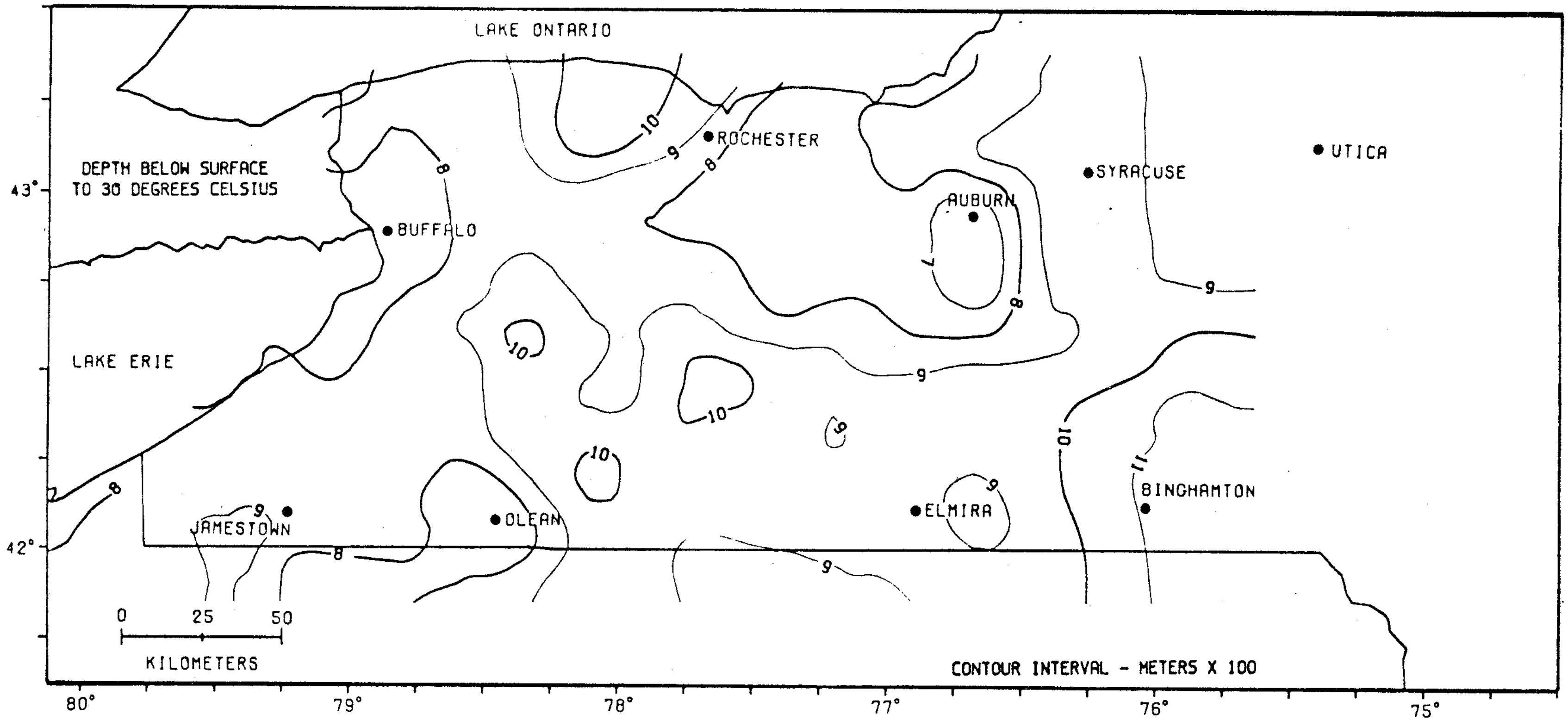


Figure 7-4b - Depth below surface to 30° C, no drilling disturbance correction.

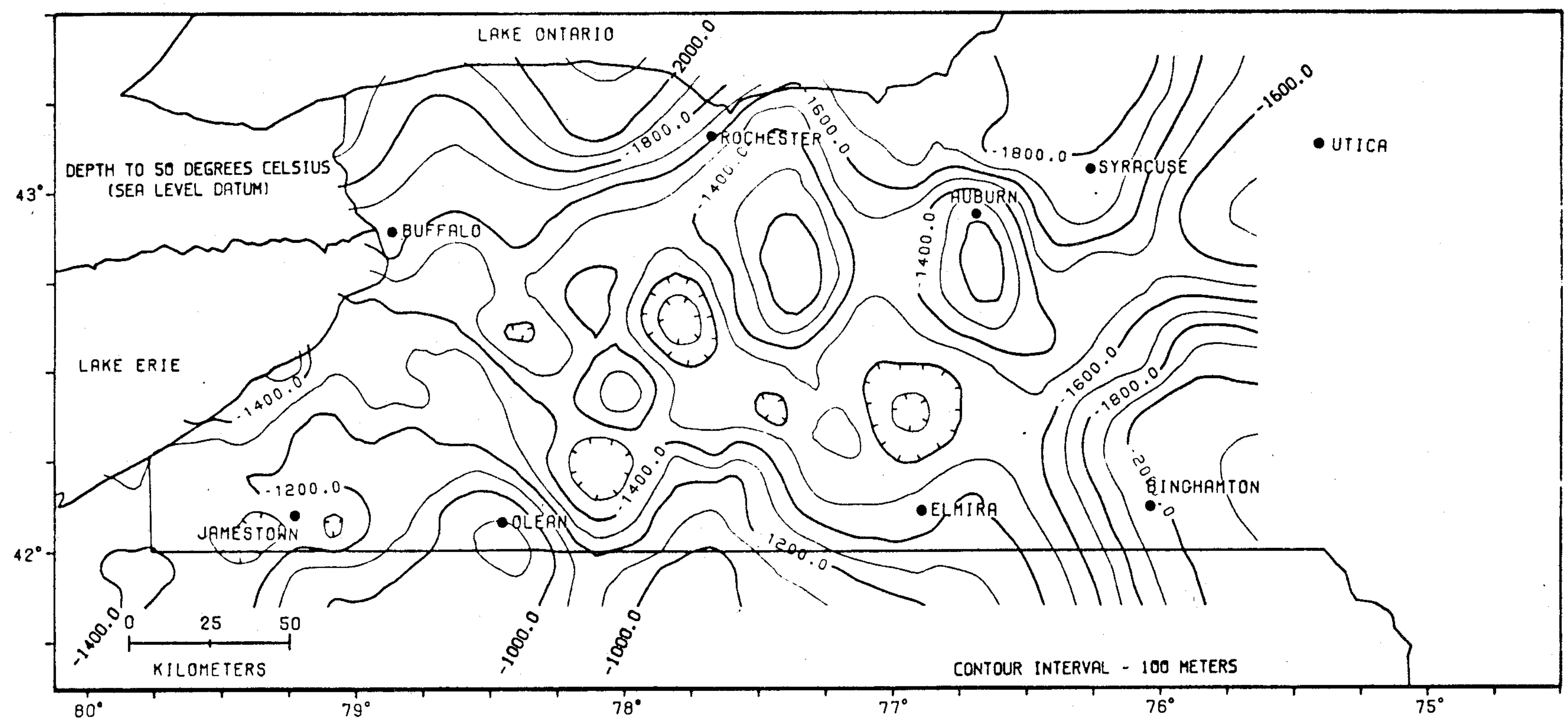


Figure 7-5a - Depth to 50° C (sea level datum), no drilling disturbance correction.

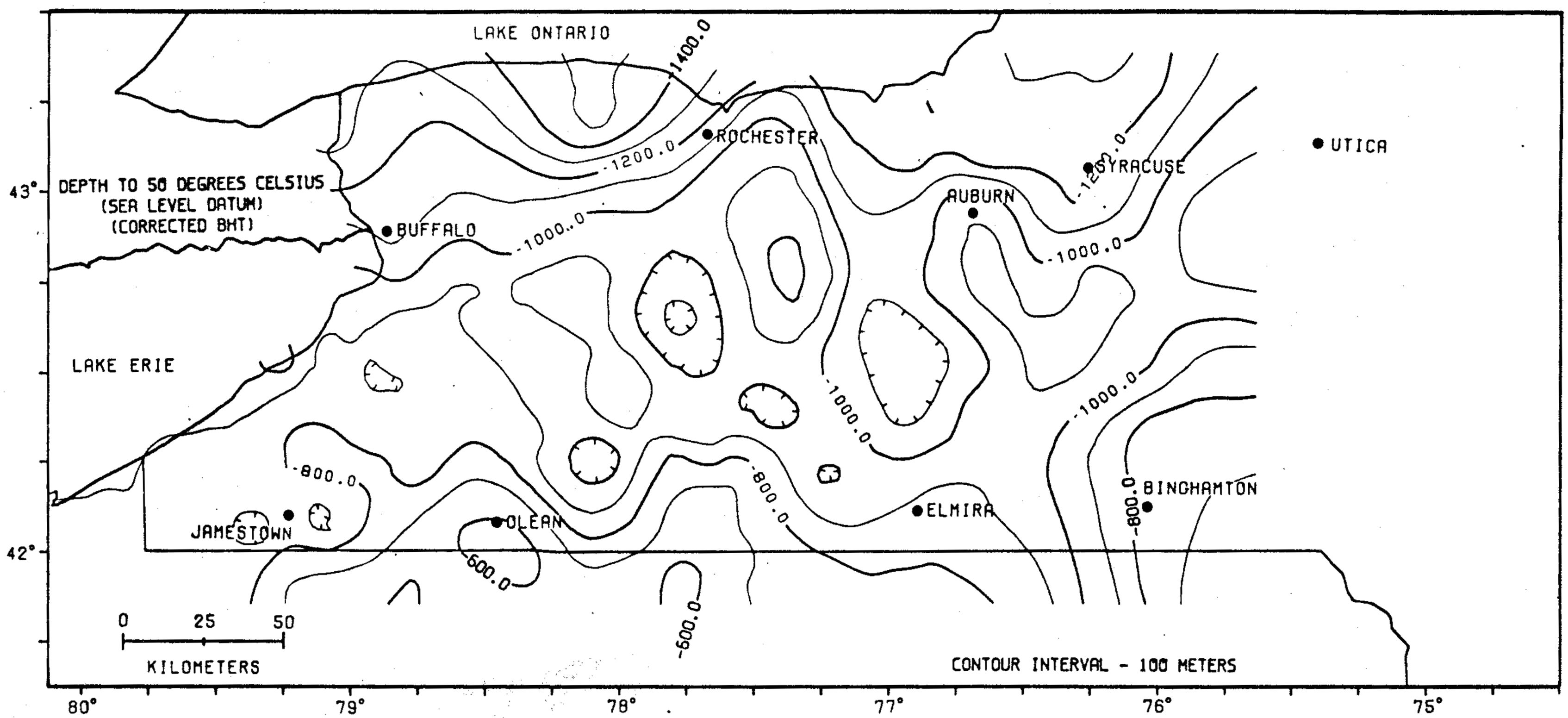


Figure 7-5b - Depth to 50° C (sea level datum), BHT correction applied.

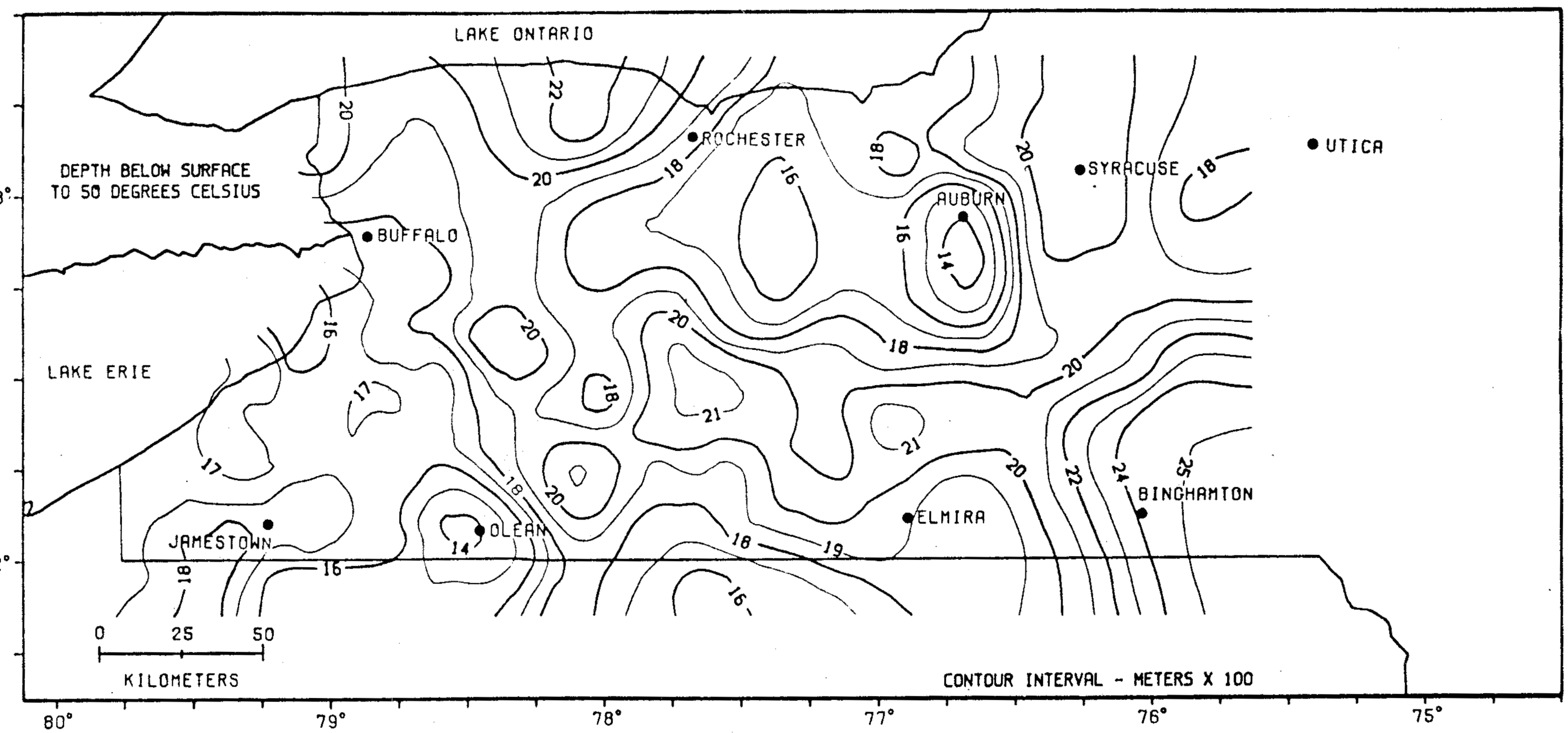


Figure 7-5c - Depth below surface to 50° C, no drilling disturbance correction.

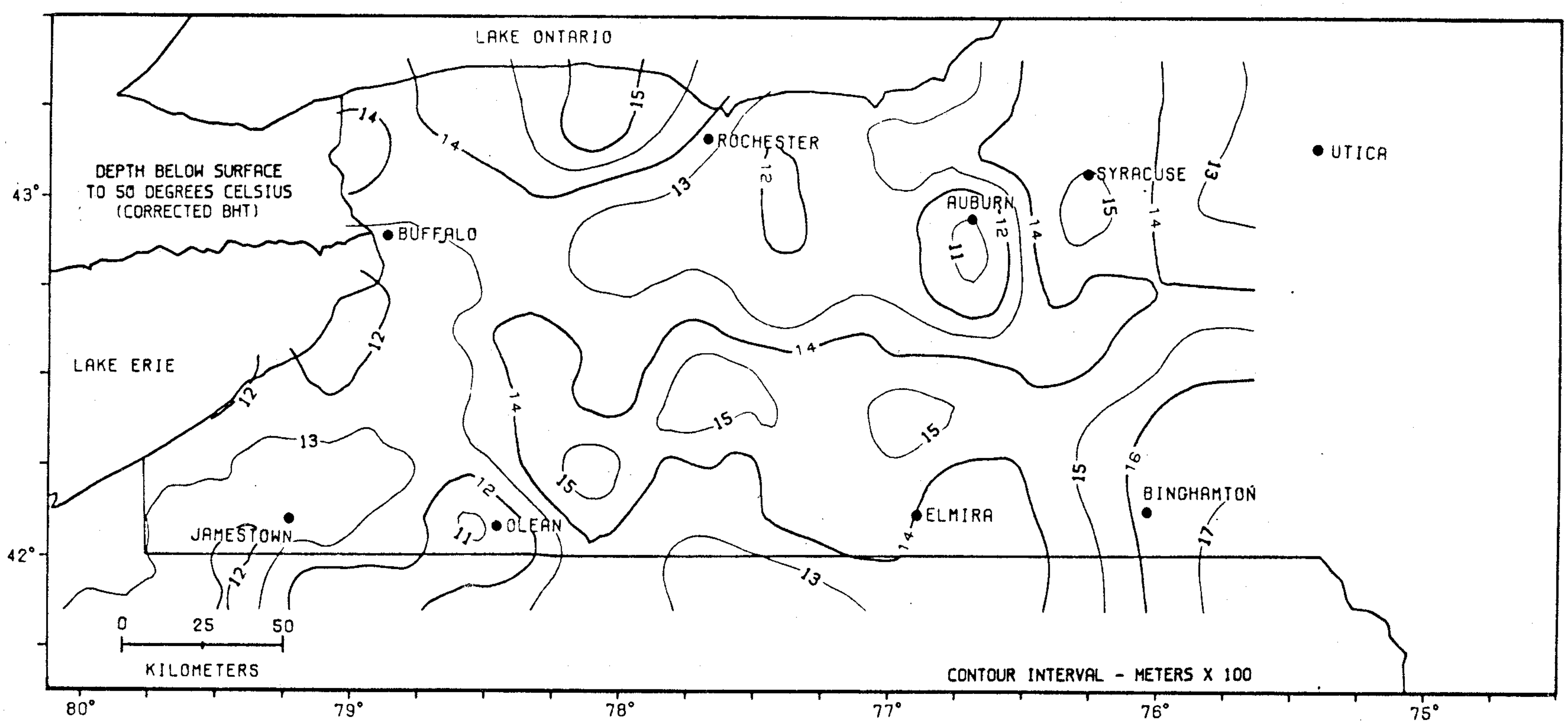


Figure 7-5d - Depth below surface to 50° C, BHT correction applied.

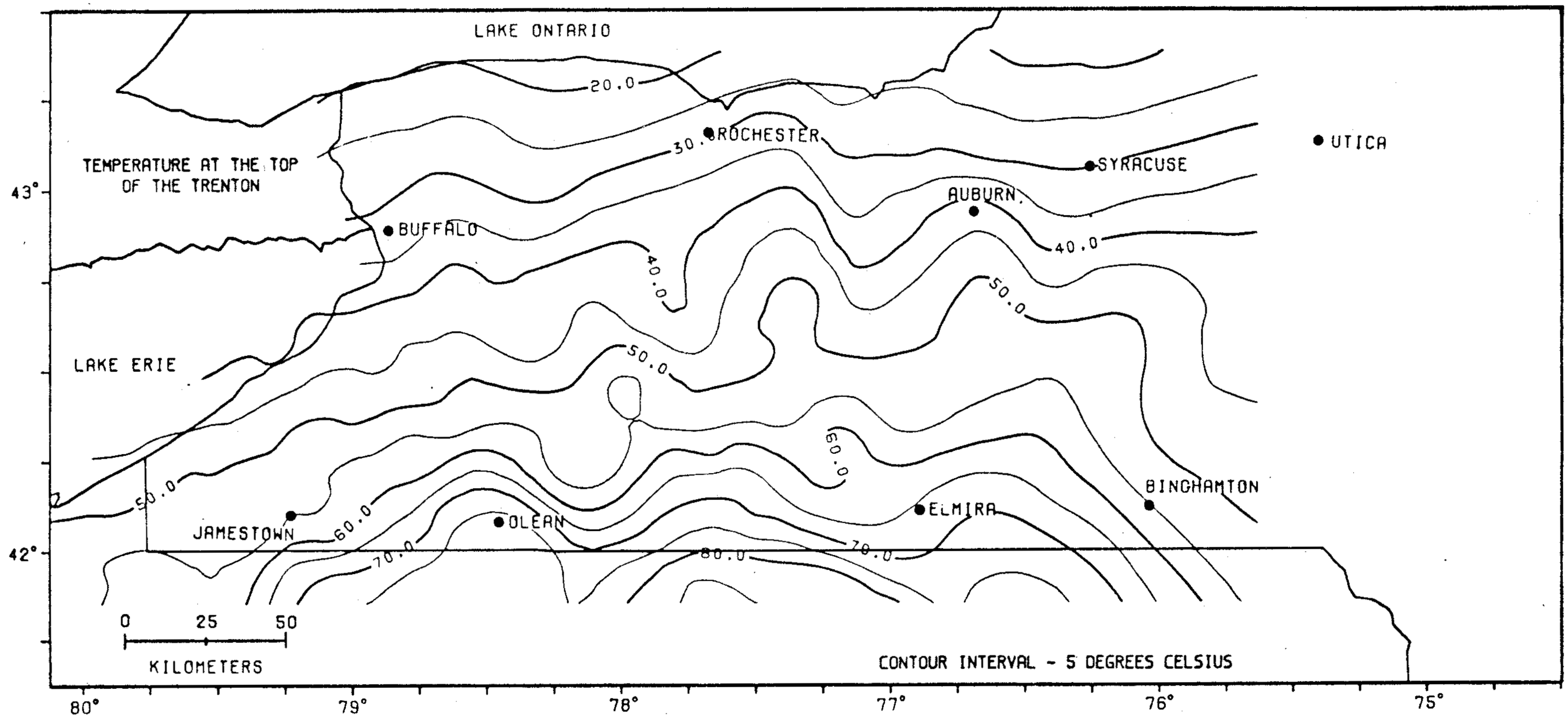


Figure 7-6a - Temperature at the top of the Trenton Group (degrees Celsius), no drilling disturbance correction.

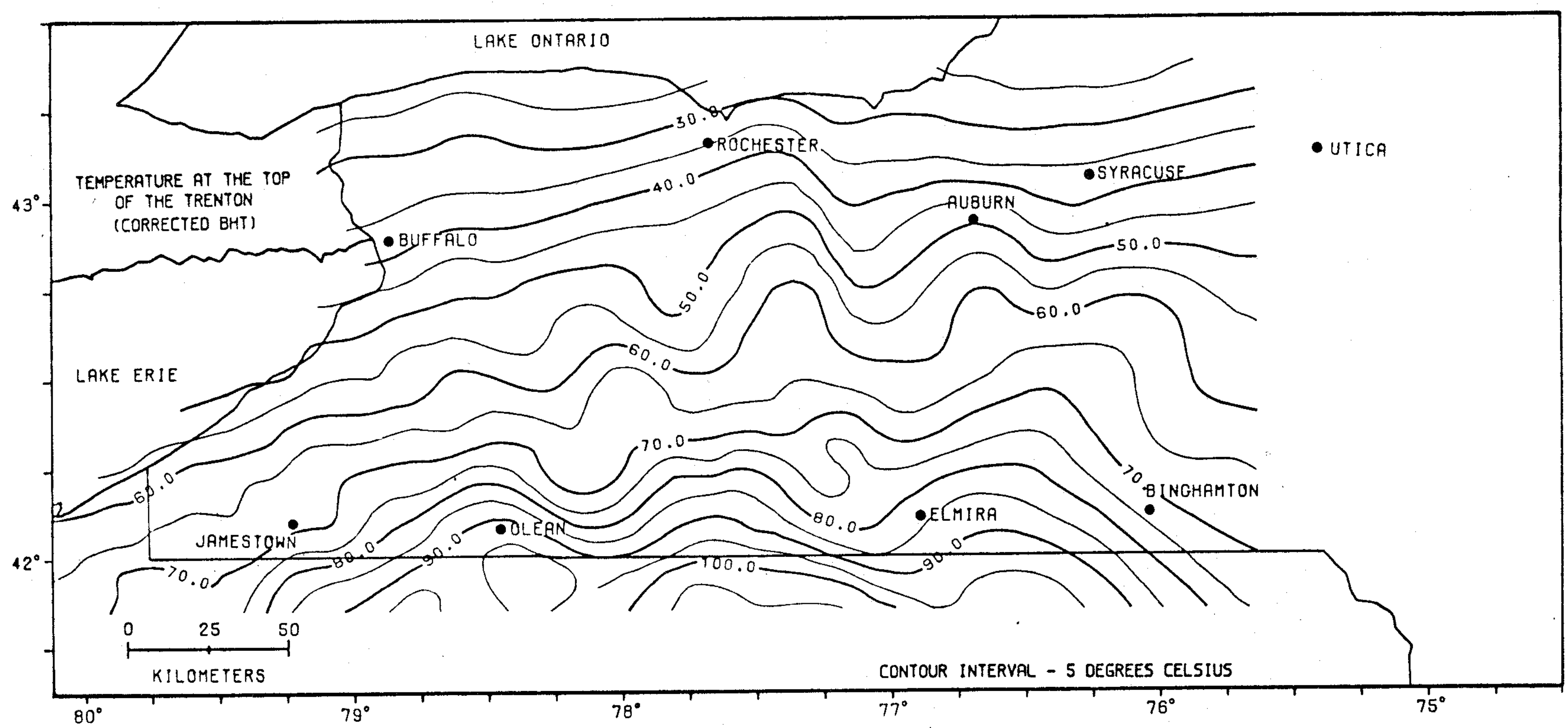


Figure 7-6b - Temperature at the top of the Trenton Group (degrees Celsius), BHT correction applied.

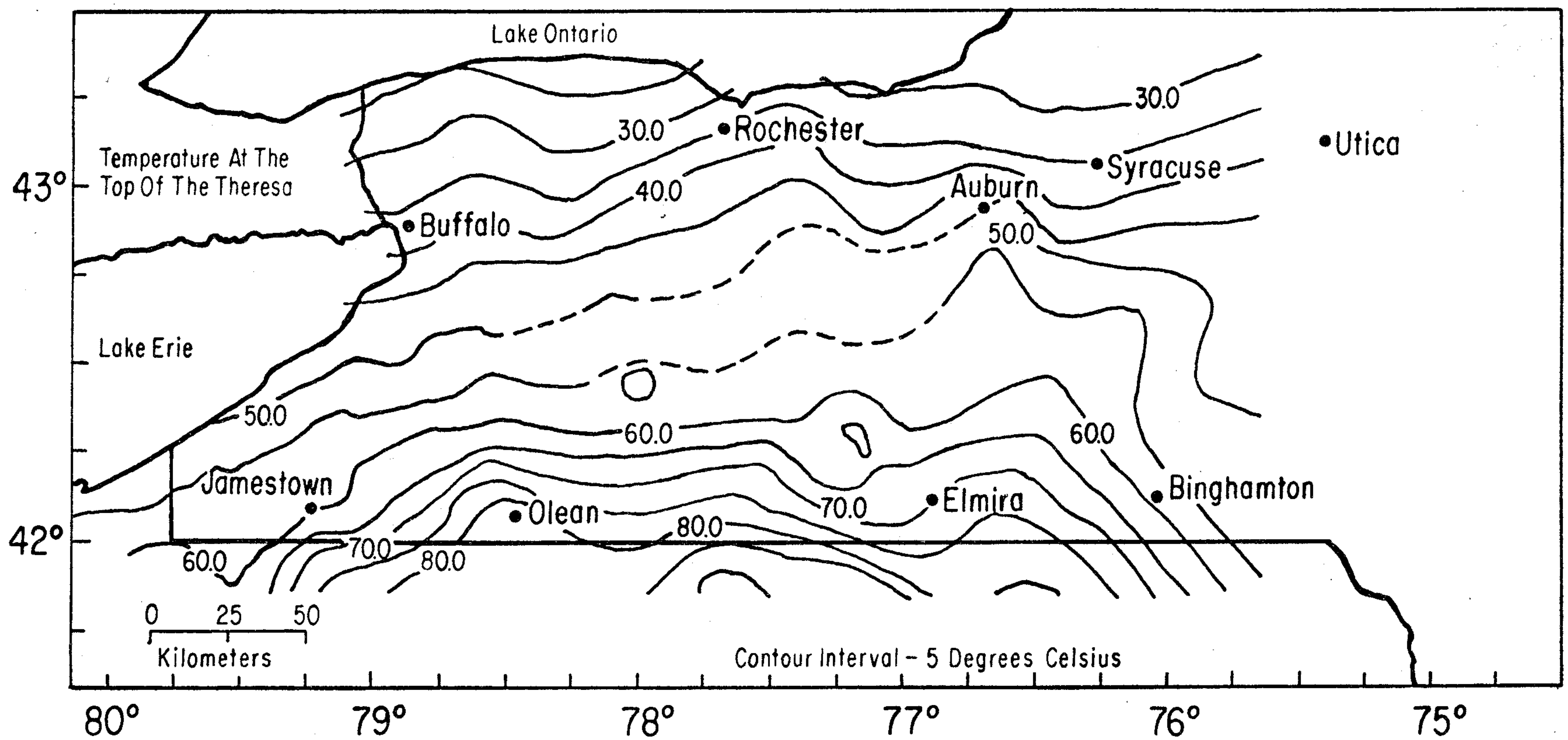


Figure 7-7a Temperatures at the top of the Theresa Formation. No drilling disturbance correction has been applied to the data.

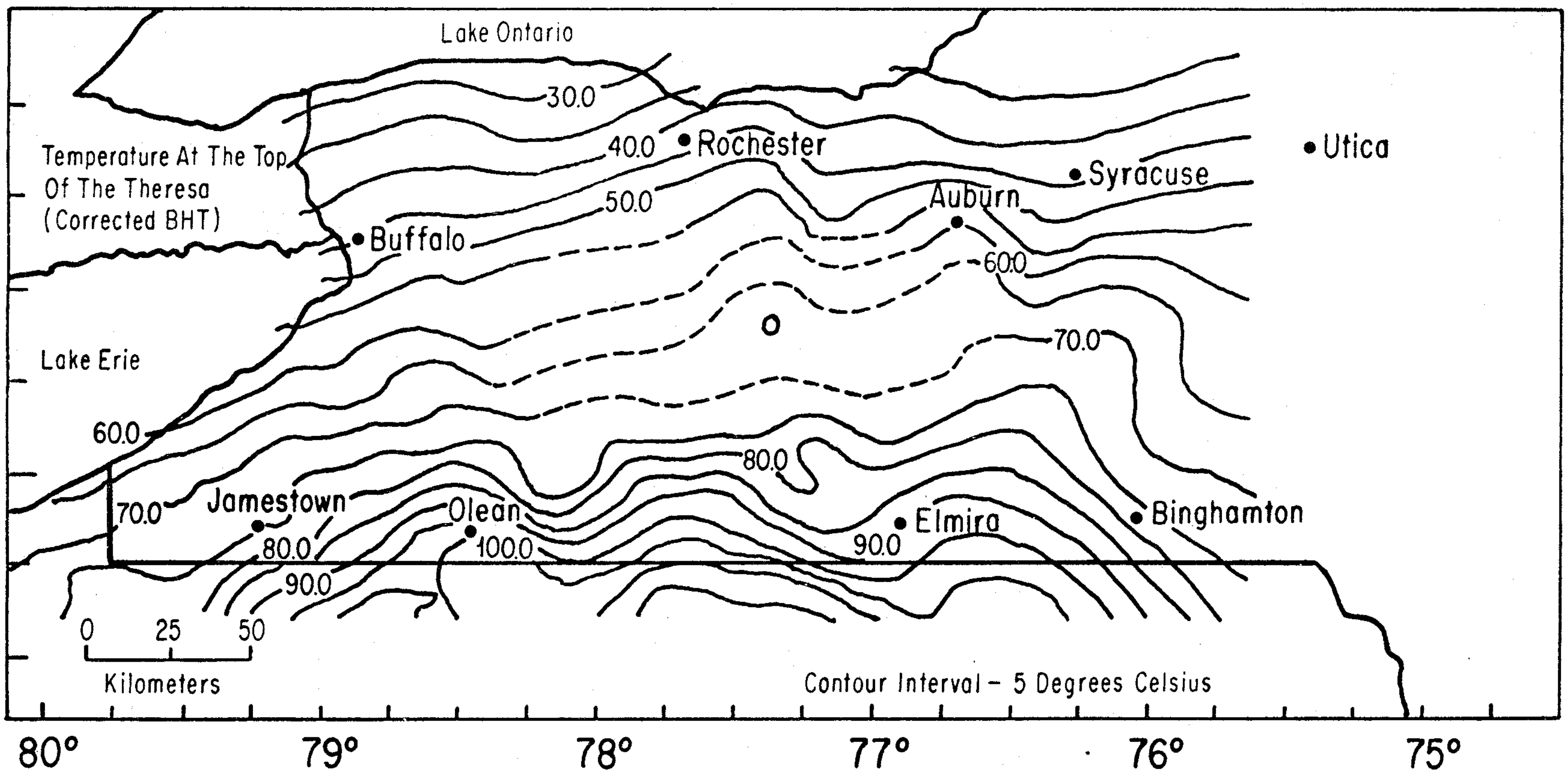


Figure 7-7b Temperature at the top of the Theresa Formation, corrected for BHT disturbance. Dashed contour lines indicate areas where BHT is scarse and some BHT data are variable due to geologic conditions.

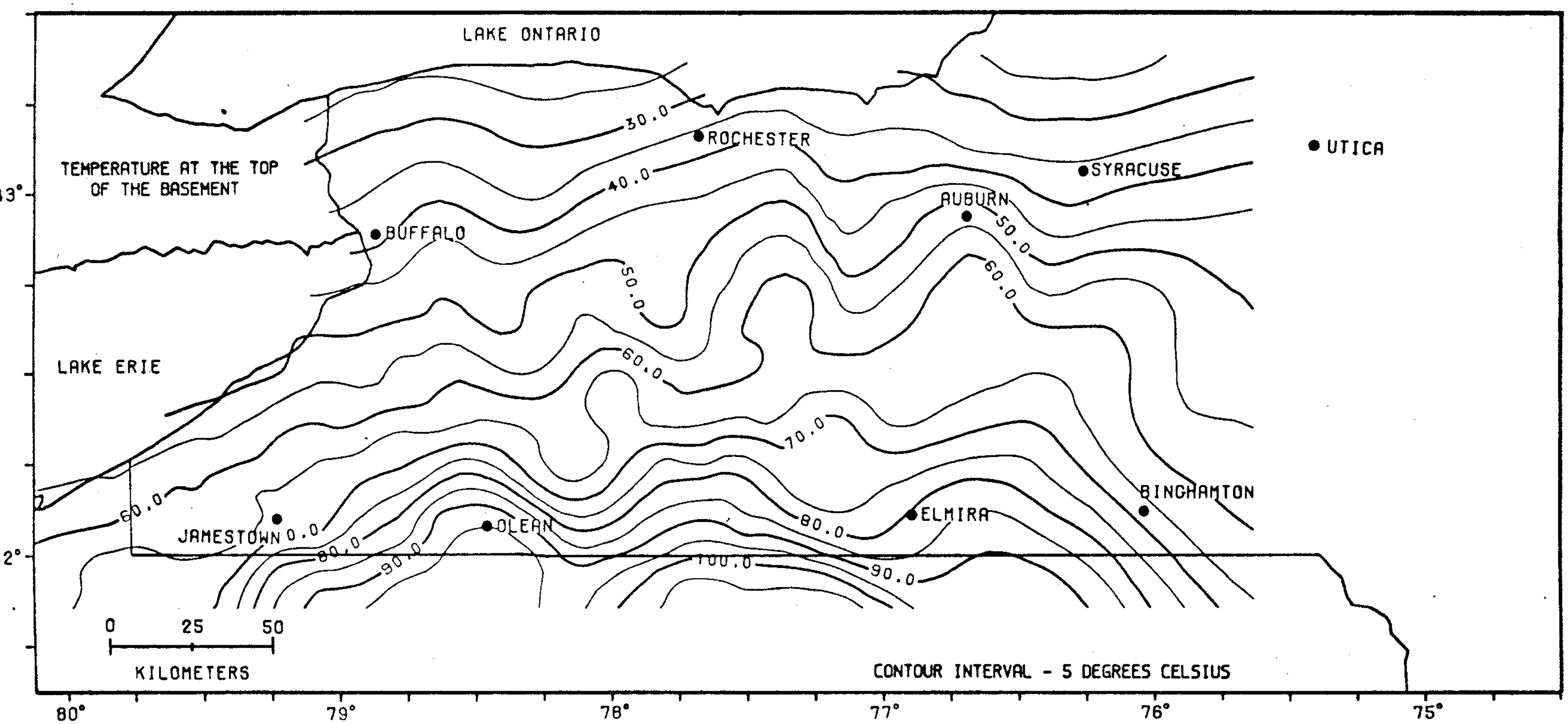


Figure 7-8a - Temperature at the top of the basement (degrees Celsius), no drilling disturbance correction.

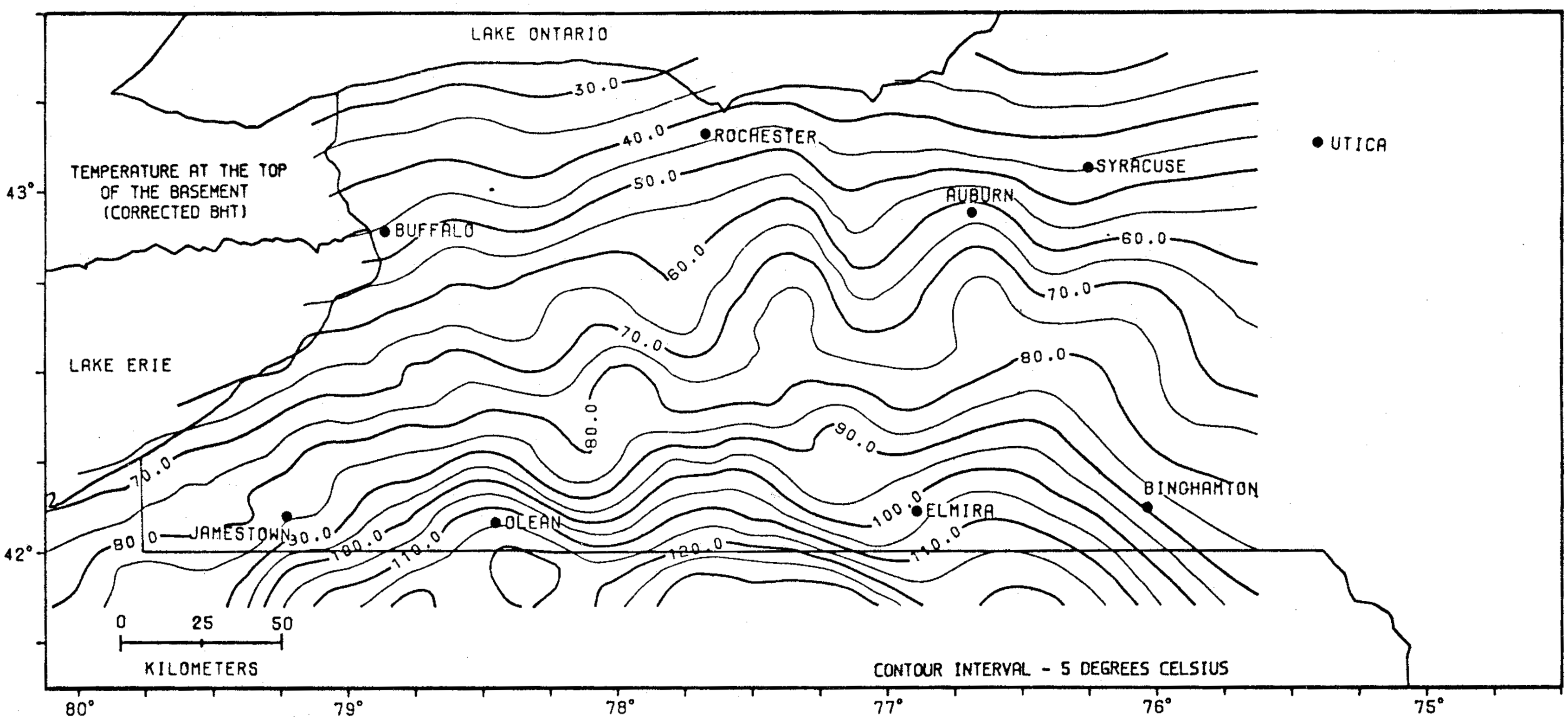


Figure 7-8b - Temperature at the top of the basement (degrees Celsius), BHT correction applied.

Evaluation of the accuracy of the model in predicting the temperature at depth was done by examining the actual temperature-depth distributions of bottom-hole temperatures in various subareas of the study area (Figure 7-9). BHT versus depth (sea level datum) was plotted, and theoretical gradients were calculated based on a general heat flow value for the area obtained from: 1) the heat flow map, 2) average depths to the conductivity layer horizons in the area, and 3) the conductivity model (Table 7-1). In some cases a shallow detailed temperature log was available to use as an estimate for heat flow in the area and to provide a point from which theoretical gradients could be projected (Appendix B). When these were not available, the absolute temperature encountered along the gradient is subject only to a best-fit approximation; the relative changes in gradient are the important factor. The temperatures which are encountered at shallower depths will generally follow the theoretical gradient as they are extrapolated to greater depths; the degree to which they approximate actual temperatures recorded at greater depths (as they follow the changing gradient) is a measure of the accuracy of the model. In the presence of a shallower temperature within the area of "fix", the gradient provides an extra factor to check this accuracy. Testing the model in this fashion is subject to limitations. Generally, temperature data is concentrated at a particular depth. This is because the nature of oil and gas exploration tends to concentrate on a "target" formation in an area which has proven resources. These oil and gas targets are shallower, for the most part, than the geothermal targets of interest. Deeper temperatures are available though, and the areas investigated were chosen based on their presence. There is also the effect of the slightly dipping horizon of the conductivity layers which is not shown on these plots. This, in addition to the possible presence of

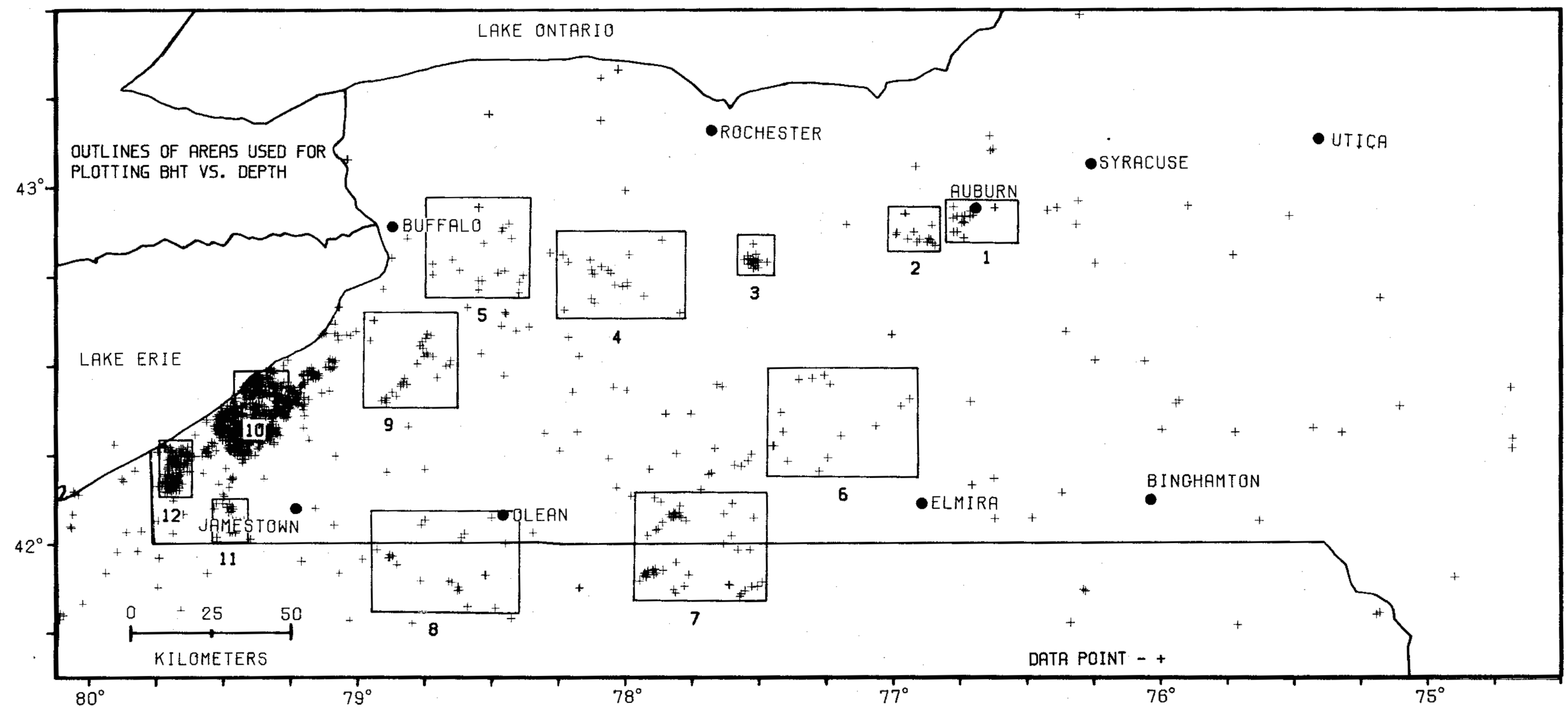


Figure 7-9 - Outlines of areas used to examine the accuracy of temperature at depth distributions by plotting BHT versus depth (sea level datum).

disequilibrium temperatures, causes the temperatures to spread out rather than align along a gradient.

The plot of BHT versus depth for Area 1, near Auburn in Cayuga County, includes detailed temperatures measured in well #13784 (Figure D-1). The general heat flow for the area is 70 mW/m^2, while an estimated value for the detailed well is 76 mW/m^2; theoretical gradients for these values of heat flow are shown as dashed lines. The average depths to the conductivity layers and the Theresa Formation in the area were obtained from the structure contour maps and are noted on the right-hand side of the plot as: 1) Onondaga (ON), 2) Queenston (QU), 3) Trenton (TR), 4) Theresa (TH), 5) basement (BA). This format is followed for all 12 areas investigated (Figures D-1 through D-12). The conductivities used for the layers are given in Table 7-1. The Queenston conductivity, which changes from east to west, for this area is approximately 2.63 $W/m^{o}C$. Plotted gradients show good agreement with the deeper temperature data. It can be seen that continuation of the relatively higher gradient encountered in the detailed log, approximately $34.5^{o}C/km$, without regard for changing conductivity would have resulted in a higher predicted temperature ($63.2^{o}C$) for the top of the basement than the range shown ($52.6 - 55.9^{o}C$) by the gradients which change when a layer of different thermal conductivity is encountered. Furthermore, if the average geothermal gradients from the surface temperature and the BHT had been extrapolated for the shallower wells in the area, the range of predicted temperatures at the top of the basement would be 62 to $80^{o}C$; this clearly contradicts the actual BHT values at this depth. The temperature at the top of the basement mapped in Figure 7-8a for this area coincides with the values obtained from the gradients which change with conductivity.

The other areas analyzed in this manner show similar agreement to Area 1. Though horizontal changes in the thermal conductivity of the layers undoubtedly exist, the model provides a generally good constraint on the process of extrapolating temperature at depth for the available BHT data. Without this constraint, the temperatures derived from near-surface gradients would not be meaningful in terms of steady-state heat conduction through a medium of changing thermal conductivity.

SECTION 8

THEORETICAL ESTIMATES OF BHT CORRECTION

Since the construction of heat flow maps and estimates of subsurface temperatures relies on the accuracy of the estimated bottom-hole temperature (BHT), analysis of the possible limits of the BHT correction are important. Early studies by Kehle (1973) used a large set of data from the Gulf Coast region to determine the BHT correction. Recent studies by Leblanc et al. (1981) and by Middleton (1982) evaluated the BHT correction by theoretical methods based on the solution of the heat-conduction equation presented by Carslaw and Jaeger (1959). This study uses the solution of the BHT correction presented in Middleton (1982) with parameters and conditions specifically based on the geology of New York State.

In New York, most oil and gas drilling is done by air percussion techniques although some wells circulate water or mud. The important parameters to consider when measuring BHT include rock conductivity and diffusivity, drilling media conductivity and diffusivity, geometry of the borehole, time elapsed since circulation and drilling technique. Standard rock densities and heat capacities were used to define an upper and lower boundary of the diffusivities for sedimentary rocks. Values of rock conductivities in New York State typically range from 3.63 to 2.53 W/m^{o}C (Hodge et al., 1979). The estimated diffusivities range from .010 to .006 cm^2/s. The values of conductivity and diffusivity for the mediums considered are listed in Table 8-1:

Table 8-1

		Conductivity (W/m°C)	Diffusivity (cm^2/s)
Rock:	High	3.63	.010
	Low	2.53	.006
Water		.585	.0017
Air		.025	.18
Mud		.920	.0022

The heat conduction equations governing temperature distribution in the borehole (medium 1) and the country rocks (medium 2) are:

In medium (1) $$\frac{\partial^2}{\partial r^2} T_1 + \frac{1}{r}\frac{\partial}{\partial r} T_1 - \frac{1}{k_m}\frac{\partial}{\partial t} T_1 = 0 \qquad (8\text{-}1)$$

In medium (2) $$\frac{\partial^2}{\partial r^2} T_2 + \frac{1}{r}\frac{\partial}{\partial r} T_2 - \frac{1}{k_f}\frac{\partial}{\partial t} T_2 = 0 \qquad (8\text{-}2)$$

where r is the distance from the center of the borehole, T is the temperature, k_m is the diffusivity of the rock, and k_f is the diffusivity of the fluid in the borehole.

The initial and boundary conditions assume that the temperature in the rock at a distance unaffected by the drilling is T_f and the temperature in the borehole initially is T_m. The radius of the borehole is specified as "a". At the contact of the borehole and the country rock, equal heat flow is required. Using these conditions, the solution of the heat conduction equation in the borehole (Equation 8-1) is:

$$T_1(r_1 t) = T_f - (T_f - T_m)\frac{4}{\pi^2 a}\int_0^\infty \frac{e^{-k_m u^2 t} J_0(ur)J_1(ua)du}{u^2[A^2(u) + B^2(u)]} \qquad (8\text{-}3)$$

The temperature at the bottom of the borehole at a specific time since cessation drilling fluid circulation is BHT(t). This gives the conditions whereby

$BHT(t) = T(t)$

$BHT_{init} = T_m$

so that at the center of the borehole (r = 0), the BHT at any time can be solved.

$$\frac{(BHT(t) - BHT_{init})}{(T_{formation} - BHT_{init})} = 1 - \frac{4}{\pi^2 a}\int_0^\infty \frac{e^{-k_m u^2 t} J_1(ua)du}{u^2[A^2(u) + B^2(u)]} \qquad (8\text{-}4)$$

where:

$A(u) = KJ_1(ua)J_0(kua) - (k/K)J_0(ua)J_1(kua)$

$B(u) = KJ_1(ua)Y_0(kua) - (k/K)J_0(ua)Y_1(kua)$

$k = (k_m/k_f)^{0.5}$

$K = (K_m/K_f)^{0.5}$

J_0, J_1, Y_0, Y_1 are Bessel functions.

Equation 8-4 was solved by Simpson's numerical integration technique. The Bessel functions were evaluated by scientific routines on the State University of New York at Buffalo CDC Cyber 170 system.

When solving for the equilibrium BHT, it is essential that the initial temperature of the medium, T_m, used in drilling the borehole is different from the formation temperature, T_f. Also, it has to be assumed that there is no further leakage of this medium into the country rock after drilling has ceased. If the well is cased all the way down, this assumption is good. In terms of BHT stabilization, leakage means equilibrium will take longer.

When the time after cessation of drilling is plotted against $((BHT(t)-BHT_{init})/(T_{formation}-BHT_{init}))$ (from Equation 8-4), the resultant curves (Figure 8-1) show how quickly BHT equilibrium is reached. A value of 1.0 represents the situation where equilibrium has been reached, ie. $T_{bottom\ hole} = T_{formation}$. A value of 0.0 represents the initial condition. From these curves, qualitative estimations of how much time must pass before there are no longer measurable differences between the bottom hole temperature and the formation temperature can be made. As would be expected, different medium in the boreholes behave quite differently in terms of the amount of time necessary to equilibrate. Air equilibrates in a matter of minutes, water and mud in a matter of hours.

The validity of the numerical algorithm was checked against other methods of measurement and the small differences in values found could be attributed to numerical error. Some of these checks included matching the numerical algorithm solution against the solution predicted by the one medium analytical solution. That same solution was also tested against an analytical solution using a constant temperature boundary condition when air was the medium in the borehole. To check the validity of Figure 8-1, the very rapid equilibrium obtained with air in the borehole was compared to the analytical solution for a constant temperature boundary condition and the solutions agreed.

The equilibrium curves in Figure 8-1 can be subdivided into four regions to represent the various stages of temperature variation. Region I is when a very small amount of time has gone by, the temperature gradient has not penetrated to the borehole center and effectively the temperature of the input medium is being measured. A rapidily changing temperature versus time curve represents Region II, while Region IV is where the temperature approaches the equilibrium temperature of T_f. Region III is an intermediate stage between Regions II and IV. Ideally measurements of bottom hole temperature should be made in Region IV where a correction factor can be neglected.

Figure 8-1 also shows that borehole medium diffusivity dominates equilibration. For the case where water or mud is present, the borehole medium measurements should only be made a minimum of 12 hours after circulation has ceased. Where only air is present, measurements can be made almost immediately after circulation has ceased.

Equilibrium bottom-hole temperatures can be predicted if at least two well-spaced measurements are made when the temperatures are rapidly changing (Region II). For water or mud this would be in the range of 1 - 12 hours after circulation has ceased. A measurement every one to two hours would probably yield reliable predictions.

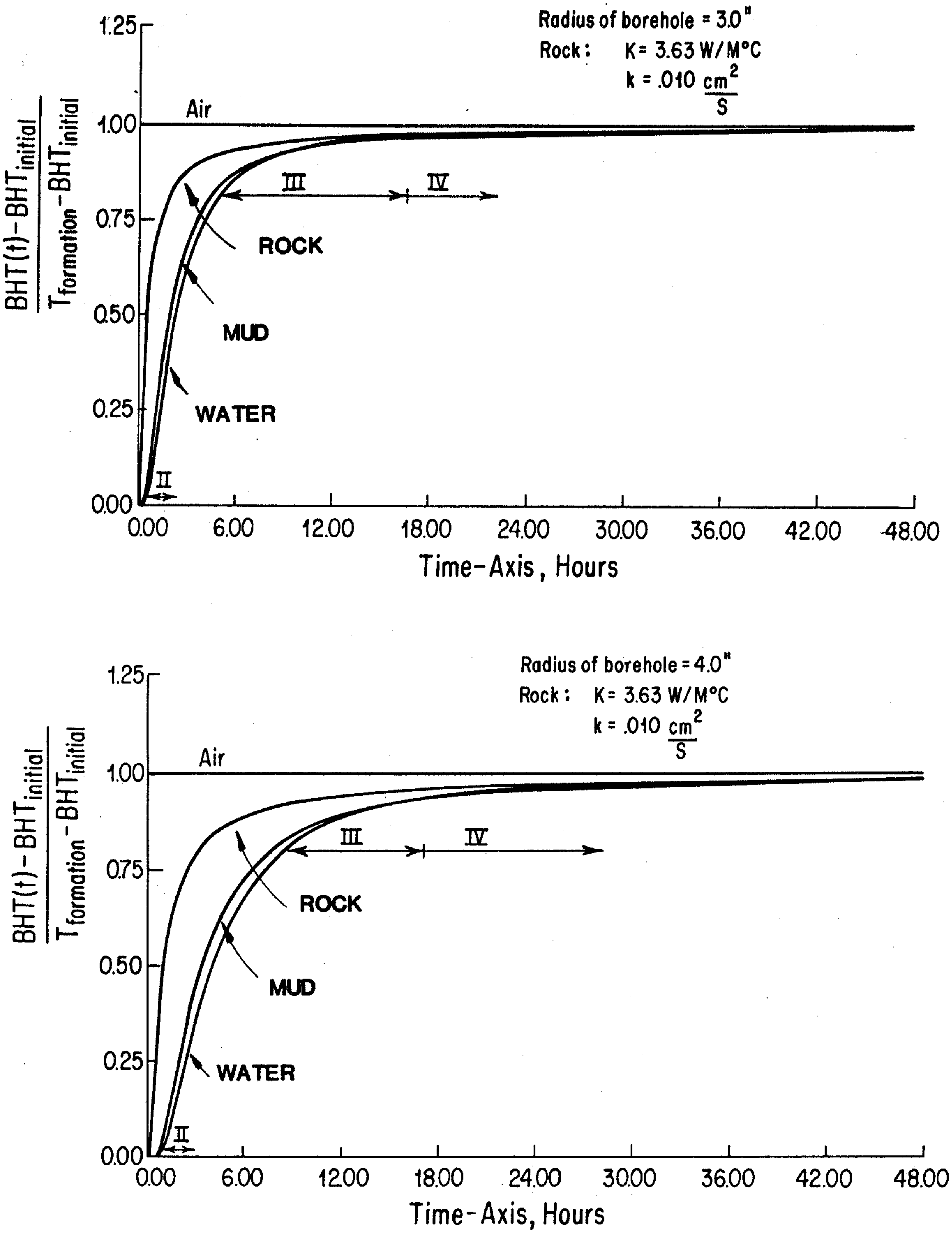


Figure 8-1 a,b Bottom-hole-temperature equilibration curves for boreholes with a 3 inches radius (fig. a) and 4 inch radius (fig. b). The curves are calculated for a borehole filled with air, water or mud. The conductivity of the rock is noted by K.

SECTION 9

CONCLUSION

Changes in geothermal gradients observed in detailed temperature logs indicate that vertical thermal conductivity changes must be considered if heat flow and temperature-at-depth estimates in the region of central and western New York are to be made. The measurement of conductivity of rock samples from wells in several locations supports this conclusion. The horizontal extent of these vertical conductivity changes was modeled based on the observation that gradient changes correlate with lithology changes encountered in the stratigraphic section. The average geothermal gradients obtained from mean annual surface temperature and bottom-hole temperatures, in conjunction with the thermal conductivity model, indicate that central and western New York is an area of generally uniform heat flow (40 to 50 mW/m^2). A distinct high heat flow anomaly in the north-central part of New York near Auburn has a maximum amplitude of approximately 75 mW/m^2. The source of this anomaly may be due to convective upwelling along fractures that extend into the basement rocks. Site-specific heat flow determinations support the heat flow values obtained from the available BHT data.

Calculations from the basal Cambrian sandstones, the primary geothermal target, indicate that a significant area of potential low-temperature geothermal energy exists. Using the limit of a minimum 50°C temperature, the 1300 meter depth to the Theresa (sea level datum) generally defines the northern extent of the area. Considering a maximum depth for economical drilling to be 3000 meters with present technology, the 2500 meters to the Theresa (sea level datum) forms the boundary to the south. Temperatures in the range of 70 to 80°C are predicted for the southern portion of the area. The presence of extractable fluids is an important consideration in targeting a potential geothermal site. Work by Robinson (1982) indicates that zones of intergranular porosity as well as fractures exist within the area targeted by the temperature and depth considerations. Reports of connate water in the section suggest that extractable fluids should coincide with these porous zones.

Confidence in the reliability of temperature estimates comes from the comparison of temperatures extrapolated from shallow BHT readings to deep temperature measurements in areas where both are available. An accuracy of ±5°C is indicated by these comparisons. Where only shallow temperatures are available, and in areas of sparse BHT data, the accuracy of the predicted temperature at deeper levels is highly dependent on the accuracy of the available data. The conductivity model for the area provides a reliable constraint to extrapolate average geothermal gradients, but only when the gradients themselves are correct. Possible disturbances to the BHT (eg., drilling, gas expulsion, water circulation) cause depressions or elevations of the gradient. This, in turn, will cause error in the temperature-at-depth prediction. Application of a correction for drilling disturbances cannot be made for all the available bottom-hole temperatures. The variability of the conditions present during the drilling and logging of the wells prevents this. A recent check of well logs with bottom-hole temperatures in the area of Friendship, N.Y. in Allegany County is one example of this problem. Two of the wells which are present near here (#15738 and #11762) report salt mud in the borehole. The use of drilling mud has probably caused a significant depression of the BHT and, therefore, the calculated gradient. Heat flow for the area is depressed because of the relatively low average gradient. The low calculated heat flow (approximately 38 mW/m^2) results in a depression of extrapolated temperatures. Problems such as this are difficult to assess in terms of the overall area.

If a potential geothermal site is targeted, a thin test borehole of 200 to 300 meters in depth could be drilled for evaluation of the heat flow at the site. The conditions in the well could be closely monitored to establish the reliability of the temperature data. An estimate of heat flow and the extrapolation of temperatures using the conductivity model and the measured temperature gradient in the borehole could be made. This would prevent the expenditure of a large sum before performing a site-specific evaluation of the potential geothermal resource.

SECTION 10

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APPENDIX A

THERMAL HISTORY OF HYDROCARBON SOURCE ROCKS IN NEW YORK

The thermal history of western and central New York is important to an understanding of the source of hydrocarbons in this area. If hydrocarbon source beds (typically shales) and reservoir rock (primarily sandstones and some carbonates) are present, then elevated temperatures are required for hydrocarbon formation. Temperature of the source rocks must be between 65^{o} to 150^{o}C for organic material in source beds to be converted to hydrocarbons (Klemme, 1975). Based on the heat flow data and sedimentary depositional history, it is possible to determine the thermal history for western and central New York. The estimation of the thermal history of the rocks can provide an evaluation as to whether temperatures were sufficient for production of hydrocarbons and also indicates the possible source beds for hydrocarbon deposits found in this area.

Deposition of sediments causes an increase in temperature at depth in the rock layers already in place. If a sedimentary layer of thickness H with zero temperature is instantaneously deposited on basement rocks at time t = 0 the temperature (T) at depth can be found by

$$T\,(y,t) = T_o\,(y) + \alpha\sqrt{\kappa t}\left(\text{ierfc}\ \frac{y}{\sqrt{4\kappa t}} - \text{ierfc}\ \frac{y+2H}{\sqrt{4\kappa t}}\right) \qquad \text{(A-1)}$$

where y is the depth measured from the top of the basement, T_o (y) is the initial surface temperature, α is the gradient which would be reached in the sediments for infinite time (i.e., if Q is the equilibrium heat flow, then α = Q/K where K is the thermal conductivity of the sediments), α is the thermal diffusivity (taken to be uniform in the sediments and the basement), and ierfc is the repeated integral of the error function (Birch et al., 1968).

Differentiating

$$\frac{dT}{dH} = \alpha \; \text{erfc} \; \frac{y+2H}{\sqrt{4\kappa t}} \; ; \qquad \text{(A-2)}$$

if H is a function of time then

$$T\,(y,t) = T_0\,(y) + \alpha \int_0^t \text{erfc}\left[\frac{y+2H(\tau)}{\sqrt{4\kappa t}}\right] dH\,(\tau) \qquad \text{(A-3)}$$

where H (τ) is a dummy variable for integration over time. If the rate of deposition (U) is uniform beginning at t = 0, then H = $U\tau$ and dH = U $d\tau$. The temperature at depth is then

$$T\,(y,t) = T_0\,(y) + \alpha\; U\; t \int_0^t \text{erfc}\; \frac{y+2U\tau}{\sqrt{4\kappa(t-\tau)}}\; \frac{d\tau}{t} \qquad \text{(A-4)}$$

which can be evaluated by numerical methods (Birch et al., 1968).

Specific examples of the thermal history in the study area can be shown by constructing a depositional history using the structure contour maps (Figures 6-10a, b, c to 7-4b) and approximate ages of deposition, and assuming that the heat flow has not changed significantly since the beginning of deposition. The depositional and thermal history for southern Steuben County (42° 00' latitude and 77° 30' longitude) is shown in Figure A-1. It is assumed that the surface temperature at the time of deposition was 20°C. The present average surface temperature in this area, reduced to sea level using the adiabatic lapse rate of 9.8°C/km (Jaeger, 1965), is approximately 12°C (Figure 6-2). The area was at much lower latitudes during sediment deposition (Windley, 1977) so 20°C is a reasonable temperature to assume. The mean harmonic conductivity calculated from the conductivity model for the sediments in this area is 2.1 W/m°C (Table C-6) and the heat flow is approximately 44 mW/m^2 (Figure 7-5). Using an average sedimentary rock density of 2.5 gm/cm^3 and heat capacity of 1.05 J/gm°C the thermal diffusivity value obtained is $\kappa = 8 \times 10^{-7}$ m^2/sec. The equilibrium gradient in the sediment is α = 21°C/km. Deposition began in the late Cambrian (510 mya) and continued (with some erosional unconformities) through the late Devonian and early Mississippian (300 mya) as shown by small outliers of Mississippian-age rock in the south of the state. Maximum rock thickness was probably not much greater than it is today. Potential source beds exist in the shales interlayered with limestones in the upper 200 meters of the Trenton Group, the shales and shaley layers in the Queenston, and shales in the lower portion of the Onondaga to Queenston sequence. Gas in this area is typically found in the Oriskany Sandstone approximately 30 meters below the top of the Onondaga Limestone. The Onondaga has been suggested as a source for the Oriskany gas (Landes, 1970) because it is rich in organic matter. The calculated thermal history implies that the temperatures necessary for hydrocarbon formation, at least 65°C, were not reached in the Onondaga. Unless the gas has migrated updip from the south where the depth of burial

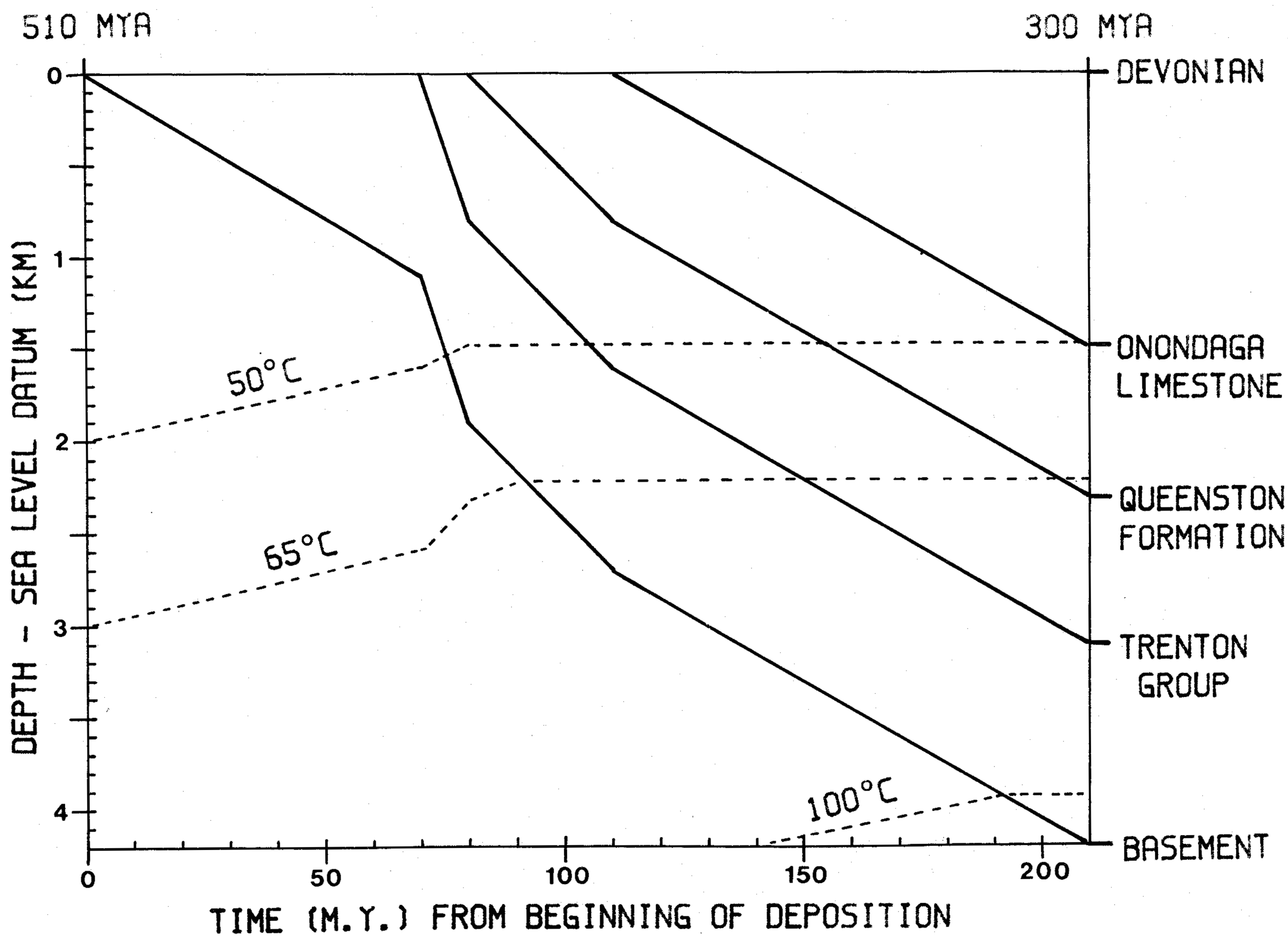

Figure A-1 - Geothermal history during sediment deposition in southern Stueben County.

(and therfore probably temperature) was greater, source beds below the Queenston seem to be more probable.

In northern Ontario County (approximately 43° 00' latitude and 77° 30' longitude), the thickness of sedimentary units is less than to the south. Though much of the Devonian sequence is missing because of erosion, an estimated thickness of 900 meters has been assumed based on thinning trends in the units still present. The mean harmonic conductivity is approximately the same as to the south in Steuben County. Here the calculated heat flow is about 55 mW/m^2 and the equilibrium gradient in the sediments is 26°C/km. As can be seen in the thermal and depositional history in Figure A-2, the depth to a temperature level is less than to the south because of the higher heat flow in the northern areas. A small amount of sediment deposition results in the critical temperature of 65°C occurring only up to the shales in the lower portion of the Queenston Formation. Major gas production in this area is from the Queenston Formation and lower Onondaga Limestone. The calculated temperatures suggest that the source beds were in the Queenston and below.

The thermal histories of these two areas show the possible source beds for hydrocarbons as well as discounting others as sources. The present-day temperatures found at the top of the basement (Figure D-3) are lower than predicted by the thermal history, but surface conditions have changed since deposition ended. Northward migration, uplift and erosion, and glaciation have caused lower surface temperatures which have depressed temperatures at depth. Other factors, such as changing heat flow, cannot be assessed by this theoretical thermal history.

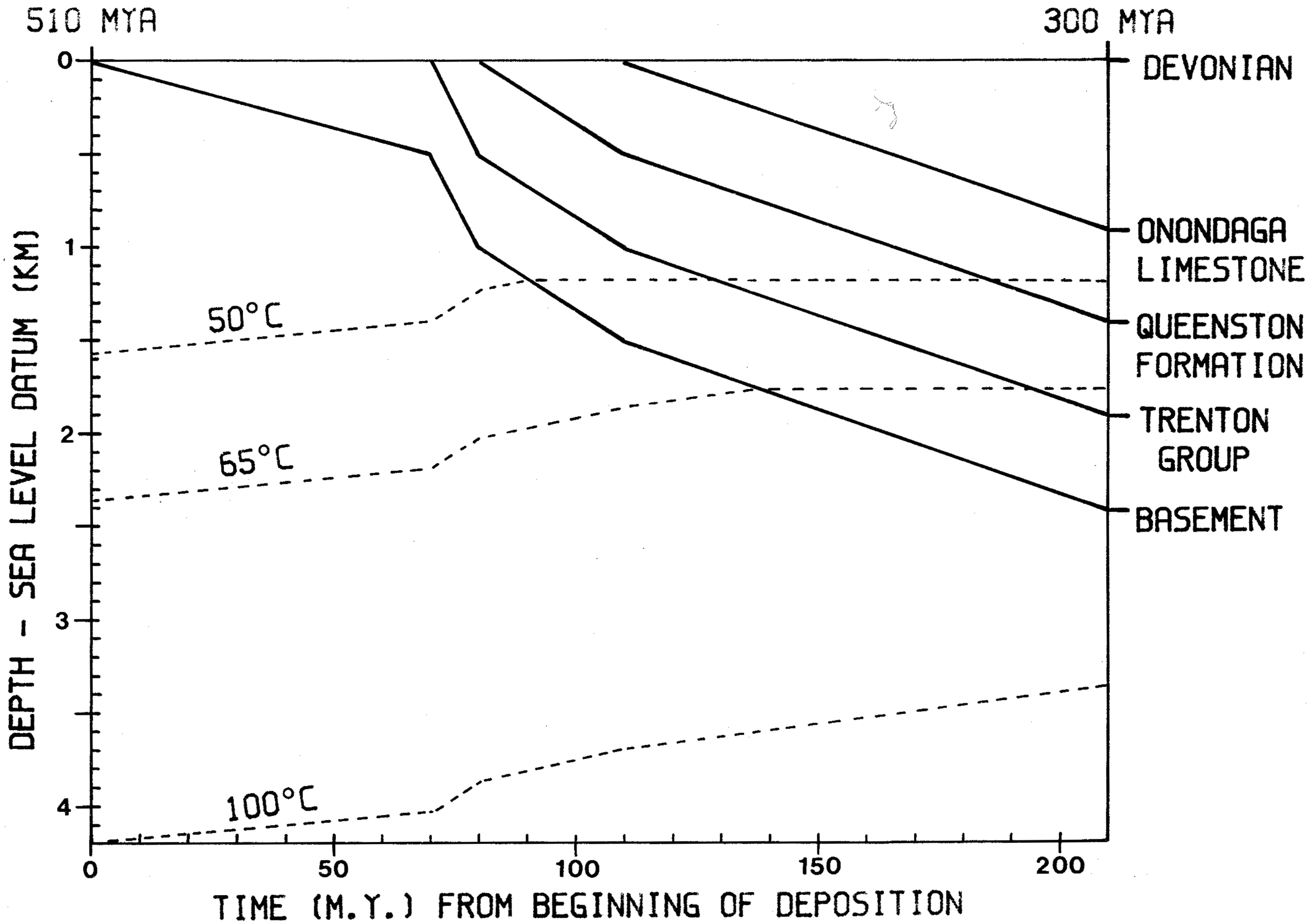

Figure A-2 - Geothermal history during sediment deposition in northern Ontario County.

APPENDIX B

THEORY AND METHODS OF THERMAL CONDUCTIVITY MEASUREMENTS

The rate of heat transfer through solids depends on the physical properties of the material. As a result of these properties, materials have a specific thermal conductivity (K) which is defined by

$$K = d\ c\ k \qquad \text{(B-1)}$$

where K is in units of $W/m^{o}C$, density, d, is in units of kg/m^3, heat capacity, c, is in units of $joules/kg^{o}C$, and thermal diffusivity, k, is in units of m^2/sec (Jaeger, 1965). Material which conducts heat equally in all directions is said to be isotropic. If the rate of heat conduction depends on direction of flow, then the material is anisotropic. When the rate differs from place to place in the material, it is heterogeneous. The variability of rock conductivity generally excludes it from being a truly isotropic material, yet the assumption of it being such is made to reduce complexities in heat flow calculation. In some cases, anisotropy and heterogeneity must be considered.

Determination of K in rock is made by direct measurement. The method of measurement chosen for this project is the needle probe, based on the theory of an infinitely long-line heat source in an infinite medium. The increase in temperature (T) at a point in an infinite medium heated by a line source is given by

$$T(r,t) = (q/2\pi K)\ \ I\ (r/2(kt)^{\frac{1}{2}}) \qquad \text{(B-2)}$$

where q is the heat per unit length of the line source in units of W/m, r is the radial distance of the point from the line source in meters, t is the time from when the heat was applied in seconds, and I(x) is the Modified Bessel Function.

The Bessel Function is equal to

$$I(x) = C - \ln x + \frac{x^2}{2} - \frac{x^4}{8} + \cdots \qquad \text{(B-3)}$$

where C is Euler's constant (Woodside and Messmer, 1961). For small values of $x=(r/2(kt)^{1/2})$, when t is large and r is small, terms of x^2 and greater may be neglected and the temperature increase T between times t_1 and t_2 is given by

$$\Delta T = (q/4\pi K) \ln (t_2/t_1) \qquad \text{(B-4)}$$

or, solving for K,

$$K = \frac{q}{4\pi} \left(\frac{\ln (t_2/t_1)}{\Delta T} \right) \qquad \text{(B-5)}$$

(Woodside and Messmer, 1961). Therefore, by applying an ideal line source of heat to an infinite medium, thermal conductivity can be measured by the change in temperture over time at a point in the medium. A large length-to-diameter ratio in the line source, ie., greater than 30, allows for the approximation of an infinite line source, and limiting the time interval of temperature measurement to before the heating effect reaches the surface of the sample allows for samples of finite size (Woodside and Messmer, 1961).

The needle probe used as a line source of heat (catalog #K1137A, Fenwal Electronics of Framingham, Massachusetts) consists of a hypodermic needle 63 mm line and 1 mm in diameter which contains a loop of heater wire over the length of the needle, with a resistance (R) equal to 2559.1 ohms/m. A thermistor with a resistance of approximately 1000 ohms is epoxied 25 mm from the tip of the probe.

The heater wire and thermistor are connected to a five-pin plug which is welded to the needle.

The heat production in the heater wire is determined by

$$P = I^2 R \tag{B-6}$$

where P is the power loss in the wire in W/m, I is the current in amperes (A), and R is the resistance in ohms. For a constant current of 0.03A and constant R, the P of the heater wire is 2.30 W/m. The temperature coefficient of resistance of the heater wire is so small that it is considered to be negligible over the temperature range being considered. Since the wire passes itself in a loop, the q of the source is twice P or q = 4.60 W/m.

The rise in temperature is measured by the change in voltage (V) across the thermistor. The voltage change is a function of the resistance of the wire and it it this resistance which is sensitive to changes in temperature. The thermistor was calibrated a thermostated water bath. A constant current of 0.03 A was applied to the thermistor and the voltage was measured using a digital multimeter. Temperature in the bath was measured using a precision-grade thermometer. The plots of voltage versus temperature for the two probes used are shown in figures B-1 and B-2. The linear response of voltage to temperature is evident from these plots. Linear regressions of voltage versus temperature were determined and values for $\Delta V/\Delta T$ obtained. For probe 1, Serial #15, a value of $\Delta V/\Delta T$ = -0.0159 V/^{o}C was obtained with a correlation coefficient of 0.9999. Probe 2, Serial #23, gave a value of $\Delta V/\Delta T$ = -0.0215 V/^{o}C with a correlation coefficient of 0.9998.

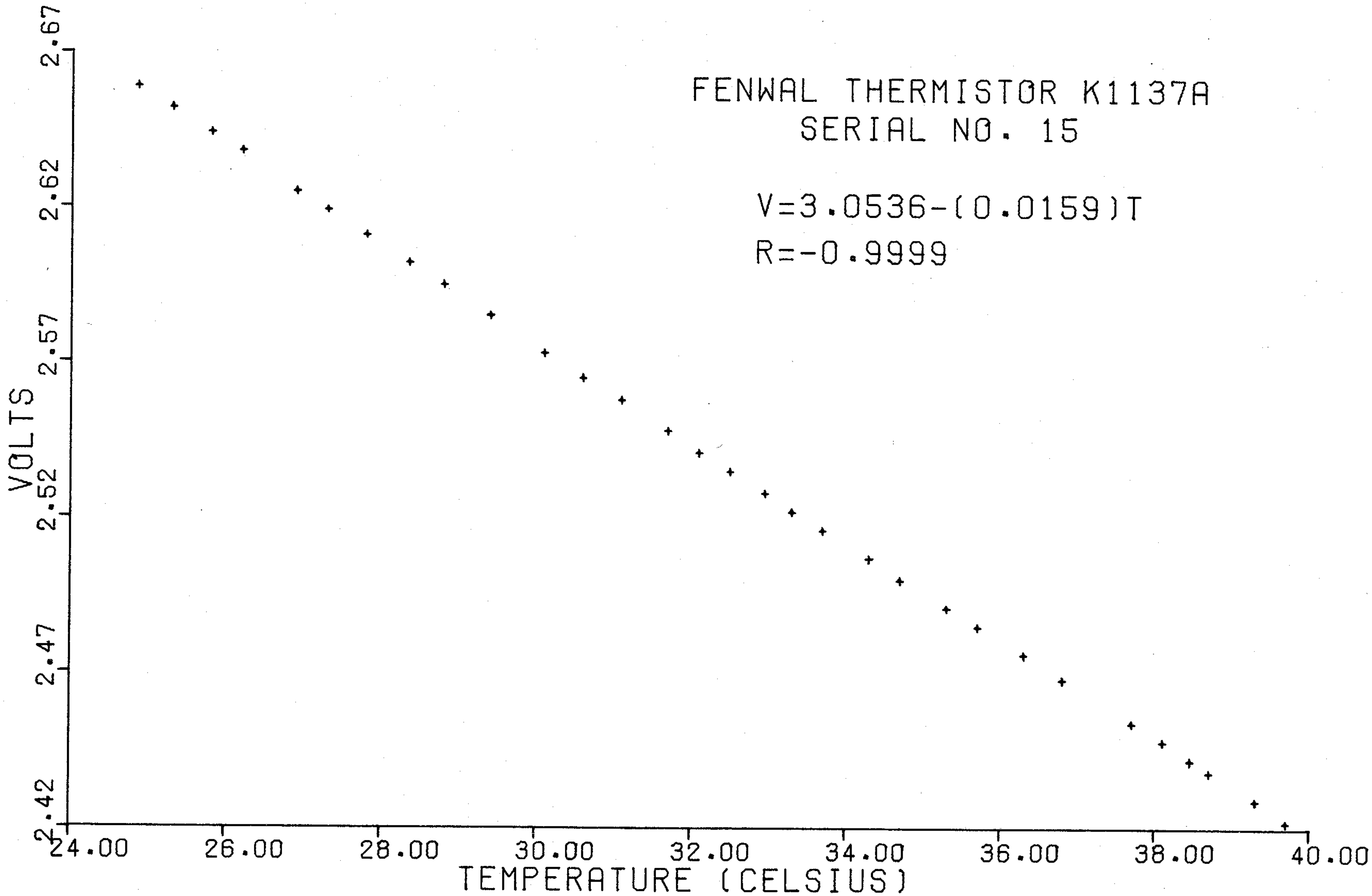

Figure B-1 - Plot of voltage versus temperature, probe 1.

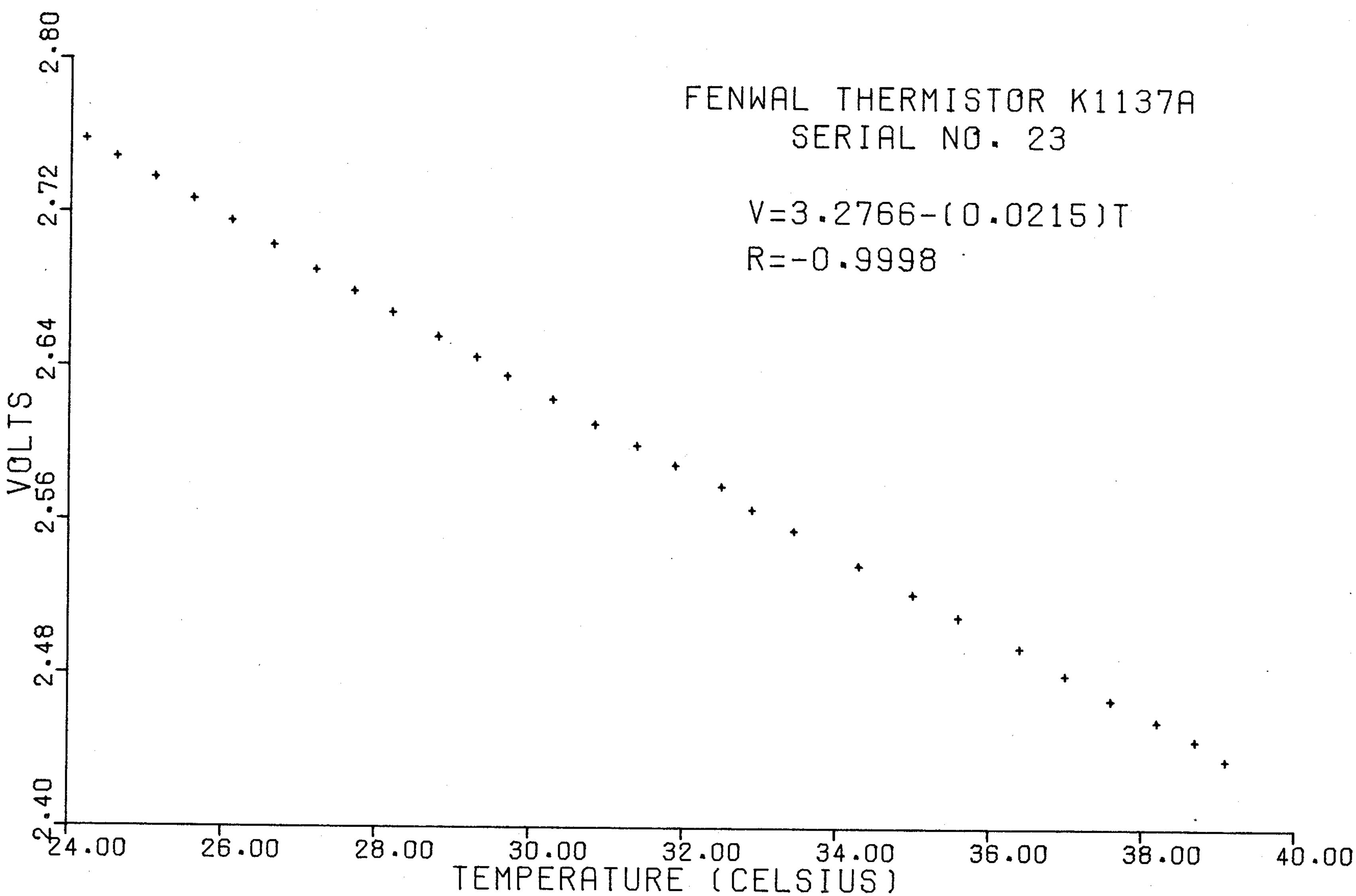

Figure B-2 - Plot of voltage versus temperature, probe 2.

The chip samples were obtained from well drilling. Since these chips do not represent a solid medium, it is necessary to saturate them with water so the medium surrounding the probe can be considered solid and its K measured. The conductivity of this rock chip-water mixture is related to the conductivity of the geometric mean of its constituents by

$$K_m = K_r^{1-\psi} K_w^{\psi} \tag{B-7}$$

where K_m is the measured conductivity of the mixture, K_r is the conductivity of the rock chips or bulk rock conductivity, K_w is the conductivity of water (K_w = 0.598 W/m^{o}C at 20^{o}C), and ψ is the volume fraction of water given by ψ = volume water/total volulme (Woodside and Messmer, 1961). This equation is also used for calculating is situ rock conductivity from the measured bulk rock conductivity and the porosity of the rock unit as determined from porosity logs taken in the borehole.

The rock chips are placed in cells made from 20 mls sections cut from graduated cylinders sealed at one end with rubber stoppers. These were used because the amount of well cuttings is often limited. Furthermore, it was found that it is necessary to sort the samples into a uniform size range, -1ϕ to $+1\phi$, so that the volume fraction of water is uniform throughout the mixture. The typical volume of sample available after sorting is approximately 15 ml. The rock chips and cell are weighed before and after saturation and the volume determined from the graduated markings on the side of the cell. The volume fraction of water is the difference in weight before and after saturation divided by the volume.

The needle probe is inserted through a hole in the rubber stopper at the base of the cell and the sample is tamped to insure good contact around the probe surface. The cell, with the probe inserted, is then placed in an insulating jacket and allowed to sit for 30 minutes so that any thermal disturbance is dissipated. The heater current is turned on when thermal equilibrium, as shown by a constant voltage in the thermistor, is obtained. The voltage is recorded at five-second intervals over a period of one minute. It was found in practice that the ln t - voltage curve is linear only over the 10- to 25-second interval. The slope of the curve in this time range calculated by linear regression gives a value for ln t/Δ V. This is then multiplied by the value of $\Delta V/\Delta T$ for the particular probe. The conductivity of the rock chip-water mixture can then be calculated using equation B-5 by substitution of the value thus obtained for $(\ln t_2/t_1)/\Delta T$ and the value of q. The bulk rock conductivity is then obtained from

$$K_r \quad = \quad (K_m/K_w^{\psi})^{1/1-\psi} \tag{B-8}$$

which is equation B-7 solved for bulk rock conductivity.

Samples for which thermal conductivity was measured by Paul Morgan (personal communication) on an established divided-bar apparatus at Southern Methodist University (SMU) in Dallas, Texas, were used to check the accuracy of the needle probe apparatus. In figure B-3, the plot of ln t versus voltage is shown for a sample of St. Peter Sandstone measured on probe 1. Though the latter part of the curve is clearly non-linear (because of boundary effects), it was uncertain where the true linearity existed in the 5- to 35-second range. Successive calculations on multiple runs of the samples determined that from 10 to 25 seconds the curve produced is linear and yields thermal conductivity values in excellent agreement

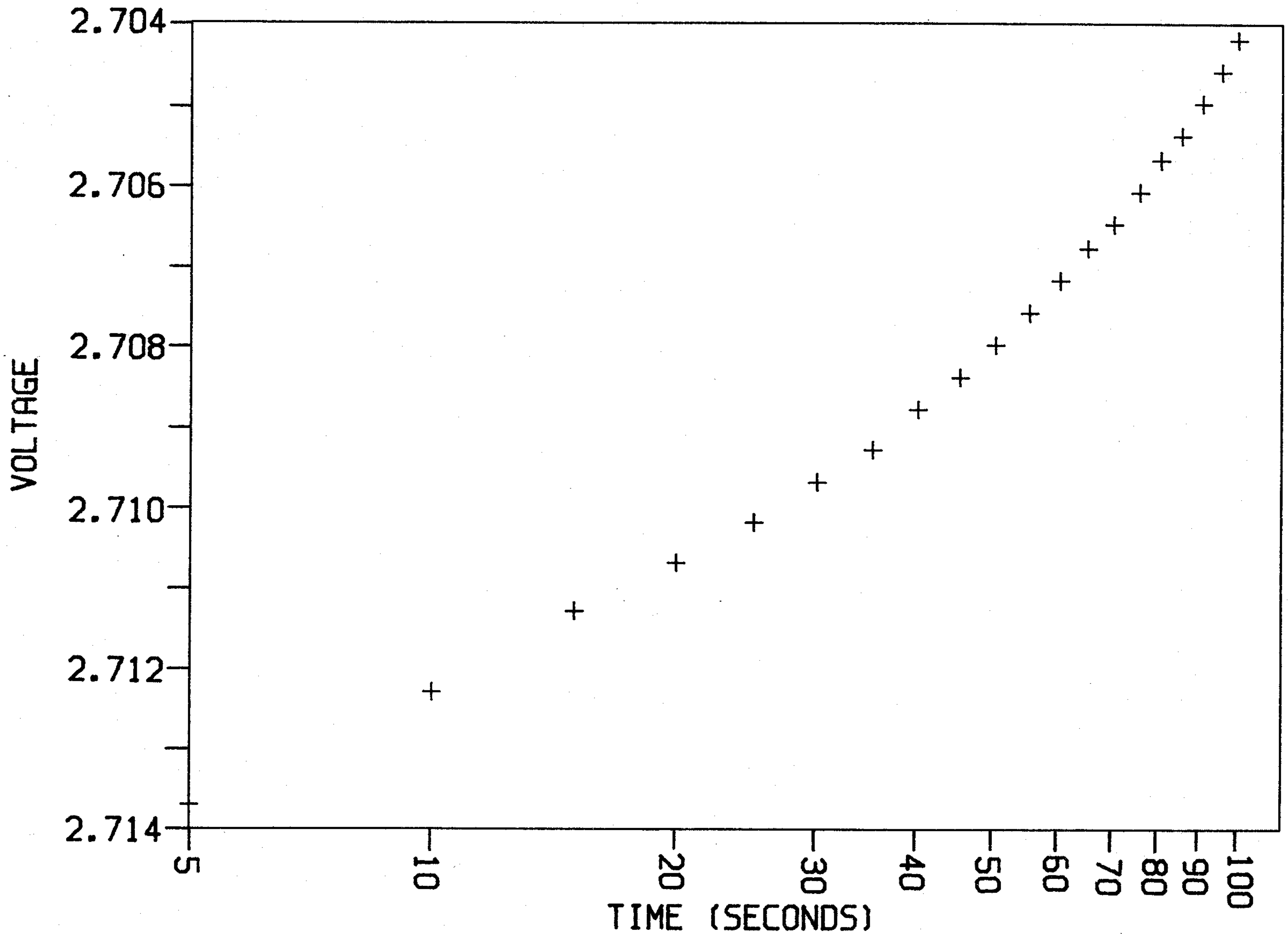

Figure B-3 - Plot of voltage versus the logarithm of time for a needle probe measurement of the St. Peter Sandstone.

with those measured on the divided-bar. The bulk rock conductivity values obtained at SMU and on the needle probe are shown in figure B-4. The values measured by the needle probe differ by no more than 9 percent from the average divided-bar values. This accuracy was considered to be adequate for use of the needle probe apparatus in the measurment of thermal conductivity.

THERMAL CONDUCTIVITY (W/m°C)

	SMU DIVIDED BAR		SUNYAB NEEDLE PROBE	
SAMPLE	LEFT	RIGHT	PROBE 1	PROBE 2
SPSS	6.03	5.86	5.92 5.88	5.91 6.18
1270	3.39	3.52	3.34 3.36	3.41 3.46
1300	2.43	2.34	2.33 2.34	2.23 2.34
1510	2.85	2.64	2.51 2.60	2.88 2.72
F4	4.85	4.60	4.74 4.81	4.91 4.75
F11	3.31	3.39	3.29 3.59	3.36 3.14

Figure B-4 - Comparison of thermal conductivity measurements by divided-bar at Southern Methodist University and needle probe at SUNY/Buffalo.

APPENDIX C

TABLES: DETAILED LOG REDUCTION DATA

Table C-1

TEMPERATURE-DEPTH DATA, WELL #13571 (WINSPEAR#1)
LOG DATE: 8/19/80

DEPTH (M)	TEMP. (C)
47.8	15.18
51.0	15.26
54.2	15.33
57.3	15.40
60.5	15.47
63.7	15.53
66.9	15.61
70.1	15.68
73.3	15.76
76.4	15.83
79.6	15.87
82.8	16.01
86.0	16.10
89.2	16.17
92.4	16.24
95.6	16.32
98.8	16.40
101.9	16.47
105.1	16.53
108.3	16.60
111.5	16.69
114.7	16.77
117.9	16.83
121.0	16.91
124.2	17.03
127.4	17.14
130.6	17.24
133.8	17.32
137.0	17.41
140.1	17.48
143.3	17.57
146.5	17.66
149.7	17.75
152.9	17.86
156.1	17.95
159.3	18.06
162.5	18.16
165.6	18.28
168.8	18.38
172.0	18.47

DEPTH (M)	TEMP. (C)
175.2	18.58
178.4	18.68
181.6	18.78
184.7	18.88
187.9	18.99
191.1	19.08
194.3	19.18
197.5	19.26
200.7	19.37
203.9	19.45
207.1	19.55
210.2	19.65
213.4	19.74
216.6	19.85
219.8	19.96
223.0	20.07
226.2	20.18
229.3	20.28
232.5	20.42
235.7	20.49
238.9	20.52
242.1	20.59
245.3	20.65
248.4	20.71
251.6	20.76
254.8	20.80
258.0	20.85
261.2	20.89
264.4	20.94
267.6	20.98
270.8	21.02
273.9	21.05
277.1	21.08
280.3	21.12
283.5	21.16
286.7	21.28
289.9	21.36
293.0	21.40
296.2	21.44

Table C-2

CONDUCTIVITY, TEMPERATURE, AND GRADIENT DATA AND CALCULATIONS (BASED ON 41.3 MW/M**2 HEAT FLOW) FOR WELL #13571 (WINSPEAR #1).

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	Ø	K(IN SITU) (W/M C)	GRADIENT (C/KM)	TEMPERATURE INTERVAL TOP (CELSIUS)
86.0 - 101.9	2.14	0.06	1.93	23.5 (0.3)	16.1
101.9 - 117.9	1.98	0.08	1.80	23.4 (0.7)	16.47
117.9 - 130.6	1.94	0.08	1.77	31.9 (0.9)	16.8
130.6 - 146.5	2.21	0.09	1.96	26.4 (0.6)	17.2
146.5 - 162.5	1.77	0.08	1.62	33.0 (0.8)	17.7
162.5 - 178.4	1.73	0.07	1.60	31.3 (0.3)	18.2
178.4 - 194.3	1.53	0.06	1.45	31.5 (0.3)	18.7
194.3 - 203.9	1.54	0.05	1.47	28.9 (1.3)	19.2
203.9 - 223.0	1.27	0.06	1.21	32.3 (0.5)	19.5
223.0 - 232.5	1.44	0.11	1.31	36.1 (1.8)	20.1
232.5 - 251.6	3.25	0.01	3.19	17.8 (0.5)	20.4
251.6 - 267.6	2.69	0.01	2.65	14.0 (0.2)	20.8
267.6 - 277.1	3.05	0.02	2.95	10.4 (0.5)	21.0
277.1 - 296.2	2.55	0.07	2.30	20.6 (1.5)	21.1
296.2 - 313.9	2.35	0.05	2.19	18.9*	21.4
313.9 - 329.2	2.72	0.03	2.60	15.9*	21.0*
329.2 - 341.4	3.19	0.02	3.09	13.4*	21.3*

(* - CALCULATED GRADIENT OR TEMPERATURE. STANDARD ERROR IN PARENTHESES)

Table C-2 continued

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	∅	K(IN SITU) (W/M C)	GRADIENT (C/KM)	TEMPERATURE INTERVAL TOP (CELSIUS)
341.4 - 359.7	3.25	0.05	2.99	13.8*	21.6*
359.7 - 371.9	2.74	0.03	2.61	15.8*	22.0*
371.9 - 390.1	3.07	0.06	2.79	14.8*	22.2*
390.1 - 405.4	3.25	0.05	2.99	13.8*	22.6*
405.4 - 420.6	3.36	0.08	2.93	14.1*	22.9*
420.6 - 435.9	2.05	0.08	1.86	22.2*	23.3*
435.9 - 451.1	1.79	0.06	1.68	24.6*	23.6*
451.1 - 466.3	2.30	0.04	2.18	18.9*	23.9*
466.3 - 481.6	2.30	0.04	2.17	19.0*	24.2*
481.6 - 496.8	4.39	0.04	4.05	10.2*	24.6*
496.8 - 512.1	4.38	0.02	4.21	9.8*	24.9*
512.1 - 527.3	3.57	0.02	3.44	12.0*	25.2*
527.3 - 542.5	2.68	0.01	2.64	15.6*	25.5*
542.5 - 557.8	2.34	0.02	2.28	18.1*	25.9*
557.8 - 573.0	2.10	0.04	1.99	20.8*	26.2*
573.0 - 588.3	1.89	0.07	1.75	23.6*	26.5*
588.3 - 600.5	1.83	0.06	1.71	24.2*	26.8*
600.5 - 618.7	2.40	0.05	2.24	18.4*	27.1*
618.7 - 634.0	2.21	0.09	1.97	21.0*	27.5*
634.0 - 649.2	1.96	0.05	1.85	22.3*	27.8*
649.2 - 661.4	2.12	0.05	1.99	20.8*	28.2*
661.4 - 667.5	2.35	0.14	1.94	21.3*	28.4*

Table C-3

CONDUCTIVITY AND GRADIENT DATA AND HEAT FLOW CALCULATIONS FOR WELL #13571 (WINSPEAR #1).

DEPTH INTERVAL (METERS)	# SAMPLES	THERMAL CONDUCTIVITY Ø	THERMAL CONDUCTIVITY K (W/M C)	GRADIENT (C/KM)	HEAT FLOW (MW/M**2)	LITHOLOGY
86.0 - 130.6	3	0.08	1.84	24.9 (0.5)	45.7	HAMILTON GROUP: SHALE, THIN LIMESTONE
130.6 - 232.5	7	0.07	1.49	31.2 (0.1)	46.4	HAMILTON GROUP: SHALE, THIN LIMESTONE
232.5 - 296.2	4	0.03	2.70	15.3 (0.3)	41.3	ONONDAGA LIMESTONE

(STANDARD ERROR IN PARENTHESES)

Table C-4

TEMPERATURE-DEPTH DATA, WELL #15529 (WELLS COLLEGE #1)
LOG DATE:11/16/80

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
15.9	8.45	207.1	15.02
19.1	8.51	210.2	15.21
22.3	8.66	213.4	15.28
25.5	8.81	216.6	15.46
28.7	8.92	219.8	15.60
31.9	9.01	223.0	15.64
35.1	9.12	226.2	15.70
38.2	9.22	229.3	15.74
41.4	9.37	232.5	15.79
44.6	9.61	235.7	15.84
47.8	9.67	238.9	15.99
51.0	9.74	242.1	16.07
54.2	9.90	245.3	16.17
57.3	10.17	248.4	16.30
60.5	10.37	251.6	16.36
63.7	10.54	254.8	16.47
66.9	10.68	258.0	16.58
70.1	10.73	261.2	16.68
73.3	10.81	264.4	16.77
76.4	10.92	267.6	16.88
79.6	11.07	270.8	16.93
82.8	11.23	273.9	17.01
86.0	11.39	277.1	17.13
89.2	11.55	280.3	17.20
92.4	11.69	283.5	17.25
95.6	11.81	286.7	17.30
98.8	11.90	289.9	17.48
101.9	11.97	293.0	17.52
105.1	12.10	296.2	17.58
108.3	12.27	299.4	17.62
111.5	12.44	302.6	17.64
114.7	12.62	487.7	21.88
117.9	12.83	490.7	21.94
121.0	13.01	493.8	22.00
124.2	13.12	496.8	22.11
127.4	13.22	499.9	22.17
130.6	13.33	502.9	22.28
133.8	13.40	506.0	22.36
137.0	13.48	509.0	22.44
140.1	13.54	512.1	22.56
143.3	13.57	515.1	22.61
146.5	13.71	518.2	22.67
149.7	13.76	521.2	22.78
152.9	13.79	524.3	22.89
156.1	13.89	527.3	22.97
159.3	13.93	530.4	23.06
162.5	13.97	533.4	23.14
165.6	14.06	536.4	23.22
168.8	14.09	539.5	23.33
172.0	14.14	542.5	23.42
175.2	14.31	545.6	23.50
178.4	14.40	548.6	23.58
181.6	14.49	551.7	23.72
184.7	14.53	554.7	23.78
187.9	14.64	557.8	23.89
191.1	14.67	560.8	24.00
194.3	14.86	563.9	24.11
197.5	14.93	566.9	24.19
200.7	14.95	570.0	24.28
203.9	14.99	573.0	24.39

Table C-4 continued

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
576.1	24.56	661.4	27.56
579.1	24.64	664.5	27.78
582.2	24.72	667.5	28.00
585.2	24.81	670.6	28.19
588.3	24.89	673.6	28.44
591.3	25.06	676.7	28.67
594.4	25.17	679.7	28.89
597.4	25.28	682.8	29.11
600.5	25.33	685.8	29.33
603.5	25.44	688.8	29.56
606.6	25.61	691.9	29.78
609.6	25.69	694.9	30.00
612.6	25.81	698.0	30.22
615.7	25.89	701.0	30.44
618.7	26.00	704.1	30.69
621.8	26.11	707.1	30.89
655.3	27.08	710.2	31.11
658.4	27.33	713.2	31.33

Table C-5

CONDUCTVITY, TEMPERATURE, AND GRADIENT DATA AND CALCULATIONS FOR WELL #15529 (WELLS COLLEGE #1)

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	Ø	K(IN SITU) (W/M C)	GRADIENT (C/KM)	TEMPERATURE INTERVAL TOP (CELSIUS)
130.6 - 137.8	2.45	.01	2.42	23.6 (.8)	13.33
137.8 - 151.2	2.44	.01	2.40	22.9 (2.9)	13.48
151.2 - 164.3	2.40	.01	2.36	17.6 (1.9)	13.76
164.3 - 172.8	2.54	.02	2.47	17.0 (2.7)	13.97
172.8 - 181.4	3.21	.07	2.85	35.8 (4.3)	14.14
181.4 - 189.0	3.83	.07	3.37	23.6 (6.3)	14.49
189.0 - 197.8	3.01	.05	2.77	33.3 (6.5)	14.64
197.8 - 207.3	2.70	.05	2.51	9.7 (.8)	14.93
207.3 - 220.1	2.68	.03	2.57	44.3 (3.0)	15.02
220.1 - 232.9	2.29	.03	2.20	15.1 (.5)	15.60
232.9 - 242.0	2.24	.02	2.18	31.1 (4.0)	15.79
242.0 - 252.1	2.20	.02	2.14	31.4 (3.0)	16.07
252.1 - 274.0	2.17	.02	2.11	29.3 (1.1)	16.36
274.0 - 297.5	2.79	.05	2.58	25.5 (1.6)	17.01
297.5 - 302.4	2.73	.05	2.53	9.5 (1.8)	17.58

(STANDARD ERROR IN PARENTHESES)

Table C-6

CONDUCTIVITY AND GRADIENT DATA AND HEAT FLOW CALCULATIONS FOR WELL #15529 (WELLS COLLEGE #1)

DEPTH INTERVAL	THERMAL CONDUCTIVITY			GRADIENT	HEAT FLOW	LITHOLOGY
(METERS)	# SAMPLES	Ø	K (W/M C)	(C/KM)	(MW/M**2)	
130.6- 302.6	15	0.03	2.42	26.4 (0.2)	63.8	ONONDAGA LIMESTONE, HELDERBERG GROUP: LIMESTONE,DOLOSTONE

(STANDARD ERROR IN PARENTHESES)

Table C-7

TEMPERATURE-DEPTH DATA, CITY OF AUBURN LOT 39 #1
LOG DATE: 3/ 2/82

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
121.9	17.44	304.8	20.67
125.0	17.67	307.8	20.83
128.0	17.83	310.9	21.00
131.1	18.00	313.9	21.17
134.1	18.06	317.0	21.33
137.2	18.17	320.0	21.44
140.2	18.22	323.1	21.56
143.3	18.28	326.1	21.61
146.3	18.33	329.2	21.69
149.4	18.39	332.2	21.75
152.4	18.44	335.3	21.83
155.4	18.58	338.3	21.89
158.5	18.83	341.4	21.94
161.5	19.06	344.4	22.00
164.6	19.22	347.5	22.06
167.6	19.31	350.5	22.08
170.7	19.42	353.6	22.14
173.7	19.50	356.6	22.19
176.8	19.61	359.7	22.28
179.8	19.61	362.7	22.31
182.9	19.50	365.8	22.39
185.9	19.33	368.8	22.42
189.0	19.11	371.9	22.44
192.0	19.03	374.9	22.44
195.1	19.11	378.0	22.39
198.1	19.25	381.0	22.33
201.2	19.39	384.0	22.36
204.2	19.44	387.1	22.42
207.3	19.50	390.1	22.56
210.3	19.50	393.2	22.83
213.4	19.50	396.2	23.06
216.4	19.50	399.3	23.11
219.5	19.53	402.3	23.14
222.5	19.53	405.4	23.17
225.6	19.47	408.4	23.22
228.6	19.44	411.5	23.25
231.6	19.56	414.5	23.28
234.7	19.64	417.6	23.36
237.7	19.72	420.6	23.44
240.8	19.81	423.7	23.50
243.8	19.83	426.7	23.56
246.9	19.86	429.8	23.61
249.9	19.89	432.8	23.69
253.0	19.94	435.9	23.72
256.0	19.94	438.9	23.83
259.1	19.97	442.0	23.89
262.1	20.28	445.0	23.92
265.2	20.08	448.1	24.00
268.2	20.08	451.1	24.06
271.3	20.06	454.2	24.14
274.3	20.06	457.2	24.19
277.4	20.06	460.2	24.28
280.4	20.11	463.3	24.36
283.5	20.14	466.3	24.44
286.5	20.17	469.4	24.50
289.6	20.19	472.4	24.58
292.6	20.28	475.5	24.67
295.7	20.33	478.5	24.75
298.7	20.42	481.6	24.86
301.8	20.53	484.6	24.94

Table C-7 continued

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
487.7	25.00	676.7	28.39
490.7	25.08	679.7	28.44
493.8	25.19	682.8	28.50
496.8	25.28	685.8	28.53
499.9	25.33	688.8	28.56
502.9	25.42	691.9	28.61
506.0	25.50	694.9	28.67
509.0	25.61	698.0	28.72
512.1	25.72	701.0	28.75
515.1	25.81	704.1	28.78
518.2	25.89	707.1	28.83
521.2	26.00	710.2	28.86
524.3	26.08	713.2	28.92
527.3	26.14	716.3	28.94
530.4	26.17	719.3	29.00
533.4	26.22	722.4	29.06
536.4	26.28	725.4	29.08
539.5	26.33	728.5	29.11
542.5	26.39	731.5	29.17
545.6	26.42	734.6	29.19
548.6	26.47	737.6	29.22
551.7	26.50	740.7	29.28
554.7	26.56	743.7	29.31
557.8	26.61	746.8	29.33
560.8	26.64	749.8	29.39
563.9	26.67	752.9	29.42
566.9	26.72	755.9	29.44
570.0	26.75	759.0	29.47
573.0	26.81	762.0	29.50
576.1	26.83	765.0	29.53
579.1	26.89	768.1	29.56
582.2	26.94	771.1	29.61
585.2	26.97	774.2	29.67
588.3	27.03	777.2	29.72
591.3	27.06	780.3	29.78
594.4	27.08	783.3	29.81
597.4	27.11	786.4	29.83
600.5	27.17	789.4	29.89
603.5	27.19	792.5	29.92
606.6	27.22	795.5	29.94
609.6	27.28	798.6	30.00
612.6	27.33	801.6	30.06
615.7	27.39	804.7	30.08
618.7	27.50	807.7	30.14
621.8	27.58	810.8	30.17
624.8	27.61	813.8	30.22
627.9	27.72	816.9	30.25
630.9	27.78	819.9	30.31
634.0	27.83	823.0	30.36
637.0	27.89	826.0	30.39
640.1	27.94	829.1	30.44
643.1	27.97	832.1	30.47
646.2	28.03	835.2	30.53
649.2	28.06	838.2	30.56
652.3	28.08	841.2	30.61
655.3	28.14	844.3	30.67
658.4	28.17	847.3	30.72
661.4	28.22	850.4	30.78
664.5	28.25	853.4	30.81
667.5	28.28	856.5	30.86
670.6	28.31	859.5	30.94
673.6	28.36	862.6	30.97

Table C-7 continued

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
865.6	31.06	1054.6	35.06
868.7	31.11	1057.7	35.11
871.7	31.19	1060.7	35.17
874.8	31.25	1063.8	35.22
877.8	31.31	1066.8	35.28
880.9	31.39	1069.8	35.31
883.9	31.44	1072.9	35.36
887.0	31.53	1075.9	35.42
890.0	31.58	1079.0	35.47
893.1	31.67	1082.0	35.50
896.1	31.72	1085.1	35.58
899.2	31.81	1088.1	35.64
902.2	31.86	1091.2	35.69
905.3	31.94	1094.2	35.75
908.3	32.00	1097.3	35.81
911.4	32.06	1100.3	35.86
914.4	32.11	1103.4	35.92
917.4	32.19	1106.4	35.97
920.5	32.28	1109.5	36.06
923.5	32.33	1112.5	36.08
926.6	32.39	1115.6	36.14
929.6	32.44	1118.6	36.22
932.7	32.50	1121.7	36.28
935.7	32.58	1124.7	36.33
938.8	32.67	1127.8	36.39
941.8	32.72	1130.8	36.42
944.9	32.78	1133.9	36.50
947.9	32.86	1136.9	36.53
951.0	32.92	1140.0	36.58
954.0	32.97	1143.0	36.64
957.1	33.06	1146.0	36.69
960.1	33.11	1149.1	36.75
963.2	33.17	1152.1	36.81
966.2	33.25	1155.2	36.83
969.3	33.31	1158.2	36.92
972.3	33.36	1161.3	36.94
975.4	33.44	1164.3	37.00
978.4	33.50	1167.4	37.06
981.5	33.58	1170.4	37.11
984.5	33.64	1173.5	37.14
987.6	33.69	1176.5	37.19
990.6	33.78	1179.6	37.28
993.6	33.83	1182.6	37.33
996.7	33.92	1185.7	37.39
999.7	34.00	1188.7	37.44
1002.8	34.06	1191.8	37.50
1005.8	34.14	1194.8	37.56
1008.9	34.17	1197.9	37.61
1011.9	34.25	1200.9	37.67
1015.0	34.33	1204.0	37.72
1018.0	34.39	1207.0	37.75
1021.1	34.44	1210.1	37.81
1024.1	34.53	1213.1	37.86
1027.2	34.58	1216.2	37.89
1030.2	34.67	1219.2	37.94
1033.3	34.72	1222.2	37.97
1036.3	34.78	1225.3	38.00
1039.4	34.83	1228.3	38.06
1042.4	34.89	1231.4	38.08
1045.5	34.94	1234.4	38.11
1048.5	35.00	1237.5	38.14
1051.6	35.03	1240.5	38.17

Table C-7 continued

DEPTH (M)	TEMP. (C)
1243.6	38.19
1246.6	38.22
1249.7	38.25
1252.7	38.25
1255.8	38.28
1258.8	38.28
1261.9	38.31
1264.9	38.33
1268.0	38.36
1271.0	38.31
1274.1	38.44
1277.1	38.75
1280.2	38.81
1283.2	38.86
1286.3	38.89
1289.3	38.94
1292.4	39.00
1295.4	39.06
1298.4	39.11
1301.5	39.17
1304.5	39.22
1307.6	39.28
1310.6	39.36
1313.7	39.44
1316.7	39.50
1319.8	39.58
1322.8	39.64
1325.9	39.72
1328.9	39.83
1332.0	39.94
1335.0	40.03
1338.1	40.11
1341.1	40.19
1344.2	40.28
1347.2	40.36
1350.3	40.44
1353.3	40.56
1356.4	40.61
1359.4	40.67
1362.5	40.72
1365.5	40.83
1368.6	40.89
1371.6	40.97
1374.6	41.03
1377.7	41.11
1380.7	41.17
1383.8	41.22
1386.8	41.28
1389.9	41.33
1392.9	41.39
1396.0	41.47
1399.0	41.56
1402.1	41.61
1405.1	41.69
1408.2	41.75
1411.2	41.78
1414.3	41.83
1417.3	41.89
1420.4	41.92
1423.4	41.89
1426.5	41.83
1429.5	41.83
1432.6	41.83
1435.6	41.72
1438.7	41.56
1441.7	41.50
1444.8	41.78
1447.8	42.17
1450.8	42.78
1453.9	43.03
1456.9	43.22
1460.0	43.56
1463.0	43.50
1466.1	43.33
1469.1	43.22
1472.2	43.19
1475.2	43.17
1478.3	43.17
1481.3	43.17
1484.4	43.22
1487.4	43.25
1490.5	43.28
1493.5	43.25
1496.6	43.25
1499.6	43.31
1502.7	43.28
1505.7	43.17
1508.8	43.00
1511.8	42.67
1514.9	42.56
1517.9	42.61
1521.0	42.83
1524.0	43.28
1527.0	43.56
1530.1	43.72
1533.1	43.83
1536.2	43.89
1539.2	43.86
1542.3	43.78
1545.3	43.72
1548.4	43.81
1551.4	43.92
1554.5	44.03
1557.5	44.17
1560.6	44.50
1563.6	44.69
1566.7	44.97
1569.7	45.39
1572.8	46.00
1575.8	46.36
1578.9	46.86
1581.9	47.44
1585.0	47.94
1588.0	48.47
1591.1	48.78
1594.1	48.83
1597.2	49.28
1600.2	49.33
1603.2	50.61

Table C-8

TEMPERATURE-DEPTH DATA, CITY OF AUBURN LOT 39 #1
LOG DATE: 5/21/82

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
4.0	11.68	220.0	16.14
20.0	11.86	224.0	16.26
40.0	12.09	228.0	16.37
60.0	12.20	232.0	16.48
80.0	12.17	236.0	16.59
100.0	12.57	240.0	16.72
120.0	13.12	244.0	16.84
140.0	13.39	248.0	16.96
160.0	14.47	252.0	17.08
180.0	14.93	256.0	17.21
200.0	15.53	260.0	17.34
204.0	15.64	264.0	17.47
208.0	15.77	268.0	17.60
212.0	15.89	272.0	17.73
216.0	16.02		

Table C-9

TEMPERATURE-DEPTH DATA, CITY OF AUBURN LOT 39 #1
LOG DATE: 5/30/82

DEPTH (M)	TEMP. (C)	DEPTH (M)	TEMP. (C)
4.0	10.16	380.0	21.69
20.0	11.03	384.0	21.80
40.0	11.08	388.0	21.96
60.0	11.09	392.0	22.04
80.0	11.09	396.0	22.15
100.0	11.69	400.0	22.32
120.0	12.23	404.0	22.48
124.0	12.38	408.0	22.64
128.0	12.53	412.0	22.80
132.0	12.58	416.0	22.94
136.0	12.69	420.0	23.11
140.0	12.83	424.0	23.26
144.0	13.09	428.0	23.45
148.0	13.44	432.0	23.62
152.0	13.87	436.0	23.77
156.0	13.94	440.0	23.94
160.0	14.02	444.0	24.13
164.0	14.08	448.0	24.30
168.0	14.16	452.0	24.44
172.0	14.23	456.0	24.64
176.0	14.31	460.0	24.82
180.0	14.45	464.0	24.99
184.0	14.55	468.0	25.14
188.0	14.65	472.0	25.29
192.0	14.81	476.0	25.43
196.0	14.93	480.0	25.57
200.0	15.05	484.0	25.71
204.0	15.17	488.0	25.87
208.0	15.29	492.0	26.13
212.0	15.41	496.0	26.48
248.0	16.76	500.0	26.78
252.0	16.91	504.0	27.13
256.0	17.07	508.0	27.55
260.0	17.22	512.0	27.70
264.0	17.38	516.0	27.86
268.0	17.51	520.0	28.00
272.0	17.62	524.0	28.14
276.0	17.75	528.0	28.24
280.0	17.80	532.0	28.34
284.0	17.92	536.0	28.44
288.0	18.05	540.0	28.61
292.0	18.17	544.0	28.74
296.0	18.45	548.0	28.84
300.0	18.62	552.0	28.93
304.0	18.76	556.0	29.03
308.0	18.96	560.0	29.10
312.0	19.10	564.0	29.20
316.0	19.28	568.0	29.27
320.0	19.46	572.0	29.35
324.0	19.59	576.0	29.42
328.0	19.72	580.0	29.54
332.0	19.88	584.0	29.63
336.0	20.04	588.0	29.72
340.0	20.24	592.0	29.77
344.0	20.43	596.0	29.87
348.0	20.60		

Table C-10

THERMAL CONDUCTIVITY, GRADIENTS (SCHLUMBERGER LOG), AND LITHOLOGIC DATA FOR AUBURN LOT 39 #1 GEOTHERMAL TEST WELL.

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	Ø	K(IN SITU) (W/M C)	GRADIENT (C/KM)	LITHOLOGY
381.0- 413.0	2.37	0.07	2.16	35.0 (3.7)	CALCAREOUS SHALE, INTERBEDDED DOLOMITE
413.0- 428.2	1.97	C.09	1.77	21.4 (1.2)	
428.2- 445.0	1.91	0.08	1.74	20.8 (1.8)	
445.0- 466.3	2.58	0.08	2.30	24.3 (.5)	
466.3- 487.7	2.78	0.12	2.31	28.3 (.8)	SHALE (SOMEWHAT SANDY), THIN LIMESTONE, TRACE OF SILTSTONES
487.7- 501.4	2.72	0.09	2.37	28.3 (1.8)	
501.4- 521.2	2.96	0.11	2.48	31.9 (.7)	
521.2- 546.2	3.89	0.15	2.94	16.9 (.6)	MEDINA GROUP: SANDSTONE WITH MINOR SHALE BEDS
546.2- 609.6				13.2 (.2)	QUEENSTON FORMATION: AS ABOVE WITH LESS SHALE (546.2 - 627.9 M DUST, NOT MEASURED)
609.6- 627.9				24.4 (1.3)	
627.9- 637.0	4.57	0.12	3.58	18.2 (C.0)	
637.0- 652.3	4.27	0.13	3.31	12.8 (.8)	
652.3- 662.9	4.85	0.12	3.77	14.6 (1.3)	
662.9- 673.6	4.83	0.11	3.84	11.9 (1.6)	
673.6- 694.9	4.05	0.13	3.16	14.1 (.6)	
694.9- 708.7	4.1C	0.16	3.02	12.8 (1.1)	
708.7- 719.3	4.03	C.13	3.15	14.6 (1.3)	

Table C-10 continued

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	Ø	K(IN SITU) (W/M C)	GRADIENT (C/KM)	LITHOLOGY
719.3- 740.7	4.79	0.11	3.81	12.4 (.5)	
740.7- 752.9	4.00	0.10	3.30	11.9 (.9)	
752.9- 768.1	3.74	0.10	3.12	9.1 (0.0)	
768.1- 804.7	3.33	0.12	2.71	14.0 (.4)	
804.7- 816.9	3.64	0.12	2.93	13.7 (.9)	
816.9- 835.2	3.87	0.12	3.09	14.7 (.6)	
835.2- 850.4	3.30	0.12	2.69	16.9 (.8)	INCREASING SHALE, SOME SILTSTONE WITH SANDSTONE INTERBEDS
850.4- 862.6	3.20	0.13	2.57	17.3 (1.8)	
862.6- 871.7	3.37	0.13	2.69	23.7 (1.3)	
871.7- 893.1	2.75	0.08	2.44	22.2 (.5)	LORRAINE GROUP: SHALE WITH SANDSTONE INTERBEDS AND SILTSTONE
893.1- 906.8	2.38	0.08	2.13	22.8 (.9)	
906.8- 923.5	2.53	0.09	2.23	22.7 (.9)	
923.5- 941.8	3.07	0.08	2.70	21.8 (.8)	
941.8- 955.5	2.56	0.08	2.28	21.0 (.9)	
955.5- 969.3	2.53	0.08	2.26	21.0 (.9)	SHALE AND INTERBEDDED LIMESTONE
969.3- 984.5	3.06	0.09	2.64	22.4 (.6)	
984.5-1001.3	2.63	0.09	2.30	23.7 (.8)	
1001.3-1015.0	2.71	0.09	2.36	21.9 (1.8)	
1015.0-1030.2	3.00	0.09	2.59	21.9 (.8)	
1030.2-1045.5	2.78	0.09	2.42	18.2 (0.0)	

Table C-10 continued

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	Ø	K(IN SITU) (W/M C)	GRADIENT (C/KM)	LITHOLOGY
1045.5-1060.7	2.54	0.12	2.13	13.8 (.9)	
1060.7-1088.1	3.27	0.01	3.21	16.8 (.4)	TRENTON GROUP: LIMESTONE WITH SHALE INTERBEDS
1088.1-1103.4	2.80	0.04	2.63	18.2 (0.0)	
1103.4-1118.6	2.23	0.05	2.09	19.3 (1.1)	
1118.6-1136.9	3.28	0.06	2.96	16.9 (.7)	
1136.9-1146.0	2.23	0.04	2.12	18.2 (0.0)	
1146.0-1170.4	3.03	0.01	2.98	16.9 (.4)	
1170.4-1179.6	2.29	0.01	2.26	18.2 (2.9)	
1179.6-1194.8	2.87	0.02	2.78	18.2 (0.0)	
1194.8-1211.6	2.23	0.03	2.14	16.1 (.7)	
1211.6-1226.8	2.28	0.01	2.25	11.9 (.9)	
1226.8-1242.1	2.26	0.01	2.23	9.1 (0.0)	
1242.1-1255.8	2.27	0.02	2.21	6.4 (.9)	
1255.8-1269.5	2.22	0.05	2.08	7.3 (1.1)	
1269.5-1286.3	2.21	0.04	2.09	39.6 (7.7)	BLACK RIVER FORMATION: ARGILLACEOUS LIMESTONE (BECOMES SOMEWHAT GYPSIFEROUS)
1286.3-1300.0	2.26	0.01	2.23	18.2 (0.0)	
1300.0-1312.2	2.24	0.01	2.21	21.0 (1.6)	
1312.2-1324.4	2.40	0.01	2.37	21.9 (1.3)	
1324.4-1338.1	2.29	0.01	2.26	31.9 (1.4)	
1338.1-1359.4	3.07	0.01	3.02	26.9 (.8)	

Table C-10 continued

DEPTH INTERVAL (METERS)	THERMAL CONDUCTIVITY K(BULK) (W/M C)	Ø	K(IN SITU) (W/M C)	GRADIENT (C/KM)	LITHOLOGY
1359.4-1377.7	3.07	0.02	2.98	24.4 (.8)	DOLOMITIC LIMESTONE
1377.7-1402.1	4.44	0.01	4.36	20.7 (.6)	
1402.1-1417.3	3.87	0.01	3.80	17.2 (1.1)	
1417.3-1438.7	4.70	0.03	4.42	-13.6 (3.3)	THERESA FORMATION: DOLOMITIC SANDSTONE, DECREASING DOLOMITE TOWARD BASE
1438.7-1450.8	4.97	0.04	4.57	102.1 (23.3)	
1450.8-1466.1	5.45	0.03	5.10	42.4 (14.6)	
1466.1-1481.3	5.05	0.03	4.74	-9.6 (3.1)	
1481.3-1496.6	5.34	0.03	5.00	5.0 (2.3)	
1496.6-1505.7	5.11	0.03	4.79	-9.1 (8.7)	
1505.7-1524.0	6.57	0.06	5.69	-.7 (19.2)	
1524.0-1536.2	6.71	0.06	5.80	49.2 (8.1)	POTSDAM FORMATION: SANDSTONE
1536.2-1554.5	4.86	0.07	4.20	6.5 (6.2)	PRECAMBRIAN: SLIGHTLY METAMORPHOSED SANDSTONE AND LIMESTONE TO 1560 METERS, MARBLE BELOW TO TOTAL DEPTH
1554.5-1575.8	4.27	0.10	3.51	111.1 (8.5)	
1575.8-1591.1	4.34	0.08	3.70	163.3 (6.4)	
1591.1-1603.2	4.84	0.04	4.45	136.7 (40.3)	

Table C-11

N.Y. AND PA. BHT DATA
AND AVERAGE GRADIENTS

Table C-11 continued

STATE CODE 031 - NEW YORK

COUNTY CODE LISTING

1	ALBANY
3	ALLEGANY
5	BRONX
7	BROOME
9	CATTARAUGUS
11	CAYUGA
13	CHAUTAUQUA
15	CHEMUNG
17	CHENANGO
19	CLINTON
21	COLUMBIA
23	CORTLAND
25	DELAWARE
27	DUTCHESS
29	ERIE
31	ESSEX
33	FRANKLIN
35	FULTON
37	GENESEE
39	GREENE
41	HAMILTON
43	HERKIMER
45	JEFFERSON
47	KINGS
49	LEWIS
51	LIVINGSTON
53	MADISON
55	MONROE
57	MONTGOMERY
59	NASSAU
61	NEW YORK
63	NIAGARA
65	ONEIDA
67	ONONDAGA
69	ONTARIO
71	ORANGE
73	ORLEANS
75	OSWEGO
77	OTSEGO
79	PUTNAM
81	QUEENS
83	RENSSELAER
85	RICHMOND
87	ROCKLAND
89	ST. LAWRENCE
91	SARATOGA
93	SCHENECTADY
95	SCHOHARIE
97	SCHUYLER
99	SENECA
101	STEUBEN
103	SUFFOLK
105	SULLIVAN
107	TIOGA
109	TOMPKINS
111	ULSTER
113	WARREN
115	WASHINGTON
117	WAYNE
119	WESTCHESTER
121	WYOMING
123	YATES

Table C-11 continued

(N.Y. BOTTOM HOLE TEMPERATURES (BHT) AND AVERAGE GRADIENTS)

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
3- 15	42.0780	77.7925	621.8	1468.2	40.6	5.9	23.6	10.6	30.8	*
3- 16	42.0787	77.8016	628.2	1504.2	46.7	5.9	27.1	10.8	34.3	
3- 17	42.0917	77.7796	659.6	1504.5	38.9	5.6	22.2	10.8	29.4	*
3- 18	42.0818	77.7796	598.3	1435.9	43.3	6.2	25.9	10.4	33.1	
3- 19	42.0902	77.8005	602.9	1435.3	44.4	6.1	26.7	10.4	33.9	
3- 412	42.0802	77.8041	599.8	1430.7	43.9	6.2	26.4	10.3	33.6	
3- 7948	42.0680	77.7550	683.7	573.6	21.1	5.3	27.5	4.0	34.5	
3- 8034	42.1320	77.8713	665.4	1508.8	51.7	5.5	30.6	10.9	37.8	*
3- 9194	42.4332	77.9652	591.0	1040.0	35.0	5.9	27.9	7.6	35.2	
3- 9330	42.1197	77.8470	673.6	1509.4	40.6	5.4	23.3	10.9	30.5	*
3- 9356	42.0422	77.8661	676.0	1503.3	42.8	5.4	24.8	10.6	32.0	*
3-11762	42.1599	78.0128	615.1	1361.6	36.1	6.0	22.1	9.9	29.4	
3-11978	42.3123	78.2814	652.6	1218.3	36.1	5.6	25.1	8.9	32.4	
3-12927	42.1368	77.9594	467.9	549.6	21.1	7.4	24.9	3.8	31.9	
3-13242	42.3166	78.1554	501.7	983.9	30.0	7.0	23.4	7.2	30.7	
3-13549	42.3656	77.8200	564.8	894.3	26.7	6.2	22.8	6.5	30.1	
3-13684	42.4410	78.0156	559.6	959.8	33.9	6.2	28.8	7.0	36.1	
3-14253	42.4301	78.1501	379.2	686.8	26.1	8.1	26.2	4.9	33.4	
3-14485	42.0867	77.7983	660.5	1501.4	52.2	5.6	31.1	10.8	38.3	*
3-14571	42.0858	77.8175	616.0	1459.4	43.9	6.0	26.0	10.5	33.2	
3-14610	42.0894	77.7938	614.5	1518.5	43.9	6.0	25.0	10.9	32.1	*
3-14665	42.0789	77.8106	600.2	1435.6	38.9	6.2	22.8	10.4	30.0	*
3-14817	42.0768	77.7733	676.7	538.3	18.9	5.4	25.1	3.8	32.0	*
3-15054	42.0641	77.8431	641.3	1507.2	39.4	5.8	22.3	10.9	29.5	*
3-15369	42.0449	77.8601	702.0	1552.3	40.0	5.2	22.4	11.2	29.6	*
3-15400	42.1089	77.7765	710.2	1535.6	44.4	5.0	25.7	11.0	32.8	
3-15738	42.2633	78.2245	471.5	1069.8	32.2	7.4	23.2	7.8	30.5	
3-15942	42.0268	77.9014	497.7	1351.2	41.1	7.2	25.1	9.8	32.3	
3-16202	42.4276	78.1692	419.7	751.3	22.8	7.7	20.1	5.4	27.3	*
3-16203	42.2570	77.7839	594.4	1213.1	39.4	6.1	27.5	8.8	34.8	
3-16227	42.2417	78.0403	420.3	1019.3	29.4	7.8	21.2	7.4	28.5	
3-16239	42.2122	77.8882	594.1	1270.4	36.7	6.1	24.0	9.2	31.3	
7- 5087	42.3235	75.9480	307.2	2934.0	55.6	8.5	16.0	17.8	22.1	
7- 6636	42.4061	75.8782	442.9	1750.8	40.0	7.1	18.8	12.4	25.9	
7- 8342	42.3977	75.8906	448.7	1832.2	40.6	7.0	18.3	12.9	25.3	
7-12805	42.0696	75.5966	573.0	1349.0	38.3	6.0	23.9	9.8	31.2	*
9- 4820	42.0036	78.4348	657.8	1454.8	51.7	5.8	31.5	10.5	38.7	

(* - DATA DELETED: OUTSIDE STUDY AREA, TOO SHALLOW, OR PROBABLE BHT DISTURBANCE)

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
9- 6743	42.0969	78.6331	424.6	457.2	23.9	6.1	34.6	3.1	41.4	
9- 6762	42.0453	78.5881	540.4	290.2	20.0	7.0	44.9	1.8	51.0	*
9- 7184	42.0429	78.5913	628.5	381.0	22.8	6.1	43.7	2.5	50.3	*
9- 8633	42.0528	78.6009	573.9	306.3	19.4	6.6	41.8	1.9	48.0	*
9- 9120	42.0561	78.7487	686.1	1329.2	29.4	5.6	25.5	9.7	32.7	
9- 9151	42.0704	78.7245	682.4	1316.1	36.1	5.6	23.2	9.6	30.4	*
9- 9829	42.0249	78.4218	558.1	457.5	18.3	6.8	25.3	3.1	32.1	*
9-10577	42.4113	78.8731	448.1	1045.5	25.6	7.6	17.2	7.6	24.5	*
9-10655	42.0210	78.6007	559.9	1272.2	28.3	6.8	16.9	9.3	24.2	*
9-10962	42.4160	78.8353	429.8	1039.4	33.3	7.8	24.6	7.6	31.9	
9-11066	42.4032	78.8921	393.2	1001.0	32.2	8.2	24.0	7.3	31.3	
9-11067	42.4283	78.8508	454.2	1055.2	35.0	7.5	26.0	7.7	33.3	
9-11147	42.4056	78.8784	438.3	1051.0	32.2	7.7	23.3	7.7	30.6	
9-11148	42.3985	78.8731	438.3	1050.6	32.8	7.7	23.9	7.7	31.2	
9-11478	42.4735	78.4261	534.9	1230.8	35.6	6.5	23.6	9.0	30.9	
9-11480	42.2038	78.8767	559.0	1409.7	42.2	6.7	25.2	10.2	32.4	
9-11706	42.4500	78.7950	341.4	872.0	27.8	8.6	22.0	6.3	29.3	*
9-11723	42.4690	78.6804	420.6	1001.6	32.8	7.7	25.0	7.3	32.3	
9-11748	41.9458	78.4045	478.5	195.1	16.1	7.6	43.7	1.0	48.9	*
9-11977	42.2114	78.7330	434.3	920.8	32.2	7.9	26.4	6.7	33.7	
9-12461	42.4444	78.8186	350.5	971.1	31.7	8.5	23.9	7.1	31.1	
9-12480	42.4507	78.8084	292.6	871.4	30.0	9.1	24.0	6.3	31.3	
9-12505	42.4511	78.9168	292.6	864.1	30.0	9.1	24.2	6.3	31.5	
9-13537	42.3307	78.7914	529.1	1247.5	41.1	6.9	27.4	9.1	34.7	
9-15765	42.0315	78.5876	567.2	1237.2	36.1	6.7	23.8	9.0	31.0	*
9-16214	42.0759	78.4853	437.4	1121.7	44.4	7.9	32.6	8.2	39.9	
9-16232	42.0343	78.3303	533.4	1291.1	46.1	7.0	30.3	9.4	37.6	
9-16242	42.0634	78.4421	443.5	333.1	20.0	7.9	36.4	2.1	42.8	*
9-16245	42.0710	78.4456	438.9	323.7	21.1	7.9	40.8	2.0	47.1	*
11- 4241	42.9188	76.6418	189.6	561.1	30.0	8.9	37.7	3.9	44.7	
11- 1	42.9448	76.5447	219.8	1588.0	52.2	8.5	27.5	11.4	34.7	
11- 4389	42.9025	76.6629	156.1	533.1	32.2	9.2	43.1	3.7	50.1	*
11- 4448	42.9019	76.6785	149.7	538.0	33.9	9.3	45.7	3.8	52.7	*
11- 4493	42.9222	76.6618	156.7	530.0	27.2	9.2	34.0	3.7	41.0	
11- 4497	42.9352	76.6397	168.2	536.8	27.2	9.0	33.9	3.7	40.8	
11- 4511	42.9235	76.6296	191.1	585.8	32.2	8.8	39.9	4.1	47.0	*
11- 4652	42.9468	76.7028	154.8	557.2	31.1	9.2	39.4	3.9	46.4	*
11- 4715	42.9204	76.6721	157.3	1450.2	50.0	9.2	28.1	10.5	35.4	
11- 5000	43.1051	76.5528	132.6	1143.6	32.2	9.0	20.3	8.3	27.6	
11- 5011	43.1465	76.5534	123.1	1090.0	26.7	9.0	16.2	8.0	23.5	*
11- 6780	43.1091	76.5469	140.2	944.3	23.9	8.9	15.8	6.9	23.1	*
11-10701	42.8763	76.7060	128.3	550.8	23.9	9.6	26.0	3.9	33.0	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
11-10702	42.8766	76.6929	141.4	553.5	27.8	9.4	33.2	3.9	40.2	
11-15502	42.9203	76.6908	161.5	611.4	23.3	9.1	23.2	4.3	30.3	*
11-15703	42.9156	76.7058	158.2	610.8	22.8	9.2	22.3	4.3	29.3	*
11-15962	42.8604	76.6680	174.3	609.0	32.8	9.1	38.8	4.3	45.9	
11-16149	42.9057	76.6669	152.4	527.0	32.8	9.3	44.6	3.7	51.6	*
13- 1142	42.4860	79.3255	185.9	605.9	26.1	10.2	26.2	4.3	33.3	
13- 2655	42.4311	79.0874	421.8	937.9	30.0	7.9	23.6	6.8	30.8	*
13- 3200	42.0682	79.4156	479.1	2042.2	48.9	7.8	20.1	14.1	27.0	
13- 3313	42.4619	79.3739	488.3	1760.5	42.8	7.3	20.2	12.5	27.2	
13- 4152	42.1639	79.7370	453.8	1086.6	42.2	8.1	31.4	7.9	38.7	*
13- 4161	42.2922	79.4927	415.4	988.2	32.8	8.3	24.8	7.2	32.1	
13- 4178	42.2887	79.4677	417.6	1004.3	35.0	8.2	26.7	7.3	33.9	
13- 4204	42.1609	79.6741	453.2	1105.2	32.8	8.1	22.3	8.1	29.6	*
13- 4347	42.1601	79.6789	455.4	1103.4	30.0	8.1	19.9	8.1	27.2	*
13- 4437	42.1843	79.3381	540.4	2339.6	66.7	7.1	25.5	15.6	32.1	
13- 4561	42.2400	79.4146	468.5	1127.8	35.6	7.8	24.6	8.2	31.9	
13- 4581	42.2393	79.4080	484.6	1121.7	31.7	7.6	21.4	8.2	28.7	*
13- 4671	42.2398	79.4202	473.4	1101.9	38.3	7.7	27.8	8.0	35.1	
13- 4986	42.4106	79.4095	214.3	678.8	27.8	10.1	26.1	4.9	33.3	
13- 5129	42.4271	79.4059	194.8	646.8	26.7	10.2	25.4	4.6	32.5	
13- 6745	42.3785	79.1880	433.4	981.5	31.7	7.9	24.2	7.2	31.5	*
13- 7649	42.4071	79.1666	492.3	1005.5	32.8	7.3	25.4	7.3	32.7	
13- 8756	42.4131	79.1847	433.4	954.0	33.3	7.8	26.7	7.0	34.0	
13- 8757	42.4271	79.1949	381.0	883.0	32.8	8.3	27.7	6.4	34.9	
13- 9616	42.3687	79.3400	448.1	988.8	33.9	7.8	26.4	7.2	33.7	
13- 9617	42.1694	79.6767	455.1	1090.9	33.3	8.1	23.2	8.0	30.5	*
13- 9619	42.3767	79.4553	241.4	723.6	29.4	9.9	27.1	5.2	34.3	
13- 9620	42.2845	79.5235	427.3	998.2	32.2	8.2	24.1	7.3	31.4	
13- 9867	42.2782	79.5312	458.4	1014.7	31.1	7.9	22.9	7.4	30.2	*
13- 9868	42.2408	79.6654	479.1	1003.7	31.7	7.8	23.8	7.3	31.1	*
13- 9870	42.3755	79.3176	356.6	910.1	30.0	8.7	23.4	6.6	30.7	
13- 9871	42.2475	79.6654	444.7	1055.5	35.6	8.1	26.0	7.7	33.3	
13- 9939	42.4158	79.3787	228.6	1523.7	40.0	9.9	19.8	11.0	26.9	
13- 9940	42.4065	79.4023	229.2	719.9	26.7	9.9	23.3	5.2	30.4	
13- 9941	42.4121	79.3872	228.6	719.6	29.4	9.9	27.1	5.2	34.3	
13- 9960	42.2408	79.6654	464.8	1067.7	32.2	7.9	22.8	7.8	30.1	*
13- 9961	42.3758	79.4460	247.2	733.0	32.2	9.8	30.6	5.3	37.8	*
13- 9962	42.3687	79.4566	259.7	766.0	29.4	9.7	25.8	5.5	33.0	
13- 9963	42.1783	79.6655	448.4	1116.5	37.8	8.1	26.6	8.1	33.9	
13- 9964	42.1661	79.6922	464.8	1100.9	33.3	8.0	23.0	8.0	30.3	*
13-10025	42.3635	79.4736	271.3	779.4	32.2	9.6	29.0	5.6	36.3	*
13-10028	42.2598	79.6681	391.7	970.8	32.2	8.6	24.3	7.1	31.6	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-10032	42.3723	79.4644	243.8	761.1	30.0	9.8	26.5	5.5	33.7	
13-10033	42.3793	79.2979	371.9	923.2	33.3	8.5	26.9	6.7	34.2	
13-10065	42.2464	79.6591	454.8	1062.5	31.1	8.0	21.8	7.8	29.1	*
13-10066	42.1710	79.6696	449.0	1118.3	36.7	8.1	25.5	8.2	32.8	
13-10069	42.3780	79.3262	406.0	952.5	33.9	8.2	27.0	6.9	34.3	
13-10084	42.3763	79.4750	236.2	730.0	26.7	9.9	23.0	5.2	30.1	
13-10086	42.2350	79.6685	477.0	1108.3	32.8	7.8	22.6	8.1	29.9	*
13-10087	42.2302	79.6614	490.7	1097.6	34.4	7.6	24.4	8.0	31.7	
13-10089	42.1546	79.6793	482.2	1148.2	32.2	7.8	21.3	8.4	28.6	*
13-10090	42.1617	79.6961	469.4	1120.7	35.6	7.9	24.6	8.2	31.9	
13-10091	42.3720	79.3519	459.6	1007.1	36.7	7.7	28.8	7.3	36.1	
13-10093	42.4247	79.4139	197.8	661.1	26.7	10.2	24.9	4.7	32.0	
13-10109	42.3557	79.4545	331.3	875.4	29.4	9.0	23.4	6.4	30.6	
13-10110	42.1747	79.6781	460.9	1112.8	39.4	8.0	28.3	8.1	35.6	
13-10111	42.3655	79.3682	455.1	1008.6	32.2	7.7	24.3	7.4	31.6	
13-10145	42.3649	79.4357	323.7	878.7	29.4	9.1	23.2	6.4	30.5	
13-10146	42.3879	79.4628	285.9	805.0	28.3	9.4	23.5	5.8	30.8	
13-10173	42.3533	79.3482	483.1	1035.4	36.1	7.5	27.7	7.6	35.0	
13-10175	42.2434	79.6783	417.6	1030.5	37.8	8.4	28.6	7.5	35.8	*
13-10176	42.2508	79.6495	460.2	1040.0	38.3	7.9	29.2	7.6	36.5	*
13-10177	42.2878	79.4229	469.1	1102.5	34.4	7.7	24.2	8.0	31.5	
13-10250	42.1599	79.6696	457.2	1125.6	34.4	8.0	23.5	8.2	30.7	
13-10251	42.1823	79.6594	470.3	1138.4	35.0	7.9	23.8	8.3	31.1	
13-10252	42.1746	79.6580	447.1	1113.4	36.7	8.1	25.6	8.1	32.9	
13-10253	42.3547	79.3632	360.6	905.0	32.2	8.7	26.0	6.6	33.3	
13-10254	42.3499	79.3554	477.9	1030.2	36.7	7.5	28.3	7.5	35.6	
13-10258	42.2404	79.6939	391.7	984.2	36.7	8.6	28.5	7.2	35.8	*
13-10278	42.1727	79.6989	463.6	1126.2	38.9	8.0	27.4	8.2	34.7	
13-10285	42.3690	79.4791	243.8	766.9	31.7	9.8	28.5	5.5	35.7	
13-10286	42.3566	79.4849	264.9	781.8	28.9	9.7	24.6	5.6	31.8	
13-10287	42.3504	79.4883	287.1	815.6	27.8	9.4	22.5	5.9	29.7	
13-10288	42.3518	79.4650	337.4	852.8	26.7	8.9	20.8	6.2	28.0	*
13-10289	42.3667	79.4840	234.7	762.0	29.4	9.9	25.6	5.5	32.8	
13-10290	42.3622	79.4801	251.5	766.9	31.7	9.8	28.5	5.5	35.8	
13-10292	42.2457	79.6718	427.9	1040.3	32.2	8.2	23.0	7.6	30.3	*
13-10293	42.2480	79.6780	402.6	1003.4	26.7	8.5	18.1	7.3	25.4	*
13-10298	42.3502	79.3682	472.4	1022.6	36.7	7.6	28.4	7.5	35.7	
13-10299	42.3605	79.3320	414.2	961.9	31.7	8.1	24.5	7.0	31.7	
13-10316	42.2289	79.6731	475.5	1080.8	37.8	7.8	27.7	7.9	35.0	*
13-10332	42.1781	79.7044	466.3	1128.7	34.4	8.0	23.5	8.2	30.8	
13-10345	42.2455	79.6920	373.4	985.7	34.4	8.8	26.0	7.2	33.3	
13-10370	42.1847	79.7062	450.5	1085.1	32.2	8.1	22.2	7.9	29.5	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-10375	42.4235	79.3762	229.5	686.7	30.6	9.9	30.1	4.9	37.3	*
13-10382	42.1595	79.6576	450.5	1127.8	35.0	6.1	23.8	8.2	31.1	
13-10389	42.1546	79.6793	485.2	1147.6	32.2	7.8	21.3	8.4	28.6	*
13-10407	42.2333	79.6856	424.3	1030.2	33.9	8.3	24.8	7.5	32.1	
13-10417	42.4233	79.3151	269.7	728.2	26.7	9.5	23.6	5.2	30.8	
13-10448	42.4542	79.3532	202.4	698.6	29.4	10.1	27.7	5.0	34.9	
13-10455	42.4134	79.3410	290.8	770.2	29.4	9.3	26.2	5.6	33.4	
13-10456	42.3624	79.3756	469.4	1019.6	29.4	7.6	21.4	7.4	28.7	*
13-10457	42.2284	79.6865	443.2	1059.5	29.4	8.1	20.1	7.7	27.4	*
13-10458	42.2371	79.6989	392.3	976.9	32.8	8.6	24.7	7.1	32.0	
13-10460	42.3624	79.3756	468.8	1016.8	34.4	7.6	26.4	7.4	33.7	
13-10461	42.3572	79.3803	475.8	1038.1	35.0	7.6	26.4	7.6	33.7	
13-10470	42.2648	79.5165	489.2	1060.4	32.2	7.6	23.2	7.7	30.5	*
13-10477	42.4115	79.4427	203.0	674.8	26.7	10.2	24.4	4.8	31.6	
13-10485	42.2234	79.6583	499.9	1115.9	32.2	7.6	22.1	8.1	29.4	*
13-10486	42.2295	79.6492	512.1	1131.7	36.7	7.4	25.8	8.3	33.1	
13-10489	42.3437	79.4910	315.5	656.5	26.7	9.2	20.4	6.2	27.7	*
13-10528	42.4075	79.4566	207.6	684.6	29.4	10.1	28.2	4.9	35.3	
13-10530	42.3616	79.4412	343.2	883.9	30.0	8.9	23.9	6.4	31.2	
13-10531	42.3451	79.3731	413.0	973.8	29.4	8.2	21.8	7.1	29.1	*
13-10532	42.2250	79.6645	492.9	1107.6	35.6	7.6	25.2	8.1	32.5	
13-10534	42.4860	79.3255	185.9	708.4	28.9	10.2	26.4	5.1	33.5	
13-10535	42.3818	79.4737	225.9	714.1	29.4	10.0	27.2	5.1	34.4	
13-10550	42.2286	79.6517	496.2	1116.5	30.0	7.6	20.1	8.1	27.4	*
13-10554	42.3363	79.3733	405.4	962.6	28.3	8.3	20.8	7.0	28.1	*
13-10564	42.3895	79.4749	204.5	697.7	26.7	10.2	23.6	5.0	30.8	
13-10566	42.2876	79.5339	434.0	1012.2	28.9	8.1	20.5	7.4	27.8	*
13-10578	42.4018	79.4445	204.5	686.1	25.6	10.2	22.4	4.9	29.6	*
13-10579	42.3470	79.4743	342.3	878.7	32.8	8.9	27.2	6.4	34.4	
13-10580	42.3324	79.5154	402.3	968.3	26.7	8.3	18.9	7.1	26.2	*
13-10584	42.3667	79.4918	237.1	753.5	25.6	9.9	20.8	5.4	28.0	*
13-10585	42.3586	79.4323	340.5	882.4	30.0	8.9	23.9	6.4	31.2	
13-10596	42.3380	79.3800	405.7	964.7	29.4	8.3	22.0	7.0	29.2	*
13-10597	42.2159	79.6577	504.1	1150.3	36.1	7.5	24.8	8.4	32.1	
13-10601	42.3876	79.4382	235.0	801.6	29.4	9.9	24.4	5.8	31.6	
13-10605	42.3412	79.4439	420.9	981.5	30.0	8.1	22.3	7.2	29.6	
13-10655	42.2104	79.6575	504.4	1200.9	37.8	7.5	25.2	8.8	32.5	
13-10656	42.3892	79.4494	221.3	712.0	27.8	10.0	24.9	5.1	32.1	
13-10658	42.3832	79.4427	241.1	730.0	28.3	9.8	25.3	5.2	32.5	
13-10700	42.3552	79.4945	251.2	770.2	28.9	9.8	24.8	5.6	32.0	
13-10705	42.1899	79.6604	475.5	1108.6	35.6	7.8	25.0	8.1	32.3	
13-10706	42.1932	79.6550	477.9	1119.2	33.9	7.8	23.3	8.2	30.6	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-10757	42.2705	79.5480	423.1	1028.7	35.6	8.2	26.6	7.5	33.9	
13-10771	42.1655	79.6659	440.4	1116.8	36.1	8.2	25.0	8.1	32.3	
13-10872	42.0539	79.4637	476.4	1312.5	38.9	7.9	23.6	9.5	30.9	
13-10873	42.0559	79.0771	443.8	1398.7	37.8	6.1	21.2	10.1	28.5	
13-10875	42.1503	79.6860	489.8	1153.7	36.7	7.7	25.1	8.4	32.4	
13-10877	42.2953	79.4667	445.9	1004.3	33.3	7.9	25.3	7.3	32.6	
13-10878	42.3358	79.4532	463.0	1034.5	34.4	7.7	25.8	7.5	33.1	
13-10883	42.3665	79.2975	423.1	993.0	37.2	8.0	29.4	7.2	36.7	*
13-10884	42.3697	79.4417	279.2	808.6	28.9	9.5	24.0	5.9	31.2	
13-10894	42.3266	79.3899	406.9	963.8	32.8	8.3	25.4	7.0	32.7	
13-10895	42.3580	79.2991	417.6	996.4	30.0	8.1	22.0	7.3	29.3	*
13-10896	42.1530	79.6920	491.6	1151.8	36.7	7.7	25.1	8.4	32.4	
13-10898	42.1707	79.6457	468.5	1137.2	38.3	7.9	26.7	8.3	34.0	
13-10899	42.2178	79.6818	475.2	1112.5	35.6	7.8	24.9	8.1	32.2	
13-10900	42.1516	79.6683	462.8	1166.5	36.7	7.8	24.7	8.5	32.0	
13-10923	42.3439	79.4620	445.0	985.1	38.9	7.9	31.5	7.2	38.7	*
13-10931	42.2008	79.5665	491.9	1143.0	35.0	7.6	23.9	8.3	31.2	
13-10937	42.3447	79.4007	407.8	980.5	33.3	8.2	25.6	7.1	32.9	
13-10943	42.1685	79.6891	458.4	1083.3	37.2	8.0	26.9	7.9	34.2	
13-10944	42.3346	79.3983	452.9	979.6	33.3	7.8	26.1	7.1	33.3	
13-10945	42.3525	79.3309	410.3	969.3	30.0	8.2	22.5	7.1	29.8	
13-10946	42.4278	79.3017	268.2	746.8	23.3	9.5	18.6	5.4	25.8	*
13-10948	42.1525	79.6572	457.8	1163.7	36.1	8.0	24.1	8.5	31.4	
13-10949	42.2244	79.6955	420.0	1040.6	34.4	8.4	25.1	7.6	32.4	
13-10955	42.2232	79.6839	462.4	1068.3	35.0	7.9	25.3	7.8	32.6	
13-10957	42.3291	79.3926	418.8	995.2	38.9	8.2	30.9	7.3	38.2	*
13-10967	42.3486	79.4447	416.7	968.3	32.8	8.2	25.4	7.1	32.7	
13-10968	42.3678	79.2907	425.2	984.5	34.4	8.0	26.9	7.2	34.1	
13-10972	42.3557	79.2507	427.0	999.4	36.1	8.0	28.1	7.3	35.4	
13-10973	42.1773	79.7103	442.3	1113.4	33.3	8.2	22.6	8.1	29.9	*
13-10993	42.3507	79.3780	420.9	975.4	29.4	8.1	21.9	7.1	29.2	*
13-10999	42.1881	79.6923	478.5	1106.7	40.0	7.8	29.1	8.1	36.4	*
13-11000	42.1919	79.6863	490.7	1135.4	36.7	7.7	25.5	8.3	32.8	
13-11004	42.3422	79.4083	458.1	997.9	32.2	7.8	24.5	7.3	31.8	
13-11005	42.3369	79.4051	417.9	1030.2	38.9	8.2	29.8	7.5	37.1	*
13-11021	42.3366	79.4454	455.7	1019.3	31.1	7.8	22.9	7.4	30.2	*
13-11022	42.3176	79.3813	404.5	1010.4	35.0	8.3	26.4	7.4	33.7	
13-11023	42.1486	79.7101	463.6	1136.6	35.0	8.0	23.7	8.3	31.0	
13-11030	42.1776	79.6919	471.8	1114.0	36.7	7.9	25.8	8.1	33.1	
13-11031	42.3734	79.4933	220.7	725.1	27.2	10.1	23.7	5.2	30.8	
13-11032	42.4097	79.2617	453.5	969.9	33.3	7.7	26.5	7.1	33.7	
13-11033	42.3340	79.4833	426.7	981.5	30.6	8.1	22.9	7.2	30.2	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11036	42.4128	79.2725	397.5	892.8	30.0	8.2	24.4	6.5	31.7	
13-11038	42.1024	79.1461	387.7	1264.9	28.9	8.6	23.9	9.2	31.2	
13-11040	42.1921	79.6693	*****	1081.7	32.2	1.9	28.0	7.9	35.3	*
13-11041	42.1941	79.6798	438.9	1073.5	35.0	8.2	25.0	7.8	32.3	
13-11042	42.1588	79.6860	506.0	1139.6	35.0	7.6	24.1	8.3	31.4	
13-11043	42.1874	79.6781	488.3	1121.1	34.4	7.7	23.8	8.2	31.1	
13-11054	42.3610	79.2908	427.0	984.5	32.2	8.0	24.6	7.2	31.9	
13-11059	42.3185	79.3682	402.0	1004.3	32.8	8.3	24.4	7.3	31.6	
13-11063	42.2482	79.6257	487.4	1089.7	34.4	7.7	24.6	8.0	31.9	
13-11069	42.3892	79.1916	424.6	607.2	21.1	8.0	21.7	4.3	28.7	*
13-11076	42.4161	79.3145	274.6	763.8	24.4	9.4	19.7	5.5	26.9	*
13-11079	42.1466	79.7028	463.9	1138.4	35.0	8.0	23.7	8.3	31.0	
13-11094	42.3223	79.3991	409.0	993.6	31.1	8.3	23.0	7.2	30.3	
13-11096	42.1909	79.7008	460.9	1107.0	31.7	8.0	21.4	8.1	28.7	*
13-11097	42.3255	79.4799	444.4	1000.0	31.1	7.9	23.2	7.3	30.5	
13-11098	42.3284	79.4718	438.3	999.7	31.1	8.0	23.1	7.3	30.4	
13-11110	42.1565	79.6989	452.0	1107.3	32.8	8.1	22.3	8.1	29.6	*
13-11111	42.3351	79.4156	416.7	992.4	32.2	8.2	24.2	7.2	31.5	
13-11112	42.3430	79.3859	401.1	958.3	32.8	8.3	25.5	7.0	32.8	
13-11117	42.1858	79.6676	448.1	1082.0	32.2	8.1	22.3	7.9	29.6	*
13-11118	42.3403	79.4218	422.5	990.0	32.8	8.1	24.9	7.2	32.2	
13-11119	42.3402	79.3958	401.7	969.9	32.8	8.3	25.2	7.1	32.5	
13-11120	42.3200	79.3492	472.1	1076.6	32.8	7.6	23.4	7.9	30.7	
13-11121	42.4032	79.2937	332.5	853.4	25.6	8.9	19.5	6.2	26.8	*
13-11130	42.1716	79.7096	442.0	1091.2	32.2	8.2	22.0	8.0	29.3	*
13-11131	42.1713	79.7188	442.0	1090.6	32.8	8.2	22.5	8.0	29.6	*
13-11132	42.1647	79.7221	445.3	1095.8	32.8	8.2	22.5	8.0	29.7	*
13-11133	42.1906	79.7098	450.5	1078.7	32.2	8.1	22.4	7.9	29.7	*
13-11136	42.1964	79.6974	448.1	1077.8	32.2	8.1	22.4	7.9	29.7	*
13-11137	42.1971	79.7091	442.9	1077.8	33.9	8.2	23.9	7.9	31.2	
13-11138	42.3259	79.3422	507.5	1150.0	31.7	7.3	21.2	8.4	28.5	*
13-11146	42.3225	79.3756	460.2	1029.3	32.2	7.7	23.8	7.5	31.1	
13-11152	42.3395	79.4975	323.4	866.2	30.6	9.1	24.8	6.3	32.0	
13-11153	42.3639	79.3113	408.1	962.3	29.4	8.2	22.1	7.0	29.4	*
13-11154	42.3250	79.3670	402.9	1208.5	31.7	8.3	19.3	8.8	26.6	*
13-11162	42.2176	79.6389	514.2	1134.2	36.1	7.4	25.3	8.3	32.6	
13-11163	42.2229	79.6255	515.4	1132.9	33.3	7.4	22.9	8.3	30.2	*
13-11165	42.2533	79.6288	483.7	1083.0	32.2	7.7	22.7	7.9	30.0	*
13-11167	42.2512	79.6209	481.0	1089.7	35.0	7.7	25.0	8.0	32.3	
13-11169	42.3283	79.3575	440.7	1026.3	36.7	7.9	28.0	7.5	35.3	*
13-11170	42.3626	79.4990	237.1	756.2	28.9	9.9	25.1	5.5	32.3	
13-11176	42.4373	79.2935	265.2	731.5	24.4	9.5	20.4	5.3	27.6	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)
13-11179	42.2557	79.6389	461.5	1051.0	33.3	7.9	24.2	7.7	31.5
13-11180	42.2295	79.6360	494.4	1105.2	35.6	7.6	25.3	8.1	32.6
13-11181	42.3283	79.3760	423.4	997.6	33.9	8.1	25.8	7.3	33.1
13-11182	42.2561	79.6154	465.7	1079.6	35.0	7.8	25.2	7.9	32.4
13-11192	42.2036	79.6537	484.9	1122.3	36.1	7.7	25.3	8.2	32.6
13-11193	42.3585	79.5036	235.0	752.9	26.7	10.0	22.2	5.4	29.4
13-11197	42.2023	79.6696	474.9	1097.3	32.8	7.8	22.7	8.0	30.0
13-11199	42.2052	79.6273	486.2	1091.8	35.6	7.7	25.5	8.0	32.6
13-11200	42.2467	79.6167	481.6	1092.1	35.6	7.7	25.5	8.0	32.8
13-11205	42.3324	79.3448	513.6	1090.6	33.3	7.2	24.0	8.0	31.3
13-11207	42.3533	79.5081	241.1	772.7	28.3	9.9	23.9	5.6	31.1
13-11208	42.3500	79.5162	240.2	792.8	28.9	9.9	23.9	5.7	31.2
13-11210	42.1004	79.4640	481.9	1244.2	36.1	7.8	22.8	9.1	30.0
13-11211	42.1009	79.4551	470.6	1040.9	33.3	7.9	24.4	7.6	31.7
13-11212	42.0946	79.4635	471.8	1240.5	33.3	7.9	20.5	9.0	27.8
13-11254	42.2278	79.6272	486.2	1103.7	35.6	7.7	25.3	8.1	32.6
13-11255	42.2598	79.6322	473.0	1067.7	35.0	7.8	25.5	7.8	32.8
13-11256	42.2337	79.6241	487.7	1100.9	35.0	7.7	24.8	8.0	32.1
13-11257	42.2643	79.6568	411.5	985.4	31.7	8.4	23.6	7.2	30.9
13-11258	42.2689	79.6491	419.1	992.7	33.3	8.3	25.2	7.2	32.5
13-11262	42.3648	79.5061	218.2	738.2	29.4	10.1	26.2	5.3	33.4
13-11263	42.3589	79.5133	228.6	750.1	29.4	10.0	25.9	5.4	33.1
13-11267	42.3247	79.4507	487.7	1051.6	32.2	7.5	23.5	7.7	30.8
13-11268	42.3195	79.4073	445.0	1028.4	31.1	7.9	22.6	7.5	29.9
13-11269	42.2604	79.6904	299.3	1174.4	31.1	9.5	18.4	8.6	25.7
13-11273	42.3351	79.5033	431.9	895.8	30.6	8.1	25.1	6.5	32.4
13-11274	42.3371	79.5120	296.9	834.8	29.4	9.4	24.0	6.1	31.3
13-11275	42.3451	79.5037	273.1	810.5	30.6	9.6	25.9	5.9	33.1
13-11285	42.1070	79.4583	486.5	1259.1	37.8	7.7	23.9	9.2	31.1
13-11294	42.3207	79.4158	441.4	1020.2	31.7	7.9	23.3	7.4	30.5
13-11295	42.2628	79.6828	313.9	878.7	29.4	9.4	22.9	6.4	30.1
13-11296	42.3145	79.3985	445.0	1034.5	31.1	7.9	22.4	7.5	29.7
13-11297	42.3199	79.3892	408.4	989.1	30.0	8.3	22.0	7.2	29.3
13-11298	42.2668	79.6877	265.8	824.2	31.1	9.8	25.8	6.0	33.1
13-11304	42.3285	79.4442	469.4	1033.9	31.1	7.7	22.7	7.5	30.0
13-11305	42.3240	79.4363	452.0	1016.2	30.0	7.8	21.8	7.4	29.1
13-11314	42.2740	79.6241	445.9	1011.6	29.4	8.0	21.2	7.4	28.5
13-11315	42.3343	79.4924	379.5	930.9	28.3	8.6	21.2	6.8	28.5
13-11316	42.3248	79.4213	426.7	1026.3	35.0	8.1	26.2	7.5	33.5
13-11323	42.3329	79.3835	424.0	999.7	33.3	8.1	25.2	7.3	32.5
13-11337	42.3264	79.4892	439.5	1000.4	40.0	8.0	32.0	7.3	39.3
13-11339	42.3357	79.4296	420.0	982.7	31.7	8.1	23.9	7.2	31.2

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11340	42.3062	79.3562	396.5	1003.4	31.1	8.4	22.7	7.3	29.9	*
13-11341	42.2991	79.3542	395.6	1006.4	36.1	8.4	27.5	7.3	34.8	
13-11342	42.3149	79.3544	407.8	1002.2	33.3	8.3	25.0	7.3	32.3	
13-11349	42.3288	79.5062	356.6	910.1	31.7	8.8	25.1	6.6	32.4	
13-11350	42.3241	79.5104	361.5	941.2	32.8	8.8	25.5	6.9	32.8	
13-11352	42.3291	79.3329	496.5	1083.6	30.6	7.4	21.4	7.9	28.7	*
13-11353	42.3241	79.5003	413.9	977.2	30.6	8.2	22.8	7.1	30.1	*
13-11354	42.2133	79.4953	417.0	982.4	32.8	8.2	25.0	7.2	32.3	
13-11355	42.3328	79.4383	447.8	1013.2	33.3	7.9	25.1	7.4	32.4	
13-11358	42.4251	79.3482	241.4	723.9	29.4	9.8	27.2	5.2	34.4	
13-11362	42.2132	79.7014	428.2	1020.8	33.9	8.3	25.1	7.4	32.4	
13-11363	42.2182	79.6982	422.8	1033.9	35.0	8.3	25.8	7.5	33.1	
13-11364	42.2723	79.6904	235.3	794.3	28.9	10.1	23.6	5.7	30.9	*
13-11370	42.4155	79.2924	296.6	780.0	29.4	9.2	25.9	5.6	33.2	
13-11372	42.3092	79.3510	413.9	1014.4	31.7	8.2	23.1	7.4	30.4	*
13-11373	42.3276	79.3230	461.2	1051.0	33.9	7.7	24.9	7.7	32.2	
13-11387	42.2214	79.6667	496.2	1886.4	47.2	7.6	21.0	13.2	28.0	
13-11388	42.1058	79.4779	469.7	1225.9	33.3	7.9	20.7	8.9	28.0	*
13-11405	42.3240	79.3156	412.7	1008.0	33.3	8.2	24.9	7.4	32.2	
13-11406	42.3195	79.3104	402.0	998.2	33.9	8.3	25.6	7.3	32.9	
13-11407	42.2083	79.6943	446.5	1073.2	33.3	8.1	23.5	7.8	30.8	*
13-11414	42.1971	79.6498	474.0	1116.2	34.4	7.8	23.8	8.1	31.1	
13-11415	42.3154	79.3439	493.2	1086.0	33.3	7.4	23.9	7.9	31.2	
13-11422	42.3951	79.4096	252.1	746.8	32.2	9.7	30.1	5.4	37.3	*
13-11423	42.3920	79.3528	369.1	864.4	26.1	8.5	20.3	6.3	27.6	*
13-11424	42.3125	79.4075	460.6	1051.9	34.4	7.8	25.4	7.7	32.7	
13-11427	42.3070	79.3835	443.5	1043.9	32.2	7.9	23.3	7.6	30.6	
13-11429	42.2691	79.6424	417.6	978.4	32.2	8.3	24.4	7.1	31.7	
13-11430	42.3331	79.5239	275.5	819.0	31.1	9.6	26.3	5.9	33.5	
13-11431	42.3094	79.3933	449.9	1042.7	33.9	7.9	25.0	7.6	32.2	
13-11448	42.3922	79.3436	379.8	885.4	31.7	8.4	26.2	6.4	33.5	
13-11453	42.3925	79.4022	255.4	756.8	24.4	9.7	19.5	5.5	26.7	*
13-11454	42.4115	79.3551	268.2	761.4	29.4	9.5	26.2	5.5	33.4	
13-11455	42.3215	79.4843	432.2	988.2	32.2	8.1	24.5	7.2	31.7	
13-11456	42.3251	79.5204	329.5	876.9	30.6	9.1	24.5	6.4	31.8	
13-11457	42.3096	79.5063	399.9	962.3	34.4	8.4	27.1	7.0	34.4	
13-11459	42.2235	79.6419	523.0	1135.4	35.6	7.3	24.9	8.3	32.2	
13-11469	42.4498	79.2961	247.8	699.5	22.2	9.6	18.0	5.0	25.1	*
13-11470	42.4543	79.3026	234.4	690.4	23.3	9.8	19.6	4.9	26.8	*
13-11471	42.4526	79.2822	254.5	691.9	25.6	9.6	23.1	5.0	30.3	
13-11472	42.4463	79.2889	259.1	711.7	28.3	9.5	26.4	5.1	33.6	
13-11473	42.4416	79.2517	359.7	813.5	24.4	8.5	19.5	5.9	26.8	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11477	42.2382	79.6276	482.8	1096.4	34.4	7.7	24.4	8.0	31.7	
13-11486	42.3191	79.4750	460.9	1021.4	35.0	7.8	26.7	7.5	33.9	
13-11487	42.3062	79.3666	397.5	1004.3	33.3	8.4	24.8	7.3	32.1	
13-11488	42.3239	79.4671	446.1	1008.6	33.9	7.9	25.8	7.4	33.1	
13-11489	42.2988	79.3674	396.8	1004.3	33.3	8.4	24.8	7.3	32.1	
13-11499	42.3677	79.2745	453.2	1001.6	31.7	7.7	23.9	7.3	31.2	
13-11500	42.2596	79.6986	272.8	853.4	31.1	9.8	25.0	6.2	32.3	
13-11501	42.3123	79.3037	401.4	1012.5	32.2	8.3	23.6	7.4	30.9	
13-11502	42.3654	79.2666	462.4	1013.5	34.4	7.6	26.4	7.4	33.7	
13-11503	42.3605	79.2595	476.4	1030.5	31.7	7.5	23.4	7.3	30.7	
13-11504	42.3648	79.2530	477.3	1064.1	32.2	7.5	23.2	7.8	30.5	
13-11505	42.3664	79.3176	404.8	965.3	30.6	8.2	23.1	7.0	30.4	
13-11511	42.3986	79.3788	286.5	774.2	35.6	9.4	33.8	5.6	41.1	*
13-11512	42.4380	79.2697	342.6	815.0	28.3	8.7	24.1	5.9	31.3	
13-11513	42.3115	79.5141	376.4	933.0	32.2	8.6	25.3	6.8	32.6	
13-11524	42.3184	79.5193	374.0	899.5	32.2	8.6	26.2	6.5	33.5	
13-11525	42.3281	79.4965	423.4	982.1	31.7	8.1	24.0	7.2	31.2	
13-11526	42.3949	79.3645	319.1	823.3	26.7	9.0	21.4	6.0	28.7	*
13-11530	42.1143	79.4695	523.0	1271.0	36.7	7.4	23.0	9.2	30.3	
13-11532	42.3741	79.4341	259.7	780.3	28.9	9.7	24.6	5.6	31.9	
13-11536	42.3854	79.3575	401.1	920.5	30.0	8.2	23.6	6.7	30.9	
13-11537	42.3873	79.3249	402.3	911.4	31.1	8.2	25.1	6.6	32.4	
13-11538	42.3772	79.3578	480.4	994.0	29.4	7.5	22.1	7.2	29.4	*
13-11552	42.4446	79.2716	309.7	796.4	22.8	9.0	17.3	5.8	24.5	*
13-11553	42.4203	79.2954	298.7	796.1	26.7	9.2	22.0	5.8	29.2	*
13-11555	42.4428	79.3432	220.1	670.0	23.3	9.9	20.0	4.8	27.1	*
13-11557	42.3117	79.4866	438.6	1010.1	33.3	8.0	25.1	7.4	32.4	
13-11558	42.3159	79.4623	463.3	1041.8	32.2	7.8	23.5	7.6	30.8	
13-11562	42.3683	79.3252	403.3	951.9	32.2	8.2	25.2	6.9	32.5	
13-11563	42.3031	79.3470	416.4	1020.2	32.2	8.2	23.6	7.4	30.9	
13-11564	42.3097	79.3218	500.8	1110.1	32.2	7.3	22.4	8.1	29.7	*
13-11568	42.3169	79.3230	517.9	1115.0	34.4	7.2	24.5	8.1	31.8	
13-11583	42.4461	79.3142	239.3	706.8	25.6	9.7	22.4	5.1	29.6	*
13-11584	42.3328	79.4230	423.7	992.4	30.0	8.1	22.1	7.2	29.3	*
13-11585	42.3143	79.4166	479.1	1066.8	32.2	7.6	23.1	7.8	30.4	
13-11586	42.3572	79.2523	513.6	1084.8	32.2	7.1	23.1	7.9	30.4	
13-11595	42.3740	79.2678	442.9	983.6	31.7	7.8	24.2	7.2	31.5	
13-11596	42.3538	79.3050	409.3	984.2	32.8	8.2	25.0	7.2	32.3	
13-11597	42.3586	79.2447	526.7	1085.7	31.1	7.0	22.2	7.9	29.5	*
13-11599	42.1422	79.4931	491.0	1215.5	36.7	7.7	23.9	8.9	31.1	
13-11603	42.3456	79.3002	450.5	1033.9	31.7	7.8	23.1	7.5	30.4	
13-11604	42.2934	79.3565	395.6	1006.8	31.1	8.4	22.6	7.3	29.8	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11605	42.3188	79.3002	400.5	1001.3	32.2	8.3	23.9	7.3	31.2	
13-11606	42.3270	79.3017	403.6	995.8	31.1	8.3	22.9	7.3	30.2	*
13-11612	42.4429	79.3294	227.1	680.6	26.1	9.9	23.9	4.9	31.0	
13-11613	42.4446	79.2652	327.4	818.4	25.6	8.9	20.4	5.9	27.6	
13-11614	42.3632	79.4234	319.4	860.1	30.6	9.1	25.0	6.2	32.2	
13-11615	42.3701	79.4160	331.3	864.7	28.9	9.0	23.0	6.3	30.3	
13-11616	42.3785	79.2799	440.4	985.7	31.7	7.8	24.2	7.2	31.5	
13-11617	42.3788	79.2723	426.7	973.8	31.7	8.0	24.3	7.1	31.6	
13-11626	42.3969	79.2864	374.9	856.2	36.1	8.5	32.3	6.2	39.5	*
13-11627	42.4260	79.2952	289.6	771.4	24.4	9.3	19.7	5.6	26.9	*
13-11634	42.3123	79.4571	499.0	1082.6	28.9	7.4	19.8	7.9	27.1	*
13-11635	42.3215	79.4285	457.2	1032.1	30.6	7.8	22.1	7.5	29.3	*
13-11636	42.3159	79.4374	443.8	1058.6	34.4	7.9	25.0	7.7	32.3	
13-11637	42.3095	79.4489	505.7	1098.8	33.3	7.3	23.7	8.0	31.0	
13-11638	42.3151	79.4278	471.8	1064.7	33.3	7.7	24.1	7.8	31.4	
13-11643	42.3807	79.2869	399.0	954.9	31.7	8.2	24.5	7.0	31.8	
13-11648	42.3100	79.4404	481.6	1068.9	32.2	7.6	23.1	7.8	30.4	
13-11649	42.3040	79.4424	497.1	1089.1	33.9	7.4	24.3	7.9	31.6	
13-11650	42.3055	79.4352	479.5	1064.1	32.8	7.6	23.7	7.8	31.0	
13-11657	42.2060	79.4926	419.1	992.4	31.1	8.2	23.1	7.2	30.4	
13-11659	42.1157	79.4948	503.2	1243.3	33.9	7.6	21.2	9.1	28.4	*
13-11661	42.0907	79.4731	460.6	1236.0	34.4	8.0	21.4	9.0	28.7	*
13-11664	42.1696	79.5091	472.7	1179.6	35.6	7.8	23.5	8.6	30.8	
13-11667	42.0663	79.7364	433.4	1176.8	38.9	8.4	25.9	8.6	33.2	
13-11671	42.3103	79.4237	487.1	1080.5	31.1	7.5	21.8	7.9	29.1	*
13-11672	42.1615	79.4705	481.3	1196.3	28.9	7.7	17.7	8.7	25.0	*
13-11678	42.4356	79.3618	210.6	672.7	26.7	10.0	24.7	4.8	31.8	
13-11679	42.4539	79.3651	195.4	652.0	28.9	10.2	28.7	4.6	35.8	*
13-11680	42.4274	79.3712	223.1	706.5	28.3	9.9	26.0	5.1	33.2	
13-11681	42.4342	79.3729	211.2	673.0	28.3	10.0	27.2	4.8	34.3	
13-11682	42.4302	79.3534	231.6	700.4	32.2	9.8	31.9	5.0	39.1	*
13-11683	42.4458	79.2327	384.7	857.4	27.2	8.3	22.1	6.2	29.3	
13-11684	42.4402	79.2331	405.4	885.1	31.1	8.1	26.0	6.4	33.3	
13-11686	42.4417	79.1986	345.9	834.2	28.9	8.7	24.2	6.0	31.5	
13-11687	42.4461	79.1936	339.9	848.9	27.8	8.7	22.5	6.2	29.7	
13-11691	42.4561	79.2596	280.7	730.6	28.9	9.3	26.8	5.3	34.0	
13-11696	42.3041	79.4615	483.7	1066.5	31.7	7.6	22.6	7.8	29.9	*
13-11697	42.3207	79.4425	489.8	1054.9	31.1	7.5	22.4	7.7	29.7	*
13-11698	42.3165	79.4475	506.0	1082.3	31.7	7.3	22.5	7.9	29.8	*
13-11701	42.3745	79.2857	433.7	991.2	30.0	7.9	22.3	7.2	29.6	*
13-11702	42.3884	79.2948	326.1	851.3	27.2	9.0	21.5	6.2	28.7	*
13-11705	42.0316	79.6814	439.2	1249.4	37.8	8.3	23.6	9.1	30.8	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11710	42.4660	79.3255	185.9	613.0	26.1	10.2	25.9	4.3	33.0	
13-11711	42.3593	79.4164	349.0	905.3	29.4	8.8	22.8	6.6	30.1	*
13-11712	42.3459	79.4237	420.3	975.4	31.1	8.1	23.6	7.1	30.9	
13-11713	42.3341	79.3139	398.7	986.9	30.0	8.3	22.0	7.2	29.3	*
13-11714	42.2679	79.3058	396.2	947.0	31.1	8.3	24.1	6.9	31.4	
13-11715	42.2971	79.4039	506.9	1112.8	34.4	7.3	24.4	8.1	31.7	
13-11716	42.3033	79.3896	450.8	1056.4	32.2	7.9	23.1	7.7	30.4	
13-11717	42.3053	79.3329	466.6	1081.7	31.7	7.7	22.2	7.9	29.5	*
13-11718	42.2900	79.3474	402.0	1016.2	30.0	8.3	21.3	7.4	28.6	*
13-11720	42.3544	79.2602	486.8	1075.9	32.8	7.4	23.6	7.9	30.9	
13-11724	42.3884	79.3681	371.6	893.4	30.6	8.5	24.6	6.5	31.9	
13-11734	42.1161	79.5185	558.1	1293.6	37.8	7.0	23.8	9.4	31.0	
13-11751	42.3384	79.3071	406.9	987.9	29.4	8.2	21.5	7.2	28.8	*
13-11752	42.2944	79.4161	504.7	1106.4	33.9	7.4	24.0	8.1	31.3	
13-11753	42.3847	79.3746	395.6	911.4	30.0	8.3	23.8	6.6	31.1	
13-11764	42.3807	79.3878	393.5	918.7	30.0	8.3	23.6	6.7	30.9	
13-11765	42.2986	79.4424	500.5	1095.1	30.0	7.4	20.6	8.0	27.9	*
13-11766	42.3036	79.4519	511.1	1097.9	30.6	7.3	21.2	8.0	28.5	*
13-11774	42.4415	79.3576	208.8	671.2	26.7	10.1	24.7	4.8	31.9	
13-11783	42.4816	79.3089	201.2	634.3	28.3	10.1	28.8	4.5	35.9	*
13-11784	42.4496	79.3490	201.2	668.7	28.9	10.1	28.1	4.8	35.2	*
13-11786	42.5179	79.2424	207.3	603.5	22.8	9.9	21.3	4.3	28.4	
13-11788	42.4240	79.3271	249.9	719.3	24.4	9.7	20.5	5.2	27.7	*
13-11793	42.3062	79.4696	432.2	1008.6	30.6	8.1	22.3	7.4	29.6	*
13-11800	42.4636	79.3170	211.8	662.3	23.9	10.0	21.0	4.7	28.1	*
13-11802	42.4661	79.3025	219.2	665.1	22.8	9.9	19.4	4.7	26.5	*
13-11803	42.3828	79.2782	420.9	871.1	34.4	8.0	30.3	6.3	37.6	*
13-11804	42.3896	79.2782	408.7	938.2	33.9	8.1	27.4	6.8	34.7	
13-11806	42.4872	79.2965	202.7	625.1	30.6	10.0	32.8	4.4	39.9	*
13-11807	42.4811	79.2954	207.6	630.6	25.6	10.0	24.7	4.5	31.8	
13-11808	42.4542	79.3532	199.3	654.1	27.8	10.1	27.0	4.7	34.1	
13-11809	42.4456	79.3536	213.4	673.6	29.4	10.0	28.9	4.8	36.0	*
13-11810	42.4331	79.3438	240.2	713.2	28.9	9.8	26.8	5.1	34.0	
13-11811	42.4426	79.4139	189.6	641.0	28.3	10.3	28.2	4.6	35.3	*
13-11812	42.4456	79.4056	186.2	637.6	25.0	10.3	23.1	4.5	30.2	
13-11866	42.2913	79.4471	504.1	1092.4	33.9	7.4	24.3	8.0	31.6	
13-11867	42.2878	79.4411	493.2	1094.2	31.7	7.5	22.1	8.0	29.4	*
13-11868	42.2871	79.4308	474.9	1102.8	30.0	7.7	20.3	8.0	27.6	*
13-11869	42.2818	79.4300	472.4	1089.4	35.6	7.7	25.6	7.9	32.9	
13-11870	42.2751	79.4284	448.1	1067.7	35.0	7.9	25.3	7.8	32.6	
13-11871	42.2807	79.4478	493.2	1202.1	35.0	7.5	22.9	8.6	30.2	
13-11872	42.2813	79.4637	434.9	1046.4	32.2	8.1	23.1	7.6	30.4	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11873	42.2779	79.4704	412.4	1018.3	34.4	8.3	25.7	7.4	33.0	
13-11874	42.2727	79.4728	408.4	1019.9	32.8	8.3	24.0	7.4	31.3	
13-11875	42.2725	79.4641	444.7	1054.9	33.3	8.0	24.0	7.7	31.3	
13-11876	42.2683	79.4693	412.4	1016.5	33.3	8.3	24.6	7.4	31.9	
13-11877	42.2656	79.4602	451.7	1069.5	33.9	7.9	24.3	7.8	31.6	
13-11879	42.2753	79.4525	474.9	1085.7	33.9	7.7	24.1	7.9	31.4	
13-11880	42.2587	79.4507	469.4	1097.3	35.6	7.8	25.3	8.0	32.6	
13-11882	42.2690	79.4290	428.5	1051.3	32.2	8.1	22.9	7.7	30.2	*
13-11883	42.2583	79.4348	416.7	1064.7	31.7	8.3	22.0	7.8	29.3	*
13-11884	42.2640	79.4312	423.1	1054.6	33.3	8.2	23.8	7.7	31.1	
13-11885	42.2757	79.4209	455.1	1058.9	33.9	7.9	24.6	7.7	31.9	
13-11886	42.2878	79.4229	469.1	1077.5	32.8	7.7	23.3	7.9	30.6	
13-11887	42.2885	79.3969	525.2	1153.7	36.7	7.2	25.6	8.4	32.9	
13-11888	42.2830	79.3936	518.8	1137.8	33.9	7.2	23.4	8.3	30.7	
13-11889	42.2878	79.3846	474.9	1092.4	33.9	7.6	24.0	8.0	31.3	
13-11890	42.2903	79.3776	443.8	1060.4	33.3	7.9	23.9	7.7	31.2	
13-11891	42.2818	79.2982	486.6	1116.5	34.4	7.5	24.1	8.1	31.4	
13-11893	42.2890	79.3952	397.8	1015.6	33.3	8.4	24.5	7.4	31.8	
13-11894	42.2807	79.3904	397.2	1029.9	33.9	8.4	24.7	7.5	32.0	
13-11895	42.2869	79.3526	393.8	1011.0	35.0	8.4	26.3	7.4	33.6	
13-11896	42.2844	79.3420	398.7	1021.4	34.4	8.4	25.5	7.5	32.8	
13-11897	42.2517	79.3707	433.4	1052.5	29.4	8.1	20.3	7.7	27.6	*
13-11900	42.2915	79.3157	398.1	1024.1	30.0	8.4	21.1	7.5	28.4	*
13-11901	42.2957	79.3225	431.9	1046.5	32.8	8.0	23.6	7.7	30.9	
13-11902	42.3010	79.3252	444.7	1057.4	33.9	7.9	24.6	7.7	31.9	
13-11903	42.3038	79.3101	402.0	1012.9	32.2	8.3	23.6	7.4	30.9	
13-11904	42.2968	79.3126	401.4	1018.0	32.8	8.3	24.0	7.4	31.3	
13-11905	42.3099	79.3104	404.5	1018.9	28.3	8.3	19.7	7.4	27.0	*
13-11907	42.2871	79.2985	401.1	1026.6	33.3	8.3	24.3	7.5	31.6	
13-11909	42.3294	79.2895	413.3	1000.0	32.2	8.2	24.1	7.3	31.3	
13-11910	42.3269	79.2806	453.5	1042.7	32.8	7.8	24.0	7.6	31.3	
13-11911	42.3225	79.2898	410.6	998.5	33.9	8.2	25.7	7.3	33.0	
13-11912	42.3165	79.2874	413.9	1020.5	32.2	8.2	23.6	7.4	30.9	
13-11913	42.3089	79.2849	439.5	1048.8	33.3	7.9	24.2	7.7	31.5	
13-11914	42.3115	79.2910	423.4	1033.9	31.7	8.1	22.8	7.5	30.1	
13-11916	42.3063	79.2755	470.0	1079.9	33.9	7.6	24.3	7.9	31.6	
13-11920	42.4516	79.3103	233.2	691.9	28.3	9.8	26.8	5.0	34.0	
13-11922	42.4419	79.3707	200.6	661.7	30.6	10.1	30.8	4.7	38.0	*
13-11923	42.4405	79.2232	411.5	899.2	30.0	8.0	24.4	6.5	31.7	
13-11928	42.4656	79.3553	199.6	638.3	27.8	10.1	27.7	4.5	34.8	
13-11929	42.4654	79.3638	185.9	630.9	28.3	10.3	28.7	4.5	35.8	*
13-11934	42.3003	79.5027	409.3	986.3	32.2	8.3	24.2	7.2	31.5	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-11939	42.2057	79.6178	515.4	1165.6	33.3	7.4	22.2	8.5	29.5	*
13-11940	42.3010	79.4709	417.6	1000.7	30.0	8.2	21.8	7.3	29.1	*
13-11941	42.2937	79.4806	411.8	989.7	33.9	8.3	25.9	7.2	33.2	
13-11952	42.4484	79.3043	240.8	707.4	28.3	9.7	26.3	5.1	33.5	
13-11956	42.5031	79.2593	204.2	601.7	21.1	10.0	18.5	4.3	25.6	
13-11961	42.4490	79.3697	196.3	661.4	30.6	10.2	30.8	4.7	37.9	*
13-11984	42.4567	79.3594	194.8	634.0	27.8	10.2	27.8	4.5	34.9	
13-11985	42.4606	79.3543	193.2	637.6	25.6	10.2	24.1	4.5	31.2	
13-12001	42.1362	79.4887	512.4	1226.8	34.4	7.5	22.0	8.9	29.3	*
13-12045	42.4342	79.3315	234.7	706.5	27.2	9.8	24.7	5.1	31.8	
13-12077	42.4880	79.1713	257.9	707.7	30.6	9.5	29.8	5.1	37.0	*
13-12078	42.4891	79.1624	253.9	711.1	27.8	9.5	25.7	5.1	32.9	
13-12090	42.4836	79.1654	261.2	716.6	31.1	9.4	30.3	5.1	37.4	*
13-12091	42.4846	79.1563	264.9	723.9	27.8	9.4	25.4	5.2	32.6	
13-12093	42.4786	79.1533	316.4	783.3	28.3	8.9	24.8	5.7	32.0	
13-12094	42.4786	79.1842	296.3	746.2	31.7	9.1	30.3	5.4	37.5	*
13-12095	42.4772	79.1923	297.2	733.0	27.8	9.1	25.5	5.3	32.7	*
13-12096	42.4732	79.1862	321.6	781.2	30.0	8.9	27.1	5.6	34.3	
13-12099	42.4556	79.1828	327.1	810.5	31.7	8.8	28.2	5.9	35.4	
13-12100	42.4502	79.1887	300.8	799.8	28.3	9.1	24.1	5.8	31.3	*
13-12101	42.4496	79.1793	365.8	858.6	31.1	8.5	26.4	6.2	33.6	
13-12102	42.3617	79.1837	362.1	866.2	31.7	8.6	26.6	6.3	33.9	
13-12103	42.4652	79.1485	369.7	853.7	30.0	8.4	25.3	6.2	32.6	
13-12105	42.4732	79.1498	341.4	816.3	30.6	8.7	26.8	5.9	34.1	
13-12106	42.4734	79.1572	320.6	791.6	28.9	8.9	25.3	5.7	32.5	
13-12130	42.3865	79.4064	297.5	807.7	31.7	9.3	27.7	5.8	35.0	
13-12131	42.3836	79.4977	282.2	796.7	36.1	9.5	33.5	5.8	40.7	*
13-12132	42.3893	79.4167	250.9	768.1	28.3	9.7	24.2	5.5	31.4	
13-12133	42.3849	79.4222	246.3	769.0	28.3	9.8	24.1	5.6	31.3	
13-12134	42.4848	79.3021	609.9	623.6	26.1	6.1	32.2	4.4	39.2	*
13-12151	42.0413	79.4684	499.0	1312.2	35.6	7.7	21.3	9.5	28.5	
13-12152	42.4565	79.3170	217.6	669.6	26.1	9.9	24.2	4.8	31.3	
13-12167	42.4630	79.3832	185.9	623.9	26.7	10.3	26.3	4.4	33.4	
13-12168	42.4628	79.3748	189.0	641.6	26.7	10.2	25.6	4.6	32.7	
13-12169	42.4591	79.3890	185.9	635.8	26.7	10.3	25.8	4.5	32.9	
13-12171	42.4584	79.3696	191.4	640.4	26.7	10.2	25.7	4.6	32.8	
13-12173	42.4723	79.3557	190.5	625.8	27.2	10.2	27.2	4.4	34.3	
13-12174	42.4661	79.3415	197.8	643.1	26.7	10.1	25.7	4.6	32.8	
13-12175	42.4638	79.3478	198.1	650.4	27.8	10.1	27.1	4.6	34.3	
13-12186	42.5130	79.0891	266.1	725.7	29.4	9.3	27.7	5.2	34.9	
13-12188	42.5203	79.0839	270.7	732.1	30.0	9.3	28.3	5.3	35.5	
13-12189	42.5169	79.0630	271.6	723.3	28.3	9.2	26.4	5.2	33.6	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-12190	42.0857	79.6419	534.9	1290.2	31.1	7.3	18.4	9.4	25.7	*
13-12191	42.4977	79.1006	284.1	745.2	28.9	9.2	26.5	5.4	33.7	
13-12198	42.4774	79.3560	185.6	630.6	26.7	10.2	26.1	4.5	33.2	
13-12202	42.4963	79.1538	249.3	698.9	28.9	9.5	27.7	5.0	34.9	
13-12203	42.0413	79.4581	520.3	1351.2	36.7	7.5	21.6	9.8	28.9	
13-12204	42.2968	79.3343	463.0	1079.3	30.0	7.7	20.6	7.9	27.9	*
13-12210	42.4512	79.4023	181.7	628.2	27.2	10.3	26.9	4.5	34.0	
13-12211	42.4520	79.3769	189.0	650.7	26.7	10.2	25.2	4.6	32.4	
13-12213	42.4391	79.3996	192.0	652.0	25.6	10.2	23.5	4.6	30.6	
13-12214	42.4333	79.3853	204.2	677.9	27.8	10.1	26.0	4.8	33.2	
13-12215	42.4288	79.3904	214.0	690.1	26.7	10.0	24.1	4.9	31.3	
13-12216	42.4264	79.3987	205.1	681.2	26.7	10.1	24.3	4.9	31.4	
13-12219	42.5171	79.0741	266.7	719.3	28.9	9.3	27.2	5.2	34.4	
13-12220	42.4997	79.0893	269.1	735.8	28.9	9.3	26.6	5.3	33.8	
13-12232	42.3984	79.2061	432.2	974.8	31.1	7.9	23.8	7.1	31.1	
13-12233	42.3920	79.2078	464.2	1014.4	31.1	7.6	23.2	7.4	30.5	
13-12234	42.4156	79.2392	527.3	1035.7	34.4	6.9	26.6	7.6	33.9	
13-12235	42.4095	79.2477	496.5	1009.5	34.4	7.2	26.9	7.4	34.2	
13-12236	42.4091	79.2384	520.3	1021.4	30.6	7.0	23.1	7.5	30.3	
13-12237	42.4001	79.2350	529.7	1060.1	34.4	6.9	26.0	7.7	33.3	
13-12238	42.4001	79.2475	501.4	1023.8	33.3	7.2	25.5	7.5	32.8	
13-12239	42.3999	79.2560	481.3	1001.3	33.3	7.4	25.9	7.3	33.2	
13-12240	42.4008	79.2630	449.0	970.8	27.2	7.7	20.1	7.1	27.4	*
13-12242	42.3951	79.2526	483.7	1000.4	31.1	7.4	23.7	7.3	31.0	
13-12243	42.3848	79.2552	460.9	984.8	31.1	7.6	23.8	7.2	31.1	
13-12244	42.4080	79.2729	410.6	920.8	28.3	8.1	22.0	6.7	29.3	*
13-12246	42.4009	79.2792	394.4	914.4	32.8	8.3	26.8	6.7	34.1	
13-12258	42.4954	79.0746	282.9	764.7	26.7	9.2	22.9	5.5	30.1	*
13-12259	42.5124	79.0679	272.8	736.7	27.8	9.2	25.2	5.3	32.4	
13-12264	42.4912	79.0821	320.6	782.7	30.6	8.8	27.8	5.7	35.0	
13-12265	42.4739	79.1256	372.5	872.0	31.1	8.3	26.1	6.3	33.4	
13-12266	42.4679	79.1283	382.8	887.3	32.2	8.2	27.0	6.5	34.3	
13-12267	42.4650	79.1395	380.4	872.0	30.6	8.3	25.5	6.3	32.8	
13-12273	42.4233	79.2089	376.7	890.3	30.0	8.4	24.3	6.5	31.5	
13-12274	42.4199	79.2154	412.1	926.9	32.2	8.0	26.1	6.7	33.4	
13-12275	42.4143	79.2120	408.7	931.2	27.8	8.1	21.1	6.8	28.4	*
13-12276	42.4093	79.2084	398.4	932.4	29.4	8.2	22.8	6.8	30.1	*
13-12277	42.4065	79.2030	427.3	898.6	32.2	7.9	27.1	6.5	34.3	
13-12278	42.3988	79.2149	459.6	989.7	31.7	7.6	24.3	7.2	31.6	
13-12286	42.4064	79.2825	370.6	954.0	33.9	8.5	26.6	7.0	33.9	
13-12294	42.4067	79.2174	457.2	973.5	31.1	7.6	24.1	7.1	31.4	
13-12296	42.3994	79.2879	365.2	892.5	31.7	8.6	25.9	6.5	33.2	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-12297	42.4347	79.2329	433.7	933.0	27.8	7.8	21.4	6.8	28.7	*
13-12298	42.4295	79.2276	447.4	939.4	29.4	7.7	23.2	6.8	30.4	
13-12299	42.4339	79.2184	526.4	905.3	28.9	6.9	24.3	6.6	31.6	
13-12300	42.4301	79.2380	475.5	961.6	27.2	7.4	20.6	7.0	27.9	*
13-12301	42.4202	79.2682	456.3	930.9	28.9	7.6	22.8	6.8	30.1	*
13-12302	42.4186	79.2769	369.7	882.4	29.4	8.5	23.8	6.4	31.0	
13-12305	42.4879	79.1486	278.9	736.4	30.0	9.2	28.2	5.3	35.4	
13-12306	42.4819	79.1466	316.4	785.2	29.4	8.9	26.2	5.7	33.4	
13-12307	42.4774	79.1412	342.0	822.4	30.6	8.6	26.7	6.0	33.9	
13-12309	42.4754	79.1332	356.6	841.9	31.7	8.5	27.5	6.1	34.8	
13-12310	42.4800	79.1279	346.3	820.8	28.3	8.6	24.1	5.9	31.3	
13-12329	42.5000	79.0683	295.4	773.3	28.9	9.0	25.7	5.6	32.9	
13-12332	42.0478	79.4992	536.4	1358.2	37.8	7.3	22.4	9.9	29.7	
13-12339	42.4162	79.2838	334.7	855.6	29.4	8.8	24.1	6.2	31.3	
13-12351	42.4139	79.2554	490.7	997.0	28.3	7.3	21.1	7.3	28.4	*
13-12366	42.3943	79.1826	423.1	972.6	29.4	8.0	22.1	7.1	29.4	*
13-12367	42.3893	79.1845	425.2	981.8	30.0	7.9	22.5	7.2	29.8	*
13-12385	42.4032	79.2410	512.7	1026.9	29.4	7.1	21.8	7.5	29.1	*
13-12386	42.3954	79.2295	535.8	1067.7	32.8	6.9	24.3	7.8	31.6	
13-12387	42.3970	79.2414	523.0	1053.4	26.7	7.0	18.7	7.7	26.0	*
13-12388	42.3918	79.2364	545.6	1083.6	31.7	6.8	23.0	7.9	30.3	
13-12390	42.3902	79.2434	517.9	1061.9	32.2	7.1	23.7	7.7	31.0	
13-12391	42.3861	79.2388	507.8	1045.5	32.2	7.2	24.0	7.6	31.3	
13-12397	42.4616	79.3383	202.7	656.8	27.8	10.1	26.9	4.7	34.1	
13-12411	42.3903	79.4243	240.8	748.9	28.3	9.8	24.7	5.4	31.9	
13-12413	42.3770	79.3666	471.8	995.2	33.3	7.6	25.9	7.3	33.2	
13-12414	42.3713	79.3630	469.4	1012.9	30.6	7.6	22.7	7.4	30.0	*
13-12418	42.4628	79.1687	324.0	792.5	23.9	8.8	19.0	5.7	26.2	*
13-12419	42.4255	79.1177	190.8	553.2	25.6	10.2	27.8	3.9	34.8	
13-12421	42.3819	79.2343	494.1	1027.8	32.8	7.3	24.8	7.5	32.1	
13-12423	42.4024	79.2241	487.4	1020.8	30.6	7.3	22.7	7.4	30.0	
13-12426	42.4325	79.2852	309.4	803.8	26.7	9.1	21.9	5.8	29.1	*
13-12427	42.4251	79.2175	404.2	964.1	30.6	8.1	23.3	7.0	30.6	
13-12445	42.3902	79.2597	466.6	996.1	31.7	7.6	24.2	7.3	31.5	
13-12458	42.2893	79.4138	481.3	1069.8	29.4	7.6	20.4	7.8	27.7	*
13-12481	42.2889	79.4039	510.8	1115.3	26.7	7.3	17.4	8.1	24.7	*
13-12482	42.2748	79.3541	397.8	1024.4	32.8	8.4	23.8	7.5	31.1	
13-12550	42.4008	79.2881	362.4	892.5	31.7	8.6	25.9	6.5	33.1	
13-12578	42.0548	79.4891	536.4	1359.7	37.2	7.3	22.0	9.9	29.3	
13-12579	42.0497	79.4918	518.5	1342.6	36.1	7.5	21.3	9.7	28.6	
13-12580	42.0548	79.4891	527.6	1347.8	36.7	7.4	21.7	9.8	29.0	
13-12581	42.0541	79.4960	518.5	1340.5	36.1	7.5	21.4	9.7	28.6	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-12582	42.0424	79.4632	526.1	1350.0	38.9	7.4	23.3	9.8	30.6	
13-12583	42.0449	79.5114	533.7	1358.5	38.3	7.3	22.8	9.9	30.1	
13-12584	42.0580	79.5058	553.5	1360.0	33.3	7.1	19.3	9.9	26.5	*
13-12585	42.0530	79.4657	531.3	1342.6	36.7	7.3	21.8	9.7	29.1	
13-12587	42.0594	79.4995	530.7	1341.1	36.1	7.4	21.4	9.7	28.7	
13-12588	42.0474	79.4624	483.4	1318.6	36.1	7.8	21.5	9.6	28.7	
13-12589	42.0338	79.4477	535.2	1387.1	37.8	7.3	22.0	10.0	29.2	
13-12591	42.0350	79.4677	500.2	1352.4	38.9	7.7	23.1	9.8	30.3	
13-12592	42.0408	79.4478	521.5	1331.4	40.0	7.4	24.5	9.7	31.7	
13-12593	42.0464	79.4525	511.8	1335.9	43.3	7.5	26.8	9.7	34.1	*
13-12594	42.0345	79.4597	524.6	1399.6	38.3	7.4	22.1	10.1	29.3	
13-12597	42.2755	79.5456	390.1	1012.9	31.7	8.5	22.8	7.4	30.1	*
13-12598	42.2788	79.4400	502.3	1112.5	32.8	7.4	22.8	8.1	30.1	*
13-12599	42.2630	79.4667	419.1	1039.7	31.7	8.2	22.5	7.6	29.8	
13-12600	42.2528	79.4460	441.0	1092.4	33.3	8.0	23.2	8.0	30.5	
13-12601	42.2508	79.4377	411.2	1054.6	32.8	8.3	23.2	7.7	30.5	
13-12602	42.2592	79.4274	426.4	1066.8	31.1	8.2	21.5	7.6	28.8	*
13-12603	42.2531	79.4276	434.6	1078.1	33.3	8.1	23.4	7.9	30.7	
13-12604	42.2585	79.4189	453.2	1097.6	33.3	7.9	23.2	8.0	30.5	
13-12605	42.2661	79.4192	453.8	1079.0	32.2	7.9	22.6	7.9	29.9	*
13-12606	42.2649	79.4108	467.9	1098.2	33.3	7.7	23.3	8.0	30.6	
13-12607	42.2627	79.4037	501.1	1137.2	35.6	7.4	24.7	8.3	32.0	
13-12609	42.2701	79.3601	526.4	1150.0	33.3	7.2	22.8	8.4	30.1	
13-12610	42.2673	79.3993	503.8	1135.7	36.7	7.4	25.8	8.3	33.1	
13-12611	42.2634	79.3935	525.5	1147.3	37.2	7.2	26.2	8.4	33.5	
13-12612	42.2579	79.3945	518.8	1164.9	33.9	7.3	22.9	8.5	30.2	*
13-12614	42.2517	79.3933	524.3	1169.2	30.0	7.2	19.5	8.5	26.8	*
13-12615	42.2524	79.4150	474.3	1121.4	36.1	7.7	25.3	8.2	32.6	
13-12616	42.2512	79.3860	533.4	1182.9	33.9	7.1	22.6	8.6	29.9	
13-12623	42.3955	79.2135	468.8	1029.3	31.1	7.5	22.9	7.5	30.2	*
13-12624	42.3707	79.2559	453.8	1001.0	30.6	7.7	22.8	7.3	30.1	*
13-12625	42.3679	79.2631	478.5	1024.7	31.1	7.5	23.1	7.5	30.4	
13-12654	42.4945	79.3045	192.3	615.1	26.1	10.1	26.0	4.4	33.1	
13-12676	42.3434	79.5521	215.8	740.4	27.2	10.2	23.0	5.3	30.2	
13-12677	42.3498	79.5524	208.5	731.8	26.1	10.2	21.7	5.3	28.9	*
13-12703	42.1233	79.6791	457.2	1226.8	36.1	8.1	22.8	8.9	30.1	*
13-12731	42.4179	79.3230	276.8	773.3	32.2	9.4	29.5	5.6	36.7	*
13-12837	42.4701	79.3218	205.7	651.7	27.2	10.0	26.4	4.6	33.5	
13-12944	42.0160	79.3912	502.3	1391.4	38.3	7.6	22.1	10.1	29.3	
13-12973	42.0578	79.4746	460.6	1283.6	36.7	8.0	22.3	9.3	29.6	
13-12974	42.0559	79.4462	499.9	1308.8	38.3	7.6	23.5	9.5	30.7	
13-12975	42.0622	79.4544	466.0	1289.6	34.4	8.0	20.5	9.4	27.8	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
13-12982	42.0472	79.4739	467.0	1312.5	37.8	8.0	22.7	9.5	30.0	
13-13043	42.0577	79.4626	458.1	1274.1	35.0	8.0	21.2	9.3	28.4	
13-13050	42.4201	79.3488	245.1	736.1	30.0	9.7	27.5	5.3	34.7	
13-13058	42.4750	79.3242	201.5	648.3	26.1	10.1	24.7	4.6	31.9	
13-13545	42.0634	79.4301	509.3	1353.0	37.8	7.5	22.4	9.8	29.6	
13-13546	42.2596	79.7369	213.4	786.4	38.9	10.4	36.2	5.7	43.5	*
13-13550	42.0618	79.4385	501.1	1324.4	36.1	7.6	21.5	9.6	28.8	
13-13552	42.0708	79.4579	474.3	1274.1	36.1	7.9	22.2	9.3	29.4	
13-13573	42.4180	79.3897	222.5	702.9	28.3	10.0	26.1	5.0	33.3	
13-13576	42.0669	79.4455	474.3	1300.3	36.7	7.9	22.1	9.5	29.4	
13-13577	42.0507	79.4247	450.8	1307.0	43.3	8.1	26.9	9.5	34.2	*
13-13603	42.2930	79.1669	647.7	1306.4	38.9	5.9	25.3	9.5	32.5	
13-13604	42.3277	79.1882	632.2	1249.7	38.3	6.0	25.9	9.1	33.2	
13-13642	42.4152	79.2262	484.0	1009.2	33.3	7.4	25.7	7.4	33.0	
13-13673	42.0219	79.5177	469.1	1289.9	38.3	8.0	23.5	9.4	30.8	
13-13755	42.1819	79.4581	407.5	1106.4	35.6	8.4	24.5	8.1	31.8	
13-13757	42.2597	79.5447	422.1	1028.7	33.9	8.2	24.9	7.5	32.2	
13-13758	42.2626	79.5535	457.2	1053.4	30.6	7.9	21.5	7.7	28.8	*
13-13760	42.2675	79.5646	426.7	1015.0	30.6	8.2	22.0	7.4	29.3	*
13-13762	42.2485	79.5697	432.8	1037.5	33.9	8.2	24.8	7.6	32.1	
13-13765	42.2509	79.5369	411.5	1030.2	31.1	8.4	22.1	7.5	29.4	*
13-13778	42.2560	79.5574	435.9	1038.8	31.1	8.1	22.1	7.6	29.4	*
13-13782	42.2468	79.5470	451.1	1073.2	32.2	8.0	22.6	7.8	29.9	*
13-13854	42.1905	79.4556	403.9	1098.2	35.6	8.5	24.7	8.0	32.0	
13-13862	42.1858	79.4545	402.9	1101.2	35.0	8.5	24.1	8.0	31.4	
13-13887	42.2147	79.4818	413.0	1085.7	35.0	8.4	24.5	7.9	31.8	
13-13893	42.1844	79.4639	408.4	1099.7	38.9	8.4	27.7	8.0	35.0	*
13-13907	42.3080	79.5960	230.1	784.6	35.6	10.1	32.5	5.7	39.7	*
13-13983	42.2747	79.7124	208.2	763.2	32.2	10.4	28.6	5.5	35.6	*
13-14250	42.2786	79.7056	207.0	761.7	28.3	10.4	23.6	5.5	30.8	*
13-16053	42.2473	79.6000	517.9	1179.0	39.4	7.3	27.2	8.6	34.5	*
13-16094	42.2492	79.0671	423.7	1156.1	41.1	8.1	28.6	8.4	35.9	*
13-16220	42.2837	79.4009	512.1	1131.7	36.7	7.3	26.0	8.3	33.3	
13-16224	42.1005	79.5261	543.5	1300.3	38.9	7.2	24.4	9.5	31.6	
15- 4350	42.1864	76.5913	440.1	1039.4	45.6	7.4	36.7	7.6	44.0	*
15-10335	42.1690	76.6744	437.1	1678.8	47.8	7.5	24.0	12.0	31.1	
15-11931	42.0748	76.5941	396.5	1297.2	40.6	7.9	25.2	9.4	32.4	
17-10607	42.4512	75.4851	528.8	1611.2	32.8	6.1	16.5	11.5	23.7	*
17-10608	42.3172	75.6714	431.3	2008.6	43.3	7.3	18.0	13.9	24.9	
23- 4714	42.5163	76.0017	484.3	2521.0	57.2	6.5	20.1	16.4	26.6	
25- 4364	42.3163	75.2678	509.3	2355.5	43.3	6.5	15.7	15.7	22.3	*
25- 4379	42.2736	74.6278	563.0	2753.9	50.6	5.9	16.2	17.3	22.5	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
25- 4455	42.3905	75.0445	456.6	2417.7	62.2	6.9	22.9	15.9	29.5	*
25- 8578	41.9111	74.8756	554.4	3043.7	63.9	6.2	18.9	18.1	24.9	*
25-10227	42.3000	74.6250	613.6	2055.3	46.1	5.4	19.8	14.2	26.7	*
25-10263	42.4424	74.6200	642.5	1304.5	37.2	5.0	24.7	9.5	32.0	*
25-10838	42.3290	75.3750	370.3	1778.5	39.4	7.6	17.8	12.6	24.9	*
29- 6666	42.8031	78.8444	180.7	1314.6	40.0	9.6	23.1	9.6	30.4	
29- 6718	42.7094	78.9438	213.4	453.5	23.3	9.5	30.5	3.1	37.3	*
29- 6918	42.6982	78.9518	214.0	445.9	18.3	9.5	19.8	3.0	26.6	*
29- 6925	42.7119	78.9698	194.2	419.1	17.8	9.7	19.3	2.8	26.0	*
29- 8862	42.6605	79.0540	178.9	470.6	21.1	9.9	23.6	3.2	30.6	*
29- 8881	42.7283	78.8982	212.4	459.9	16.1	9.4	14.5	3.1	21.3	*
29- 8882	42.6747	79.0400	180.4	459.3	20.0	9.9	22.0	3.1	28.8	*
29- 9196	42.6661	79.0487	178.6	469.1	22.2	9.9	26.2	3.2	33.0	
29- 9938	42.7412	78.8946	209.1	438.0	21.7	9.5	27.9	3.0	34.6	
29- 9958	42.8454	78.8250	177.7	329.5	18.3	9.6	26.6	2.1	33.0	*
29-10836	42.6650	78.5609	322.5	666.9	31.1	8.4	34.1	4.8	41.2	*
29-10960	42.8566	78.7847	160.0	609.6	26.7	9.7	27.8	4.3	34.9	
29-11002	42.5575	78.7441	512.7	1909.6	53.3	6.7	24.4	13.3	31.4	
29-11114	42.5976	78.9843	246.9	1469.7	39.4	9.3	20.5	10.6	27.7	*
29-11183	42.8456	78.8332	176.8	347.8	23.3	9.6	39.6	2.2	46.0	*
29-11447	42.6783	78.8107	185.6	339.5	23.3	9.4	41.0	2.2	47.4	*
29-11510	42.5869	78.7002	328.6	790.7	25.0	8.5	20.9	5.7	28.1	*
29-11645	42.5867	79.0067	228.6	615.1	20.6	9.5	17.9	4.4	25.0	*
29-11728	42.5695	78.7346	509.6	962.3	32.2	6.7	26.5	7.0	33.8	
29-11730	42.7142	78.5180	431.9	1688.9	42.8	7.2	21.1	12.0	28.2	*
29-11951	42.5511	78.7330	465.7	950.1	22.8	7.2	16.4	6.9	23.7	*
29-11975	42.5578	78.7436	451.1	932.4	22.2	7.3	16.0	6.8	23.2	*
29-12287	42.5929	79.1057	191.4	556.0	25.6	9.9	28.1	3.9	35.1	
29-12288	42.5921	79.0973	192.9	558.1	26.7	9.9	30.0	3.9	37.0	
29-12289	42.5884	79.1137	183.2	554.4	26.7	10.0	30.0	3.9	37.0	
29-12290	42.5870	79.0540	204.5	574.9	24.4	9.8	25.5	4.0	32.5	
29-12292	42.5929	79.0650	199.3	586.7	25.6	9.8	26.8	4.1	33.6	
29-12350	42.5910	78.7153	330.7	763.5	26.1	8.5	23.1	5.5	30.3	*
29-12359	42.7160	78.8787	234.7	506.0	18.3	9.2	18.0	3.5	24.9	*
29-12383	42.6272	78.6392	249.9	460.6	17.2	8.8	18.2	3.1	25.0	*
29-12403	42.5354	78.5109	427.0	980.5	33.3	7.5	26.3	7.1	33.6	
29-12450	42.7405	78.5181	359.1	678.2	25.6	7.9	26.1	4.8	33.2	
29-12452	42.7406	78.5043	326.1	659.9	26.7	8.2	28.0	4.7	35.1	
29-12459	42.4564	78.8099	293.2	876.3	30.6	9.0	24.5	6.4	31.8	
29-12465	42.5740	79.0521	198.1	585.5	21.1	9.9	19.2	4.1	26.2	*
29-12641	42.8348	78.7206	220.1	394.7	23.3	9.1	36.0	2.6	42.0	*
29-12719	42.8458	78.6708	227.1	421.5	16.1	9.0	16.8	2.8	23.5	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
29-12745	42.5792	78.7203	444.4	1679.8	43.9	7.4	21.7	12.0	28.9	
29-12778	42.8451	78.6839	227.1	424.9	17.8	9.0	20.6	2.9	27.3	*
29-12782	42.8528	78.6614	231.6	424.3	17.8	9.0	20.8	2.8	27.5	*
29-12783	42.8591	78.6713	213.4	394.1	16.7	9.1	19.1	2.6	25.7	*
29-12784	42.8432	78.6615	228.6	424.6	18.3	9.0	22.0	2.9	28.7	*
29-12800	42.9639	78.6154	228.6	340.8	15.6	8.8	19.9	2.2	26.3	*
29-12806	42.5718	78.9308	349.0	767.2	23.3	8.4	19.5	5.5	26.7	*
29-12819	42.8822	78.6290	180.1	338.3	17.8	9.4	24.7	2.2	31.1	*
29-12910	42.4665	78.8036	353.6	1777.6	48.9	8.4	22.8	12.6	29.8	
29-12970	42.5282	78.7288	429.8	909.5	30.0	7.6	24.6	6.6	31.9	
29-12983	42.5376	78.7195	470.9	967.1	27.8	7.2	21.3	7.0	28.6	*
29-12985	42.5327	78.7146	457.2	953.7	30.6	7.3	24.4	6.9	31.7	
29-13000	42.6304	78.9151	260.9	618.7	25.0	9.1	25.6	4.4	32.7	
29-13113	42.5875	79.0205	228.6	611.4	22.2	9.6	20.7	4.3	27.8	*
29-13271	42.9471	78.5119	277.7	392.6	20.0	8.3	29.8	2.6	36.4	*
29-13316	42.9240	78.4861	256.0	409.3	16.7	8.5	19.8	2.7	26.5	*
29-13625	42.5079	78.7548	426.7	938.8	33.9	7.6	27.9	6.8	35.2	
29-13702	42.8359	78.8233	179.8	329.5	15.6	9.5	18.2	2.1	24.6	*
29-13707	42.6186	79.0640	185.9	532.5	29.4	9.9	36.6	3.7	43.0	*
29-13812	42.7983	78.6152	275.8	525.8	31.1	8.6	42.8	3.7	49.7	*
29-13859	42.8288	78.6624	239.3	448.1	18.3	8.9	21.0	3.0	27.8	*
29-15388	42.7870	78.6906	271.3	523.6	26.7	8.7	34.3	3.6	41.2	*
29-15742	42.5053	78.6314	408.1	963.8	33.3	7.8	26.5	7.0	33.8	
29-15761	42.5008	78.6483	408.4	965.9	32.8	7.8	25.8	7.0	33.1	
29-15808	42.5170	78.6291	430.7	975.4	33.9	7.6	27.0	7.1	34.3	
29-15831	42.7565	78.6910	298.7	553.8	18.3	8.5	17.8	3.9	24.8	*
29-15916	42.5278	78.6957	499.9	1011.9	28.3	6.9	21.2	7.4	28.5	*
29-15957	42.7694	78.5891	308.5	580.3	18.9	8.3	18.2	4.1	25.2	*
37- 9343	43.0417	78.4002	239.9	259.1	16.1	8.4	29.6	1.5	35.5	*
37- 9344	43.0407	78.3802	263.0	275.8	18.3	8.2	36.7	1.7	42.7	*
37- 9345	43.0407	78.3705	261.2	283.8	19.4	8.2	39.6	1.7	45.6	*
37- 9346	43.0478	78.3607	271.3	284.7	18.3	8.1	35.9	1.7	42.0	*
37-11609	42.9112	78.4341	283.5	438.9	24.4	8.3	36.8	3.0	43.6	*
37-11610	43.0174	78.3101	267.6	341.1	13.3	8.2	15.1	2.2	21.5	*
37-11621	42.8991	78.4193	286.5	463.9	20.0	8.3	25.3	3.2	32.1	
37-11623	42.8919	78.4091	300.2	484.0	14.4	8.2	13.0	3.3	19.9	*
37-11699	42.8784	78.4250	291.4	511.5	21.1	8.3	25.1	3.5	32.0	
37-11742	42.8870	78.4210	321.9	501.4	20.0	8.0	24.0	3.5	30.9	
37-11776	42.8968	78.4076	295.7	488.3	21.7	8.2	27.6	3.4	34.5	*
37-11777	42.9007	78.4035	304.5	490.1	13.9	8.1	11.8	3.4	16.7	*
37-11778	42.8992	78.3973	295.7	504.4	13.3	8.2	10.2	3.5	17.1	*
37-11932	42.9398	78.3222	289.0	417.9	17.2	8.1	21.7	2.8	28.4	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
37-12059	42.9318	78.3224	282.2	430.1	16.1	8.2	18.3	2.9	25.1	*
37-12135	42.9482	78.3224	279.5	409.7	15.0	8.2	16.5	2.7	23.2	*
37-12408	42.9613	78.3167	284.1	396.2	13.9	8.2	14.5	2.6	21.1	*
37-12564	42.8445	78.4944	309.7	534.6	22.8	8.2	27.3	3.7	34.3	*
37-12848	42.8559	78.3903	285.6	483.1	18.9	8.3	21.9	3.3	28.8	*
37-12891	42.9468	78.3149	280.7	408.7	15.0	8.2	16.6	2.7	23.3	*
37-12892	42.9391	78.3160	286.8	417.6	15.0	8.2	16.4	2.8	23.0	*
37-12893	42.9306	78.3333	281.6	417.6	16.7	8.2	20.2	2.8	26.9	*
37-12894	42.9290	78.3358	288.3	417.6	13.9	8.2	13.7	2.8	20.4	*
37-12895	42.9548	78.3172	276.8	394.1	16.7	8.2	21.4	2.6	28.0	*
37-13248	42.9383	78.3417	280.4	386.8	16.1	8.2	20.4	2.5	26.9	*
37-13249	42.9458	78.3337	277.4	386.5	19.4	8.3	29.0	2.5	35.5	*
37-13250	42.9448	78.3427	273.1	379.2	21.1	8.3	33.8	2.5	40.4	*
37-13672	42.9936	77.9518	243.8	1281.1	40.6	8.4	25.1	9.3	32.4	
37-15896	42.9038	78.4266	286.5	449.6	16.1	8.3	17.4	3.0	24.2	*
51- 4138	42.8090	77.9518	298.1	634.0	17.8	8.2	15.1	4.5	22.2	*
51- 4363	42.8618	77.8151	188.4	489.2	17.8	9.2	17.6	3.4	24.5	*
51- 4630	42.6505	77.7562	186.5	1943.4	47.2	9.5	19.4	13.5	26.4	
51- 5061	42.8534	77.8169	185.6	514.2	17.2	9.2	15.6	3.6	22.5	*
51-11403	42.7259	77.9529	337.4	791.6	30.0	8.0	27.8	5.7	35.0	
51-12706	42.7865	77.8685	177.4	199.9	18.9	9.4	47.3	1.0	52.5	*
51-13700	42.6972	77.8919	271.3	1942.8	47.8	8.7	20.1	13.5	27.1	
51-13841	42.7250	77.9529	326.1	804.7	29.4	8.1	26.5	5.8	33.8	
51-14178	42.7239	77.9724	332.5	788.8	26.1	8.0	22.9	5.7	30.1	*
53- 4500	42.8130	75.6439	511.5	1024.7	33.9	5.8	27.4	7.5	34.7	
53- 9578	42.9511	75.8079	417.6	1492.3	44.4	6.5	25.4	10.8	32.6	
55- 4502	43.3309	77.9649	95.1	666.0	38.3	9.1	43.9	4.8	51.1	*
55- 9540	43.1890	78.0387	185.0	874.8	25.6	8.6	19.4	6.4	26.7	
63- 6667	43.2076	78.4651	167.6	878.7	30.6	8.8	24.8	6.4	32.1	
63- 6669	43.0799	79.0068	174.3	935.7	31.7	9.1	24.1	6.8	31.4	
65-11950	43.2929	75.2747	266.4	222.2	14.4	7.2	32.6	1.2	38.1	*
65-16018	42.9235	75.4223	409.7	545.6	21.1	6.6	26.6	3.8	33.6	*
67-11654	42.8984	76.2386	420.3	931.5	28.9	6.6	23.9	6.8	31.2	
67-11655	42.9450	76.3079	347.5	794.6	26.7	7.2	24.5	5.7	31.7	
67-11946	42.9642	76.2260	293.8	707.7	24.4	7.7	23.6	5.1	30.8	
67-12148	42.7894	76.1736	559.6	1268.9	38.9	5.4	26.4	9.2	33.7	
67-12163	42.9369	76.3459	306.6	1274.4	37.2	7.6	23.2	9.3	30.5	
69- 3859	42.7917	77.4570	431.0	901.3	34.4	6.9	30.6	6.6	37.9	
69- 3929	42.7743	77.4728	318.5	809.2	33.3	8.0	31.3	5.9	38.6	
69- 3930	42.7889	77.4744	364.2	843.4	27.2	7.5	23.4	6.1	30.6	*
69- 3931	42.7806	77.4654	417.9	891.5	31.7	7.0	27.7	6.5	34.9	
69- 3945	42.8430	77.4717	354.5	823.0	32.2	7.5	30.0	6.0	37.3	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
69- 3947	42.7878	77.4841	307.5	788.2	28.3	8.1	25.7	5.7	32.9	
69- 3964	42.7670	77.4946	324.9	410.0	18.9	7.9	26.7	2.7	33.4	
69- 3971	42.7851	77.4931	285.9	765.0	29.4	8.3	27.6	5.5	34.9	
69- 3976	42.7971	77.4548	452.3	915.0	33.9	6.6	29.8	6.7	37.1	
69- 3978	42.8136	77.4632	443.8	904.3	33.9	6.7	30.1	6.6	37.3	
69- 3985	42.7946	77.4714	423.1	889.1	32.8	6.9	29.1	6.5	36.3	
69- 3991	42.7762	77.4563	405.7	866.7	32.8	7.1	28.9	6.4	36.2	
69- 3997	42.7985	77.5086	296.9	703.5	34.4	8.2	37.3	5.0	44.5	*
69- 4005	42.8015	77.4935	335.9	791.0	28.9	7.8	26.7	5.7	33.9	
69- 4023	42.7990	77.4849	351.1	807.7	29.4	7.6	27.0	5.8	34.2	
69- 4027	42.7917	77.4212	466.3	937.6	35.0	6.5	30.4	6.8	37.7	
69- 4036	42.8095	77.4946	312.4	752.2	26.7	8.0	24.8	5.4	32.0	*
69- 4040	42.8012	77.4752	394.4	848.6	30.0	7.2	26.9	6.2	34.1	*
69-11428	42.8972	77.1139	245.1	646.5	30.0	8.4	33.4	4.6	40.5	*
69-12393	42.7715	77.4957	322.8	347.2	17.8	8.0	28.3	2.2	34.7	*
73- 5086	43.3080	78.0340	115.8	746.8	25.6	8.9	22.3	5.4	29.5	
75- 9540	43.1890	78.0387	185.0	874.8	25.6	8.6	19.4	6.4	26.7	*
77-12398	43.4868	76.1890	119.8	556.0	23.3	8.2	27.3	3.9	34.3	*
77-12399	43.5087	76.1958	103.6	544.1	18.3	8.3	18.5	3.8	25.5	*
77-12406	43.5019	76.2001	100.6	546.5	22.8	8.3	26.5	3.8	33.4	*
79-10138	42.6935	75.0950	499.9	830.0	28.9	6.1	27.5	6.0	34.7	*
97-11921	42.3328	77.0291	449.9	882.4	28.3	7.2	23.9	6.4	31.2	
97-12859	42.4088	76.8977	248.4	896.7	27.8	9.1	20.8	6.5	28.1	*
97-13796	42.3888	76.9325	426.1	740.7	24.4	7.4	23.0	5.3	30.2	
99- 4158	42.9177	76.8626	152.4	492.9	17.8	9.3	17.3	3.4	24.2	*
99- 4203	42.8763	76.8590	165.5	1685.8	48.9	9.2	23.5	12.0	30.6	
99- 4544	42.8689	76.9264	152.1	632.2	37.2	9.4	44.1	4.5	51.2	*
99- 4590	42.8564	76.8826	165.8	626.7	32.2	9.2	36.7	4.4	43.8	*
99- 4600	42.8744	76.9223	152.4	631.9	26.7	9.4	27.4	4.5	34.5	
99- 4814	42.8947	76.7875	144.8	565.1	30.0	9.4	36.5	4.0	43.5	*
99-11666	42.8452	76.7874	176.2	641.3	27.8	9.2	29.0	4.6	36.2	
99-11708	42.8386	76.7790	178.3	661.4	30.0	9.1	31.5	4.7	38.7	
99-12051	42.8481	76.8079	167.3	814.4	33.3	9.2	29.6	5.9	36.6	
99-12052	42.8545	76.7945	240.2	683.1	25.6	8.5	25.0	4.9	32.1	*
99-12053	42.8580	76.8018	170.4	675.7	24.4	9.2	22.6	4.8	29.7	*
99-13676	42.8555	76.8374	164.9	699.5	23.3	9.3	20.1	5.0	27.3	*
99-13689	42.8484	76.8473	178.0	719.9	28.3	9.1	26.7	5.2	33.8	
101- 291	42.0039	77.6173	631.9	1531.9	48.9	5.8	28.1	11.0	35.3	
101- 5123	42.1158	77.5806	687.9	1448.7	28.9	5.2	16.3	10.5	23.6	*
101- 8318	42.2363	77.5155	650.1	1338.7	40.0	5.5	25.8	9.7	33.1	
101- 8348	42.2778	77.4176	500.2	1156.7	40.6	6.9	29.1	8.4	36.4	*
101- 9582	42.2779	77.4222	546.8	1184.1	34.4	6.4	23.7	8.6	31.0	

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
101-10024	42.4430	77.6059	626.7	1051.0	30.0	5.5	23.3	7.7	30.6	
101-10246	42.2014	77.6554	642.5	1406.3	41.7	5.6	25.6	10.2	32.9	
101-10259	42.2442	77.2167	325.8	887.3	28.9	8.6	22.9	6.5	30.2	
101-11027	42.4634	77.3172	447.1	811.7	33.9	7.2	32.9	5.9	40.2	*
101-11105	42.2203	77.5426	649.8	1375.6	43.3	5.5	27.5	10.0	34.8	
101-11126	42.2706	77.6400	477.0	1118.6	32.8	7.2	22.9	8.2	30.2	
101-11462	42.2069	77.2508	462.1	1079.6	27.8	7.3	19.0	7.9	26.3	*
101-11561	42.4499	77.1976	360.9	679.7	30.0	8.0	32.4	4.9	39.5	*
101-11570	42.4753	77.2189	417.0	698.9	25.0	7.4	25.1	5.0	32.3	
101-11754	42.3668	77.7256	548.9	1056.1	30.6	6.4	22.9	7.7	30.2	
101-11781	42.3056	77.1636	536.8	991.8	35.0	6.4	28.8	7.2	36.1	
101-11983	42.2235	77.5685	444.7	1147.3	31.7	7.5	21.1	8.4	28.4	*
101-12075	42.4494	77.6259	535.8	974.1	29.4	6.4	23.7	7.1	31.0	
101-12179	42.2545	77.5033	540.4	1216.2	37.8	6.5	25.7	8.9	33.0	
101-12402	42.3167	77.3822	525.2	1791.6	47.2	6.6	22.7	12.7	29.7	
101-12765	42.1980	77.6656	670.6	1417.6	37.8	5.3	22.9	10.3	30.1	*
101-12960	42.3711	77.3893	407.8	911.0	27.8	7.7	22.1	6.6	29.3	
101-12972	42.2341	77.3689	590.1	1271.6	35.6	6.0	23.2	9.3	30.5	
101-13011	42.0266	77.5871	557.2	1516.7	42.8	6.6	23.9	10.9	31.1	*
101-13578	42.1551	77.6962	702.3	1497.2	43.3	5.1	25.6	10.8	32.8	
101-13690	42.0867	77.6140	701.3	1534.7	46.1	5.1	26.7	11.0	33.9	
101-13699	42.4662	77.2654	571.5	2989.5	67.8	5.9	20.7	18.0	26.7	
101-14570	42.0762	77.5024	662.6	1493.8	40.0	5.5	23.1	10.8	30.3	
107- 9557	42.1461	76.3373	457.8	1567.0	41.1	7.2	21.6	11.2	28.8	
107- 9848	42.0759	76.4522	399.0	1593.5	70.0	7.9	39.0	11.4	46.2	*
109-10243	42.4010	76.6685	566.0	1119.8	32.2	6.0	23.4	8.2	30.7	
109-12149	42.5978	76.2951	486.8	1386.8	41.1	6.4	25.0	10.0	32.2	
117- 5032	43.0592	76.8405	146.6	1194.2	35.6	9.0	22.2	8.7	29.5	
121- 4408	42.9278	76.8869	153.0	498.3	24.4	9.2	30.5	3.4	37.4	*
121- 7278	42.7975	78.0912	323.4	1516.4	45.6	8.0	24.7	10.9	31.9	
121- 9524	42.8167	78.2442	287.1	1247.2	32.2	8.4	19.1	9.1	26.4	*
121-10917	42.7612	78.4439	480.7	681.5	35.0	6.6	41.6	4.9	48.8	*
121-10939	42.7668	78.4179	460.6	1652.0	42.2	6.8	21.4	11.8	28.6	
121-11311	42.7552	78.3473	542.5	872.0	28.3	6.0	25.6	6.3	32.9	
121-11312	42.8119	78.1936	501.4	815.3	18.9	6.3	15.5	5.9	22.7	*
121-11989	42.6775	78.0794	477.9	1015.0	33.9	6.7	26.8	7.4	34.1	
121-12178	42.7908	78.1753	461.2	1625.2	58.3	6.7	31.8	11.6	38.9	*
121-12721	42.8421	78.1717	342.3	422.5	23.9	7.8	38.1	2.8	44.8	*
121-12724	42.8432	78.1690	350.8	424.3	19.4	7.7	27.7	2.8	34.4	*
121-13082	42.7059	78.3668	493.8	876.0	24.4	6.6	20.4	6.4	27.7	*
121-13083	42.6124	78.4346	464.8	950.7	27.8	7.0	21.8	6.9	29.1	
121-13084	42.6510	78.4193	419.1	868.7	25.6	7.4	20.9	6.3	28.1	*

Table C-11 continued

API CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
121-13085	42.6107	78.3293	536.4	1058.3	28.3	6.3	20.8	7.7	28.1	*
121-13241	42.6571	78.1939	524.0	1048.5	31.7	6.3	24.2	7.7	31.5	
121-13268	42.5814	78.1805	494.1	1070.2	31.1	6.7	22.8	7.8	30.1	
121-13308	42.5279	78.1414	485.5	1133.2	33.3	6.9	23.3	8.3	30.6	
121-13662	42.7708	78.0863	448.4	826.6	25.0	6.9	22.0	6.0	29.2	*
121-13664	42.7687	78.0235	450.5	816.6	28.9	6.8	27.0	5.9	34.3	
121-13666	42.7610	78.0142	443.5	835.2	26.1	6.9	23.0	6.1	30.3	*
121-13725	42.6462	78.4157	437.4	887.0	28.3	7.2	23.8	6.4	31.0	
121-13790	42.5988	78.3792	515.4	1043.0	29.4	6.5	22.0	7.6	29.2	
121-13891	42.7797	78.0482	463.3	818.7	26.7	6.7	24.4	5.9	31.7	*
121-13892	42.7587	78.0845	451.7	822.7	28.3	6.8	26.1	6.0	33.4	
121-13919	42.7587	78.0772	456.3	830.9	25.0	6.8	21.9	6.0	29.2	*
121-15545	42.6693	78.0917	450.2	909.2	26.7	7.0	21.7	6.6	28.9	*
121-15933	42.7278	78.0010	419.4	894.0	30.0	7.2	25.5	6.5	32.8	
121-16016	42.8574	78.3902	366.7	565.7	21.1	7.6	23.9	4.0	31.0	
123-12812	42.5839	76.9422	225.9	419.7	22.2	9.1	31.2	2.8	37.9	
123-12813	42.5884	76.9539	244.1	437.1	20.6	8.9	26.6	2.9	33.4	

Table C-11 continued

(PA. BOTTOM HOLE TEMPERATURES (BHT) AND AVERAGE GRADIENTS)

CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
15- 2	41.7838	76.3252	420.6	2012.9	42.8	7.7	17.4	13.9	24.3	*
15- 7	41.8725	76.2655	407.2	1402.1	40.6	7.8	23.3	10.2	30.6	*
15- 41	41.7839	76.3258	417.9	2012.9	46.1	7.8	19.0	13.9	26.0	*
15- 42	41.8764	76.2725	403.3	1402.1	36.7	7.9	20.5	10.2	27.8	*
39- 429	41.8335	80.0188	415.7	1314.9	33.3	8.8	18.7	9.6	25.9	*
39-20466	41.8160	79.6533	550.5	1593.5	43.3	7.4	22.6	11.4	29.7	*
39-20500	41.8069	80.1026	357.8	1241.1	36.7	9.4	22.0	9.0	29.2	*
39-20501	41.7910	80.1042	381.6	1272.5	36.1	9.2	21.2	9.3	28.4	*
39-20502	41.8019	80.0909	362.7	1254.6	35.0	9.4	20.4	9.1	27.7	*
49- 49	42.2799	79.8997	184.1	1445.1	45.6	10.7	24.1	10.4	31.4	*
49- 61	42.1772	79.8643	303.0	900.1	35.0	9.6	28.2	6.5	35.5	
49- 67	41.9822	79.8130	465.7	1259.4	43.3	8.2	27.9	9.2	35.2	
49- 68	42.0253	79.8551	468.8	1204.3	35.0	8.1	22.3	8.8	29.6	
49- 78	42.0372	79.7999	474.9	1221.6	34.4	8.0	21.6	8.9	28.9	
49- 103	42.1840	79.8704	273.1	865.6	29.4	9.9	22.6	6.3	29.8	*
49- 109	42.1481	80.0528	191.7	1820.3	42.2	10.8	17.3	12.8	24.3	*
49- 110	42.1425	80.0478	198.1	1820.3	42.2	10.7	17.3	12.8	24.3	
49- 116	42.0468	80.0608	387.4	742.5	28.9	9.0	26.8	5.3	34.0	*
49- 172	41.9644	79.7331	224.0	1361.8	40.6	10.5	22.1	9.9	29.3	*
49- 176	42.1961	79.8303	242.9	378.0	20.0	10.2	26.0	2.5	32.6	
49- 177	41.9789	79.8883	465.7	1260.3	43.3	8.2	27.9	9.2	35.2	
49- 326	42.0514	80.0650	382.8	726.0	28.9	9.0	27.4	5.2	34.6	
49- 1612	41.9619	79.7330	528.8	1361.8	43.3	7.5	26.3	9.9	33.6	
49-20163	41.8803	79.7396	509.6	1496.3	42.8	7.8	23.4	10.8	30.6	
49-20367	42.2069	79.8222	266.1	869.0	31.1	9.9	24.4	6.3	31.6	
49-20415	41.9204	79.9329	378.0	1203.7	36.7	9.1	22.9	8.8	30.2	
49-20419	42.0843	80.0573	292.6	946.7	33.9	9.9	25.4	6.9	32.7	
49-20437	42.1392	80.0337	213.4	794.0	23.3	10.6	16.1	5.7	23.3	*
65- 487	41.9208	79.0605	411.8	2164.1	74.4	8.5	30.5	14.7	37.3	*
83- 267	41.8950	78.6378	467.6	1264.9	48.3	7.8	32.1	9.2	39.3	
83- 268	41.8739	78.6106	678.8	3618.0	75.6	5.7	19.3	18.9	24.5	*
83- 269	41.9156	78.5139	536.4	1399.0	47.8	7.1	29.1	10.1	36.3	
83- 273	41.8994	78.7564	635.8	1438.4	50.0	6.2	30.5	10.4	37.7	
83- 275	41.9733	78.8697	452.9	1140.0	42.8	8.0	30.5	8.3	37.8	
83- 277	41.9644	78.8742	530.7	1219.5	40.0	7.2	26.9	8.9	34.2	*
83- 280	41.8231	78.4769	620.3	585.2	23.9	6.3	30.1	4.1	37.2	*
83- 2503	41.8988	78.6512	467.3	1280.2	48.3	7.8	31.7	9.3	38.9	
83- 2529	41.8819	78.6154	679.4	3566.2	83.3	5.7	21.8	18.9	27.1	
83- 3173	41.9449	78.8428	640.4	1359.7	35.6	6.1	21.6	9.9	28.9	*
83- 3273	41.9161	78.5103	537.1	1356.4	46.1	7.1	26.8	9.8	36.0	*

Table C-11 continued

CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
83- 9158	41.9698	78.8592	478.5	1158.2	36.1	7.7	24.5	8.4	31.8	*
83- 9441	41.9739	78.8710	453.5	152.4	11.1	6.0	20.7	.7	25.0	*
83- 9639	41.7809	78.7886	441.7	1659.9	47.8	8.1	23.9	11.8	31.0	*
83-10629	41.8278	78.5807	669.6	2127.2	50.0	5.8	20.8	14.5	27.6	*
83-31744	41.6722	78.6183	687.9	3191.3	77.8	5.6	22.6	18.4	28.4	
83-33110	41.7942	78.4177	467.6	1492.0	43.9	7.8	24.2	10.8	31.4	*
83-10598	41.9648	78.8703	534.9	1219.5	40.0	7.2	26.9	8.9	34.2	
105- 296	41.8811	78.1578	740.1	1740.1	46.7	5.0	24.0	12.3	31.0	*
105- 303	41.8658	77.8019	731.8	1566.7	52.2	5.0	30.2	11.2	37.3	*
105- 304	41.8850	77.7683	715.4	1633.7	47.8	5.1	26.1	11.7	33.3	
105- 305	41.8750	77.8089	734.9	1600.2	54.4	4.9	30.9	11.5	38.1	*
105- 306	41.9300	77.8847	638.3	1608.7	47.2	5.9	25.7	11.5	32.9	*
105- 307	41.9102	77.9089	611.4	1565.1	46.1	6.2	25.5	11.2	32.7	*
105- 308	41.9294	77.8464	665.0	1575.6	40.6	6.2	21.8	11.5	29.0	*
105- 302	41.9116	77.9104	615.4	1564.8	46.1	6.1	25.6	11.2	32.7	*
105- 304	41.8999	77.9349	669.0	1634.6	41.1	5.6	21.7	11.7	28.9	
105- 317	41.9282	77.9019	618.7	1593.8	45.0	6.1	24.4	11.4	31.6	*
105- 315	41.9217	77.8719	666.6	1631.0	48.9	5.6	26.5	11.7	33.7	
105- 300	41.9332	77.8757	682.8	1652.0	49.4	5.4	26.6	11.6	33.8	*
105- 302	41.9509	77.7965	598.3	1569.7	40.0	6.2	21.5	11.3	28.7	*
105-20478	41.8784	78.1626	740.1	1739.8	46.7	5.0	24.0	12.3	31.0	
105- 148	41.9167	77.7500	731.8	1584.0	51.7	4.9	29.5	11.4	36.7	
105- 296	41.9221	77.9148	657.8	1630.4	48.3	5.7	26.1	11.7	33.3	
105- 301	41.9299	77.8835	917.4	1599.6	47.2	3.1	27.6	11.5	34.7	
105- 297	41.9171	77.9084	658.1	1617.0	47.8	5.7	26.0	11.6	33.2	
105- 305	41.9230	77.9041	614.8	1582.2	43.9	6.1	23.9	11.3	31.0	*
105- 299	41.9174	77.8807	654.7	1613.0	46.1	5.7	25.0	11.5	32.2	*
105- 316	41.9142	77.9204	655.3	1622.6	40.6	5.7	21.5	11.6	28.6	*
115- 6	41.7778	75.6979	380.4	2591.1	60.0	8.0	20.1	16.7	26.5	*
117- 19	41.8876	77.5988	509.6	1581.0	52.2	7.1	28.5	11.3	35.7	*
117- 22	41.8832	77.5166	533.7	1417.9	45.6	6.8	27.3	10.3	34.5	
117- 23	41.8846	77.4954	495.3	1310.6	41.7	7.2	26.3	9.5	33.6	
117- 26	41.8566	77.5630	603.5	1416.4	40.6	6.2	24.3	10.2	31.5	*
117- 30	41.8719	77.5427	610.8	1492.3	49.4	6.1	29.0	10.8	36.3	
117- 31	41.8638	77.5569	594.7	1452.4	38.3	6.3	22.1	10.5	29.3	*
117- 43	41.9863	77.5644	568.1	1681.0	52.2	6.5	27.2	12.0	34.3	
117- 329	41.8964	77.4778	528.5	1387.8	38.3	6.9	22.7	10.1	29.9	*
117- 330	41.8892	77.6028	506.3	1584.0	52.2	7.1	28.5	11.4	35.6	
117- 331	41.9867	77.5189	564.8	1681.0	52.2	6.5	27.2	12.0	34.3	
123- 609	41.9539	79.2014	497.7	2471.6	73.9	7.6	26.8	16.2	33.4	
123-24704	41.9207	79.5535	468.2	1418.2	40.6	8.1	22.9	10.3	30.1	
123- 2693	41.7866	79.0225	597.1	1730.3	43.3	6.7	21.2	12.3	28.3	*

Table C-11 continued

CODE	LATITUDE	LONGITUDE	ELEV. (M)	DEPTH (M)	BHT (C)	SURF. TEMP. (C)	AVERAGE GRADIENT (C/KM)	BHT CORRECT. (C)	CORRECTED GRADIENT (C/KM)	
123- 346	41.9608	78.9722	514.8	1209.1	41.7	7.4	28.3	8.8	35.6	
123- 349	41.9844	79.2000	493.8	2478.0	73.9	7.7	26.7	16.2	32.2	
123- 3313	42.4619	79.3739	488.3	1760.5	42.8	7.3	20.2	12.5	27.2	*
127- 2	41.8121	75.1647	328.3	1524.0	32.8	8.5	15.9	11.0	23.1	*
127- 364	41.8069	75.1775	328.3	1521.0	32.8	8.5	16.0	10.9	23.2	*

Table C-12

(NOAA DATA)

STATION ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	SURFACE T (DEG C)	S.L. DATUM T (DEG C)
30 23	42.1000	77.2333	304.8	8.5	11.5
30 85	42.2500	77.6000	530.4	7.3	12.5
30 93	42.1000	78.7500	457.2	7.8	12.3
30 183	42.3000	78.0167	432.8	7.6	11.9
30 321	42.9000	76.5333	217.9	6.8	10.9
30 360	42.3000	75.4833	309.4	6.4	11.4
30 443	43.0000	78.1833	274.3	6.4	11.1
30 687	42.2167	75.9833	484.6	7.8	12.5
30 1012	42.9333	78.7333	214.9	8.4	10.5
30 1752	42.7000	74.9167	378.0	7.6	11.3
30 1799	42.6000	76.1833	344.1	7.7	11.0
30 1974	42.5667	77.7000	208.8	9.4	11.5
30 2036	42.2500	74.9333	411.5	7.7	11.7
30 2610	42.1000	76.8167	268.2	8.9	11.6
30 3033	42.4167	79.3000	231.6	9.7	12.0
30 3184	42.8833	77.0333	218.8	9.0	11.1
30 3773	42.7833	77.6167	274.9	8.6	11.2
30 4174	42.4500	76.4500	292.6	6.1	11.0
30 4208	42.1167	79.2333	423.7	8.8	12.9
30 4715	43.1833	79.0500	100.6	9.7	10.7
30 4791	43.0667	74.8667	274.3	7.4	10.1
30 4808	42.2500	78.8000	480.1	7.1	11.8
30 4844	43.1833	78.6500	158.5	8.8	10.3
30 5512	42.9000	75.6500	396.2	6.4	10.3
30 6085	42.5333	75.5000	341.4	7.0	10.3
30 6314	43.4667	76.5000	106.7	8.6	9.7
30 6510	42.6500	77.0833	219.5	9.6	11.8
30 7167	43.1167	77.6667	166.7	8.8	10.5
30 7317	42.2833	74.5667	454.2	7.3	11.8
30 7413	43.1667	74.8667	420.6	5.8	9.9
30 7642	43.2000	77.0167	128.0	9.3	10.5
30 8058	42.7167	78.6000	332.2	7.9	11.1
30 8383	43.1167	76.1167	125.0	8.9	10.2
36 865	41.8000	78.6333	645.6	6.6	12.9
36 868	41.9500	78.7333	512.1	7.4	12.4
36 1790	41.9167	79.6333	438.9	8.4	12.7
36 4432	41.6833	78.8000	533.4	6.6	11.8
36 4873	42.0000	77.1333	304.8	8.7	11.7
36 5915	41.8333	75.8667	475.5	7.1	11.8
36 8905	41.7500	76.4167	227.1	9.3	11.6
36 9298	41.8500	79.1333	390.1	9.1	12.9

Table C-13

ONONDAGA, QUEENSTON, TRENTON,
THERESA, AND BASEMENT TOPS DATA

Table C-13a

(ONONDAGA DATA)

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
1105510.	42.0800	78.0532	602.6	1402.1	-800.4
1104463.	42.2584	77.7556	535.5	1158.5	-624.2
1203995.	42.2911	78.1623	486.5	1024.7	-539.2
1204925.	42.2979	77.9575	492.6	1040.6	-548.9
1403990.	42.4006	78.0769	551.7	922.0	-371.2
1504248.	42.4705	78.1603	479.1	765.7	-290.2
1504025.	42.3463	78.2162	512.7	977.8	-466.0
1604052.	42.2662	78.1954	568.8	1121.7	-553.8
1604168.	42.2774	78.2876	613.3	1134.8	-522.4
1704153.	42.2763	78.9206	558.7	902.8	-346.9
1705060.	42.1850	77.9418	605.3	1295.4	-690.7
1804673.	42.0404	77.8474	682.4	1501.1	-819.6
1804777.	42.1952	77.9106	572.1	1254.6	-683.4
1904849.	42.1240	78.1810	622.1	1355.8	-734.6
2004854.	42.3990	75.8804	436.8	951.0	-515.1
2005087.	42.3235	75.9480	307.2	944.9	-641.6
2104169.	42.0081	78.5120	726.9	1487.4	-761.4
2204373.	42.1337	78.5220	569.7	1184.1	-615.4
2304713.	42.0987	78.5358	442.3	1063.8	-624.5
2403900.	42.0958	78.6628	432.2	1050.0	-618.7
2604170.	42.0448	78.6929	682.1	1348.4	-667.2
2704554.	42.0564	78.6210	568.1	1216.5	-649.2
2805327.	42.3682	78.9914	396.8	623.3	-227.4
2904134.	42.1892	78.3522	459.0	1048.5	-590.4
3304197.	42.2616	78.3637	608.7	1129.3	-521.8
3404529.	42.1135	78.4545	531.3	1167.4	-637.0
3504820.	42.0036	78.4348	657.8	1436.5	-779.7
3605204.	42.3964	78.8370	517.2	765.7	-249.3
4204550.	42.4407	78.9594	342.3	527.3	-185.9
4504594.	42.4638	78.9825	337.4	513.6	-177.1
4704238.	42.1115	78.9775	550.2	1039.1	-489.8
5004088.	42.0238	78.9518	397.2	1006.4	-609.9
5104142.	42.8987	76.6506	163.4	6.1	156.4
5204241.	42.9460	76.6413	188.4	3.7	183.8
6004043.	42.8611	76.4533	252.1	144.8	106.7
7004356.	42.2767	79.5095	417.3	630.9	-214.6
7204154.	42.3421	79.1319	493.5	712.0	-222.5
7204200.	42.3129	79.5249	471.2	688.8	-217.9
7304561.	42.2345	79.3730	468.2	743.7	-279.2
7304437.	42.1503	79.3379	539.8	805.3	-268.8
7404671.	42.2398	79.4202	465.7	738.5	-273.7
7504173.	42.5235	79.0949	256.0	335.9	-80.8
7504039.	42.1661	79.2845	540.1	899.8	-360.6
7604204.	42.1606	79.6731	453.2	734.6	-282.2
7804948.	42.3873	79.3905	353.9	491.9	-139.0
7804867.	42.4314	79.3865	204.5	303.3	-99.7
8005267.	42.4317	79.4196	187.8	289.6	-102.7
8104024.	42.2499	79.6747	400.8	612.6	-212.8
8204535.	42.5115	79.2632	200.9	254.2	-54.3
8404156.	42.3344	79.3905	406.9	598.0	-192.0
8405447.	42.3790	79.1355	489.8	678.2	-189.0
8504001.	42.1085	76.7972	264.0	848.9	-585.8
8503933.	42.2716	76.9198	458.4	927.8	-470.3
8604191.	42.1734	76.6182	390.4	962.3	-573.3
8604026.	42.2762	76.9454	499.9	934.2	-435.3
8703974.	42.0518	76.8888	479.5	1295.4	-816.9
8704923.	42.0225	76.9471	378.9	1229.6	-851.6
9104087.	42.2201	76.7700	341.1	851.9	-512.1
9204863.	42.2523	76.7787	466.0	975.4	-510.2
9204543.	42.3833	75.7704	454.5	1027.2	-573.6
9704714.	42.5185	76.0009	480.1	808.3	-330.1
9804455.	42.3905	75.0445	456.0	1010.4	-557.8

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
9804073.	42.3739	75.0427	610.5	1200.9	-594.4
9904214.	42.1826	74.9218	544.4	1562.1	-1020.8
9904379.	42.2736	74.6278	563.3	1347.2	-787.9
10004364.	42.3169	75.2341	508.4	1229.9	-724.5
10304240.	42.8759	78.5030	280.4	111.3	168.2
10504527.	42.9346	78.6118	253.3	32.0	220.4
10604758.	42.9130	78.5067	253.9	59.1	193.9
10904816.	42.5943	79.0067	221.0	257.3	-37.2
11104181.	42.6263	78.6010	531.9	579.1	-48.2
11404725.	42.6389	78.8869	301.1	310.9	-10.7
11504157.	42.8360	76.6178	251.2	120.7	129.5
11604231.	42.6947	79.0126	199.0	129.5	68.6
11804108.	42.7833	78.8505	182.3	64.0	117.3
11904123.	42.7143	78.9664	190.2	89.0	100.6
12105509.	42.7017	78.9400	217.3	133.2	83.2
12704341.	42.6840	78.5688	295.0	289.6	4.6
12804183.	42.8291	78.8498	178.9	36.6	141.7
12804462.	42.6928	78.4947	461.2	465.4	-4.6
12904545.	42.9610	78.5073	243.2	10.1	232.3
13104645.	42.6052	78.8684	407.8	438.3	-31.4
13204668.	42.6048	78.8951	356.0	401.1	-46.0
13204184.	42.5747	78.4686	473.7	606.6	-133.5
13504576.	42.5463	78.5588	536.1	671.5	-136.2
13704632.	42.5663	78.5899	496.2	603.5	-108.2
14104434.	42.9163	78.2573	323.1	137.2	185.0
14104477.	42.9168	78.0808	316.4	114.0	201.5
14704374.	42.9071	78.3502	291.1	89.9	200.3
15206726.	42.9410	77.9356	274.9	67.1	207.3
15204551.	42.9292	77.9628	284.4	86.0	197.5
15305213.	42.9588	78.3265	284.4	56.4	227.1
15503993.	42.8807	74.9165	476.4	7.0	468.5
15604056.	42.8725	77.7067	278.0	137.2	139.9
15604149.	42.8942	77.7919	172.5	29.9	141.7
15803942.	42.6853	77.6618	497.7	576.1	-79.2
15804567.	42.9323	77.8841	243.5	38.1	201.5
15904188.	42.7664	77.7551	349.9	330.1	18.9
16005061.	42.8535	77.8172	184.4	96.6	86.9
16104451.	42.9369	77.7130	209.7	10.1	198.7
16304166.	42.7960	75.9408	283.2	225.2	57.3
16404217.	42.7671	77.8823	176.5	156.1	19.5
16404234.	42.7519	77.9502	322.5	317.0	4.6
16504457.	42.8804	77.6226	286.2	143.3	142.0
16604053.	42.7649	77.6594	421.2	410.3	7.6
16704630.	42.6503	77.7560	182.6	286.5	-108.5
16804069.	42.8716	77.9322	269.4	130.1	138.4
17504032.	42.7963	75.4047	459.6	334.7	124.1
17604085.	42.8798	75.6867	477.9	287.4	189.6
17604556.	42.8666	75.3358	489.8	218.6	270.1
17704185.	42.8435	75.6150	456.0	291.1	164.3
18204499.	42.9150	75.4414	432.5	172.2	259.4
18304510.	42.8377	75.4618	465.7	277.4	187.8
18804902.	42.9204	76.2905	327.1	187.8	138.4
19604035.	42.8007	77.4391	451.4	401.7	48.5
20003999.	42.7968	77.3351	361.5	318.5	42.1
20104395.	42.9328	77.3590	221.9	29.9	191.1
20203998.	42.8648	77.3801	267.3	144.8	121.9
20804099.	42.9420	77.4037	242.0	36.6	204.5
21104402.	42.9051	77.4367	268.5	68.9	198.7
21504607.	42.8202	77.2135	320.6	239.3	80.8
21604449.	42.8688	77.1966	276.5	162.8	113.4
21603929.	42.7424	77.5237	319.4	292.6	25.6
22404160.	42.8369	77.0354	235.6	150.9	83.8
22503866.	42.6785	77.4432	531.0	598.9	-68.9

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
22505056.	42.8227	77.0574	260.6	192.6	67.1
23804245.	42.5503	74.8853	490.7	646.8	-157.0
24004050.	42.6045	75.2412	467.3	628.5	-162.2
24104187.	42.4128	76.7220	479.5	812.9	-334.4
24104400.	42.3677	76.8640	140.2	395.6	-259.1
24503940.	42.4208	76.8950	186.8	427.3	-242.9
24804244.	42.8251	76.8657	201.8	117.0	84.1
24804544.	42.8689	76.9268	152.7	40.2	111.6
25104814.	42.8947	76.7875	146.6	10.7	135.0
25204378.	42.9239	76.8686	154.2	12.2	141.1
25303944.	42.3089	77.2056	342.0	794.0	-452.9
25804573.	42.2355	77.2226	439.2	1012.5	-574.2
26003943.	42.1186	77.0874	527.6	1269.5	-742.8
26004575.	42.1444	77.1411	340.8	1024.7	-684.9
26103864.	42.2141	77.6800	715.4	1436.2	-721.8
26207031.	42.1935	77.6860	533.4	1272.2	-739.4
26203896.	42.2750	77.0616	514.2	998.5	-485.2
26303932.	42.2136	76.9663	388.3	1005.5	-618.1
26404474.	42.3313	77.6123	549.6	1082.6	-534.0
26504355.	42.1873	77.5911	698.9	1440.2	-744.3
26705300.	42.1281	77.5507	629.7	1414.3	-787.3
26905063.	42.4756	77.1944	432.8	673.0	-241.1
27004247.	42.2682	77.3347	534.3	1144.5	-611.1
27003897.	42.0969	77.6007	692.5	1492.9	-801.3
27104172.	42.0164	77.7385	639.2	1530.4	-892.1
27203924.	42.0630	77.4307	505.4	1232.0	-730.6
27304007.	42.3654	76.5033	404.8	708.7	-308.5
27404446.	42.3396	76.4969	442.3	877.5	-436.2
27404130.	42.4421	76.5928	444.1	762.0	-318.8
27503938.	42.5482	76.5531	182.3	374.3	-194.5
27605017.	42.5620	76.5707	267.9	449.9	-183.2
27604051.	42.5170	76.6920	328.6	536.4	-208.8
28604469.	42.8172	78.4135	363.6	256.0	106.7
28604432.	42.8360	78.3325	440.4	327.7	111.9
28804349.	42.8035	78.0004	392.6	325.5	66.1
29104092.	42.6173	78.0803	479.5	612.6	-137.2
29104162.	42.6702	78.0826	451.4	522.1	-73.5
29404385.	42.6300	78.1539	539.8	626.4	-87.5
29504133.	42.8306	78.1170	463.0	345.9	116.1
29704537.	42.8507	78.1817	442.6	321.3	120.4
30004649.	42.7866	78.1357	482.5	397.8	83.8
30104392.	42.7477	78.1979	490.1	469.4	19.8
30304212.	42.7451	78.3582	405.7	371.9	32.9
30406073.	42.7552	78.0976	458.1	420.6	36.9
30604797.	42.7494	77.0038	253.3	256.0	-3.7
30604796.	42.6838	77.0223	293.8	336.5	-43.6
30704410.	42.4739	76.9555	336.2	522.7	-187.5
60004055.	42.6310	74.7082	603.2	524.9	78.3
60001160.	42.6933	75.3618	418.5	445.0	-26.5
60000443.	42.1988	76.5370	328.3	909.5	-581.3
60010608.	42.3177	75.6711	428.2	1104.3	-676.0
60010607.	42.4565	75.4851	528.8	1013.2	-484.3
60010609.	42.3476	75.5887	516.3	1110.1	-593.8
60010096.	42.1855	74.7150	512.7	1543.2	-1030.5
60010227.	42.2978	74.6251	613.3	1327.7	-714.5
60010138.	42.7083	75.0833	495.3	427.6	67.7
60010725.	42.5417	75.2083	352.3	659.9	-307.5
60006787.	42.7861	75.6898	465.1	413.9	51.2
60009848.	42.0833	76.4167	393.8	1278.9	-885.1
60009557.	42.1667	76.3333	452.6	1325.3	-872.6
60010335.	42.2083	76.6250	432.2	1037.8	-605.6
60012163.	42.9369	76.3459	303.9	148.7	155.1
60011654.	42.9167	76.2551	417.6	292.0	125.6

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
60099999.	42.3333	75.9167	303.6	947.9	-644.3
60008578.	41.9167	74.8750	549.6	2200.7	-1651.1
76100032.	41.7501	79.6703	531.6	1188.4	-656.8
76100056.	42.1840	79.8704	273.1	499.9	-226.8
76100078.	41.9253	77.3414	584.6	1507.2	-922.6
76100080.	41.6716	79.3436	525.8	1359.4	-833.6
76200069.	42.0372	79.8002	474.9	823.0	-348.1
76200077.	41.8988	78.6512	466.6	1256.7	-790.0
76200095.	41.8876	77.5988	509.6	1568.5	-1058.9
76300015.	41.7838	76.3414	420.9	1888.5	-1467.6
76300095.	41.8848	77.4952	491.3	1320.7	-829.4
76400109.	42.1428	80.0477	198.1	424.3	-226.2
76403173.	41.9449	78.8428	640.4	1327.4	-687.0
76400609.	41.9539	79.2014	498.0	1098.8	-600.8
76404380.	41.9375	79.2688	551.7	1153.1	-601.4
76500163.	41.9662	79.7275	540.4	954.3	-413.9
76500368.	41.6900	77.3109	511.5	1635.6	-1124.1
76500955.	41.8353	79.0324	602.3	1392.3	-790.0
76600004.	41.9303	76.4063	218.2	1628.9	-1410.6
76900301.	41.9299	77.8835	638.3	1572.8	-934.5
76900295.	41.6697	77.7295	575.8	1860.8	-1285.0
77003237.	41.9170	78.5100	537.1	1375.9	-838.8
77000357.	41.9479	77.8053	562.1	1507.5	-945.5
77002693.	41.7883	79.0225	597.4	1424.0	-826.6
77002435.	41.9959	79.3155	414.5	926.6	-512.1
77000346.	41.9196	77.9216	674.8	1617.3	-942.4
77107520.	41.9870	78.9170	452.0	1105.2	-653.2
77102602.	41.6534	79.3275	402.3	1261.0	-858.6
77209376.	41.6822	78.3117	656.8	1876.0	-1219.2
77200005.	41.6822	75.1808	458.7	2438.4	-1979.7
77300009.	41.6991	76.3422	417.3	2115.3	-1698.0
77309369.	41.7809	78.7886	455.7	1356.4	-900.7
77309580.	41.6825	78.6465	674.8	1716.6	-1041.8
77300345.	42.1576	79.8114	435.9	690.1	-254.2
77300006.	41.7778	75.6979	380.4	2087.3	-1706.9
77420429.	41.8335	80.0188	411.8	874.2	-462.4
77420057.	41.6896	77.5470	478.2	1716.0	-1237.8
77520468.	41.6562	79.8666	494.4	1151.2	-656.8
77520466.	41.8160	79.6533	550.5	1143.0	-592.5
77520372.	41.8714	79.7727	481.6	929.6	-448.1
77524704.	41.9207	79.5535	468.2	981.5	-513.3
77520370.	41.9534	79.8269	398.4	794.0	-395.6
77620445.	41.7767	80.0519	430.1	901.0	-470.9
77620500.	41.8073	80.1028	357.8	793.7	-435.9
77820415.	41.9204	79.9329	378.0	767.8	-389.8
37358001.	42.3424	75.0818	444.1	1108.9	-664.8
37357001.	42.5474	75.2746	429.2	695.9	-266.7
37357002.	42.6933	75.3451	418.5	443.5	-25.0
37356002.	42.8608	75.4024	371.9	149.4	222.5
37338002.	42.0949	75.9035	286.5	1193.3	-906.8
37339001.	42.1664	76.0759	295.0	1134.5	-839.4
37340001.	42.2223	76.4200	294.1	912.6	-618.4
37340003.	42.0839	76.2718	298.7	1189.9	-891.2
37341002.	42.2375	76.7078	506.9	1024.7	-517.9
37341005.	42.1985	76.5382	328.3	906.5	-578.2
37341009.	42.1027	76.6840	328.9	1025.3	-696.5
37341010.	42.0086	76.5626	234.7	1133.9	-899.2
37342001.	42.2234	76.9045	389.2	920.5	-531.3
37342003.	42.2312	76.8249	300.8	816.9	-516.0
37342008.	42.0959	76.8814	277.7	998.2	-720.5
37342009.	42.0563	76.7748	411.2	1190.9	-779.7
37343015.	42.1909	77.2376	482.8	1104.0	-621.2
37343020.	42.1568	77.0155	353.6	980.8	-627.3

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
37343021.	42.0839	77.1901	470.3	1343.6	-873.3
37343022.	42.0847	77.2486	307.5	1142.7	-835.2
37343024.	42.2237	77.0167	530.7	1097.6	-566.9
37343027.	42.0278	77.0550	507.5	1434.4	-926.9
37344003.	42.1954	77.3187	509.9	1192.1	-682.1
37344007.	42.1601	77.4670	520.9	1267.1	-746.2
37344017.	42.1469	77.4114	518.2	1287.8	-769.6
37344036.	42.0887	77.3587	427.9	1189.6	-761.7
37344052.	42.0688	77.4108	471.2	1193.0	-721.8
37344056.	42.0471	77.2973	517.9	1454.8	-937.0
37345004.	42.2366	77.5059	647.7	1306.7	-659.0
37345024.	42.1361	77.6905	705.3	1467.9	-762.6
37345035.	42.1005	77.6338	678.2	1496.9	-818.7
37345043.	42.0500	77.6759	694.6	1575.8	-881.2
37345057.	42.0220	77.5713	583.7	1493.8	-910.1
37345060.	42.0193	77.5144	492.6	1473.7	-981.2
37330001.	42.3608	75.9920	396.2	939.1	-542.8
37331001.	42.4222	76.2016	358.7	763.8	-405.1
37332001.	42.3918	76.3918	326.4	725.7	-399.3
37333001.	42.4704	76.5041	121.9	474.0	-352.0
37333002.	42.4309	76.5093	120.7	515.7	-395.0
37333008.	42.3295	76.5960	477.0	851.6	-374.6
37333009.	42.3333	76.7205	448.7	726.9	-278.3
37334001.	42.4982	76.8371	374.9	597.1	-222.2
37334003.	42.4082	76.7712	574.9	897.6	-322.8
37334011.	42.4388	76.9613	481.3	713.8	-232.6
37334014.	42.3624	76.8824	208.8	447.4	-238.7
37334017.	42.3615	76.9935	511.8	812.3	-300.5
37334020.	42.3147	76.8135	317.0	725.4	-408.4
37335006.	42.4860	77.0534	347.2	510.8	-163.7
37335017.	42.4805	77.0778	380.4	525.8	-145.4
37335019.	42.4550	77.0748	446.2	620.3	-174.0
37335027.	42.4018	77.2153	222.5	555.7	-333.1
37335030.	42.3999	77.1123	483.1	712.6	-229.5
37335031.	42.3385	77.0885	507.5	859.5	-352.0
37336001.	42.4962	77.3300	557.2	876.0	-318.8
37336003.	42.4560	77.3136	424.9	752.9	-328.0
37336004.	42.4196	77.4951	489.8	931.8	-442.0
37336005.	42.3975	77.4158	359.4	787.9	-428.5
37336006.	42.3950	77.2715	299.3	687.9	-388.6
37336007.	42.3429	77.3400	377.6	920.2	-542.5
37336009.	42.3007	77.2882	343.8	869.9	-526.1
37337001.	42.4625	77.6166	610.8	990.0	-379.2
37337004.	42.3728	77.5726	480.1	970.8	-490.7
37337013.	42.3339	77.5844	568.5	1107.0	-538.6
37337014.	42.3103	77.7130	493.5	1078.1	-584.6
37337017.	42.2861	77.6834	634.0	1226.8	-592.8
37322001.	42.5209	75.8947	326.1	725.4	-399.3
37323001.	42.6422	76.2356	459.9	588.3	-128.3
37324006.	42.5751	76.3122	420.6	633.4	-212.8
37324013.	42.5493	76.3970	413.3	625.1	-211.8
37324018.	42.5348	76.4852	312.7	479.1	-166.4
37325003.	42.6848	76.6443	251.2	307.8	-56.7
37326001.	42.6749	76.7832	267.9	345.6	-77.7
37326002.	42.6208	76.9497	249.6	333.1	-83.5
37326008.	42.5322	76.9828	341.4	502.6	-161.2
37326009.	42.5209	76.8735	232.6	452.9	-220.4
37326012.	42.5309	76.7733	477.0	712.3	-235.3
37326014.	42.6647	76.9840	158.5	203.9	-45.4
37327001.	42.7165	77.0103	270.7	292.0	-21.3
37327011.	42.5110	77.0419	407.8	581.3	-173.4
37327013.	42.5866	77.2393	434.3	554.1	-119.8
37327015.	42.5151	77.1475	416.4	600.8	-184.4

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
37328004.	42.6141	77.4137	237.7	426.7	-189.0
37329002.	42.5446	77.6741	283.5	518.2	-234.7
37329003.	42.6999	77.6695	487.7	553.2	-65.5
37314001.	42.8809	75.6449	384.0	113.1	271.0
37315002.	42.8892	76.1899	189.0	74.4	114.6
37316002.	42.9568	76.5792	170.7	.3	170.4
37318004.	42.9104	77.9243	162.2	8.2	153.9
37318007.	42.8435	77.1697	285.0	100.6	184.4
37319001.	42.9458	77.3889	214.3	12.5	201.8
37319005.	42.8251	77.3315	317.0	243.8	73.2
37319020.	42.8685	77.4839	271.3	151.8	119.5
37320001.	42.9523	77.6186	208.8	4.0	204.8
37320011.	42.8272	77.5622	246.9	167.6	79.2
37320015.	42.8583	77.6431	313.9	158.5	155.4
37320018.	42.7979	77.6802	329.8	264.0	65.8
37320019.	42.8660	77.5150	263.7	137.2	126.5
37309003.	43.0025	76.1873	308.8	102.1	206.7
37347002.	41.7547	76.4218	232.0	1569.7	-1337.8
37348002.	41.9816	76.7367	410.0	1341.1	-931.2
37348003.	41.8215	76.5326	440.4	1670.3	-1229.9
37349001.	41.9818	76.9213	487.4	1434.1	-946.7
37349002.	41.8899	76.8746	565.7	1702.3	-1136.6
37349003.	41.8362	76.9678	500.5	1656.0	-1155.5
37350001.	41.9915	77.1392	321.9	1289.3	-967.4
37350040.	41.9337	77.1438	436.5	1466.1	-1029.6
37350042.	41.8990	77.2306	489.5	1528.9	-1039.4
37350049.	41.7692	77.1370	440.4	1668.8	-1228.3
37350050.	41.7540	77.0464	419.1	1629.8	-1210.7
37351015.	41.9069	77.4159	533.4	1532.2	-998.8
37351018.	41.8799	77.4635	513.0	1597.8	-1084.8
37352002.	41.9907	77.6833	656.5	1545.6	-889.1
37352006.	41.9986	77.5778	627.6	1521.3	-893.7
37352011.	41.9791	77.6225	520.9	1477.7	-956.8
37352033.	41.8495	77.6169	643.4	1674.0	-1030.5
37352034.	41.8351	77.6821	631.5	1657.2	-1025.7
39008003.	43.0310	78.2774	269.7	6.1	263.7
39012006.	42.8807	77.9792	334.7	178.3	156.4
39012013.	42.8763	77.8646	193.5	63.4	130.1
39012019.	42.7870	77.8689	187.1	144.8	42.4
39012023.	42.8457	77.9697	364.2	254.5	109.7
39012024.	42.8182	77.9884	338.3	256.0	82.3
39012026.	42.7919	77.9768	361.2	331.6	29.6
39012027.	42.7602	77.9950	405.4	393.2	12.2
39013001.	42.9904	78.1894	271.0	30.5	240.5
39013003.	42.9482	78.0437	283.5	65.5	217.9
39013013.	42.8927	78.1801	350.5	166.1	184.4
39013030.	42.8997	78.0704	323.1	141.7	181.4
39013062.	42.8890	78.2476	285.0	132.9	152.1
39014003.	42.9842	78.4382	256.0	9.8	246.3
39014015.	42.9877	78.4283	268.2	30.8	237.4
39014028.	42.9468	78.4185	262.1	32.3	229.8
39014040.	42.8761	78.3290	371.9	166.4	205.4
39014047.	42.8550	78.3998	371.9	254.8	117.0
39014052.	42.8402	78.4586	286.2	164.6	121.6
39014082.	42.7733	78.4824	358.1	240.8	117.3
39014098.	42.7651	78.2814	451.1	368.8	82.3
39014099.	42.8976	78.4620	275.8	91.1	184.7
39015002.	42.9732	78.6265	221.0	29.0	192.0
39015004.	42.9556	78.9140	245.4	44.2	201.2
39015037.	42.8970	78.6757	225.6	39.6	185.9
39015041.	42.8879	78.5949	221.0	48.8	172.2
39015071.	42.8374	78.7412	198.1	51.8	146.3
39015087.	42.8270	78.5166	306.3	187.5	118.9

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39015103.	42.7714	78.7276	269.7	181.1	88.7
39015107.	42.7769	78.5692	303.3	251.5	51.8
39016016.	42.9219	78.7916	201.2	18.6	182.6
39016017.	42.8848	78.7560	185.3	9.8	175.6
39016027.	42.8106	78.7929	193.5	61.0	132.6
39016041.	42.7947	78.7556	225.6	106.4	119.2
39016042.	42.7629	78.7784	239.3	149.4	89.9
39017001.	42.7313	77.8713	175.0	204.2	-29.3
39017002.	42.5795	77.9413	300.2	490.1	-189.9
39018002.	42.7164	78.0058	406.9	445.9	-39.0
39018003.	42.6853	78.1139	426.7	472.7	-46.0
39018018.	42.5011	78.2295	599.5	880.6	-281.0
39018020.	42.5704	78.0789	486.2	662.0	-175.9
39019004.	42.7294	78.4688	302.1	273.4	28.7
39019015.	42.6527	78.4931	414.8	461.8	-46.9
39019022.	42.7270	78.4182	452.0	427.9	24.1
39019025.	42.7009	78.4566	298.4	300.8	-2.4
39019029.	42.6513	78.3221	530.4	606.6	-76.2
39019030.	42.6228	78.4260	460.2	557.2	-96.9
39019031.	42.6848	78.3009	481.6	528.2	-46.6
39019032.	42.6094	78.2582	546.8	685.8	-139.0
39019033.	42.5869	78.3835	507.5	653.5	-146.0
39019037.	42.5332	78.3389	566.9	786.4	-219.5
39019038.	42.5776	78.2929	554.7	745.8	-191.1
39019042.	42.5306	78.4236	452.0	653.8	-201.8
39020001.	42.7420	78.6416	286.5	246.9	39.6
39020008.	42.7253	78.5949	256.0	262.1	-6.1
39020021.	42.7445	78.5237	352.0	304.8	47.2
39020040.	42.6955	78.7059	359.7	384.7	-25.0
39020050.	42.6351	78.7321	317.0	350.8	-33.8
39020068.	42.6653	78.6383	461.8	393.2	68.6
39020081.	42.6134	78.5981	503.2	554.7	-51.5
39020089.	42.6783	78.5261	454.5	459.6	-5.2
39020092.	42.6019	78.7101	326.7	386.2	-59.4
39020093.	42.5982	78.6488	379.2	457.2	-78.0
39020099.	42.5507	78.7303	451.1	570.6	-119.5
39020103.	42.5302	78.6767	444.7	563.9	-119.2
39020108.	42.5220	78.5859	432.8	584.3	-151.5
39021003.	42.7484	78.8014	234.7	161.5	73.2
39021018.	42.7134	78.8162	245.4	198.1	47.2
39021020.	42.7108	78.8857	240.8	159.4	81.4
39021026.	42.7382	78.7500	256.3	204.2	52.1
39021038.	42.6137	78.9696	233.2	242.3	-9.1
39021042.	42.6754	78.5994	233.2	178.3	54.9
39021052.	42.6754	78.8037	344.4	321.6	22.9
39021062.	42.6165	78.8022	374.9	440.1	-65.2
39021092.	42.5614	78.9260	292.6	386.5	-93.9
39021100.	42.5422	78.8393	407.2	516.6	-109.4
39021115.	42.5677	78.7519	459.3	559.6	-100.3
39021122.	42.5154	78.9695	248.4	370.3	-121.9
39021133.	42.5184	78.7835	438.9	586.7	-147.8
39022001.	42.6697	79.0280	187.1	137.2	50.0
39022005.	42.6135	79.1057	181.4	182.9	-1.5
39022011.	42.6094	79.0457	208.8	221.0	-12.2
39022023.	42.5737	79.0967	225.6	259.1	-33.5
39022026.	42.5463	79.0413	189.0	271.3	-82.3
39022028.	42.5381	79.2306	175.3	198.1	-22.9
39022067.	42.5187	79.1723	219.5	281.9	-62.5
39022083.	42.5192	79.0242	246.9	362.7	-115.8
39023001.	42.4520	77.9948	610.2	929.6	-319.4
39023003.	42.4348	77.8426	468.8	835.5	-366.7
39023009.	42.3295	77.9524	529.1	1082.0	-552.9
39023010.	42.3204	77.7990	467.6	1018.0	-550.5

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39023015.	42.4289	77.9564	550.8	918.7	-367.9
39024031.	42.3409	78.1476	549.9	998.5	-448.7
39024037.	42.3303	78.0449	531.0	1086.3	-555.3
39024040.	42.2702	78.0569	411.5	1026.6	-615.1
39024041.	42.2579	78.0078	516.0	1078.7	-562.7
39024043.	42.4260	78.1797	457.5	782.4	-324.9
39024045.	42.4531	78.1743	509.6	823.0	-313.3
39024050.	42.3552	78.0917	524.3	941.8	-417.6
39025001.	42.4682	78.4621	463.3	730.6	-267.3
39025004.	42.3374	78.4684	495.3	887.6	-392.3
39025005.	42.4488	78.2812	587.3	916.2	-328.9
39025007.	42.3166	78.2879	634.0	1108.9	-474.9
39026001.	42.4940	78.6879	391.7	548.6	-157.0
39026002.	42.4861	78.6455	403.9	589.8	-185.9
39026003.	42.4095	78.6934	460.2	723.6	-263.3
39026004.	42.4232	78.6144	440.4	693.7	-253.3
39026005.	42.4443	78.6577	490.7	725.4	-234.7
39026006.	42.3717	78.6919	521.2	812.3	-291.1
39026007.	42.4336	78.7310	426.7	656.8	-230.1
39027002.	42.4967	78.9115	274.3	433.4	-159.1
39027003.	42.4996	78.8560	337.4	484.6	-147.2
39027012.	42.4597	78.8983	322.5	487.7	-165.2
39027023.	42.4479	78.8460	367.6	560.8	-193.2
39027027.	42.4638	78.7943	296.3	440.4	-144.2
39027053.	42.4073	78.9059	417.6	645.9	-228.3
39027063.	42.3931	78.8825	394.4	655.3	-260.9
39027066.	42.3451	78.9115	555.0	826.0	-271.0
39028003.	42.4984	79.2137	227.1	297.2	-70.1
39028018.	42.4583	79.2489	298.7	402.3	-103.6
39028034.	42.4723	79.1350	356.6	474.0	-117.3
39028040.	42.4517	79.1239	425.2	576.1	-150.9
39028052.	42.4342	79.1808	381.0	512.7	-131.7
39028055.	42.3859	79.2292	541.0	720.9	-179.8
39028062.	42.4523	79.0718	487.7	667.5	-179.8
39028071.	42.2999	79.1863	621.8	848.9	-227.1
39028081.	42.4734	79.0272	352.0	518.2	-166.1
39028088.	42.4556	79.0275	423.7	612.6	-189.0
39028103.	42.2813	79.0260	416.7	708.4	-291.7
39029001.	42.4863	79.3387	176.8	251.5	-74.7
39029029.	42.4482	79.2757	271.3	368.8	-97.5
39029036.	42.3906	79.4744	201.5	329.2	-127.7
39029048.	42.3676	79.3307	375.5	548.0	-172.5
39029059.	42.4071	79.2651	442.0	586.4	-144.5
39030002.	42.3556	79.5594	189.9	332.2	-142.3
39030004.	42.3372	79.5846	201.2	344.4	-143.3
39031008.	42.2184	77.8278	673.0	1330.1	-657.1
39031012.	42.1348	77.9711	450.8	1196.3	-745.5
39031014.	42.1370	77.8277	630.3	1450.2	-819.9
39031019.	42.1158	77.7694	676.4	1476.1	-799.8
39031028.	42.0188	77.9488	612.0	1433.8	-821.7
39031066.	42.0781	77.7707	669.6	1490.5	-820.8
39032009.	42.1818	78.0798	635.5	1307.0	-671.5
39032013.	42.2143	78.0000	544.1	1182.3	-638.3
39032020.	42.1433	78.0902	584.3	1311.2	-726.9
39032027.	42.0955	78.1728	566.9	1325.0	-758.0
39032031.	42.0060	78.1469	615.4	1485.0	-869.6
39032033.	42.0578	78.0106	737.0	1596.2	-859.2
39033001.	42.2206	78.4683	579.7	1109.2	-529.4
39033009.	42.1135	78.3789	542.5	1225.3	-682.8
39033017.	42.2385	78.3937	532.2	1069.2	-537.1
39033025.	42.1940	78.4315	608.1	1178.7	-570.6
39033027.	42.1903	78.2981	554.7	1181.7	-627.0
39033028.	42.0562	78.4036	455.7	1168.0	-712.3

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39034002.	42.1807	78.5352	591.9	1155.2	-563.3
39034008.	42.0592	78.7389	684.9	1286.0	-601.1
39034019.	42.1361	78.5674	534.6	1131.7	-597.1
39034023.	42.1302	78.6270	662.9	1259.7	-596.8
39035001.	42.2398	78.9904	499.9	865.6	-365.8
39035008.	42.1543	78.8659	495.9	966.2	-470.3
39035010.	42.1149	78.7766	438.6	981.5	-542.8
39035013.	42.0316	78.7674	587.3	1234.1	-646.8
39035015.	42.0067	78.8879	611.4	1255.8	-644.3
39036002.	42.2135	79.2211	541.0	847.6	-306.6
39036009.	42.0929	79.2408	403.9	845.8	-442.0
39036010.	42.1102	79.0600	414.2	901.9	-487.7
39036011.	42.0192	79.1669	379.2	914.1	-534.9
39036014.	42.0144	79.0508	544.1	1143.0	-598.9
39037004.	42.1551	79.4611	477.0	811.1	-334.1
39037007.	42.0501	79.3849	467.0	921.4	-454.5
39037009.	42.0229	79.2548	463.6	964.1	-500.5
39037010.	42.0682	79.4156	479.1	891.2	-412.1
39038001.	42.0589	79.6803	512.7	872.0	-359.4
39038003.	42.1248	79.6894	479.1	791.0	-311.8
39039001.	42.1641	79.7574	443.5	703.8	-260.3
39039006.	42.1236	79.9233	326.1	590.7	-264.6
39039007.	42.1169	79.8257	429.5	716.0	-286.5
39039008.	42.1074	79.7637	422.5	731.5	-309.1
39039009.	42.0674	79.9971	428.5	701.3	-272.8
39039017.	42.0374	79.8942	432.8	740.7	-307.8
39039018.	42.2800	79.8995	184.1	320.0	-135.9
39040001.	42.1657	80.1148	177.1	385.6	-208.5
39040002.	42.1359	80.0784	182.9	403.9	-221.0
39040014.	42.0480	80.0781	377.3	640.1	-262.7
39040018.	42.0467	80.0245	378.0	643.4	-265.5
39042001.	41.9984	77.9879	635.8	1446.9	-811.1
39042006.	41.9745	77.9260	654.1	1606.3	-952.2
39042020.	41.9703	77.7502	661.1	1612.4	-951.3
39042040.	41.9062	77.7677	631.5	1609.6	-978.1
39042060.	41.8019	77.9546	621.5	1644.4	-1022.9
39043001.	41.9786	78.1196	609.3	1484.1	-874.8
39043012.	41.9244	78.1628	618.4	1576.1	-957.7
39043019.	41.8773	78.0972	547.7	1597.2	-1049.4
39043021.	41.8757	78.0132	605.0	1573.4	-968.3
39043025.	41.8484	78.0251	700.4	1595.3	-894.9
39043030.	41.8042	78.1164	675.7	1598.7	-922.9
39043031.	41.9131	78.2072	570.3	1496.9	-926.6
39044001.	41.9667	78.2802	474.0	1379.5	-905.6
39044002.	41.9467	78.2872	542.5	1464.0	-921.4
39044003.	41.8499	78.3390	453.5	1356.4	-902.8
39045001.	41.9710	78.5764	480.4	1239.0	-758.6
39045002.	41.7678	78.7220	470.9	1418.8	-947.9
39046002.	41.7990	78.9843	626.4	1446.3	-819.9
39046003.	41.9922	78.7732	634.6	1324.4	-689.8
39046005.	41.8957	78.8869	413.9	1149.1	-735.2
39046006.	41.8710	78.8431	488.6	1269.8	-781.2
39046007.	41.8649	78.7673	652.6	1467.9	-815.3
39046009.	41.8087	78.8949	409.0	1240.5	-831.5
39046011.	41.8111	78.7563	621.8	1505.1	-883.3
39047001.	41.9313	79.0284	587.0	1250.9	-663.9
39047005.	41.7926	79.1890	500.5	1285.6	-785.2
39047006.	41.7743	79.2152	513.9	1305.8	-791.9
39048002.	41.8752	79.4673	563.6	1143.6	-580.0
39048003.	41.8543	79.3100	368.2	1031.7	-663.5
39048004.	41.8553	79.2696	384.7	1060.1	-675.4
39049007.	41.9300	79.7375	467.3	917.4	-450.2
39049009.	41.7750	79.5804	531.9	1180.2	-648.3

Table C-13a continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39050001.	41.7788	79.9971	371.9	864.4	-492.6
39050002.	41.7701	79.9182	417.0	948.2	-531.3
39051001.	41.9875	80.1108	408.4	707.1	-298.7
39051005.	41.8949	80.0748	430.7	825.4	-394.7
39068001.	42.9022	79.7497	191.1	10.4	180.7
39068003.	42.8515	79.7091	183.5	7.0	176.5

Table C-13b

(QUEENSTON DATA)

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
1704153.	42.2763	78.9206	558.7	1282.0	-726.0
2005087.	42.3235	75.9480	307.2	1783.4	-1480.1
2805327.	42.3682	78.9914	396.8	997.6	-601.7
3605204.	42.3964	78.8370	517.2	1138.7	-622.4
3605313.	42.4311	78.8663	478.5	1047.6	-569.7
3705375.	42.3717	78.8526	526.4	1168.6	-643.1
4404592.	42.4432	78.9717	363.6	897.0	-534.3
4704238.	42.1115	78.9775	550.2	1453.0	-903.7
5004088.	42.0238	78.9518	397.2	1421.3	-1024.7
5604652.	42.9465	76.7030	158.2	460.2	-302.7
5704999.	43.0260	76.5289	179.5	429.5	-252.7
5805467.	43.1007	76.5128	139.9	290.2	-153.3
5805011.	43.1459	76.5535	123.1	214.3	-93.9
6004624.	43.2525	76.4911	137.8	90.2	46.6
6104365.	42.9705	76.5170	227.1	552.3	-326.1
6606644.	42.8589	76.6519	193.5	562.4	-370.9
6905031.	43.2015	76.6101	134.7	181.1	-49.1
7004356.	42.2767	79.5095	417.3	980.5	-564.2
7204154.	42.3421	79.1319	493.5	1085.7	-596.2
7204200.	42.3129	79.5249	471.2	1034.2	-563.3
7304561.	42.2345	79.3730	468.2	1100.9	-636.4
7304437.	42.1503	79.3379	539.8	1248.5	-712.0
7404671.	42.2398	79.4202	465.7	1096.4	-631.5
7604152.	42.1634	79.7362	453.8	1082.0	-629.1
7604204.	42.1606	79.6731	453.2	1100.9	-648.6
7804948.	42.3873	79.3905	353.9	841.2	-488.3
8005267.	42.4317	79.4196	187.8	624.2	-437.4
8104000.	42.2539	79.6673	407.5	967.4	-560.8
8404156.	42.3344	79.3905	406.9	950.7	-544.7
9705344.	42.3904	75.7734	470.9	1810.5	-1340.5
10304240.	42.8759	78.5030	280.4	441.4	-161.8
10504527.	42.9346	78.6118	253.3	357.2	-104.9
10604758.	42.9130	78.5067	253.9	387.7	-134.7
11004866.	42.6080	79.0276	211.8	550.8	-339.9
11404725.	42.6389	78.8869	301.1	636.1	-335.9
11504157.	42.8360	78.6178	251.2	435.9	-185.6
11604231.	42.6947	79.0126	199.0	443.5	-245.4
11804094.	42.7832	78.8535	179.2	372.8	-194.5
12406722.	42.7158	78.9422	209.4	432.5	-223.7
12804183.	42.8291	78.8498	178.9	334.7	-156.4
12904545.	42.9610	78.5073	243.2	323.1	-80.8
13204184.	42.5747	78.4686	473.7	975.1	-502.0
13504576.	42.5463	78.5588	536.1	1022.3	-487.1
13705115.	43.0906	78.3136	221.6	206.7	14.0
13704632.	42.5663	78.5899	496.2	951.9	-456.6
13805117.	43.0403	78.3902	265.2	281.9	-19.2
14104434.	42.9163	78.2573	323.1	489.5	-167.3
14104477.	42.9168	78.0808	316.4	489.2	-173.7
14204593.	43.0429	78.0774	217.3	220.7	-6.4
14304806.	43.1154	78.0916	203.6	132.6	70.1
15204551.	42.9292	77.9628	284.4	466.3	-182.9
15305213.	42.9588	78.3265	284.4	387.7	-104.2
15704363.	42.8618	77.8149	189.3	484.6	-296.3
15803942.	42.6853	77.6618	497.7	1075.9	-579.1
15804567.	42.9323	77.8841	243.5	437.4	-197.8
15904188.	42.7664	77.7551	349.9	792.2	-443.2
15904189.	42.8281	77.8010	223.4	571.8	-349.3
16104451.	42.9369	77.7130	209.7	419.1	-210.3
16404217.	42.7671	77.8823	176.5	582.2	-406.6
16504457.	42.8804	77.6226	286.2	580.9	-295.7
16504458.	42.9295	77.6349	230.4	462.1	-232.6
16604053.	42.7649	77.6594	421.2	882.1	-464.2

Table C-13b continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
16704630.	42.6503	77.7560	182.6	784.3	-606.2
16804069.	42.8716	77.9322	269.4	536.1	-267.6
17604085.	42.8798	75.6867	477.9	848.3	-371.2
17703970.	42.8048	75.6506	472.1	929.3	-458.7
17704185.	42.8435	75.6150	456.0	825.7	-370.3
18404724.	43.1509	77.9753	196.9	112.8	83.2
18504063.	43.1227	78.7982	183.8	106.1	76.8
18506669.	43.0799	79.0068	177.4	119.5	54.9
18606667.	43.2076	78.4651	167.6	38.1	125.9
19804054.	42.8119	77.4733	432.2	863.8	-432.5
20003999.	42.7968	77.3351	361.5	811.4	-450.8
20004107.	42.7897	77.4095	405.7	882.4	-477.6
20104395.	42.9328	77.3590	221.9	479.5	-258.5
20104409.	42.8965	77.3097	240.2	556.3	-317.0
20204947.	42.8392	77.3679	321.0	703.2	-383.1
20804099.	42.9420	77.4037	242.0	483.1	-242.0
21104760.	42.9894	77.2799	182.6	362.1	-180.4
21304871.	43.0216	77.3354	172.2	323.7	-154.2
21504607.	42.8202	77.2135	320.6	737.0	-417.0
21604449.	42.8688	77.1966	276.5	649.8	-373.7
21603929.	42.7424	77.5237	319.4	808.3	-490.1
22503866.	42.6785	77.4432	531.0	1168.0	-637.9
22505056.	42.8227	77.0574	260.6	696.8	-437.1
22604450.	42.8863	77.4817	279.5	615.7	-337.1
22604394.	42.9102	77.5240	287.4	558.1	-271.6
22704730.	43.1803	78.1527	210.6	126.5	82.0
22704611.	43.1909	78.2583	200.9	79.2	120.7
23204722.	43.1858	78.4419	190.5	79.2	109.1
24504082.	42.8759	76.8400	143.9	511.5	-368.5
24804244.	42.8251	76.8657	201.8	627.9	-426.7
24804544.	42.8689	76.9268	152.7	529.7	-378.0
25005095.	43.0349	76.9769	124.7	336.8	-214.9
25304524.	42.9402	76.8877	148.1	434.9	-287.7
27203924.	42.0630	77.4307	505.4	2186.9	-1685.5
27304007.	42.3654	76.5033	404.8	1738.9	-1338.7
27404130.	42.4421	76.5928	444.1	1629.2	-1186.0
27905041.	43.1458	76.7616	131.7	202.7	-73.8
27905116.	43.1520	77.0699	181.4	224.0	-45.1
28005032.	43.0592	76.8961	145.4	303.6	-159.4
28006719.	43.0292	76.9439	122.2	317.0	-197.5
28104754.	43.0824	77.2696	154.2	235.9	-83.8
28105114.	43.1116	77.0207	149.4	228.6	-80.2
29104092.	42.6173	78.0803	479.5	1026.0	-550.5
29404385.	42.6300	78.1539	539.8	1026.6	-487.7
29604464.	42.8384	78.0967	355.4	627.3	-272.8
29904601.	42.8106	78.1501	476.1	754.7	-279.5
30104392.	42.7477	78.1979	490.1	854.0	-364.8
30404342.	42.7411	78.3595	392.6	721.2	-329.5
30406073.	42.7552	78.0976	458.1	810.8	-353.3
30604797.	42.7494	77.0038	253.3	773.6	-521.2
30604796.	42.6838	77.0223	293.8	876.6	-583.7
60010608.	42.3177	75.6711	428.2	1953.8	-1525.5
60006778.	42.5189	76.0009	478.2	1557.5	-1079.3
60012163.	42.9369	76.3459	303.9	693.7	-389.8
60011654.	42.9167	76.2551	417.6	874.8	-457.2
76000115.	41.6716	75.3737	482.5	1777.0	-1294.5
76100032.	41.7501	79.6703	531.6	1618.2	-1086.6
76100056.	42.1840	79.8704	273.1	865.6	-592.5
76100059.	41.9822	79.8130	465.7	1254.3	-788.5
76100080.	41.6716	79.3436	525.8	1838.2	-1312.5
76200069.	42.0372	79.8002	474.9	1218.0	-743.1
76200078.	41.8820	78.6150	682.8	2034.2	-1351.5
76200096.	41.6642	79.3747	524.9	1824.2	-1299.4

Table C-13b continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
76400109.	42.1428	80.0477	198.1	797.4	-599.2
76400609.	41.9539	79.2014	498.0	1510.0	-1011.9
76404380.	41.9375	79.2688	551.7	1556.3	-1004.6
77107520.	41.9870	78.9170	452.0	1539.2	-1087.2
77300345.	42.1576	79.8114	435.9	1061.9	-626.1
77420429.	41.8335	80.0188	411.8	1305.5	-893.7
77430629.	41.8278	78.5807	664.5	2115.3	-1450.8
77420057.	41.6896	77.5470	478.2	2688.3	-2210.1
77520468.	41.6562	79.8666	494.4	1606.3	-1111.9
77520466.	41.8160	79.6533	550.5	1568.8	-1018.3
77520372.	41.8714	79.7727	481.6	1342.3	-860.8
77524704.	41.9207	79.5535	468.2	1393.5	-925.4
77620445.	41.7787	80.0519	430.1	1345.4	-915.3
77620500.	41.8073	80.1028	357.8	1228.6	-870.8
77820436.	42.2169	79.8997	207.3	761.7	-554.4
77820415.	41.9204	79.9329	378.0	1193.0	-815.0
37341005.	42.1985	76.5382	328.3	2027.5	-1699.3
37343011.	42.1804	77.1937	523.6	2049.8	-1526.1
37334019.	42.3199	76.8639	367.6	1688.0	-1320.4
37335017.	42.4805	77.0778	380.4	1284.7	-904.3
37325003.	42.6848	76.6443	251.2	944.6	-693.4
37316002.	42.9568	76.5792	170.7	487.7	-317.0
37317013.	42.8778	76.7831	145.7	498.3	-352.7
37317038.	42.9121	76.9893	143.6	429.8	-286.2
37318007.	42.8435	77.1697	285.0	662.9	-378.0
37318009.	42.7990	77.2848	338.3	777.2	-438.9
37319002.	42.9433	77.2545	192.9	467.3	-274.3
37319039.	42.8380	77.4039	263.7	659.6	-395.9
37320012.	42.8380	77.7022	254.5	582.8	-328.3
37307002.	43.1552	75.7086	131.1	56.4	74.7
37308002.	43.0510	75.8705	135.3	290.8	-155.4
37309003.	43.0025	76.1873	308.8	664.5	-355.7
37310009.	43.1656	76.3282	115.8	189.0	-73.2
37311004.	43.1211	76.5935	145.1	274.3	-129.2
37312005.	43.0883	76.8532	125.9	262.1	-136.2
37313001.	43.1702	77.6185	154.2	94.5	59.7
39006005.	43.0877	77.8431	165.2	154.8	10.4
39008003.	43.0310	78.2774	269.7	295.7	-25.9
39010003.	43.0222	78.8266	175.3	224.6	-49.4
39011001.	43.1158	79.1936	157.6	72.2	85.3
39012023.	42.8457	77.9697	364.2	647.4	-283.2
39012024.	42.8182	77.9884	338.3	654.1	-315.8
39012027.	42.7602	77.9950	405.4	791.3	-385.9
39013003.	42.9482	78.0437	283.5	435.9	-152.4
39013009.	42.8958	78.2000	323.1	531.0	-207.9
39013019.	42.8851	78.0766	347.5	578.2	-230.7
39013037.	42.8906	78.0341	294.1	538.0	-243.8
39013042.	42.8671	78.2101	426.7	620.9	-194.2
39014003.	42.9842	78.4382	256.0	321.0	-64.9
39014035.	42.9250	78.3886	272.8	393.2	-120.4
39014042.	42.8182	78.4888	346.3	569.4	-223.1
39014048.	42.8473	78.3693	378.0	589.8	-211.8
39014052.	42.8402	78.4586	286.2	496.5	-210.3
39014077.	42.7892	78.3961	350.8	633.1	-282.2
39014078.	42.8583	78.2957	370.3	570.6	-200.3
39014097.	42.7591	78.4368	385.6	687.3	-301.8
39014098.	42.7651	78.2814	451.1	734.3	-283.2
39014099.	42.8976	78.4620	275.8	413.3	-137.5
39015002.	42.9732	78.6265	221.0	292.0	-71.0
39015004.	42.9556	78.9140	245.4	317.3	-71.9
39015022.	42.9331	78.6768	224.0	321.3	-97.2
39015038.	42.8936	78.6453	208.5	340.2	-131.7
39015041.	42.8879	78.5949	221.0	369.4	-148.4

Table C-13b continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39015050.	42.9544	78.5697	253.0	323.4	-70.4
39015071.	42.8374	78.7412	198.1	358.1	-160.0
39015081.	42.8174	78.6779	239.3	445.0	-205.7
39015082.	42.8045	78.6356	288.0	501.4	-213.4
39015092.	42.7925	78.5595	262.1	496.5	-234.4
39015103.	42.7714	78.7276	269.7	495.0	-225.2
39016011.	42.9775	78.8198	181.4	224.6	-43.3
39016016.	42.9219	78.7916	201.2	306.6	-105.5
39016017.	42.8848	78.7560	185.3	313.3	-128.0
39016027.	42.8106	78.7929	193.5	371.2	-177.7
39016050.	42.9694	78.9482	178.3	213.7	-35.4
39016051.	42.9144	78.9532	180.7	279.5	-98.8
39018003.	42.6853	78.1139	426.7	862.9	-436.2
39018015.	42.6354	78.0431	461.8	971.1	-509.3
39018018.	42.5011	78.2295	599.5	1284.7	-685.2
39018020.	42.5704	78.0789	486.2	1086.3	-600.2
39019017.	42.5477	78.4698	441.0	993.0	-552.0
39019025.	42.7009	78.4566	298.4	657.5	-359.1
39019029.	42.6513	78.3221	530.4	976.9	-446.5
39019030.	42.6228	78.4260	460.2	916.8	-456.6
39019033.	42.5869	78.3835	507.5	999.1	-491.6
39019037.	42.5332	78.3389	566.9	1179.6	-612.6
39019038.	42.5776	78.2929	554.7	1132.0	-577.3
39019042.	42.5306	78.4236	452.0	1025.7	-573.6
39020001.	42.7420	78.6416	286.5	568.1	-281.6
39020032.	42.7135	78.5418	385.6	723.9	-338.3
39020040.	42.6955	78.7059	359.7	706.5	-346.9
39020050.	42.6351	78.7321	317.0	682.8	-365.8
39020081.	42.6134	78.5981	503.2	897.0	-393.8
39020089.	42.6783	78.5261	454.5	810.2	-355.7
39020092.	42.6019	78.7101	326.7	733.7	-406.9
39020098.	42.5658	78.6916	422.1	885.4	-463.3
39020105.	42.5058	78.7262	417.3	901.9	-484.6
39020108.	42.5220	78.5859	432.8	937.9	-505.1
39021003.	42.7484	78.8014	234.7	480.1	-245.4
39021018.	42.7134	78.8162	245.4	513.0	-267.6
39021020.	42.7108	78.8857	240.8	479.8	-239.0
39021026.	42.7382	78.7500	256.3	522.7	-266.4
39021037.	42.6359	78.9489	228.6	554.4	-325.8
39021052.	42.6754	78.8037	344.4	644.3	-299.9
39021055.	42.6455	78.7746	425.2	786.4	-361.2
39021062.	42.6165	78.8022	374.9	768.7	-393.8
39021079.	42.5800	78.8549	399.3	820.8	-421.5
39021092.	42.5614	78.9260	292.6	709.3	-416.7
39021100.	42.5422	78.8393	407.2	841.9	-434.6
39021112.	42.5912	78.7541	475.5	880.9	-405.4
39021122.	42.5154	78.9695	248.4	698.6	-450.2
39021133.	42.5184	78.7835	438.9	911.4	-472.4
39022002.	42.6415	79.0425	200.6	495.3	-294.7
39022005.	42.6135	79.1057	181.4	507.2	-325.8
39022021.	42.5740	79.0253	232.3	606.9	-374.6
39022022.	42.5743	79.1213	178.3	536.4	-358.1
39022028.	42.5381	79.2306	175.3	551.7	-376.4
39022052.	42.5450	79.1715	179.8	557.5	-377.6
39022066.	42.5288	79.0915	249.9	647.7	-397.8
39022083.	42.5192	79.0242	246.9	680.3	-433.4
39024024.	42.3936	78.0141	610.5	1503.3	-892.8
39024039.	42.2848	78.0074	595.0	1659.6	-1064.7
39024045.	42.4531	78.1743	509.6	1252.7	-743.1
39025001.	42.4682	78.4621	463.3	1105.5	-642.2
39025003.	42.4046	78.4300	609.0	1342.9	-734.0
39025005.	42.4488	78.2812	587.3	1321.9	-734.6
39026002.	42.4861	78.6455	403.9	950.7	-546.8

Table C-13b continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39026004.	42.4232	78.6144	440.4	1062.5	-622.1
39026005.	42.4443	78.6577	490.7	1092.7	-602.0
39026006.	42.3717	78.6919	521.2	1177.4	-656.2
39027002.	42.4967	78.9115	274.3	769.9	-495.6
39027003.	42.4996	78.8560	337.4	826.9	-489.5
39027009.	42.4916	78.8047	405.4	910.1	-504.7
39027053.	42.4073	78.9059	417.6	1012.5	-595.0
39027065.	42.3939	78.7571	423.7	1057.0	-633.4
39027066.	42.3451	78.9115	555.0	1200.3	-645.3
39028003.	42.4984	79.2137	227.1	630.9	-403.9
39028018.	42.4583	79.2489	298.7	742.8	-444.1
39028030.	42.4953	79.0844	286.5	728.8	-442.3
39028034.	42.4723	79.1350	356.6	822.0	-465.4
39028053.	42.4249	79.2061	344.4	846.1	-501.7
39028055.	42.3859	79.2292	541.0	1069.8	-528.8
39028062.	42.4523	79.0718	487.7	1043.3	-555.7
39028063.	42.4130	79.1256	524.3	1040.6	-516.3
39028067.	42.3789	79.0906	405.4	952.5	-547.1
39028071.	42.2999	79.1863	621.8	1215.5	-593.8
39028073.	42.2802	79.2056	526.1	1175.0	-648.9
39028081.	42.4734	79.0272	352.0	846.4	-494.4
39028103.	42.2813	79.0260	416.7	1101.5	-684.9
39029001.	42.4863	79.3387	176.8	581.6	-404.8
39029006.	42.5156	79.2738	185.9	579.7	-393.8
39029029.	42.4482	79.2757	271.3	708.4	-437.1
39029036.	42.3906	79.4744	201.5	670.9	-469.4
39029044.	42.4018	79.3281	372.2	854.7	-482.5
39029059.	42.4071	79.2651	442.0	929.3	-487.4
39030002.	42.3556	79.5594	189.9	680.0	-490.1
39030004.	42.3372	79.5846	201.2	695.6	-494.4
39032020.	42.1433	78.0902	584.3	1834.3	-1250.0
39032023.	42.1195	78.1459	631.5	1877.0	-1245.4
39035001.	42.2398	78.9904	499.9	1248.2	-748.3
39035010.	42.1149	78.7766	438.6	1406.7	-968.0
39036002.	42.2135	79.2211	541.0	1244.8	-703.8
39036010.	42.1102	79.0600	414.2	1298.4	-884.2
39036011.	42.0192	79.1669	379.2	1298.4	-919.3
39037003.	42.1969	79.2507	408.4	1121.1	-712.6
39037004.	42.1551	79.4611	477.0	1179.6	-702.6
39037010.	42.0682	79.4156	479.1	1298.4	-819.3
39038001.	42.0589	79.6803	512.7	1240.2	-727.6
39039002.	42.2271	79.8400	198.1	762.0	-563.9
39039008.	42.1074	79.7637	422.5	1115.0	-692.5
39039018.	42.2800	79.8995	184.1	682.1	-498.0
39040001.	42.1657	80.1148	177.1	759.9	-582.8
39040002.	42.1359	80.0784	182.9	792.5	-609.6
39040018.	42.0467	80.0245	378.0	1052.5	-674.5
39044003.	41.8499	78.3390	453.5	2000.7	-1547.2
39045001.	41.9710	78.5764	480.4	1737.4	-1257.0
39045002.	41.7678	78.7220	470.9	1928.2	-1457.2
39046011.	41.8111	78.7563	621.8	2001.6	-1379.8
39047001.	41.9313	79.0284	587.0	1690.1	-1103.1
39048001.	41.9952	79.3142	414.5	1345.1	-930.6
39048002.	41.8752	79.4673	563.6	1565.8	-1002.2
39048003.	41.8543	79.3100	368.2	1446.3	-1078.1
39048004.	41.8553	79.2696	384.7	1489.3	-1104.6
39049001.	41.9662	79.7315	506.0	1338.1	-832.1
39049007.	41.9300	79.7375	467.3	1329.5	-862.3
39049009.	41.7750	79.5804	531.9	1617.0	-1085.1
39049010.	41.9954	79.7155	512.7	1356.4	-843.7
39050001.	41.7788	79.9971	371.9	1308.2	-936.3
39051001.	41.9875	80.1108	408.4	1119.2	-710.8
39051002.	41.9722	80.0785	442.0	1172.9	-730.9

Table C-13b continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39051005.	41.8949	80.0748	430.7	1268.0	-837.3
39061002.	43.1287	79.3178	96.0	6.4	89.6
39063001.	43.2301	79.9919	171.0	49.4	121.6
39064001.	43.1015	80.0207	215.5	170.7	44.8
39066001.	42.9685	79.0641	182.9	187.1	-4.3
39066002.	42.9862	79.1737	186.8	190.2	-3.4
39066003.	42.9243	79.1008	184.4	235.9	-51.5
39066006.	42.8513	79.1010	175.3	278.9	-103.6
39067002.	42.8726	79.3612	179.8	251.5	-71.6
39068001.	42.9022	79.7497	191.1	258.2	-67.1
39068002.	42.8533	79.5107	178.9	264.3	-85.3
39068003.	42.8515	79.7091	183.5	261.8	-78.3
39069002.	42.9016	79.9494	209.1	265.2	-56.1
39070002.	42.8160	80.2054	224.3	366.7	-142.3

Table C-13c

(TRENTON DATA)

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
1403956.	42.4531	78.1743	509.6	1862.3	-1353.6
2005087.	42.3235	75.9480	307.2	2298.2	-1994.9
5604715.	42.9217	76.6716	157.3	991.2	-834.8
5704999.	43.0260	76.5289	179.5	947.9	-771.1
5805467.	43.1007	76.5128	139.9	798.9	-662.0
5805011.	43.1459	76.5535	123.1	709.0	-588.6
6004624.	43.2525	76.4911	137.8	585.8	-449.0
6905031.	43.2015	76.6101	134.7	686.7	-554.7
7304561.	42.2345	79.3730	468.2	1664.2	-1199.7
7304437.	42.1503	79.3379	539.8	1819.0	-1282.6
8204460.	42.5212	79.2623	188.1	1117.1	-929.9
9704714.	42.5185	76.0009	480.1	2101.6	-1623.4
9804455.	42.3905	75.0445	456.0	1866.9	-1414.3
9904214.	42.1826	74.9218	544.4	2510.6	-1969.3
9904379.	42.2736	74.6278	563.3	2063.5	-1504.2
10004364.	42.3169	75.2341	508.4	2229.9	-1724.6
12004663.	42.7232	78.9451	189.9	985.7	-796.7
12306668.	42.8033	78.8444	180.7	737.0	-559.3
13304440.	42.5559	78.5063	430.7	1525.2	-1095.5
13705115.	43.0906	78.3136	221.6	749.8	-529.1
13805117.	43.0403	78.3902	265.2	826.9	-564.2
14204593.	43.0429	78.0774	217.3	749.8	-535.5
14304806.	43.1154	78.0916	203.6	656.8	-454.2
15503993.	42.8807	74.9165	476.4	912.0	-436.5
15804567.	42.9323	77.8841	243.5	975.1	-735.5
16704630.	42.6503	77.7560	182.6	1488.3	-1310.3
16804069.	42.8716	77.9322	269.4	1089.1	-820.5
17204552.	42.8353	77.9371	305.1	1175.3	-874.8
17703970.	42.8048	75.6506	472.1	1392.3	-921.7
18506669.	43.0799	79.0068	177.4	639.5	-465.1
18604719.	43.3360	78.5128	102.4	381.0	-280.7
18606667.	43.2076	78.4651	167.6	562.1	-398.1
18703928.	42.8680	75.4266	402.9	1041.8	-639.8
21104760.	42.9894	77.2799	182.6	900.7	-719.0
21304871.	43.0216	77.3354	172.2	857.4	-687.9
21506395.	42.8126	77.2029	332.2	1305.8	-976.6
22704730.	43.1803	78.1527	210.6	659.3	-450.8
22704611.	43.1909	78.2583	200.9	611.7	-411.8
22804873.	43.3627	78.3051	85.6	345.9	-261.5
22804476.	43.3235	78.2055	110.0	405.7	-296.3
22904912.	43.2823	78.1742	132.9	476.1	-343.8
23004994.	43.4017	77.9610	99.1	384.4	-288.0
23105069.	43.3191	78.0825	110.3	421.2	-313.3
23205008.	43.2442	78.3293	153.3	531.9	-379.2
23204722.	43.1858	78.4419	190.5	613.6	-425.2
23305096.	43.1621	78.3733	192.3	646.8	-454.8
23404752.	43.3067	78.4530	107.6	421.5	-314.9
23404753.	43.3485	78.4448	100.0	365.2	-268.2
23504208.	43.2620	76.1033	153.3	451.7	-299.3
23504764.	43.3259	78.3320	102.1	399.3	-298.1
23604209.	43.3479	76.3190	141.7	491.9	-351.1
23605012.	43.3693	76.6017	96.9	435.9	-341.4
23804357.	43.4440	75.8772	227.1	256.3	-33.8
23904547.	42.5306	74.8834	385.3	1322.8	-938.2
24604203.	42.8762	76.8586	165.2	1083.0	-920.2
25005095.	43.0349	76.9769	124.7	870.5	-748.6
27203924.	42.0630	77.4307	505.4	2948.9	-2447.5
27303973.	42.3702	76.5063	394.7	2347.0	-1961.4
27404130.	42.4421	76.5928	444.1	2225.0	-1781.9
27504467.	42.3844	76.5409	318.2	2239.1	-1921.8
27905041.	43.1458	76.7616	131.7	715.4	-586.4
27905116.	43.1520	77.0699	181.4	741.3	-562.4

Table C-13c continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
28005032.	43.0592	76.8961	145.4	837.0	-692.8
28006719.	43.0292	76.9439	122.2	849.2	-729.7
28104754.	43.0824	77.2696	154.2	762.0	-609.9
28105114.	43.1116	77.0207	149.4	757.4	-609.0
29104092.	42.6173	78.0803	479.5	1618.5	-1143.0
29604447.	42.8027	78.1501	475.2	1336.5	-862.3
29604464.	42.8384	78.0967	355.4	1179.6	-825.1
30104392.	42.7477	78.1979	490.1	1439.6	-950.4
30406073.	42.7552	78.0976	458.1	1382.3	-924.8
60010227.	42.2978	74.6251	613.3	2020.2	-1407.0
60010335.	42.2083	76.6250	432.2	2843.5	-2411.3
60012163.	42.9369	76.3459	303.9	1206.4	-902.5
82901160.	42.6933	75.3618	418.5	1346.3	-927.8
82400698.	43.1552	75.7086	131.1	459.3	-328.3
77300345.	42.1576	79.8114	435.9	1599.3	-1163.4
77420429.	41.8335	80.0188	411.8	1891.3	-1479.5
77420057.	41.6896	77.5470	478.2	3511.3	-3033.1
77633511.	41.8674	78.6145	684.0	2781.3	-2097.3
37353001.	43.0151	75.0353	123.4	144.8	-21.3
37353002.	43.2058	75.1975	268.2	97.5	170.7
37353003.	43.1043	75.2459	130.5	173.7	-43.3
37354001.	43.2067	75.4479	135.6	190.5	-54.9
37354003.	43.1187	75.4797	207.3	421.5	-214.3
37354004.	43.1080	75.2866	146.3	243.8	-97.5
37359002.	43.3029	75.2070	289.6	59.4	230.1
37360001.	43.2523	75.4459	156.1	153.9	2.1
37360003.	43.2988	75.4498	173.7	157.0	16.8
37360005.	43.3374	75.3416	249.9	131.1	118.9
37341005.	42.1985	76.5382	328.3	2713.3	-2385.1
37316002.	42.9568	76.5792	170.7	1005.8	-835.2
37317001.	42.9540	76.7620	120.4	914.4	-794.0
37317015.	42.9800	76.9339	153.0	923.5	-770.5
37307001.	43.2291	75.5143	129.5	221.9	-92.4
37307003.	43.1365	75.5627	158.5	426.7	-268.2
37307004.	43.0809	75.5393	187.5	487.7	-300.2
37308002.	43.0510	75.8705	135.3	746.8	-611.4
37309003.	43.0025	76.1873	308.8	1136.9	-828.1
37310009.	43.1656	76.3282	115.8	685.8	-570.0
37310022.	43.1274	76.3322	131.1	732.7	-601.7
37310028.	43.0757	76.3281	137.5	821.7	-684.3
37310029.	43.0189	76.3040	262.4	1021.1	-758.6
37310030.	43.0729	76.4599	129.5	798.0	-668.4
37311004.	43.1211	76.5935	145.1	787.0	-641.9
37312001.	43.2228	76.8134	96.6	594.4	-497.7
37312002.	43.1050	76.8345	140.5	774.2	-633.7
37303001.	43.4340	75.5907	408.4	329.8	78.6
37303003.	43.4174	75.6816	342.0	355.1	-13.1
37303010.	43.3383	75.7413	156.7	256.9	-100.3
37304001.	43.4813	75.7583	355.1	317.0	38.1
37304002.	43.4040	75.7738	278.3	354.8	-76.5
37304008.	43.3712	75.7983	182.6	297.2	-114.6
37305001.	43.4636	76.2300	106.7	313.0	-206.3
37305003.	43.3813	76.0931	158.5	440.4	-281.9
37305004.	43.2983	76.1525	128.0	490.4	-362.4
37305005.	43.2807	76.0038	152.4	467.9	-315.5
37306001.	43.4680	76.4955	91.4	364.5	-273.1
37306002.	43.4340	76.4652	117.3	401.1	-283.8
37306005.	43.3676	76.4265	97.5	417.6	-320.0
37306014.	43.3152	76.3827	115.8	426.7	-310.9
37306018.	43.2879	76.4655	125.0	518.2	-393.2
39004001.	43.2681	78.7376	106.7	365.8	-259.1
39008001.	43.2445	78.2575	157.9	552.9	-395.0
39008002.	42.9342	78.2725	228.6	838.2	-609.6

Table C-13c continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39008003.	43.0310	78.2774	269.7	838.2	-568.5
39009001.	43.1990	78.5720	158.5	548.6	-390.1
39011001.	43.1158	79.1936	157.6	580.6	-423.1
39012006.	42.8807	77.9792	334.7	1128.4	-793.7
39015081.	42.8174	78.6779	239.3	944.9	-705.6
39016014.	42.9276	78.8326	207.3	792.5	-585.2
39016015.	42.8663	78.8028	178.3	902.2	-723.9
39016051.	42.9144	78.9532	180.7	818.4	-637.6
39019042.	42.5306	78.4236	452.0	1628.2	-1176.2
39021117.	42.5463	78.9959	198.1	1168.9	-970.8
39022023.	42.5737	79.0967	225.6	1143.0	-917.4
39028106.	42.4601	79.0403	397.5	1456.3	-1058.9
39028108.	42.3411	79.1320	493.5	1654.8	-1161.3
39029003.	42.4816	79.3088	200.9	1222.2	-1021.4
39037010.	42.0682	79.4156	479.1	1866.6	-1387.4
39039018.	42.2800	79.8995	184.1	1204.0	-1019.9
39040002.	42.1359	80.0784	182.9	1295.4	-1112.5
39040018.	42.0467	80.0245	378.0	1577.6	-1199.7
39051005.	41.8949	80.0748	430.7	1790.7	-1360.0
39061001.	43.1594	79.2828	90.5	459.0	-368.5
39061002.	43.1287	79.3178	96.0	463.0	-367.0
39063001.	43.2301	79.9919	171.0	414.5	-243.5
39064001.	43.1015	80.0207	215.5	602.0	-386.5
39066001.	42.9885	79.0641	182.9	705.0	-522.1
39066002.	42.9882	79.1737	186.8	711.7	-524.9
39066004.	42.9021	79.1554	182.9	768.1	-585.2
39066006.	42.8513	79.1010	175.3	811.7	-636.4
39067001.	42.9167	79.3819	177.4	743.7	-566.3
39068001.	42.9022	79.7497	191.1	746.8	-555.7

Table C-13d

(THERESA DATA)

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
1403956.	42.4531	78.1743	508.7	2200.7	-1691.9
1504248.	42.4705	78.1603	475.5	2138.2	-1662.7
2005087.	42.3235	75.9480	303.3	2782.8	-2479.5
5604715.	42.9217	76.6716	156.4	1372.2	-1215.8
5705000.	43.1051	76.5528	130.1	1104.9	-974.8
6004624.	43.2525	76.4911	136.9	898.6	-761.7
7204154.	42.3421	79.1319	489.5	1905.0	-1415.5
7304437.	42.1503	79.3379	536.4	2087.9	-1551.4
7304561.	42.2345	79.3730	464.5	1912.3	-1447.8
8204460.	42.5212	79.2623	187.1	1344.2	-1157.0
9704714.	42.5165	76.0009	478.2	2450.6	-1972.4
9904214.	42.1826	74.9218	541.3	2856.6	-2315.3
9904379.	42.2736	74.6278	559.3	2380.5	-1821.2
12306668.	42.8033	76.8444	177.7	964.7	-787.0
13304440.	42.5559	78.5063	429.8	1793.4	-1363.7
13705115.	43.0906	78.3136	220.7	1011.9	-791.3
13805117.	43.0403	78.3902	262.7	1083.0	-820.2
14204593.	43.0429	78.0774	214.3	1072.9	-858.6
15403904.	42.3336	74.2307	587.7	1981.2	-1393.5
15404034.	42.9093	74.8352	484.6	762.6	-278.0
15503993.	42.8807	74.9165	475.5	1066.8	-591.3
15804567.	42.9323	77.8841	239.6	1293.6	-1054.0
16704630.	42.6503	77.7560	178.0	1713.9	-1535.9
17204552.	42.8353	77.9371	300.5	1487.4	-1186.9
17301173.	42.8614	75.4026	381.6	1144.5	-762.9
17504032.	42.7963	75.4047	458.7	1388.4	-929.6
17703970.	42.8048	75.6506	470.6	1588.0	-1117.4
18304502.	43.3310	77.9651	94.5	659.3	-564.8
18404724.	43.1509	77.9753	196.0	971.4	-775.4
18506669.	43.0799	79.0068	174.3	862.3	-687.9
18606667.	43.2076	78.4651	164.0	804.7	-640.7
18703928.	42.8680	75.4266	402.0	1184.8	-782.7
21104760.	42.9894	77.2799	181.7	1252.7	-1071.1
21304871.	43.0216	77.3354	169.5	1193.3	-1023.8
21506395.	42.8126	77.2029	329.2	1679.4	-1350.3
22704611.	43.1909	78.2583	199.9	877.8	-677.9
22704730.	43.1803	78.1527	208.5	931.2	-722.7
22904912.	43.2823	78.1742	132.3	742.2	-609.9
23004994.	43.4017	77.9610	96.3	654.7	-558.4
23105069.	43.3191	78.0825	107.9	689.5	-581.6
23105086.	43.3080	78.0340	114.3	725.4	-611.1
23205008.	43.2442	78.3293	152.7	793.7	-641.0
23204722.	43.1858	78.4419	188.4	867.8	-679.4
23305096.	43.1621	78.3733	192.0	903.7	-711.7
23404752.	43.3067	78.4530	106.7	663.5	-556.9
23504764.	43.3259	78.3320	101.2	658.4	-557.2
24004055.	42.6310	74.7082	603.2	1517.9	-914.7
24604203.	42.8762	76.8586	162.8	1488.3	-1325.6
27203924.	42.0630	77.4307	501.4	3581.7	-3080.3
27303973.	42.3702	76.5063	385.6	2861.5	-2475.9
27404130.	42.4421	76.5928	443.2	2677.7	-2234.5
27504467.	42.3844	76.5409	317.3	2744.4	-2427.1
28006719.	43.0292	76.9439	119.5	1188.7	-1069.2
28104754.	43.0824	77.2696	152.1	1092.7	-940.6
29104092.	42.8173	76.0803	475.5	1934.0	-1458.5
29504133.	42.8306	76.1170	462.1	1591.1	-1129.0
29704536.	42.8267	76.1385	457.5	1584.0	-1126.5
30104392.	42.7477	78.1979	489.2	1712.4	-1223.2
30406073.	42.7552	78.0976	457.5	1683.7	-1226.2
39028105.	42.4557	79.0408	404.8	1822.7	-1417.9

Table C-13e

(BASEMENT DATA)

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
6004624.	43.2525	76.4911	137.8	922.3	-785.5
9804455.	42.3905	75.0445	456.0	2401.2	-1948.6
9904214.	42.1826	74.9218	544.4	3342.1	-2800.6
9904379.	42.2736	74.6278	563.3	2718.8	-2159.5
13705115.	43.0906	78.3136	221.6	1085.1	-864.4
13805117.	43.0403	78.3902	265.2	1175.6	-912.9
15804567.	42.9323	77.8841	243.5	1446.6	-1207.0
16704630.	42.6503	77.7560	182.6	1927.6	-1749.6
17204552.	42.8353	77.9371	305.1	1714.5	-1414.0
17703970.	42.8048	75.6506	472.1	1725.5	-1254.9
18304502.	43.3310	77.9651	95.1	661.4	-566.9
18404724.	43.1509	77.9753	196.9	1135.1	-939.1
18506669.	43.0799	79.0068	177.4	925.4	-751.0
18604719.	43.3360	78.5128	102.4	607.8	-507.5
18606667.	43.2076	78.4651	167.6	827.5	-663.5
18703928.	42.8680	75.4266	402.9	1315.5	-913.5
21304871.	43.0216	77.3354	172.2	1282.6	-1113.1
22704611.	43.1909	78.2583	200.9	920.5	-720.5
22804873.	43.3627	78.3051	85.6	605.0	-520.6
22904912.	43.2823	78.1742	132.9	767.5	-635.2
22905007.	43.3579	78.1488	93.0	635.5	-545.0
23005091.	43.3060	78.2245	113.4	706.5	-595.6
23004994.	43.4017	77.9610	99.1	669.6	-573.3
23105069.	43.3191	78.0825	110.3	703.5	-595.6
23105086.	43.3080	78.0340	116.4	744.9	-630.6
23205008.	43.2442	78.3293	153.3	804.7	-652.0
23204722.	43.1858	78.4419	190.5	908.3	-719.9
23304489.	43.3491	78.3788	96.9	626.4	-530.4
23404752.	43.3067	78.4530	107.6	673.0	-566.3
23404753.	43.3485	78.4448	100.0	608.1	-511.1
23504208.	43.2620	76.1033	153.3	669.0	-516.6
23504764.	43.3259	78.3320	102.1	666.0	-564.8
23604209.	43.3479	76.3190	141.7	780.0	-639.2
23605012.	43.3693	76.6017	96.9	762.3	-667.8
23804357.	43.4440	75.8772	227.1	504.1	-281.6
27303973.	42.3702	76.5063	394.7	3132.7	-2747.2
27905041.	43.1458	76.7616	131.7	1115.0	-986.0
27905116.	43.1520	77.0699	181.4	1124.7	-945.8
92004593.	43.0429	78.0774	217.3	1162.2	-947.9
93605096.	43.1621	78.3733	192.3	946.4	-754.4
94705114.	43.1116	77.0207	149.0	1129.3	-980.8
83604203.	42.8762	76.8586	165.2	1638.9	-1476.1
82400698.	43.1552	75.7086	131.1	730.0	-598.9
81904055.	42.6310	74.7082	603.2	1632.2	-1029.0
76400109.	42.1428	80.0477	198.1	1814.2	-1616.0
37357002.	42.6933	75.3451	418.5	1686.8	-1268.3
37353001.	43.0151	75.0353	123.4	336.8	-213.4
37354001.	43.2067	75.4479	135.6	475.5	-339.9
37354004.	43.1080	75.2866	146.3	609.6	-463.3
37359001.	43.3832	75.1872	400.8	103.6	297.2
37311004.	43.1211	76.5935	145.1	1180.5	-1035.4
37313002.	43.0554	77.6524	164.6	1192.4	-1027.8
37303010.	43.3383	75.7413	156.7	466.3	-309.7
37304005.	43.3651	75.7659	182.0	505.4	-323.4
37305004.	43.2983	76.1525	128.0	736.1	-608.1
37305005.	43.2807	76.0038	152.4	717.8	-565.4
37306002.	43.4340	76.4652	117.3	709.3	-591.9
39004001.	43.2681	78.7376	106.7	588.3	-481.6
39028105.	42.4557	79.0408	404.8	1966.0	-1561.2
39063001.	43.2301	79.9919	171.0	657.8	-486.8
39066001.	42.9885	79.0641	182.9	923.5	-740.7
39066003.	42.9243	79.1008	184.4	992.1	-807.7

Table C-13e continued

WELL ID#	LATITUDE	LONGITUDE	ELEVATION (METERS)	DEPTH (METERS)	DATUM DEPTH (METERS)
39066004.	42.9021	79.1554	182.9	1005.8	-823.0
39067001.	42.9167	79.3819	177.4	966.5	-789.1
90001808.	42.4901	79.2825			-1439.0
90004437.	42.1921	79.3601			-1923.9
90004561.	42.2380	79.4291			-1808.4
90004154.	42.3316	79.1461			-1800.1
90003956.	42.4297	78.2437			-2174.1
90004248.	42.4658	78.2270			-2117.6
90000615.	42.5423	78.4170			-1754.1
90004092.	42.6314	78.0883			-1731.6
90004392.	42.7475	78.2225			-1438.0
90006073.	42.7520	78.0875			-1449.0
90004069.	42.8970	77.9164			-1249.7
90004806.	43.1176	78.0763			-841.9
90003924.	42.0471	77.4358			-3644.5
90006395.	42.8115	77.1875			-1555.7
90004760.	42.9348	77.2365			-1364.6
90004754.	43.0888	77.2215			-1044.9
90006719.	43.0284	76.8952			-1176.2
90000443.	42.1966	76.5553			-3251.3
90004467.	42.3820	76.5520			-2724.9
90004715.	42.8943	76.6274			-1389.9
90004999.	42.9834	76.4875			-1207.0
90005000.	43.0609	76.5117			-1074.4
90001003.	43.0735	76.5763			-1060.7
90005031.	43.1599	76.5533			-914.4
90001008.	43.4120	76.3714			-557.2
90004032.	42.8151	75.3771			-1029.0
90004547.	42.5504	74.8495			-1364.9
90003993.	42.8925	74.8849			-471.5
90005087.	42.3541	75.9771			-2708.8
90004714.	42.5261	75.9533			-2215.3

APPENDIX D

BHT AND DETAILED LOG DATA

AND GLOSSARY

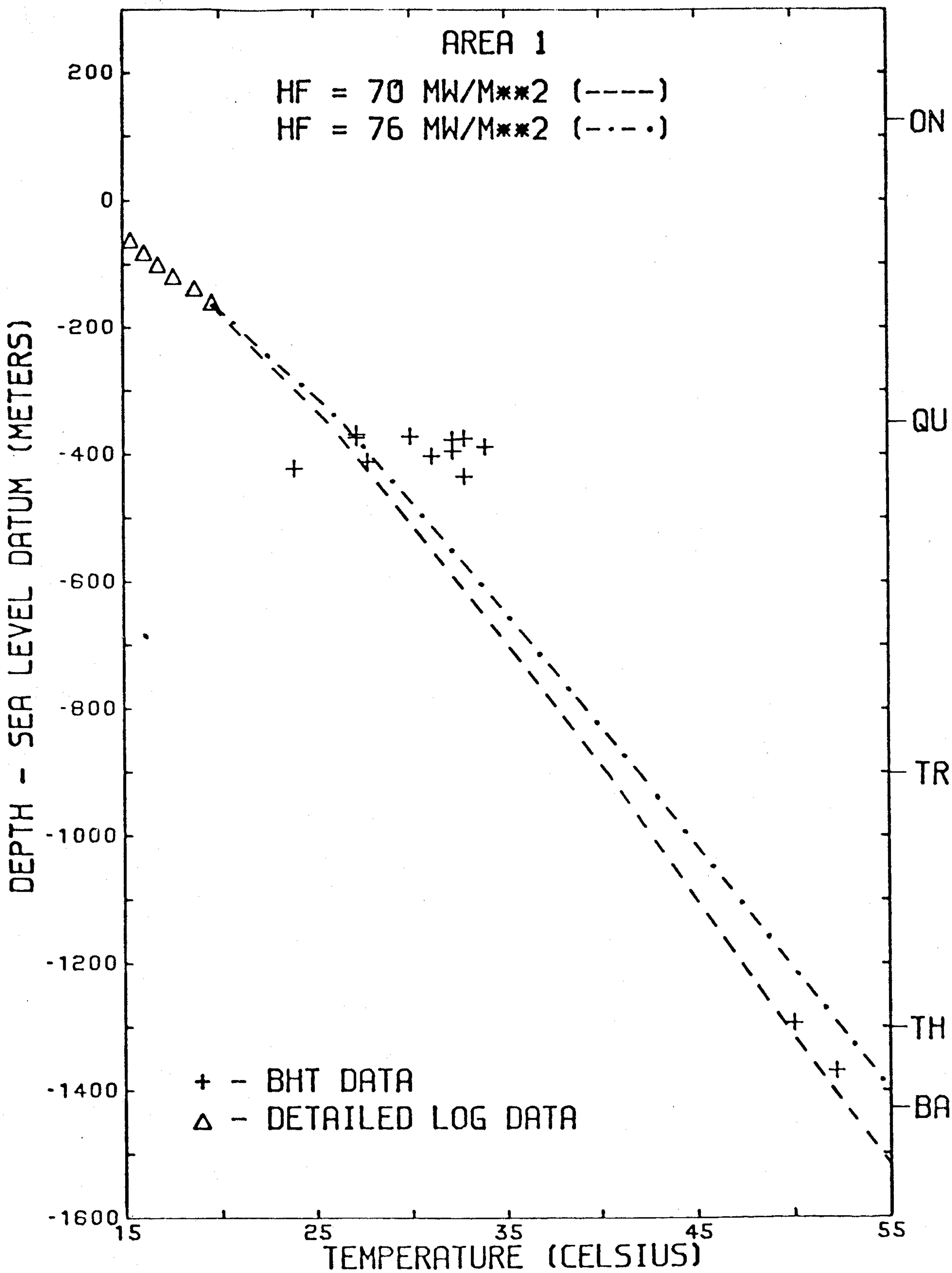

Figure D-1 - BHT and detailed log (#13784) data, Area 1 (dashed lines are theoretical gradients for heat flow as given).

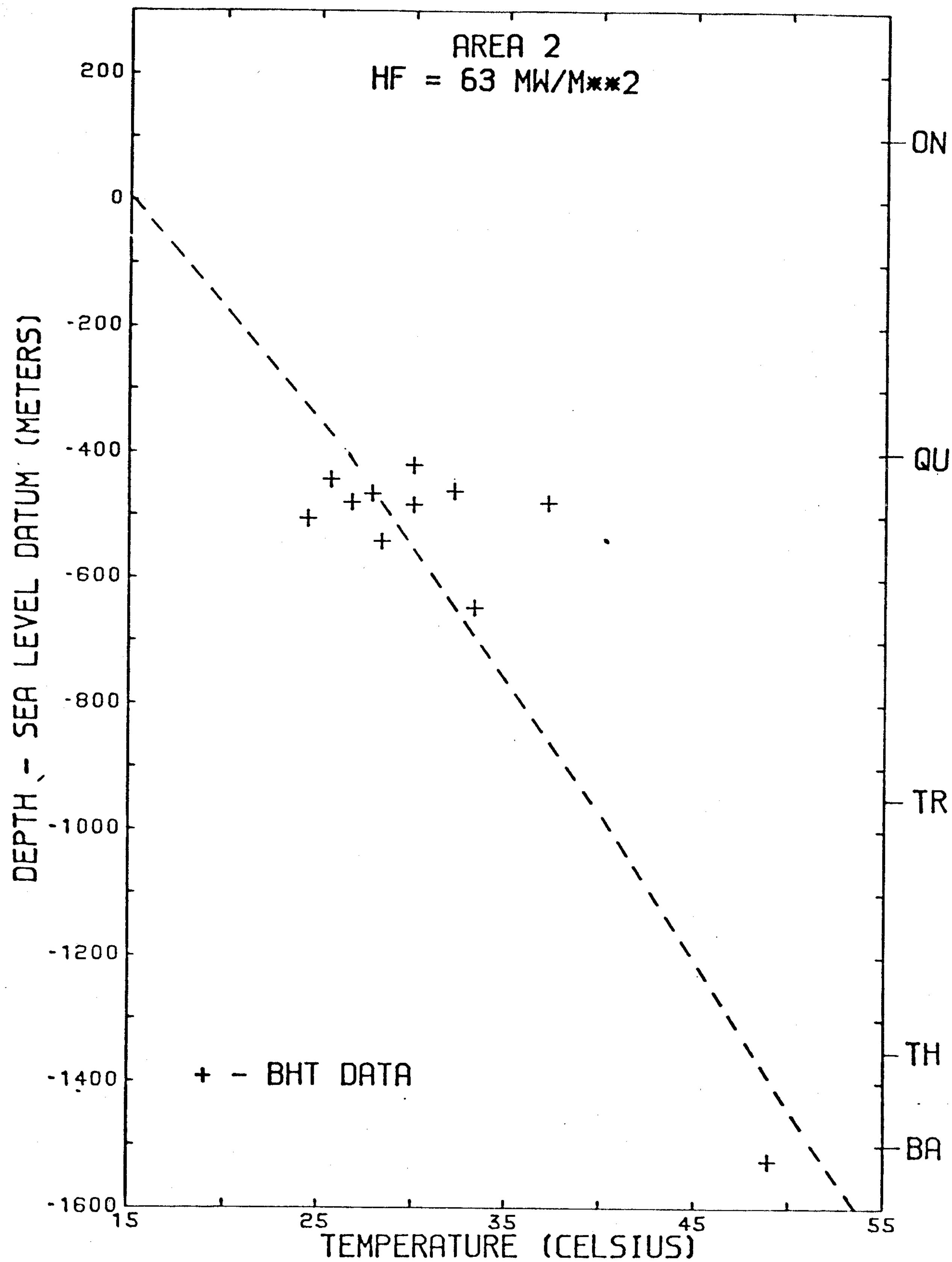

Figure D-2 - BHT data, Area 2 (dashed line is the theoretical gradient for the given heat flow).

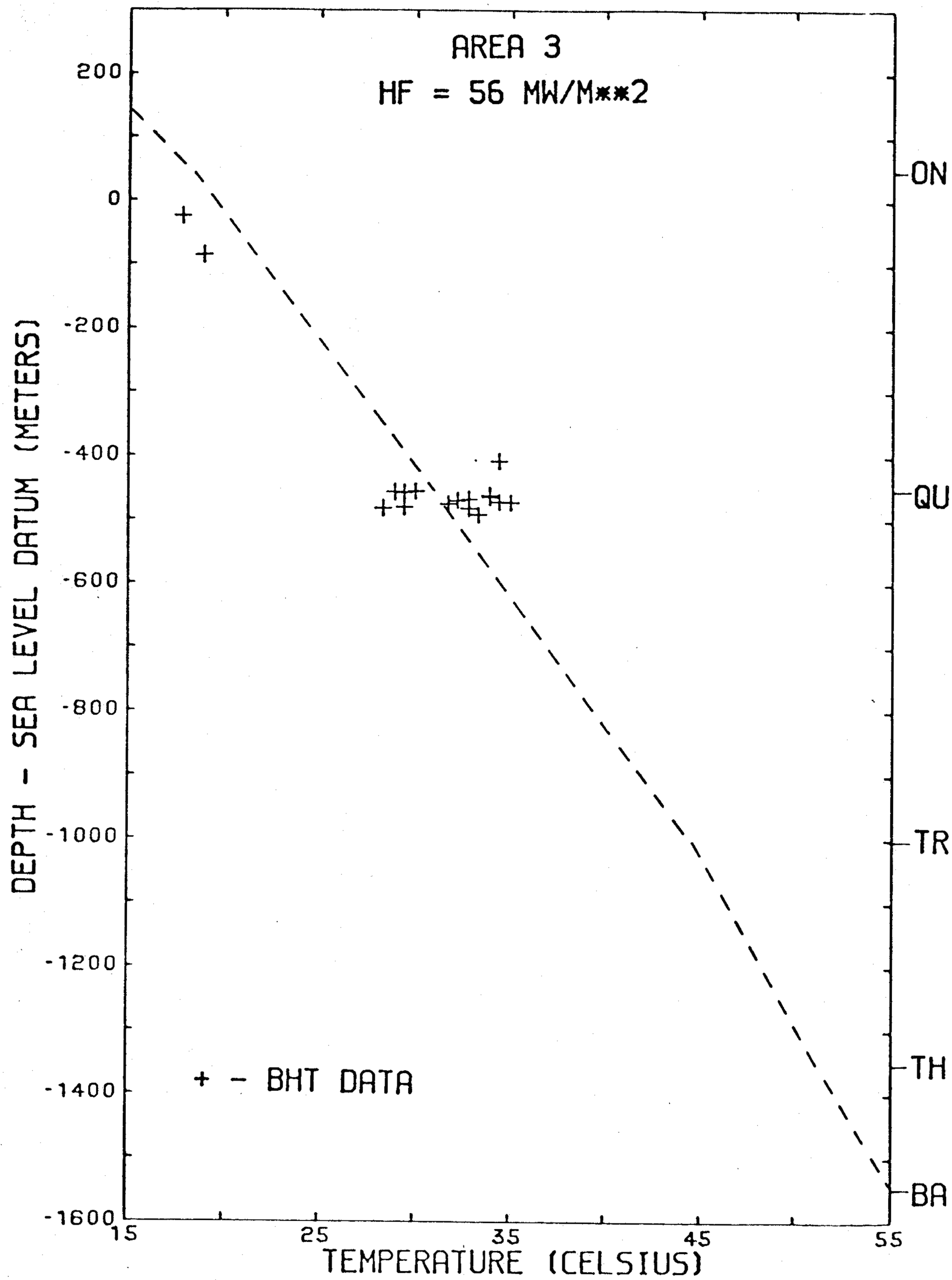

Figure D-3 - BHT data, Area 3 (dashed line is the theoretical gradient for the given heat flow).

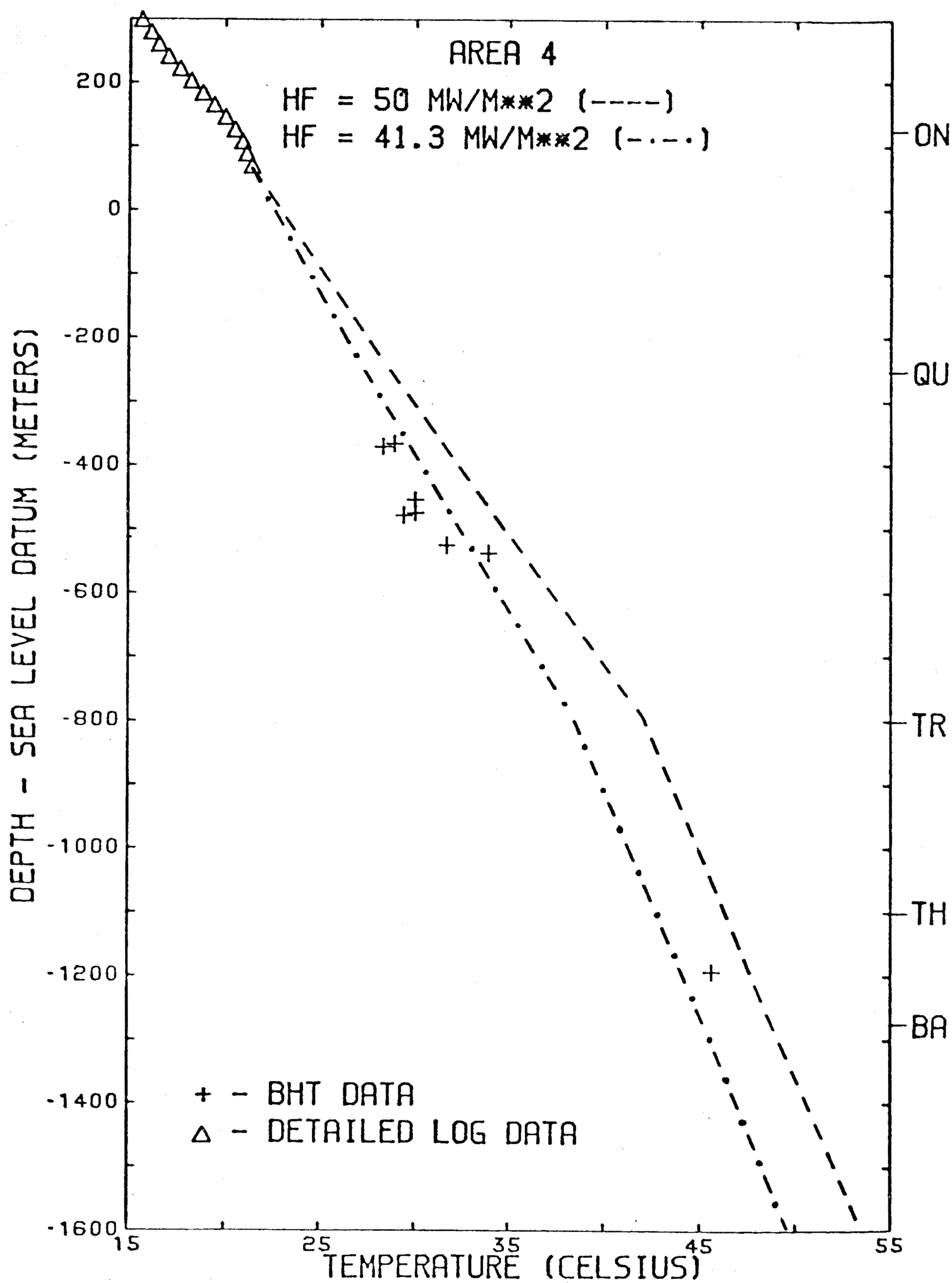

Figure D-4 - BHT and detailed log (#13571) data, Area 4 (dashed lines are theoretical gradients for heat flow as given).

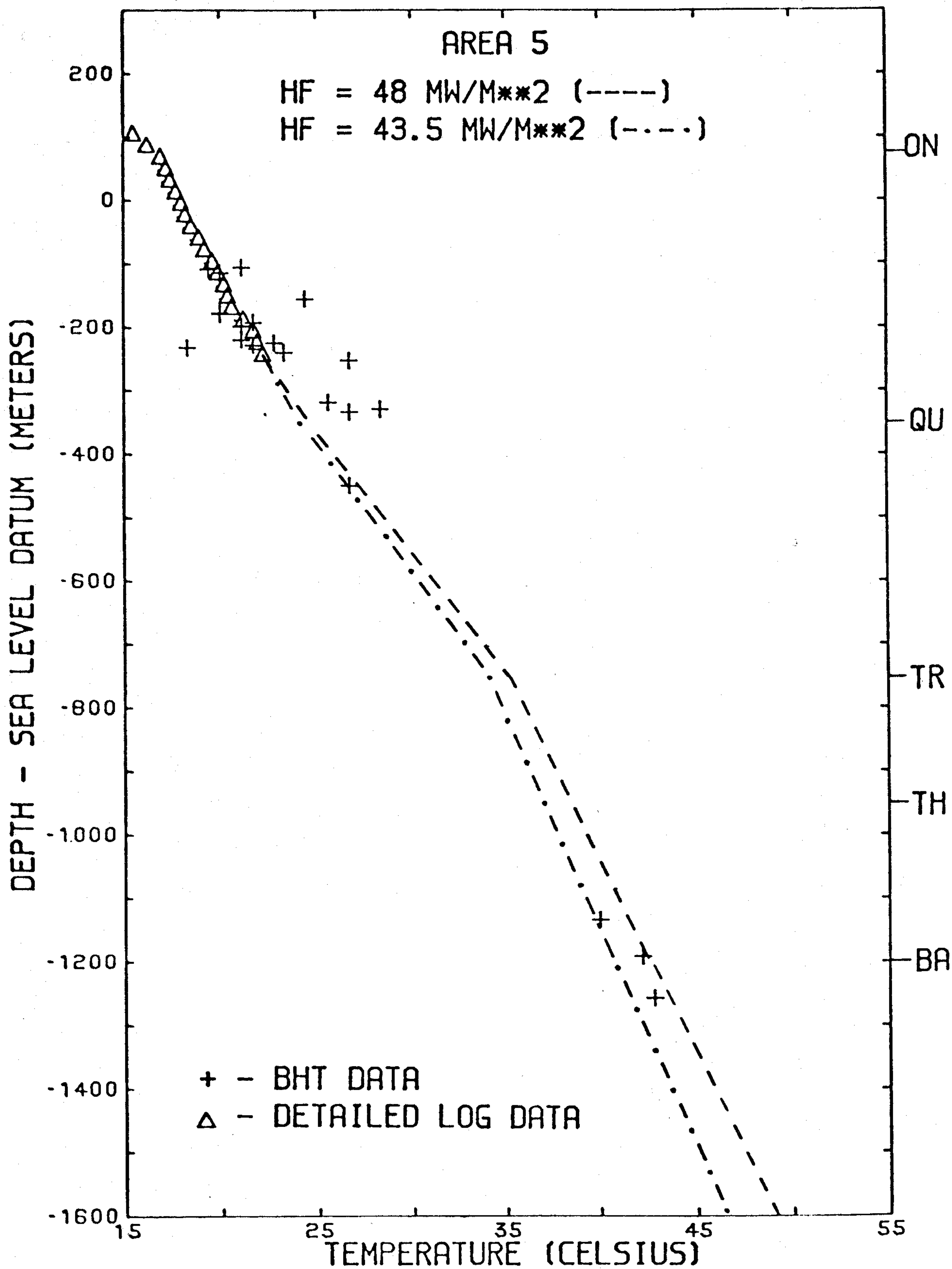

Figure D-5 - BHT and detailed log (#14423) data, Area 5 (dashed lines area theoretical gradients for heat flow as given).

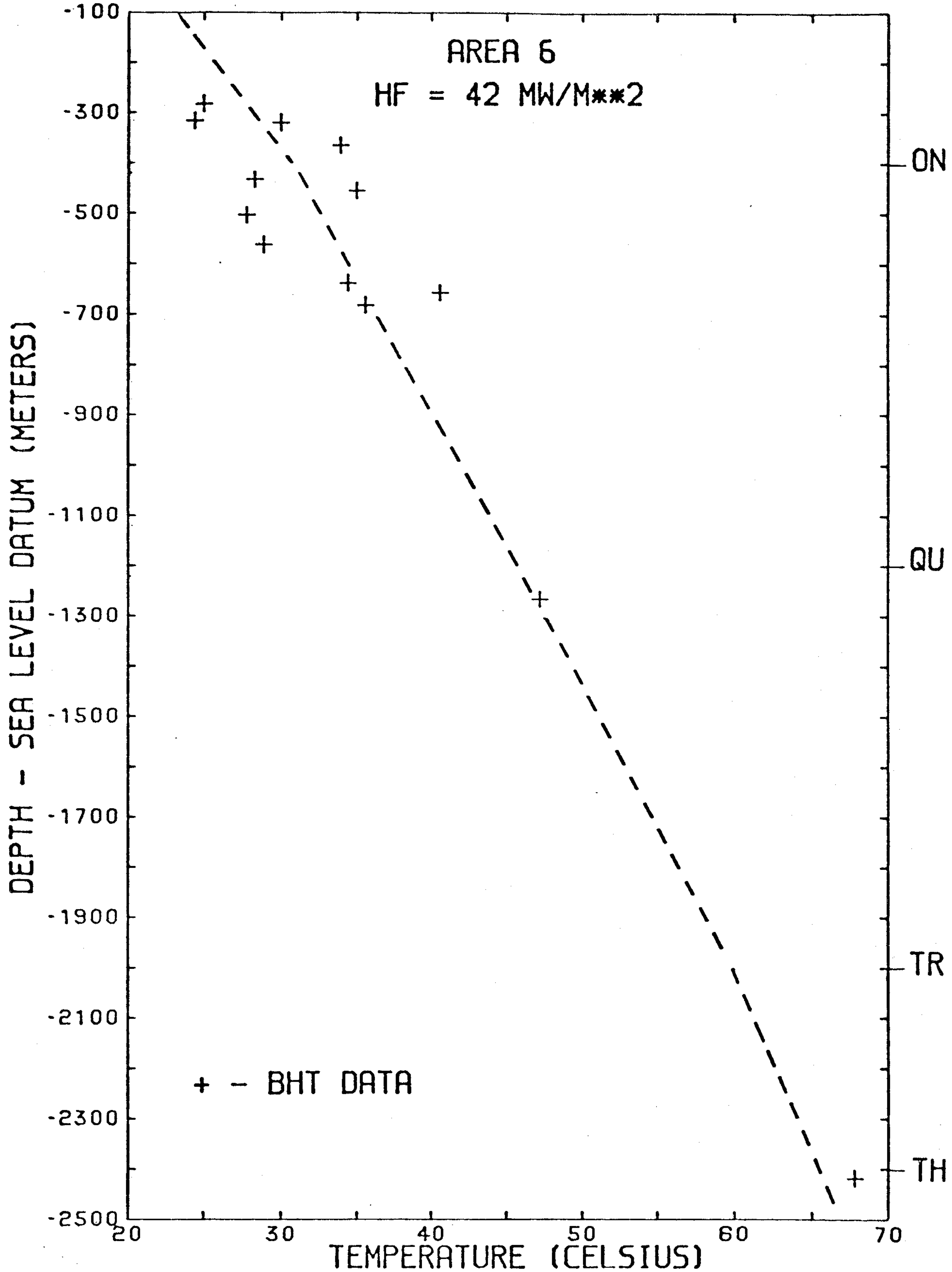

Figure D-6 - BHT data, Area 6 (dashed line is the theoretical gradient for the given heat flow).

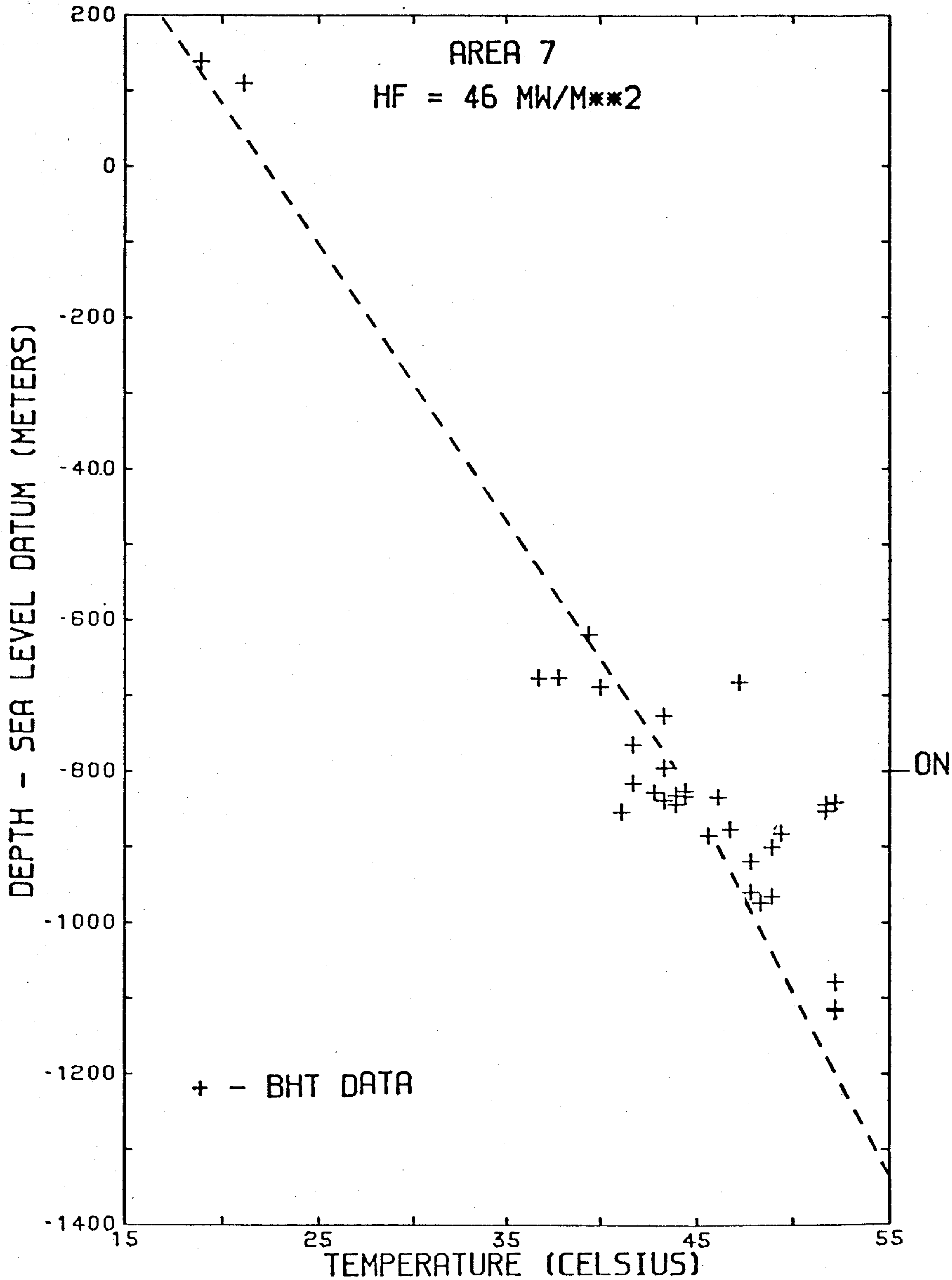

Figure D-7 - BHT data, Area 7 (dashed line is the theoretical gradient for the given heat flow).

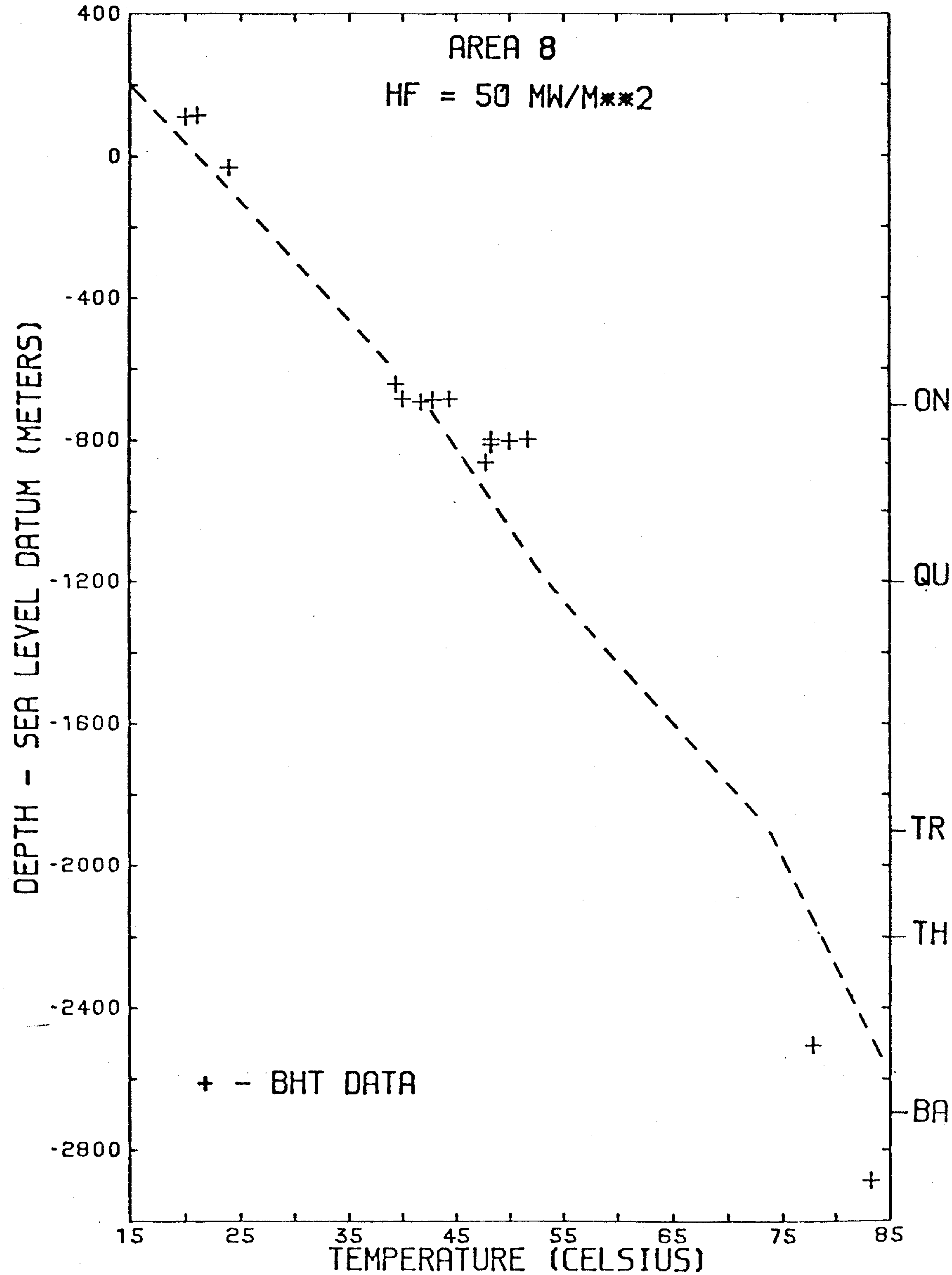

Figure D-8 - BHT data, Area 8 (dashed line is the theoretical gradient for the given heat flow).

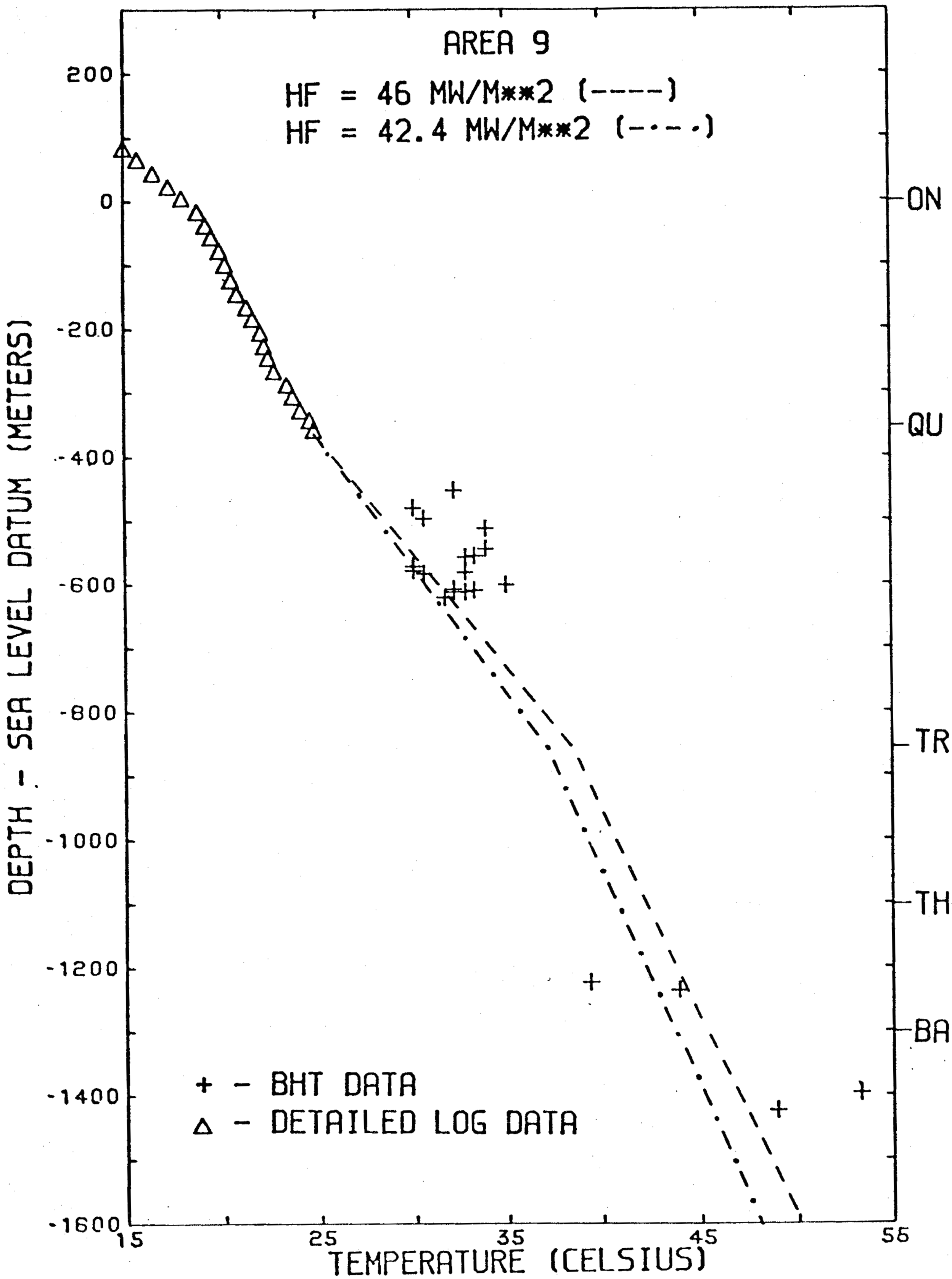

Figure D-9 - BHT and detailed log (#13000) data, Area 9 (dashed lines are theoretical gradients for heat flow as given).

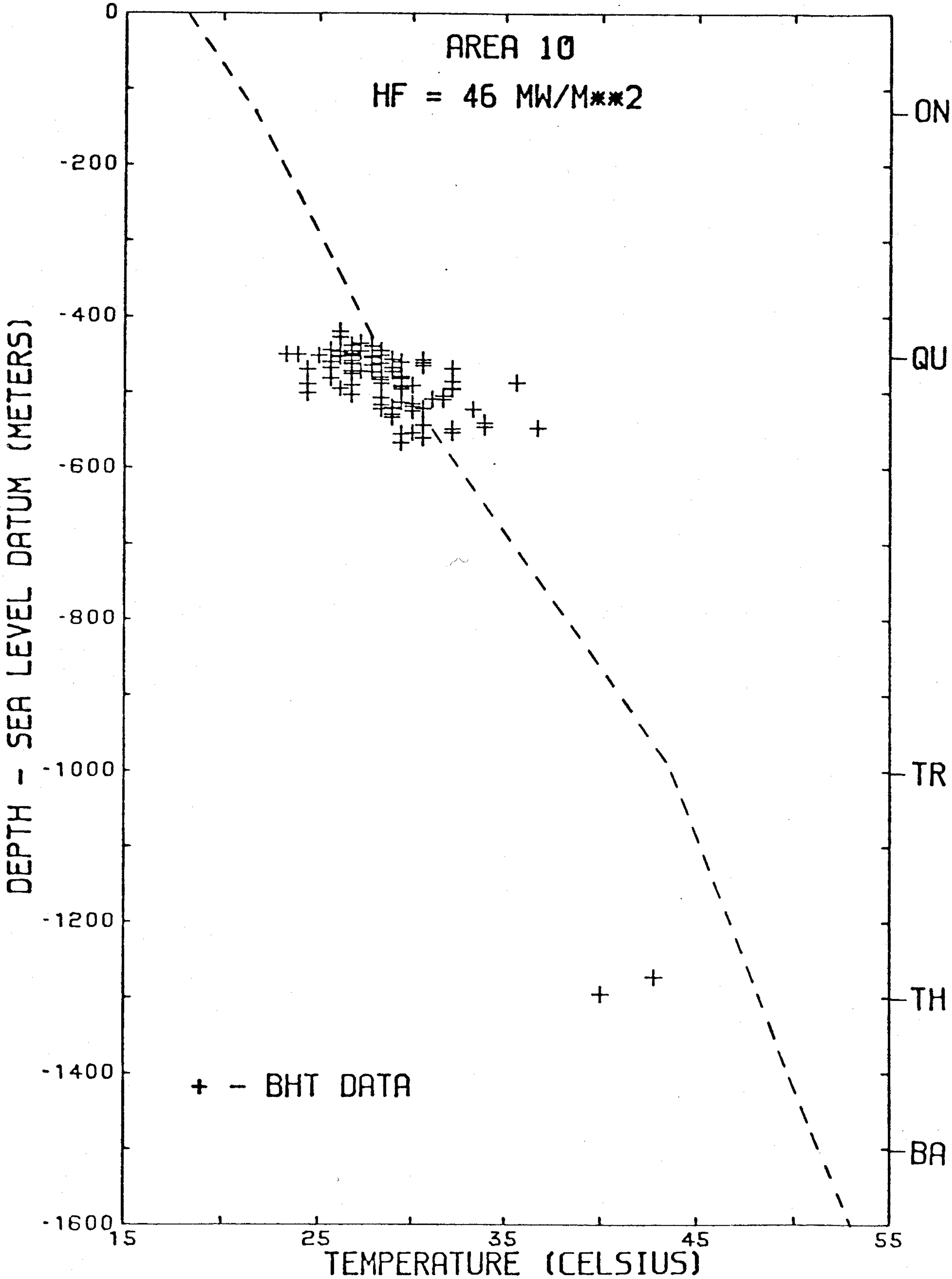

Figure D-10 - BHT data, Area 10 (dashed line is the theoretical gradient for the given heat flow).

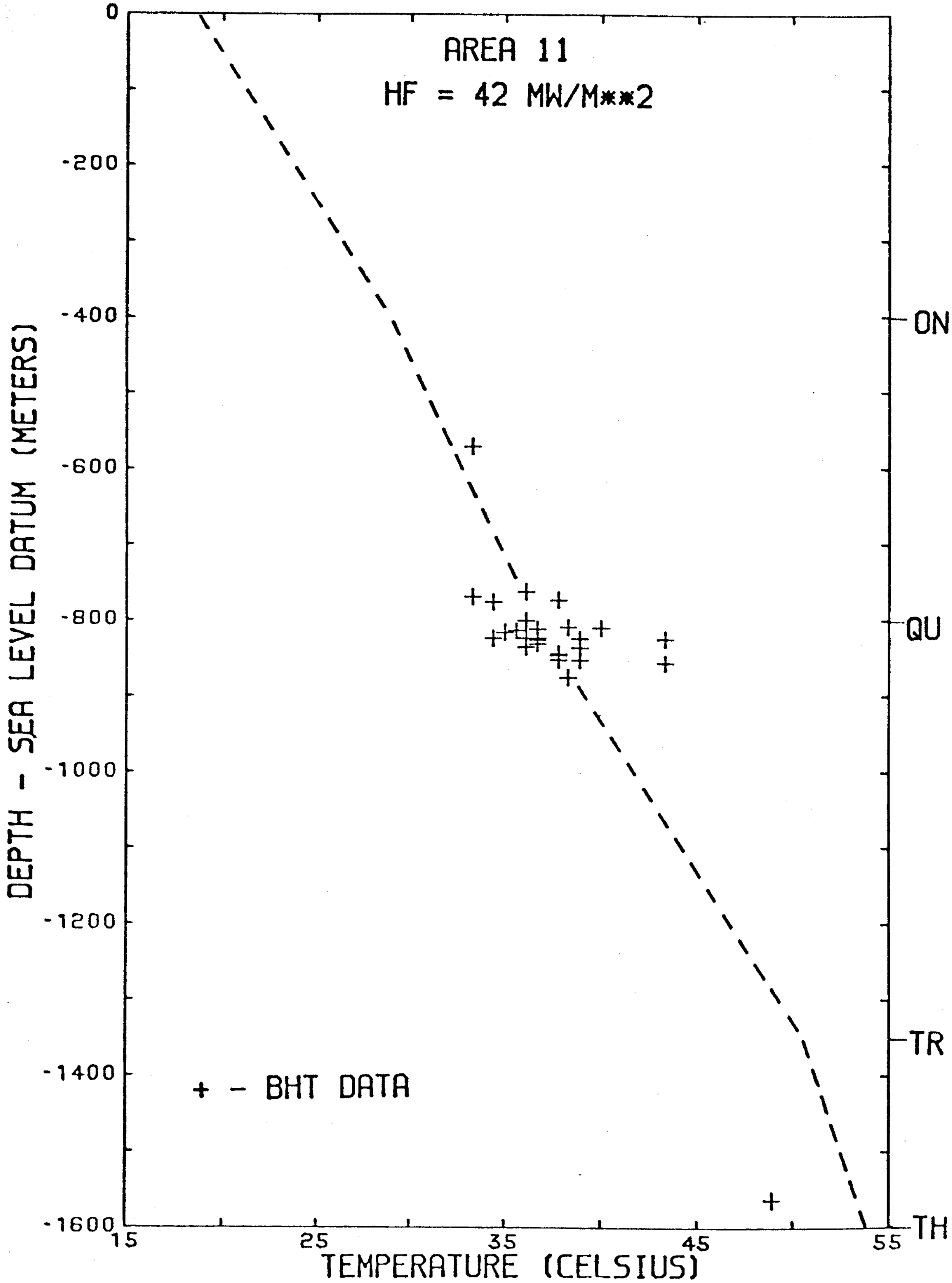

Figure D-11 - BHT data, Area 11 (dashed line is the theoretical gradient for the given heat flow).

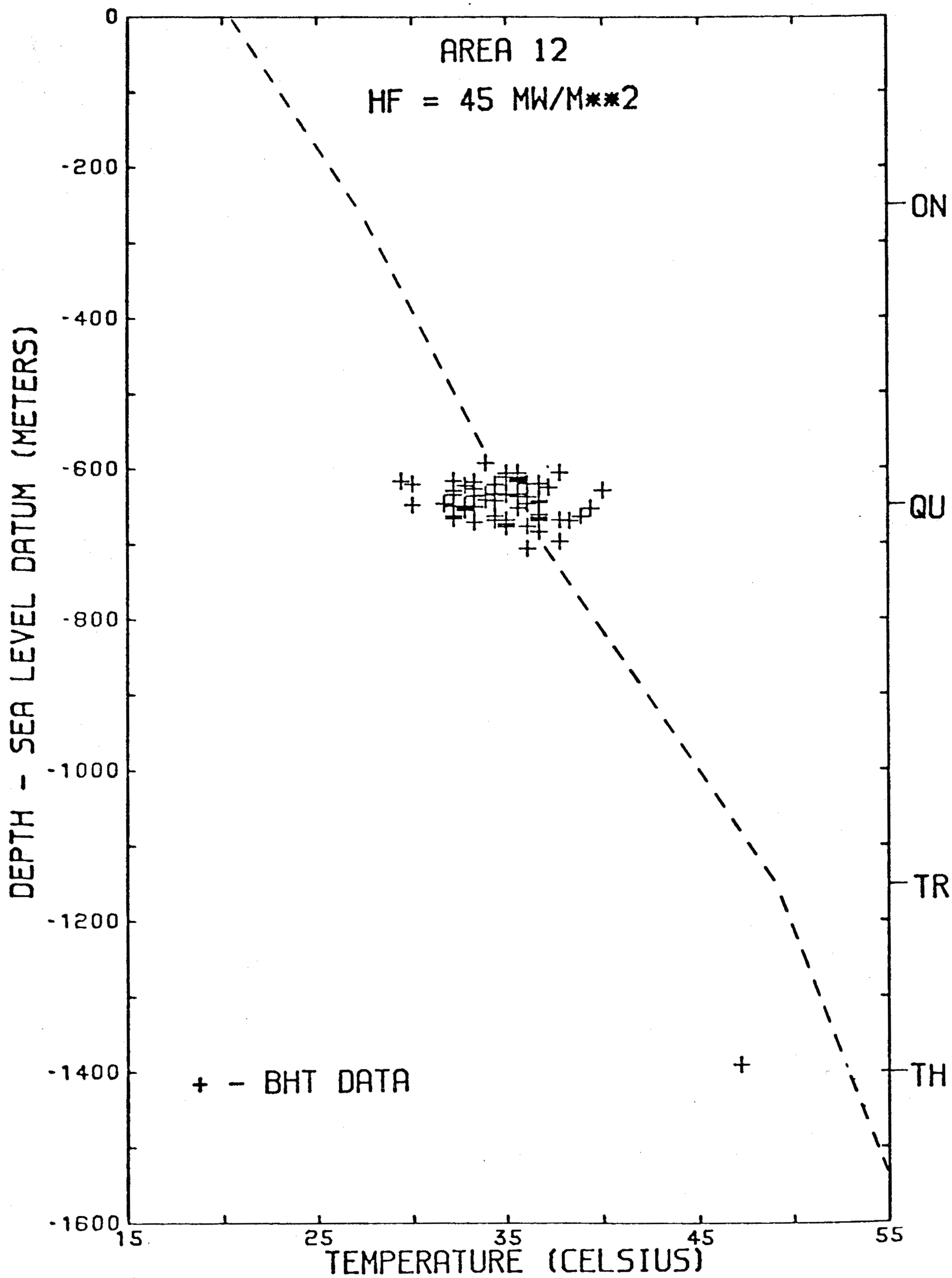

Figure D-12 - BHT data, Area 12 (dashed line is the theoretical gradient for the given heat flow).

GLOSSARY

HF - heat flow

BHT - bottom hole temperature

ON - Onondaga Limestone

QU - Queenston Shale

Tr - Trenton Limestone

TH - Theresa Sandstone

BA - basement