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Temperatures and Natural Gamma-ray Logs Obtained in Boreholes MLGRAP # 1 and # 2, Mammoth Lakes, California: Data and Preliminary Interpretations

by

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ABSTRACT

Two 500-m holes were drilled within the Town of Mammoth Lakes during the Winter of 1987-88 in connection with the Mammoth Lakes Geothermal Assessment Project (MLGRAP). We obtained precision temperature and natural gamma-ray logs in them during July 1989 at 0.3-m (1 ft) intervals in tubing installed at completion of drilling. These data are reported here in both graphical and numerical form as well as some data obtained by others that are relevant to interpretation.

Both holes penetrate sequences of glacial tills and materials of basaltic and rhyolitic composition of various textures as determined by examination of nearly continuous core (Goodwin, 1988). Major units and many minor ones can be easily correlated with the natural gamma-ray logs. However, detailed correlations between the two holes (2.0 km apart) are not readily evident, either in the core or gamma-ray stratigraphies, although this might be possible with further study.

Although the maximum temperatures in both holes are about the same (77 and 74 °C near their bottoms), MLGRAP # 1 exhibits two maxima (52.4 °C at 156 m = 512 ft and 77.0 °C at 429 m = 1408 ft). The shallow maximum ("shallow geothermal aquifer") is in a thick zone of basaltic cinders, presumably of high fluid permeability. The second maximum ("deep geothermal aquifer") is in a zone of fractured rhyolites with solution cavities, which we also presume to be of high permeability. There are no temperature reversals with depth in MLGRAP # 2 (2 km SE of MLGRAP # 1), and the stratigraphy is different in the sense that there appear to be fewer strata of very high permeability.

Although tubing was installed in both holes to keep them open for repeated measurements, the annuli between hole and tubing were not effectively sealed (a near impossibility in such lithology). Consequently, exchanges of water among aquifers plays a role in determining the shapes of the temperature profiles.

INTRODUCTION

Although the geothermal potential of the Long Valley caldera has been studied since the 1950's, little was known of the subsurface thermal regime of the southwest moat of the caldera until boreholes PLV-1 (Benoit, 1984; Urban, *et al.*, 1988) and RDO-8 (Urban, *et al.*, 1987a, 1987b) were drilled (locations shown in figure 1). The maximum temperatures measured in these holes were 123 °C at 712 m (2336 ft) and 202 °C at 338 m (1109 ft), respectively. These unexpectedly high temperatures led to the creation of the Mammoth Lakes Geothermal Assessment Project (MLGRAP) and the drilling of the two exploration holes which are the subject of this report.

Our primary objective is to report the temperature and gamma-ray data obtained in July 1989 in sufficient detail so that they can be further processed and/or compared with any future results that might be obtained. We also include the temperature data obtained by Douglas Goodwin shortly after drilling, as well as generalized lithologic logs derived from his logs of the core. Full information is contained in the "Well Summary Reports - Geothermal" of the California Division of Oil and Gas which also contain the driller's logs and the well completion reports. The API numbers are: 051–90120 (MLGRAP # 1) and 051–90121 (MLGRAP # 2).

DRILLING AND COMPLETION

Both holes were drilled by Tonto Drilling Services at the locations given in table 1. MLGRAP # 2 was relatively easy to drill (fig. 4). MLGRAP # 1 was not (figs. 2 and 3). Problems of lost circulation, caving, and stuck rods were severe. They are reminiscent of those encountered in the drilling of PLV–1 (Benoit, 1984) and RDO8 (Urban, *et al.*, 1987a, 1987b).

Hole completion diagrams are shown in figures 5 and 6. In MLGRAP # 1, an attempt was made to cement the annulus between the hole and the upper casing by pumping 250 gallons (950 l) of cement down the casing and displacing it with 100 gallons (380 l) of water behind a rubber plug. There was no cement return through the annulus to the surface, so 40 gallons (150 l) of cement were poured down the annulus to bring the cement level to the surface. We doubt the annulus is completely filled with cement and suppose that fluid may flow along the annulus in this interval. Moreover, no attempt was made to cement the annulus between the hole/casing and the 2.75-in (7.0 cm) tubing. Because of a clogged

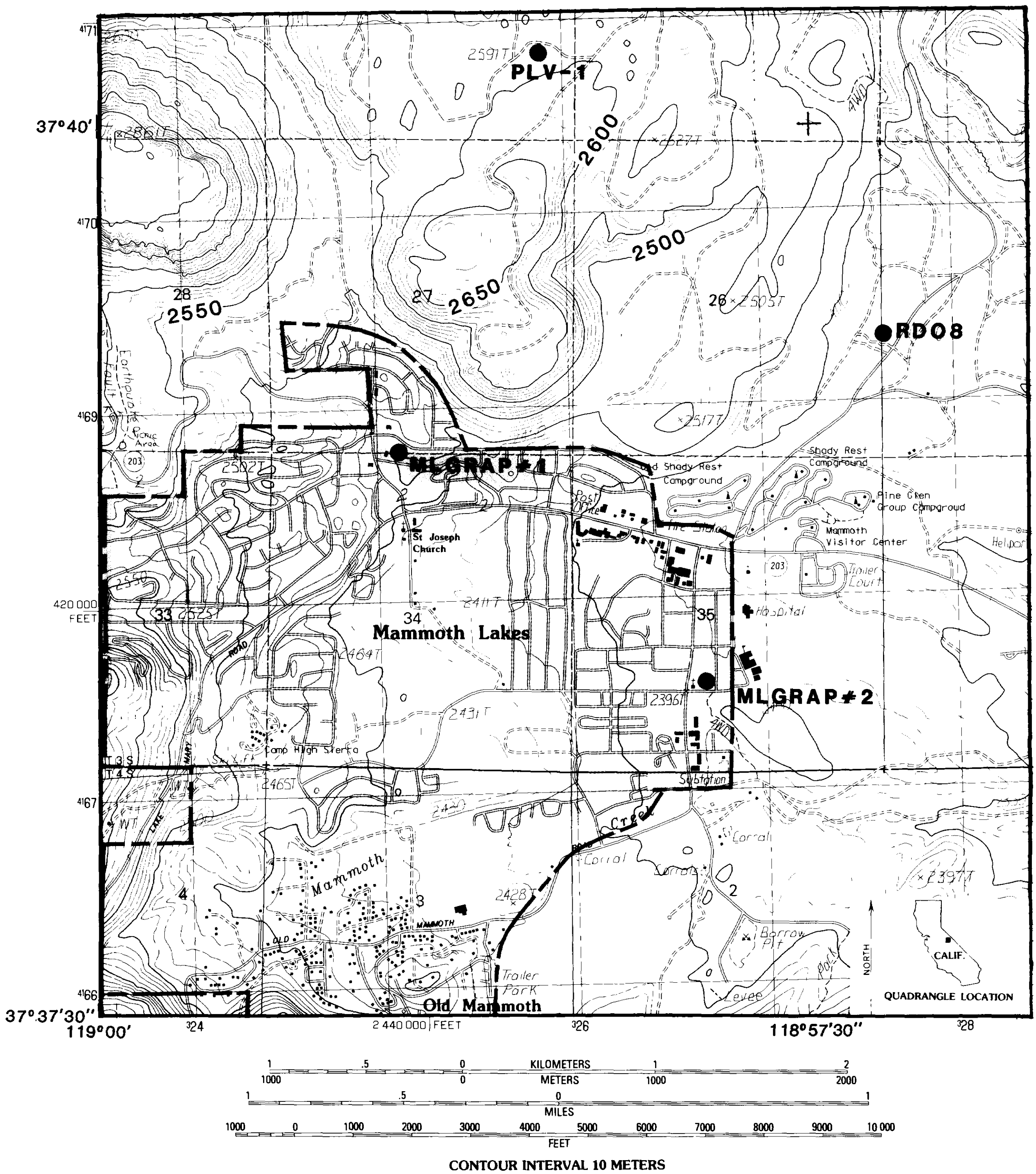


Figure 1. Map showing location of MLGRAP # 1 and # 2. Base is Old Mammoth Quadrangle 7.5 Minute Topographic Map, U.S. Geological Survey 1983 Provisional Edition. Other wells in the vicinity are PLV-1 (Benoit, 1984; Urban, *et al.*, 1988) and RDO8 (Urban, et al., 1987a; 1987b).

Table 1. Location, elevation, depth, drilling history, and A.P.I. number for the MLGRAP holes in Mammoth Lakes, California.

Hole	**MLGRAP # 1**	**MLGRAP # 2**
Latitude (N)	37°39.07'	37°38.44'
Longitude (W)	118°58.99'	118°57.84'
Elevation (GL,M)	2450	2396
Depth (M)	468	491
Drilling started	12/12/87	11/26/87
Drilling completed	1/31/88	12/11/87
A.P.I. No.	051-90120	051-90121

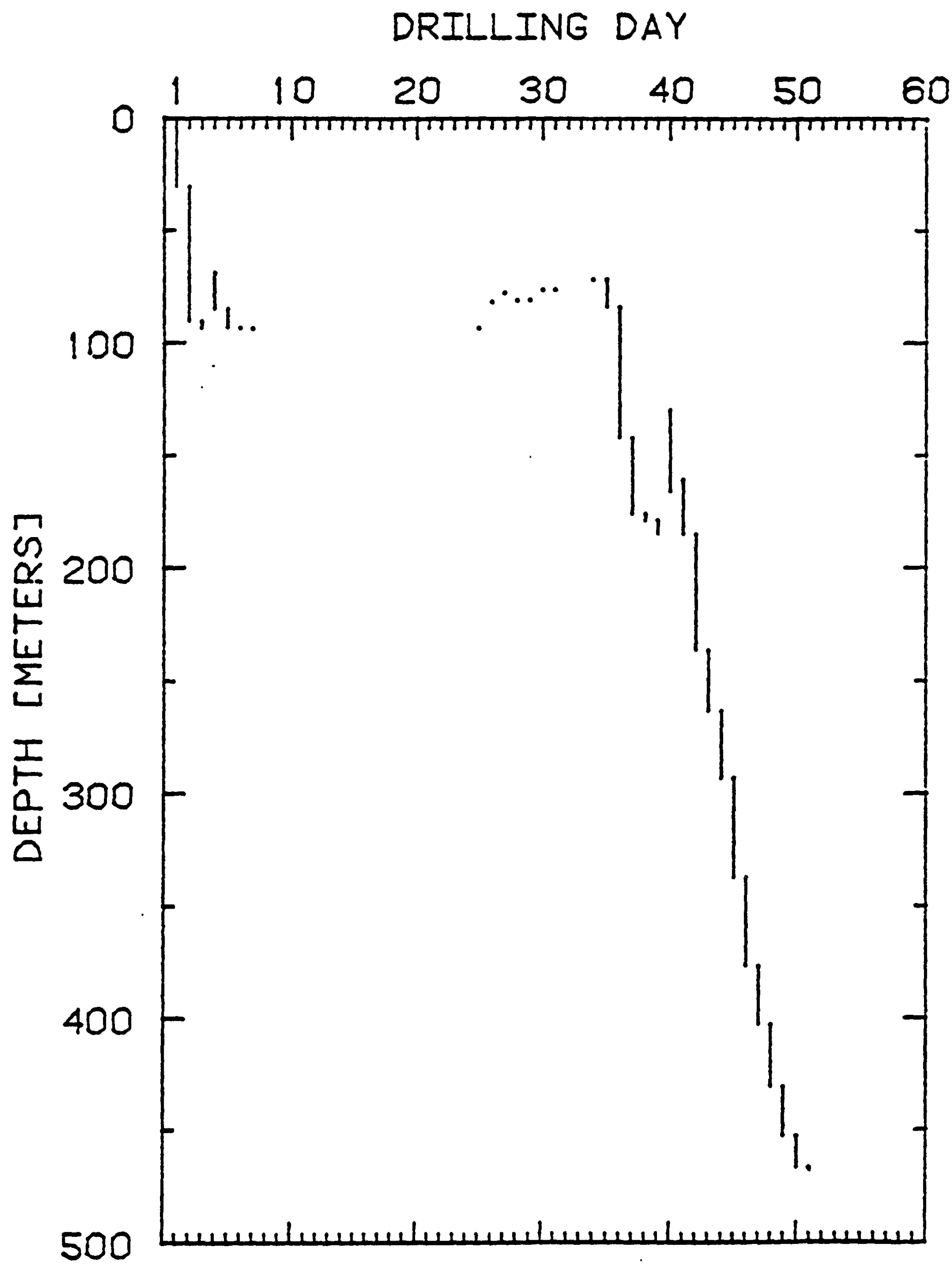


Figure 2. Drilling history for MLGRAP # 1. Vertical bars indicate interval drilled each day. See table 1 for dates.

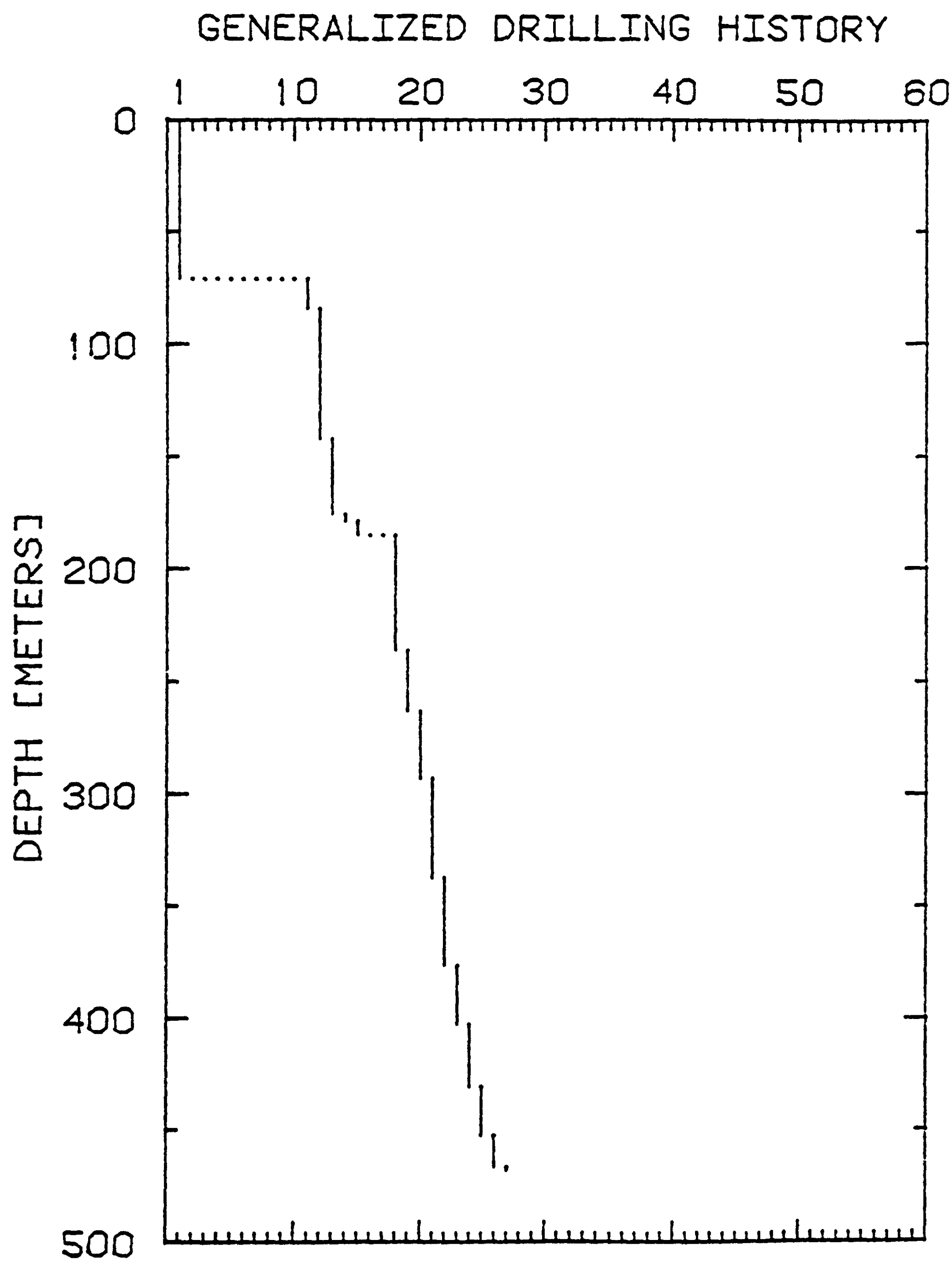


Figure 3. Generalized drilling history for MLGRAP # 1. Data from figure 2 was generalized by omitting the two week period when there was no circulation of drilling fluid in order to calculate time-history for figure 7. Day 1 corresponds to day 25 in figure 2. See text for discussion.

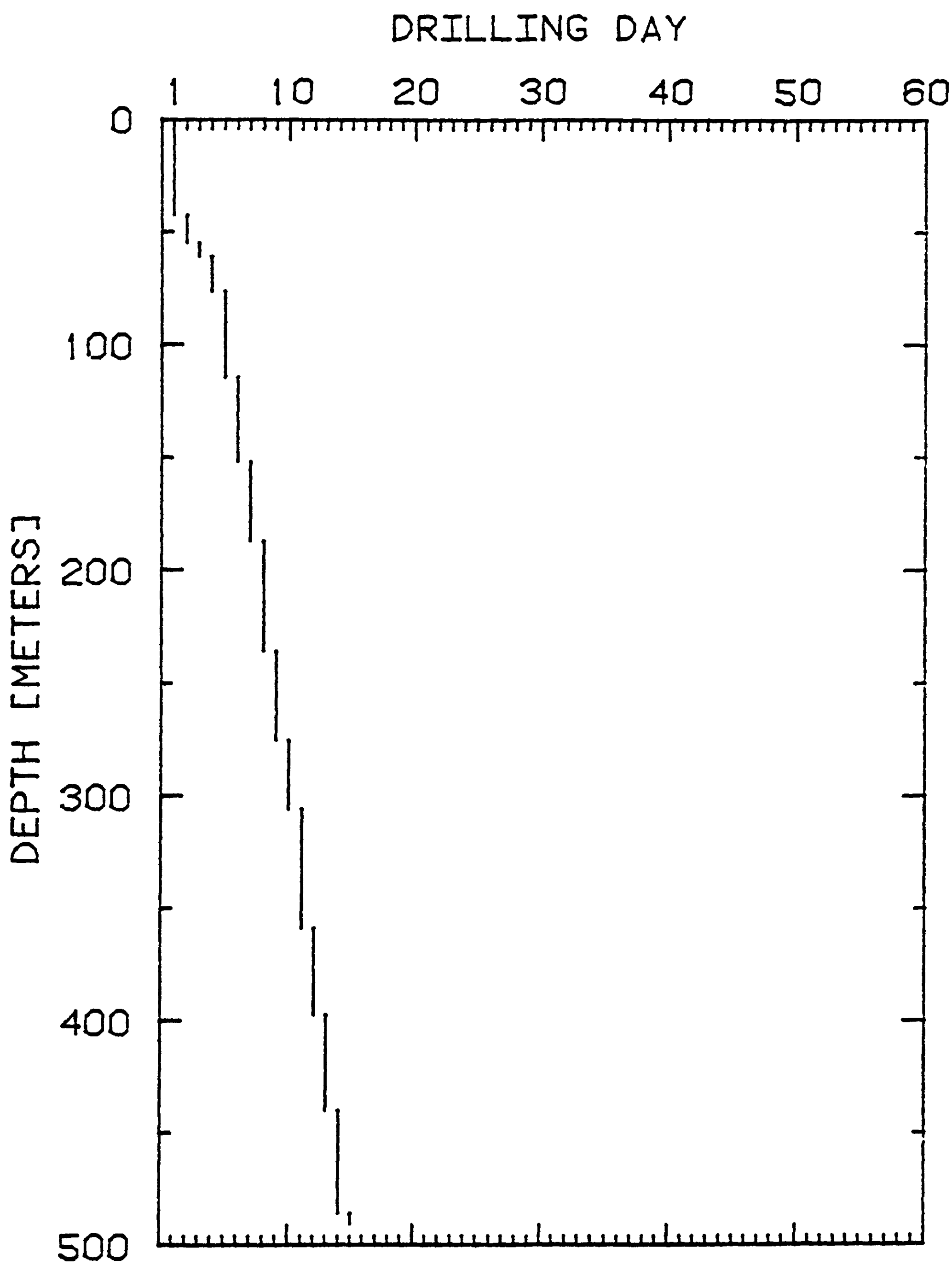


Figure 4. Drilling history for MLGRAP # 2. Vertical bars indicate interval drilled each day. See table 1 for dates.

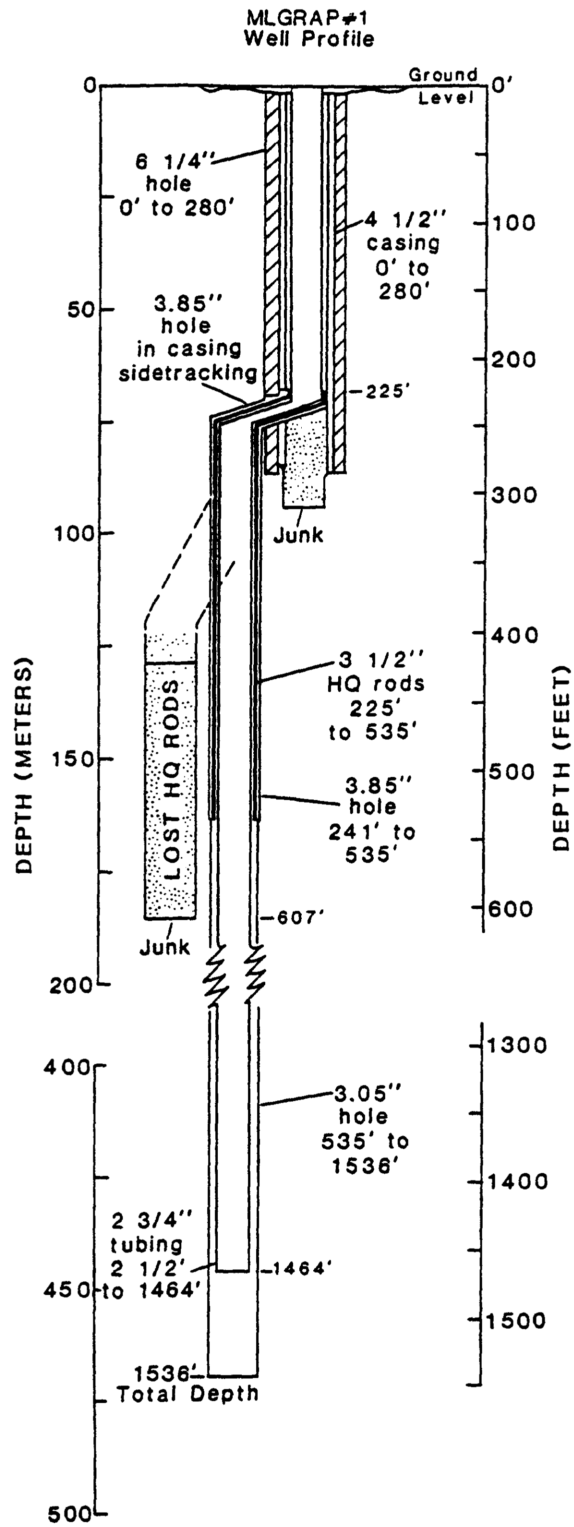


Figure 5. Diagram illustrating drilling of MLGRAP # 1 and completion with casing and cement. Tubing and annulus (to 470 ft = 143 m) filled with mud.

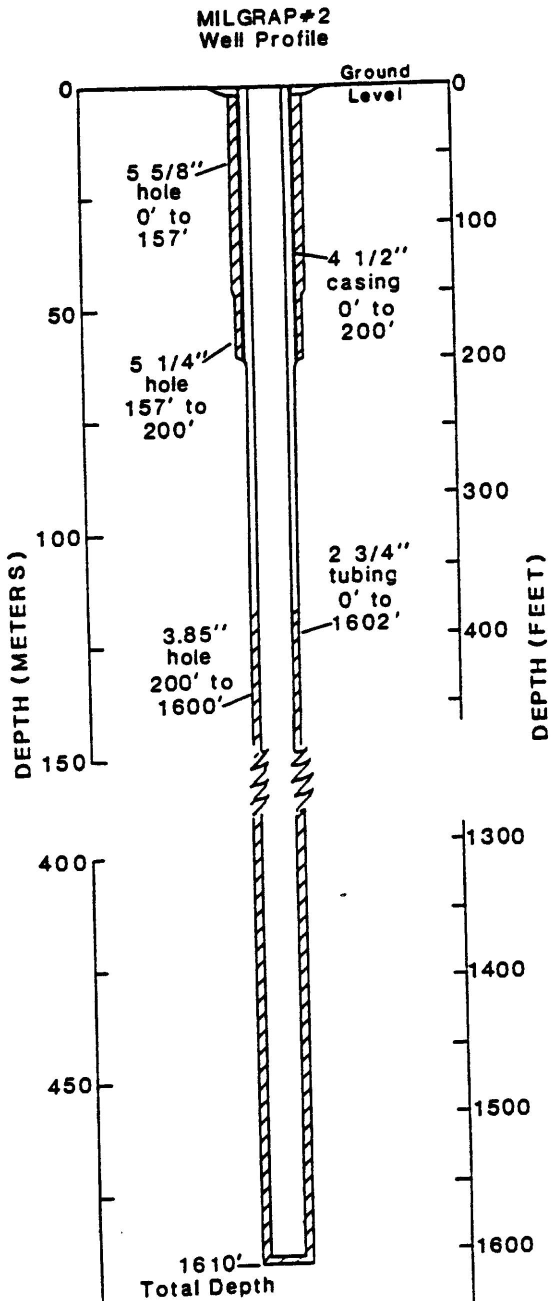


Figure 6. Diagram illustrating drilling of MLGRAP # 2 and completion with casing and cement. Top of lower section of cement uncertain (~ 380 ft = 116 m).

bit, both the tubing and the annulus were left filled with bentonite-gel-polymer mud, the former to the surface and the latter to about 470 ft (143 m). We had no difficulty logging through the mud in the tubing 1.5 yr after completion and suppose that the mixture was rather dilute initially or that it has broken down with time. This would, of course, also apply to the mixture in the annulus, and we suppose that fluids may flow along the annulus.

Cementing operations were more successful in MLGRAP # 2. Cement returns were obtained through the annulus to the surface while installing the 4.5–in (11.4–cm) casing (fig. 6). Attempts to seal the annulus between the hole/casing and the 2.75 in (7.0 cm) tubing were not as successful. 350 gallons (1325 l) of cement were pumped followed by a rubber plug and 400 gallons (1514 l) of water, but no returns were observed at the surface. The top of the cement is thought to be at a depth of about 380 ft (116 m), but it could be much deeper.

Both holes are thought to be nearly vertical, although there must be deviations at least over a short interval where trouble was encountered in MLGRAP # 1 (fig. 5). We obtained inclinations in each hole using acid-etch techniques with 16-mm glass tubes (Urban and Diment, 1989a, 1989b): MLGRAP # 1 (0.25° at 426.7 m = 1400 ft) and MLGRAP # 2 (0° at 381.0 m = 1250 ft and 1.25° at 481.6 m = 1580 ft) where the angle is the deviation from the vertical and the depth is measured from the surface.

MEASUREMENTS/INSTRUMENTATION

Temperature. Precision temperature measurements were obtained in MLGRAP # 1 and # 2 on July 23 and July 24, 1989, respectively. Temperatures were measured with a thermistor probe containing a single glass-encapsulated bead with a nominal resistance at 25 °C of 500,000 ohms. Details of the construction of the probe and its calibration are given in Urban and Diment (1990). The probe was lowered at a continuous rate of 3 m/min (10 ft/min). In order to aid in lowering, two sinker bars were attached to the cable above the cablehead to which the probe was mounted. The first bar above the cablehead had a diameter of 2.5 cm (1 in) and the second one above that a diameter of 3.7 cm (1.5 in). Both bars were 1.2 m (4 ft) long. As the probe was lowered, resistances were measured by a Fluke 8502A Digital Multimeter at 0.3 m (1 ft) intervals. In the field, the resistances were converted, using a computer interfaced to the multimeter, to temperature by the equation

$$\mathrm{T} = \frac{\mathrm{C1} + \mathrm{C2} \times \ln(\mathrm{R})}{\mathrm{C3} + \ln(\mathrm{R})}, \tag{1}$$

where C1, C2, and C3 are the calibration constants (calibration of July 11, 1989 in Appendix V), ln is the natural logarithm, R is the thermistor resistance in ohms, and T is the temperature in degrees Celsius. Equation 1 is equation 4 of Robertson, *et al.* (1966) in which we have solved for the temperature and combined some of the constants (Urban and Diment, 1990). The resistance is measured using the 4-wire technique whereby a known current is sent down two of the leads through the thermistor and the voltage drop across the thermistor is measured with the other two leads. Since the current through the thermistor and the voltage drop across the thermistor are known, the resistance can be calculated by Ohm's law. This is done automatically by the 8502A. The output from the multimeter to the computer is the resistance.

At the time the logs were obtained, the temperatures were printed, plotted, and recorded on punch-paper tape for later processing. After a subsequent recalibration of the probe on October 21, 1989, the temperatures were corrected for drift by a linear interpolation between the two calibrations spanning the field measurements. The drift-corrected temperatures are listed in Appendix II and plotted in figures 12 and 13 and in Appendix III. No correction has been applied for the thermal inertia of the probe assembly due to the slow logging rate (3 m/min = 10 ft/min) and short time constant ($< 2\,s$) of the probe. All depth measurements are relative to the ground surface.

Natural Gamma-ray Logs. The natural gamma-ray logs were obtained with a scintillation tool with an outside diameter of 5 cm (2 in). This tool has a maximum operating temperature of 85 °C. A single sinker bar (1.25 in × 4 ft = 13.2 cm × 1.2 m) was attached to the cable above the tool. The hole was logged downward at a rate of 6 m/min (20 ft/min). The pulses from the tool were integrated by a rate meter with a filter time constant of 3 s. This combination of logging speed and time constant generally yield acceptable logs (Hilchie, 1978, p. 6-18). The output of the rate meter was recorded by a strip-chart recorder set at 5 in/100 ft and 10 in/500 counts/s. The counts/s-calibration on the recorder was set by calibration pulses from the rate meter. Before logging, the tool was calibrated against a known source of 200 API units: A background level was recorded. Then the source was attached and the background plus 200 API units was recorded. Finally, another recording of the background was recorded. The time constant in the rate meter was set at 10 s for the calibration recordings in order to minimize the fluctuations in the background radiation. With the time constant set at 3 s during logging, the lag or the apparent shift of an anomaly in the direction the tool is moving is 0.3 m (1 ft). Since the depth-reference point was located at the bottom of the tool, this placed the bed boundary anomaly a foot shallower than the logging depth. However, the crystal in the scintillation tool is centered about 1 ft up from the bottom of the tool. Thus, the depths listed in Appendix IV are effectively compensated for this lag.

Back in the office, the logs were digitized at 0.3 m (1 ft) intervals using a four-button cursor and a digitizing tablet. The digitization was semi-automatic in that the x and y scales were set, the operator traced the curves while the points were digitized at a rate of 30/s, the computer selected the integer depth from the digitized points, and the corresponding gamma-ray value was calculated from the scale factors. This data is tabulated in Appendix IV and plotted in Appendix V and figures 12 and 13.

TEMPERATURE

Data. In the preliminary analyses which follow, we rely on the precision temperature logs obtained in July 1989 as well as the measurements made by Goodwin (1988) at 20 ft (6 m) intervals shortly after drilling. Both sets are tabulated in Appendix II and plotted in Appendix III.

Goodwin made his measurements with an EnviroLabs Digital Thermometer (DT201B) and recorded them to the nearest tenth of a degree Fahrenheit. We converted them to degrees Celsius and tabulated them to the nearest 0.01 °C (Appendix II). We know nothing of the system used by Goodwin or how it was calibrated. When comparing results obtained in the same hole with different logging systems, differences are always found between the data sets. Aside from equipment malfunction and changes with time, these differences can usually be attributed to either a difference in calibrations or differences in cable stretch, or both. Although Goodwin's data seem to fit reasonably well with ours, one is cautioned about over interpretation.

Decay of drilling disturbance. Temperatures measured in boreholes shortly after drilling are usually far from virgin rock temperatures because of the temperature perturbations imposed by the circulation of the drilling fluid. Lachenbruch and Brewer (1959) introduced a useful way to study the decay of the drilling disturbance. We follow it here.

Temperatures at 20 ft (6 m) depth intervals are plotted against a function of time in figures 7a and 8a. These plots are hard to decipher at this depth interval so they were replotted as a series of graphs at 100 ft (30.5 m) depth intervals (figs. 7b and 8b). The drilling histories used to determine s and t are shown in figures 2, 3, and 4. Note that the drilling history of MLGRAP # 1 (fig. 2) has been generalized (fig. 3) to take account of a 2-week period when there was no circulation of drilling fluid. t is the time difference from when the drill bit first reached the depth in question and the time of temperature measurement. s is the difference in time from when the drill bit first reached the depth in question and the time when drilling ceased, i.e., the duration of the drilling/circulation disturbance. As $t \to \infty$, $\frac{t}{t-s} \to 1$, and $\ln\left(\frac{t}{t-s}\right) \to 0$.

Using this time function, plots of temperature at a given depth tend to be linear, provided that the virgin thermal regime is steady state and the decay of the drilling disturbance is by conduction alone. The plots in figures 7a and 8a are quasi-linear. Some departures from linearity are probably the result of the exchange of formation fluids along unsealed sections of the annulus between the hole and casing.

Aspect-ratio plots. When the thermal gradient is positive downward, the fluid in a borehole will convect once a small critical gradient is exceeded. The aspect ratios (A = h(height)/a(tubing I.D. radius)) usually have modal values between 6 and 9 as determined from temperature-time records of 1 hr or so at fixed depths (Urban and Diment, 1985). Aspect ratios can also be obtained from a single precision temperature log by comparing the temperature gradient over a short interval of depth (ΔZ) with that over a longer spanning interval using the relation:

$$A = \left(\frac{G}{G''} - 1\right) \cdot \frac{\Delta Z}{a},$$

where G is the gradient over a short interval and G'' is over the spanning interval (Urban and Diment, 1985). In constructing the plots in figures 9 and 10, we have taken ΔZ = 2 ft (0.61 m) and the spanning interval as equal to $5 \cdot \Delta Z$. This method of determining A does not take into account the effect of variations in the thermal conductivity of the surrounding rocks, but these effects are usually small (Urban and Diment, 1985).

Aspect-ratios may be anomalously large when fluid is moving along the hole as in, or between, perforated intervals, or when it is moving in the annulus between hole and casing (Diment and Urban, 1983).

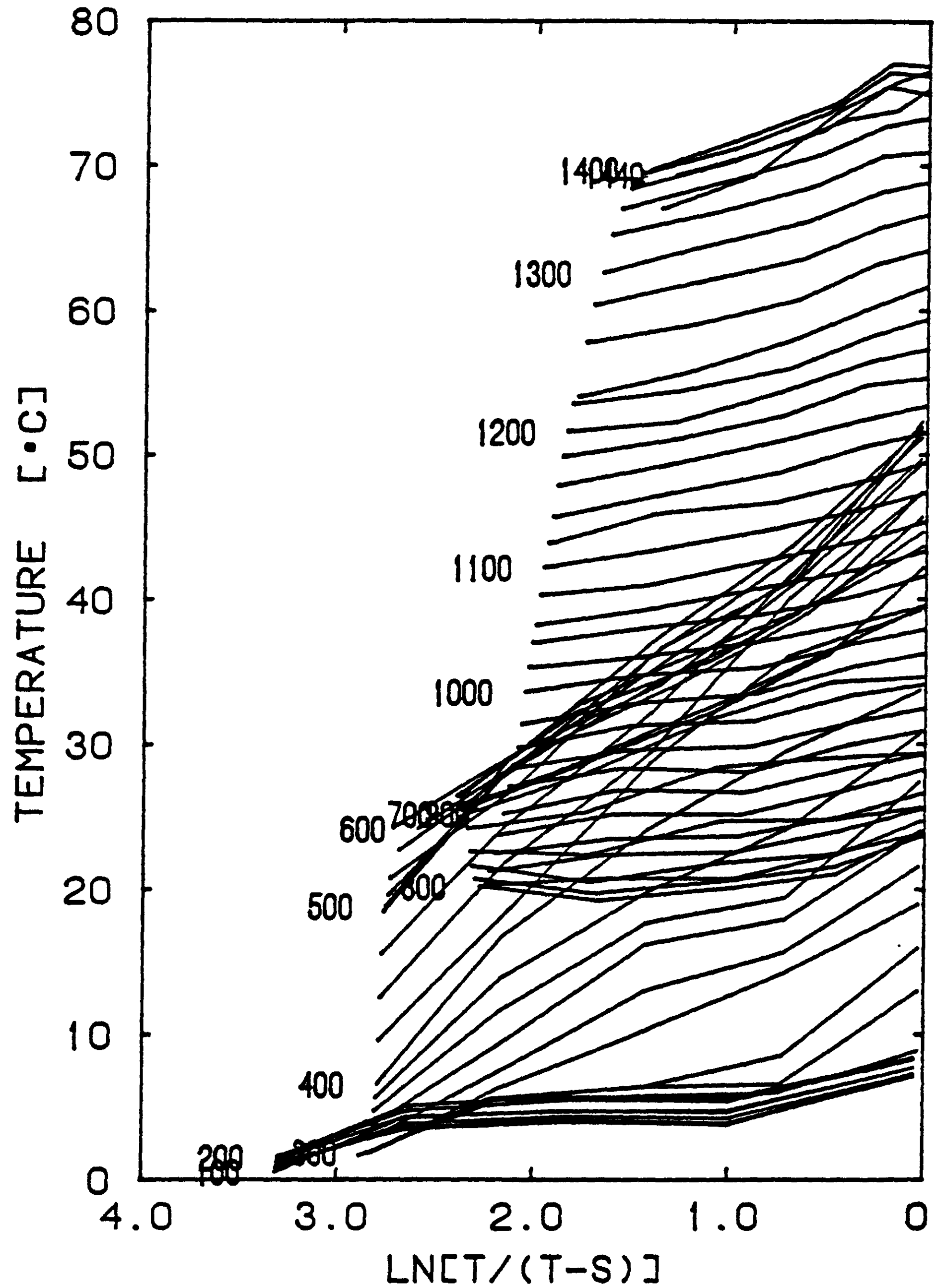
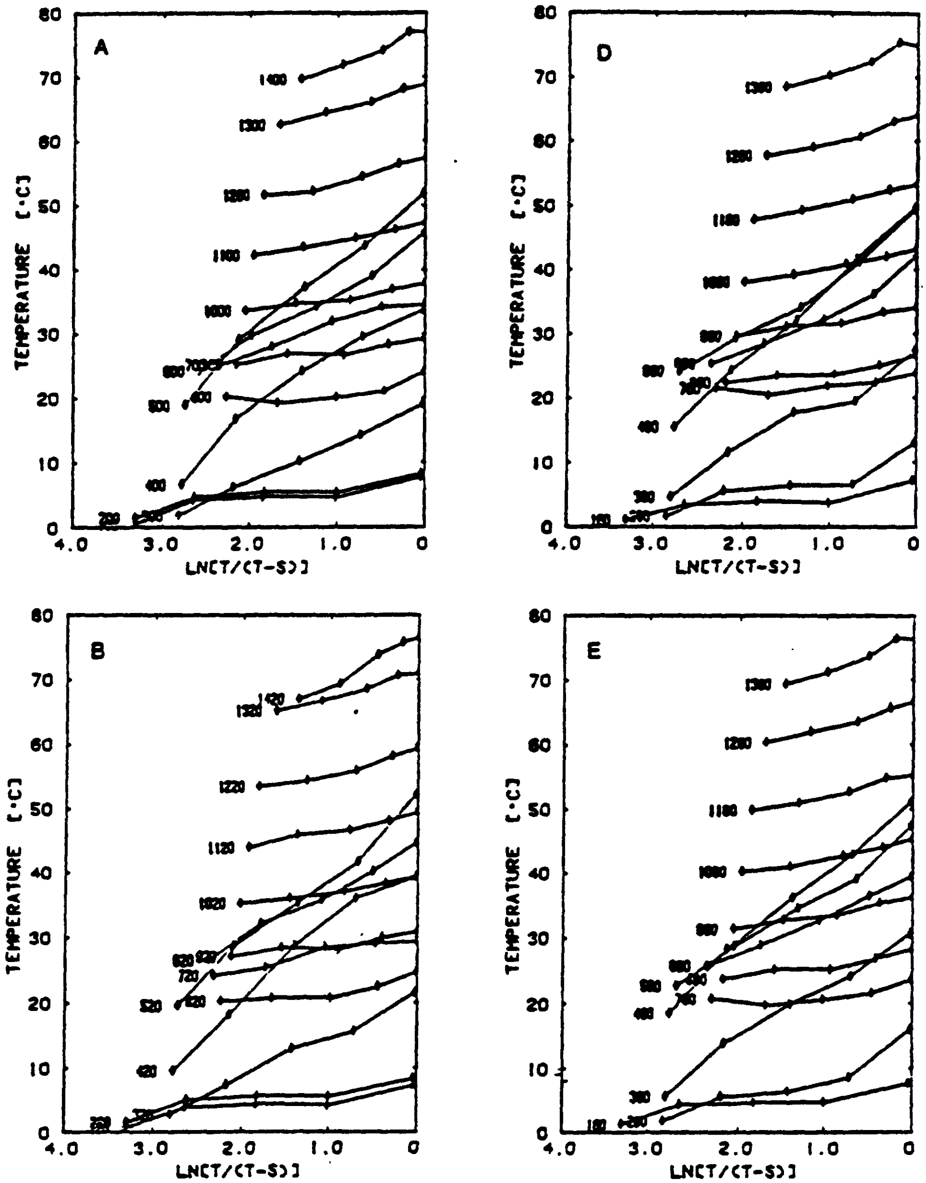


Figure 7a. Observed temperatures plotted against $\ln(\frac{t}{t-s})$ for MLGRAP # 1. Each line represents the set of temperatures with time at a specific depth. Depth interval 20 ft (6 m).



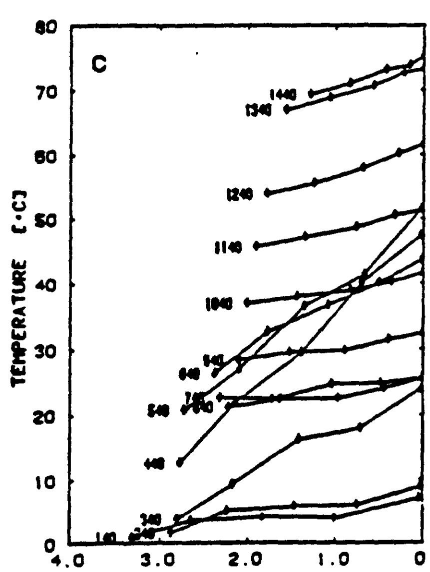


Figure 7b. Same as figure 7a but with 100 ft (30.5 m) depth intervals.

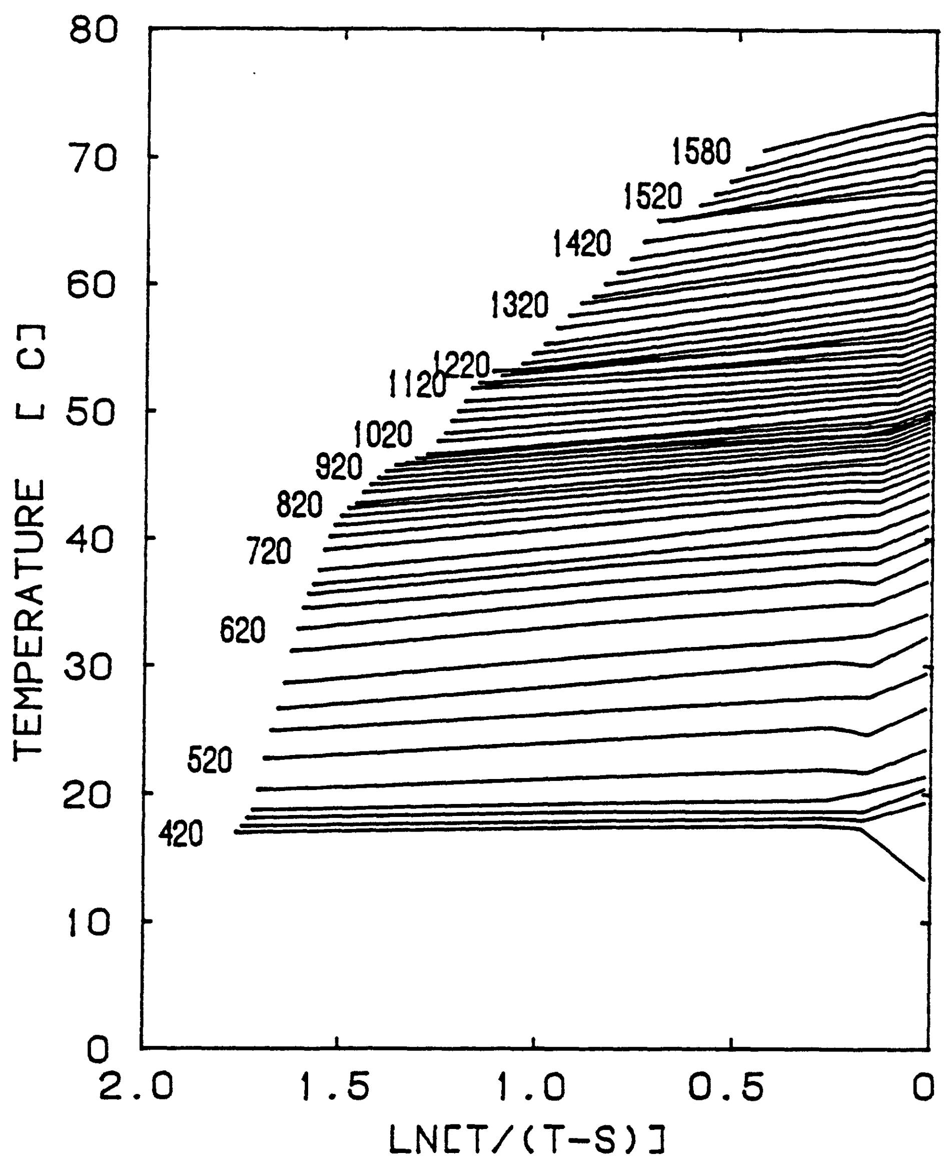


Figure 8a. Observed temperatures plotted against $\ln(\frac{t}{t-s})$ for MLGRAP # 2. Each line represents the set of temperatures with time at a specific depth. Depth interval 20 ft (6 m).

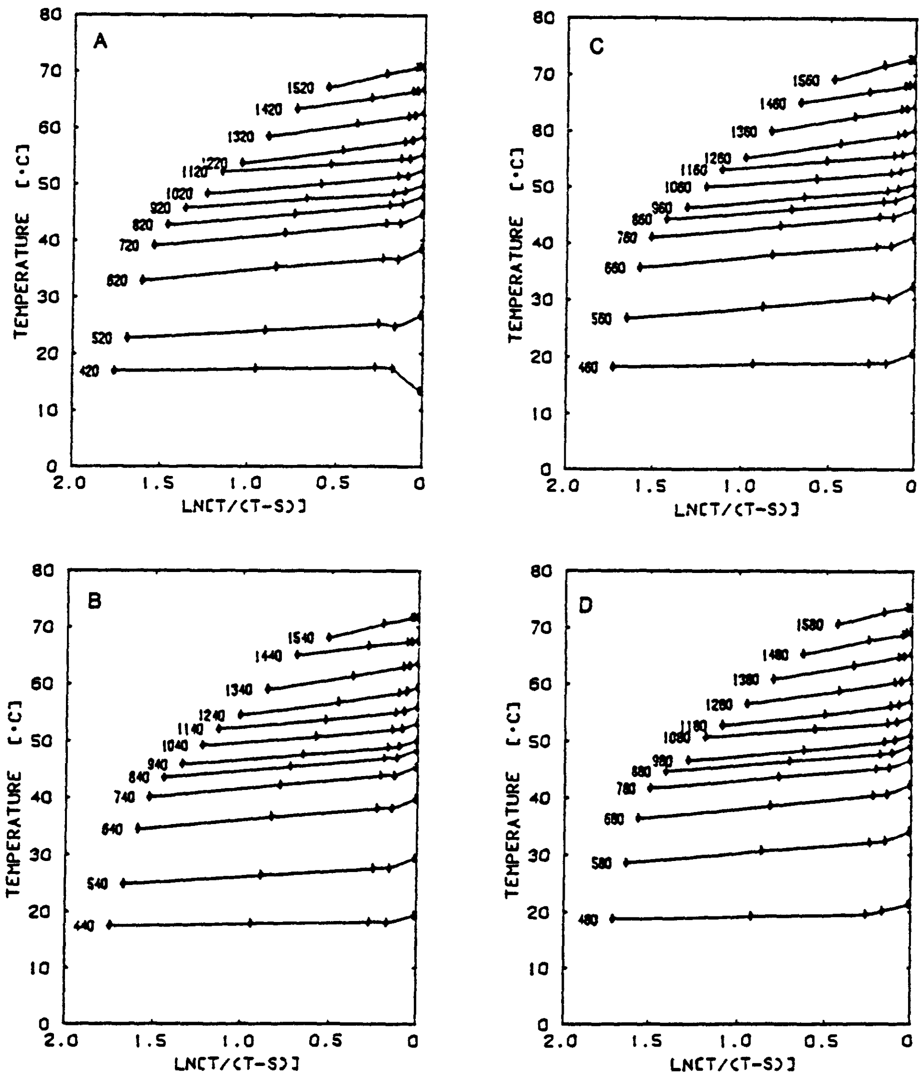


Figure 8b. Same as figure 8a but with a 100 ft (30.5 m) depth interval.

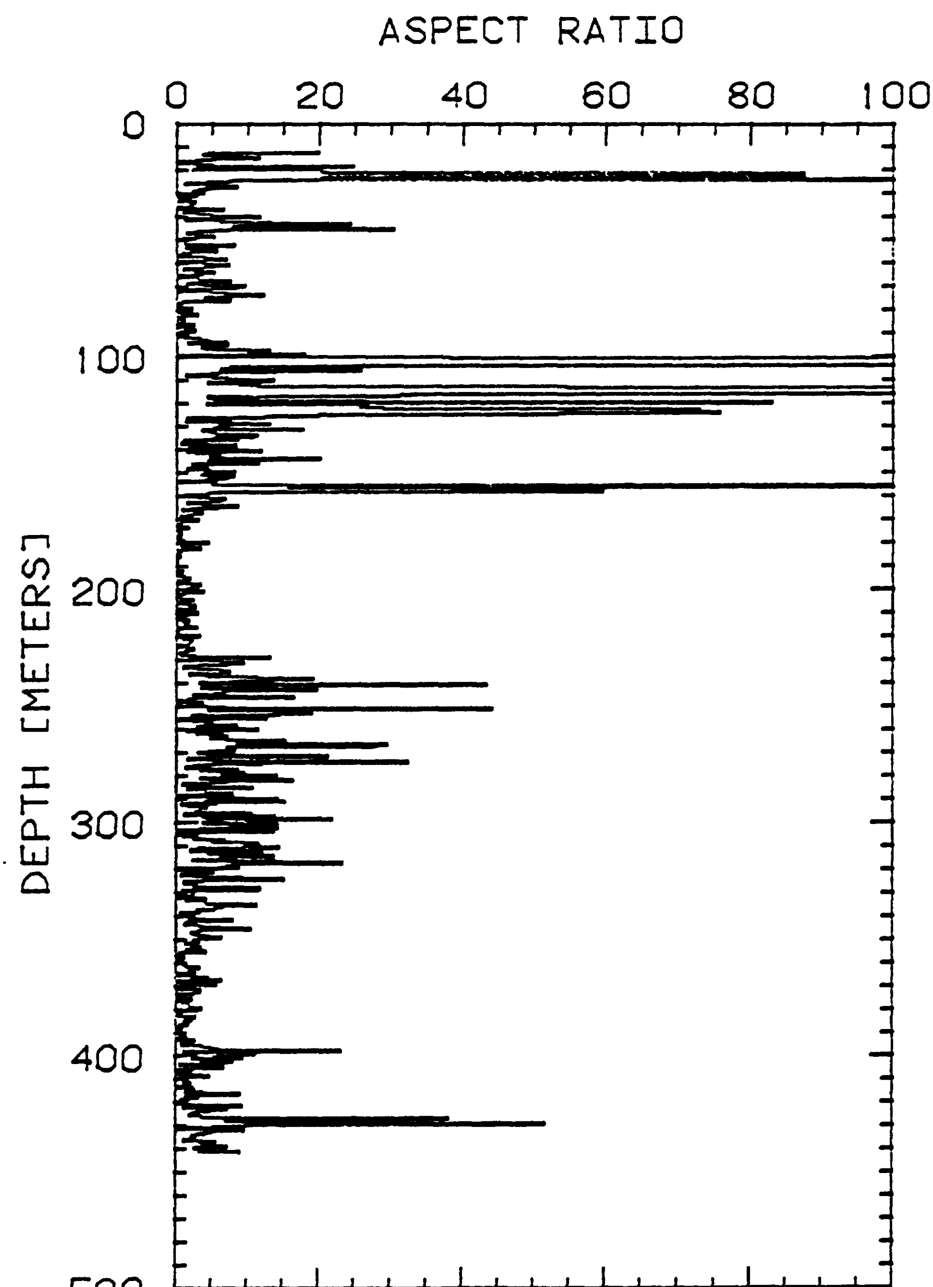


Figure 9. Aspect ratio versus depth for MLGRAP # 1.

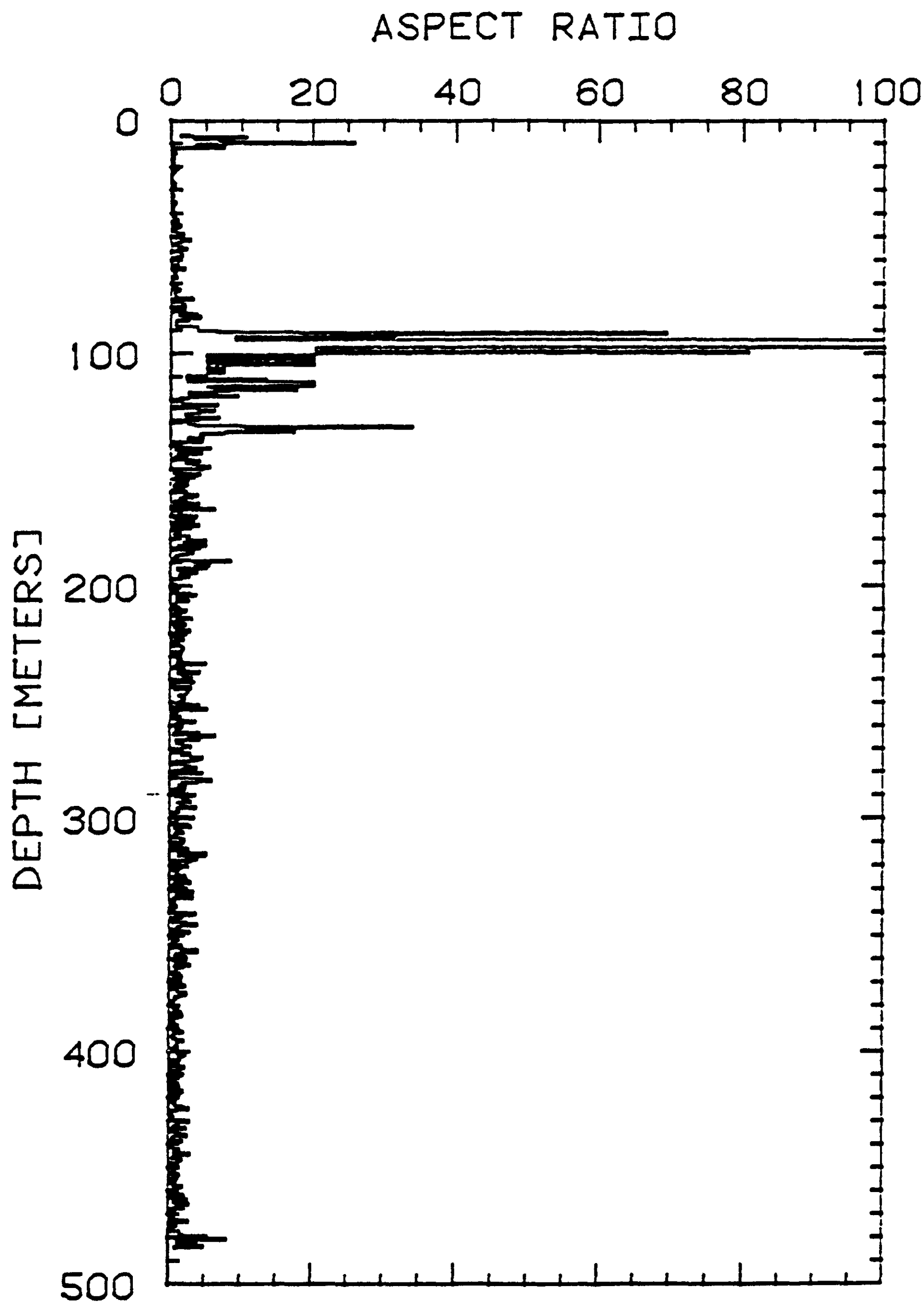


Figure 10. Aspect ratio versus depth for MLGRAP # 2.

The A–plots mean nothing when derived from continuous temperature logs in air–filled holes because the time response of the temperature sensor is too long to give accurate temperatures at the logging rates employed (3 m/min = 10 ft/min). So we can discard the anomalous results in the air column (132 m = 432 ft) in MLGRAP # 2. Once this is done, the A–values are uniformly low in this hole. They are on the order of what we have previously observed in other well–behaved holes. The implication is that there is little or no anomalous flow of fluid along the borehole complex. However, slow steady flows cannot be ruled out by this technique.

Now consider the A–plots for MLGRAP # 1. There are spikes at each temperature reversal simply because as $G'' \rightarrow 0$, $A \rightarrow \infty$. A's tend to be very low where the thermal gradient is negative because this is a stable thermal stratification. The small variation may reflect changes in lithology or noise. The cause of the variations in the interval 100–130 m (325–425 ft) is enigmatic. The temperature anomalies have persisted far longer than they should have if they were due to conductive decay of the drilling disturbance. This zone is well above a water table at about 143 m (470 ft). We conclude that there is flow of fluid in the borehole complex and/or the surrounding rock, but the details are not clear. The large values of the A's below about 230 m (755 ft) are attributed to fluid flow along the uncemented annulus.

GAMMA–RAY

Data reduction and uncertainties. Natural gamma–ray logs are the most primative of the arsenal of nuclear logs that can be run in boreholes. However, when constraints of hole/tubing diameter ($\leq$ 2 in = 5 cm), operating temperature, and cost are considered, we are often left with a γ – ray log obtained with a scintillation crystal ($\leq$ 80 °C) or a less sensitive Geiger–Mueller tube ($\geq$ 80 °C). So it is here, and in RDO8 (Urban, *et al.*, 1987a, 1987b) and PLV-1 (unpublished).

Natural γ – rays sensed by a detector in a borehole originate from a volume of rock less than a meter from the borehole (e.g., Belknap, *et al.*, 1978). They are attenuated by the rock itself and by the casings, mud, and other fluids in and about the hole. Complete theory is lacking, but it is clear that corrections for the effects are required. We used standard nomograms (Schlumberger, 1975, diagram GR–2, p. 66). Our choice of corrections, for the moment, are given in tables 2 and 3. The uncorrected and corrected γ – ray data are tabulated in Appendix IV and plotted in Appendix V.

Table 2. Correction to natural γ-ray log for casing and cement in MLGRAP # 1.

Depth From / To (ft)	Hole Diameter / Content (in)	Casing O.D. / I.D. / Content	Casing O.D. / I.D. / Content	Casing O.D. / I.D. / Content	γ-ray Corrected / Apparent
0	6.25	4.500	-	2.750	1.17
30	Cement	4.026		2.375	
		Air		Air	
30	6.25	4.500	-	2.750	1.23
225	Cement	4.026		2.375	
		Air		Gel	
225	6.25	4.500	3.500	2.750	1.65
241	Cement	4.026	3.068	2.375	
		Air	Air	Gel	
241	3.85	-	3.500	2.750	1.00
470	Air	-	3.068	2.375	
			Air	Gel	
470	3.85	-	3.500	2.750	1.02
535	Gel	-	3.068	2.375	
			Gel	Gel	
535	3.05	-	-	2.750	0.82
1464	Gel	-	-	2.375	
				Gel	

Table 3. Correction to natural γ-ray log for casing and cement for MLGRAP # 2.

Depth From / To (ft)	Hole Diameter / Content (in)	Casing O.D. / I.D. / Content	Casing O.D. / I.D. / Content	γ-ray Corrected / Apparent
0	5.625	4.500	2.750	1.16
157	Cement	4.026	2.375	
		Air	Air	
157	5.250	4.500	2.750	1.07
200	Cement	4.026	2.375	
		Air	Air	
200	3.850	-	2.750	0.77
380	Air		2.375	
			Air	
380	3.850	-	2.750	0.88
432	Cement		2.375	
			Air	
432	3.850	-	2.750	0.93
1602	Cement		2.375	
			Water	

Another class of problems involves the γ – ray emissions of the drilling fluid and its entrained cuttings, emissions from filter (mud) cake at the borehole wall and in the invaded zone beyond, and emissions from the cement in the annulus between the casing and the hole. All of these emissions may be significant, especially when the walls of the hole are porous, as with basalt cinders, and where formation radioactivity is low.

Hilchie (1978) gives a γ – ray activity of 10–30 API units for cement. The activity of the drilling mud is unknown. Although the principal constituent (montmorillonite) of the bentonite–gel–polymer mud is not intrinsically radioactive, it is a clay capable of adsorbing radioactive species during processing and from drill cuttings. We have no idea how these species might be distributed near the borehole wall. No wonder many regard the γ – ray log a qualitative tool. Some regard γ – ray results as unreliable unless the hole has been thoroughly flushed prior to logging (Cumming and Wicklund, 1980, p. 270). Such an operation would have been impossible in the MLGRAP holes, because they were mostly drilled without return of drilling fluid to the surface.

The principal unknown is the variation in hole diameter. No doubt there are zones of enlargement due to washouts and cavings which are notoriously common in holes drilled in this environment. Such would lead to reduced γ – ray intensities, provided that the annulus was filled with liquid or non-radioactive cement (air doesn't attenuate γ – rays significantly). The question is how much? The distribution of cement injected to seal the annulus between hole and casing is largely unknown. Furthermore, the water table(s) are uncertain.

Rock type and gamma-ray intensity. Goodwin's (1988) core logs have yet to be supplemented by the detailed petrographic and chemical analyses necessary to adequately describe the units and to relate them to those mapped at the surface (Bailey, 1989). His primary separation was between rocks of basaltic and rhyolitic composition, with occasional use of the terms intermediate to basic and silicic.

This he supplemented with textural terms which also suggest mode of emplacement/deposition: flow, breccia, cinders, lapilli/lapillite, ash, tuff, etc. This is the best that can be done with hand specimen descriptions and it is the one adopted in our figures and tables.

Table 4. Generalized lithologic log of MLGRAP # 1. Goodwin (1988).

Depth in meters to:		Description
Top of unit	Bottom of unit	
0	6.1 (Est.)	Glacial Till - unconsolidated
6.1 (Est.)	24.1 (Est.)	Rhyolite - colluvium or flow
24.1 (Est.)	51.1	Basalt (Lost circulation at 24.1 m - No sample 24.1 m to 30.5 m) - commonly rubbly
51.1	53.0	Rhyolite Tuff - unconsolidated
53.0	54.9	Cinder-rich Tephra - unconsolidated
54.9	70.7	Glacial Till - unconsolidated
70.7	164.6	Basalt Tephra - unconsolidated
164.6	198.7	Basalt
198.7	207.6	Intermediate to Basic Tuff/Breccia
207.6	219.4	Basalt Breccia
219.4	233.5	Intermediate to Basic Tuff/Breccia
233.5	238.3	Basalt
238.3	244.7	Intermediate to Basic Tuff/Breccia
244.7	250.2	Basalt
250.2	251.4	Basic Lapillite
251.4	258.8	Basalt
258.8	276.4	Silicic Lapillite/Tuff/Breccia
276.4	278.9	Basalt
278.9	294.4	Silicic Tuff w/Breccia
294.4	374.6	Basalt
374.6	376.7	Silicic Tuff
376.7	378.5	Basalt
378.5	427.6	Early Rhyolite Tuff
427.6	468.1	Early Rhyolite

Table 5. Generalized lithologic log of MLGRAP # 2. Goodwin (1988).

Depth in meters to:		Description
Top of unit	Bottom of unit	
0	42.4	Glacial Till - unconsolidated
42.4	61.1	Basalt
61.1	64.9	Silicic Lapilli - Ash Tephra - unconsolidated
64.9	73.8	Basalt
73.8	92.7	Glacial Till - poorly consolidated
92.7	100.7	Silicic Lapilli - Ash Tephra - unconsolidated
100.7	106.8	Glacial Till?/Regolith/Sediments
106.8	110.3	Basalt Flows with rare Breccia and interflow Cinders/Tephra
110.3	114.0	Basalt Cinders
114.0	161.9	Basalt Flows with rare Breccia and interflow Cinders/Tephra
161.9	170.1	Basalt Cinders
170.1	206.7	Basalt Flows with rare Breccia and interflow Cinders/Tephra
206.7	210.9	Basalt Cinders
210.9	246.6	Basalt Flows with rare Breccia and interflow Cinders/Tephra
246.6	248.7	Basalt Cinders
248.7	271.0	Basalt Flows with rare Breccia and interflow Cinders/Tephra
271.0	294.6	Early Rhyolite Lapilli Tuff
294.6	300.2	Early Rhyolite Flow Breccia
300.2	490.7	Early Rhyolite Tuff, Tuff-Breccia, Lapilli Tuff - unconsolidated to moderately consolidated

The first order correlations of $\gamma -$ ray intensities and rock type (figs. 12 and 13) is between basalt (low in lithophile elements and radioactivity) and rhyolites (rich in the same and high in radioactivity). The basalts owe their radioactivity largely to K^{40}, whereas the rhyolites, in addition to higher K^{40}, are likely to have much higher concentrations of U^{238} and Th^{232}. Let us consider only K^{40}.

Bailey (1989) refers to voluminous flows of trachybasalts, trachyandesites, and quartz latites in and about the southwest moat of the caldera. These are alkalic rocks which tend to have highly variable K_2O concentrations roughly twice that of "normal" rocks (compare tables 1–2 and 2–3 in Carmichael, *et al.*, 1974; see also Sorensen, 1974). Bailey, *et al.* (1976, p. 729) tabulated the concentration of K_2O (wt %) for 40 whole–rock samples of basalt and andesites from the caldera with the following results: Basalt, K_2O mean 1.80, range 1.63 to 2.26, n = 28. Andesite, K_2O mean 2.59, range 2.13 to 3.01, n = 12. Rinehart and Ross (1964, table 9) present K_2O concentrations: Andesine basalt (1.0), trachyandesite (2.2), olivine bearing quartz latite (4.8), quartz latite (3.9), younger rhyolite (4.5), and older rhyolite (5.2). Now, an increase of one percent in K_2O (wt %) causes an increase of 15 API units in a $\gamma -$ ray log (Schlumberger, 1975, p. 5) or $15/0.9 = 16.7$ in our cps units. Clearly the $\gamma -$ ray intensities shown in figures 12 and 13 are in reasonable agreement with the K_2O concentrations, and that the range in intensities for the "basaltic" rocks could be attributed to variation in K_2O content. Additional K_2O analyses for the area have been tabulated by Higgins, *et al.* (1985) who also present a variation diagram of major oxides with SiO_2. It is not clear, however, how far the correlation can be trusted, especially in view of the uncertainties in the borehole corrections previously discussed. On the otherhand, Anderson and Bartholomay (1990) have successfully used natural $\gamma -$ ray logs in about 200 holes near the Idaho National Engineering Laboratory to study the distribution of basaltic rocks and interbedded sediments. They found that $\gamma -$ ray intensity correlates with K_2O content as determined by X–ray fluorescence analysis.

Within these contrasting compositional regimes, further differentiation may be possible with the natural $\gamma -$ ray logs. Interfaces between basaltic flows (as logged in the core by Goodwin (1988)) are rather thin and sometimes mark the change between flows of significantly different $\gamma -$ ray intensity and, presumably of different rock composition. These discontinuities tend to be composed of volcanic rubble. Moreover, the rubble/rock tends to be more vesicular in these zones than in the interior of flows. So we enter the realm where concentration of γ − ray emitters must be balanced against γ − ray absorption. The problem isn't simple, and will not be addressed here. The rubble also tends to be more hydro–thermally altered (Goodwin, 1988), which leaves open the possibility of deposition or solution γ − ray emitters in these zones. It is certain, however, that "Two formations having the same amount of radioactive material per unit volume but having different densities will show, on the Gamma–Ray Log, different radioactivity levels; the less dense formation will appear to be more radioactive." (Schlumberger, 1975, p. 3).

HYDROLOGIC CONSIDERATIONS

A borehole is a zone of enhanced permeability and focused flow of water. Unless the annulus between hole and casing is effectively sealed, water will flow along it until hydrostatic equilibrium is achieved, if ever. So the temperatures measured in the casing (assuming the casing itself does not leak) represent the result of heat exchange between the surrounding rock and fluid flowing along the annulus. The size of the temperature perturbation from virgin rock temperature depends on the initial conditions, the temperature and rate of flow of the fluid, hole geometry and time (e.g., Birch, 1947; Beck and Shen, 1985).

The variation of pressure with depth is a poorly known parameter in many geothermal systems. The Long Valley caldera is no exception. Some holes have been drilled blind (*i.e.*, no return of drilling fluid to the surface), zones of water entry or loss may occur in the same hole. The point is that complicated thermal profiles could be produced by exchange of fluids along aquifers and produce a thermal picture that does not accurately reflect virgin rock temperatures, even though the measurements were made years after drilling.

The annuli of most holes drilled in the Long Valley caldera are not effectively sealed over their entire lengths, or even over major portions thereof. In some cases a tubing was lowered into the hole to preserve it for further measurements, but no attempt was made to cement the annulus. Attempts to cement the annuli usually failed partially or completely. The reason is simple. There are many highly permeable formations that are capable of accepting large quantities of cement. On the other hand, many of the rock types are extremely friable and fragments of them could partially seal the annuli and impede the flow of water along them. Moreover, many altered volcanic rocks are composed of plastic clays which may squeeze in about the tubing thus preventing fluid flow along the annulus.

Fluid flow along the annulus is an important factor in determining the temperature–depth profiles in some boreholes. Indeed, fluid flow may be controlling the shapes of some characteristic profiles in the caldera. The size of the disturbance is difficult to quantify. Temperature–gradient and aspect–ratio plots may call attention to anomalous conditions but they give no notion as to the size of the thermal perturbations. Temperature–time plots at fixed depths of the kind previously discussed could be more definitive indicators of fluid flow along the annulus, but experimental uncertainties, especially when different temperature logging systems are used over time, suggest caution. Water–levels in boreholes as they are drilled give another clue, but they may be suspect because the liquid level is measured inside the drill pipe with the assumption that the level in the drill pipe is that in the surrounding annulus, which could be obviated by closure of the annulus by caving of the borehole walls. Nonetheless, when all these uncertain measures seem to point in the same direction, guesses can be made as to the effects of fluid flow along the annulus. Now let us examine the data from the two MLGRAP holes, where similar procedures and reporting add credence to comparisons.

Liquid level in tubings. After completion of drilling, tubings were installed in each hole to preserve them for later measurements. The tubing was actually used NQ drill rod (2.75 in = 7.0 cm O.D., 2.375 in = 6.0 cm I.D.) which, in our experience, may leak like a sieve at the joints, because of minor knicks in the quick coupling threads. It is not known, of course, which joints, if any, leak. But it is a possibility that should be kept in mind in an environment where the pressure distribution with depth may be far from hydrostatic.

The fluid levels in the tubings of both holes are plotted as a function of the logarithm of time after last circulation (MLGRAP # 1) or after cementing (MLGRAP # 2) in Figure 11 along with the approximate depth of the "shallow" water tables. Some of the depths are plotted as 20 ft (6.1 m) long lines because they are based on Goodwin's (1988) temperature measurements which were spaced at 20 ft (6.1 m) intervals. (It's easy to tell whether the sensor is in air or water from the time response of the instrument as observed at the surface.)

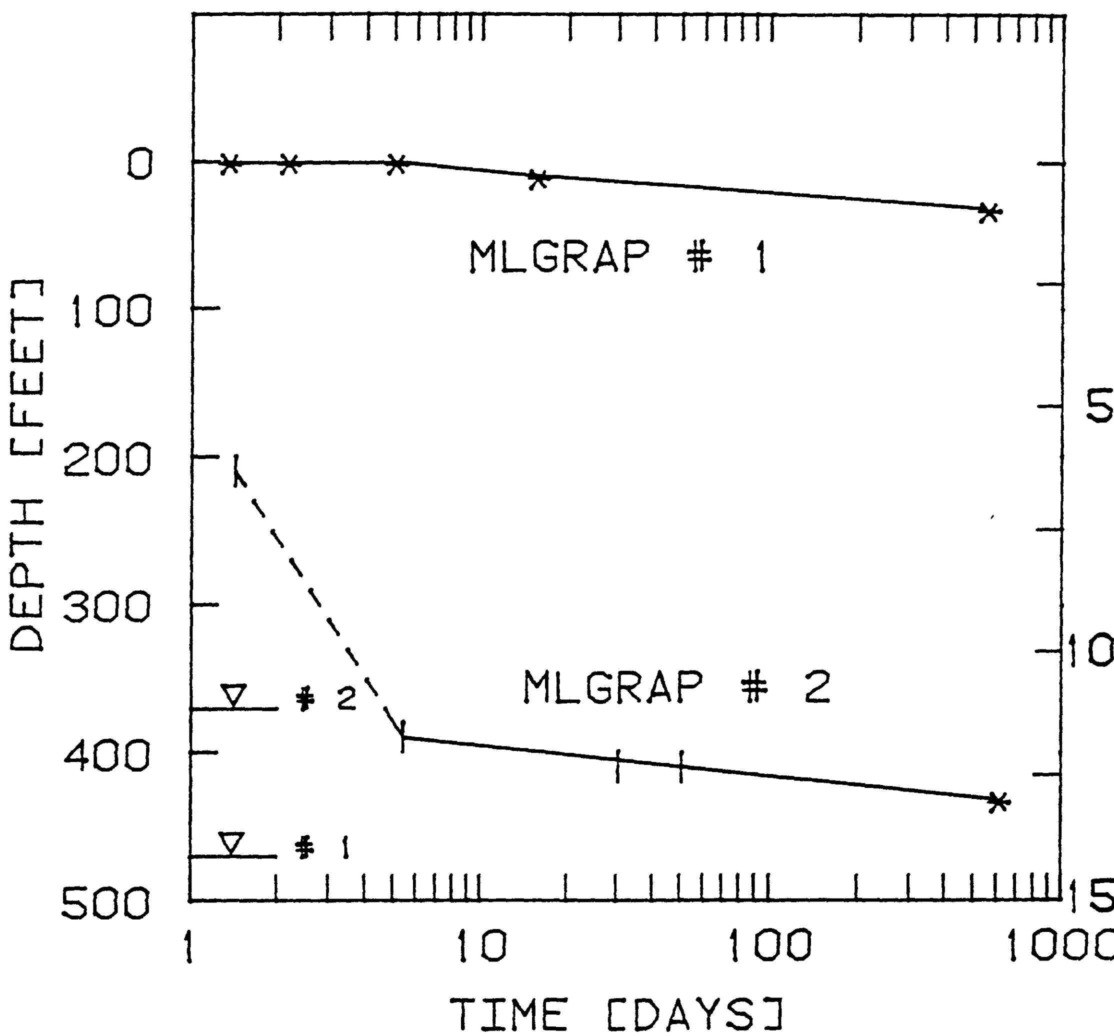


Figure 11. Water level below ground surface in tubing versus time for MLGRAP # 1 and MLGRAP # 2. ▽ indicates the approximate depths of the water table.

In MLGRAP # 1, both the tubing and the annulus (to 470 ft = 143 m) were left filled with mud with a plugged bit at the bottom, as previously explained. For the first few days, the liquid level remained at the top of the tubing which probably means that there was a small overflow as the cold liquid column expanded as it was warmed by the surrounding rocks. Thereafter, the liquid level slowly declined but to a level (32 ft = 10 m) far above the shallow water table (470 ft = 143 m). Does this mean that the tubing doesn't leak much? It's filled with mud which may have a tendency to seal the joints in the tubing. Or, does it mean that the tubing taps a super–hydrostatic aquifer at some unknown depth?

Conditions for the completion of MLGRAP # 2 were different. An attempt was made to cement the annulus between the hole and the tubing by pumping cement down the tubing and then up the annulus. The attempt failed in the sense that no cement returned to the surface through the annulus, which means that fluid flow is possible along at least part of the annulus. Undoubtedly, the cement went into the first permeable beds it encountered on its upward path. This condition is not unusual (e.g., Urban, *et al*, 1987a, 1987b). Indeed, it is probably impossible to fill annuli of holes in such stratigraphy, without inordinate expense.

The liquid level dropped rapidly in MLGRAP # 2 after cementing (fig. 11), then more slowly at a rate comparable to the decline in # 1. The last observation is about 60 ft (18.3 m) below the shallow water table (370 ft = 113 m). The most likely explanation is that water in the tubing is leaking into the subhydrostatic aquifers.

Liquid levels in the open hole during drilling. The lower parts of both holes were drilled blind (i.e., no mud returns to the surface): MLGRAP # 1 below 520 ft (158 m) and MLGRAP # 2 below 350 ft (107 m). Thereafter the liquid levels in the drill rods were periodically recorded as drilling progressed (Goodwin, 1988). The shallow water tables (MLGRAP # 1, 470 ft = 143.3 m; MLGRAP # 2, 370 ft = 112.8 m) shown in figure 11 are probably accurate within a few meters.

Liquid level in the boreholes (as determined by measurements of the level in the drill rods during the interruptions in drilling) usually remained within a few meters of the shallow water tables. Noteable exceptions occurred at about 1235 ft (376.4 m) in MLGRAP # 1 and at about 900 ft (274 m) in MLGRAP # 2, where transient increases in liquid level of 10 and 30 m (30 and 100 ft), respectively, were noted (Goodwin, 1988). These zones of water entry are close to the top of the "early rhyolite" (Bailey, 1989) in both holes (tables 4 and 5, figs. 12 and 13).

Effects of borehole flows on shape of temperature profiles. Few temperature–depth profiles in the Long Valley caldera reflect constant heat flow in the sense that the thermal gradient is inversely proportional to the thermal conductivity of the surrounding rocks. The thermal regime of the caldera is dominated by fluid flows in permeable rocks. The actual temperature distribution in the rocks are clouded by fluid heat and salt transport along the borehole complexes. In some cases this perturbation is obvious. For examples: temperatures in holes that perennially boil at the surface follow the boiling–point–depth curve for some depth below the surface (e.g., Diment, *et al.*, 1985; Urban, *et al.*, 1987). Clearly, heat is transported up the hole/tubing and salt downward. In holes with alternating sections of perforated and unperforated casing exchange of fluids amoung aquifers is clearly evident from precision temperature logs (e.g., UNOCAL IDFU 44–16, Suemnicht, 1987, Urban and Diment, 1988). In other cases the effects are far more subtle and impossible to assess quantitatively.

This long preamble is necessary to illustrate some obvious phenomena, which may appear in far more subtle forms in any hole drilled in the caldera.

In MLGRAP # 1, the high level of the liquid column, for whatever reason, should allow a glimpse at conditions in the vadose (unsaturated) zone in a region of significant precipitation. Unfortunately, this is not the case. The nearly isothermal zone above 74 m (243 ft)(fig. 12) is probably a consequence of flow along the partially cemented annulus of the 4.5 in (11.4 cm) casing. Hole construction (fig. 5) may permit alternate flow paths to a depth of 185 m (bottom of the lost HQ rods). Erratic gradients, particularly from 100 to 140 m (33 to 460 ft), indicate a non-steady state regime. Therefore, the temperature–time plots (fig. 7a,b), which are based on the assumption of conductive decay of the drilling disturbance, are meaningless. These plots do, however, indicate a strong increase of temperature with time and that the temperatures may continue to increase.

The fluctuations in the gradients (fig. 12) and aspect ratios (fig. 9) in the interval from 250 to 350 m (820 to 1150 ft) are unusually large for reasons unknown to us. Note, however, that a water entry was observed at 376 m (1234 ft). Possibly water is flowing up the uncemented annulus. Note, also, that the temperature profile exhibits step–like structures in the upper part of this interval. This raises the possibility of double diffusive transport of heat and salt (e.g., Turner, 1973) along the borehole complex. The required salinity gradients seem unaceptably large, however, if the mechanism is to be operative over a significant length of the hole. The phenomenon has not been investigated in boreholes.

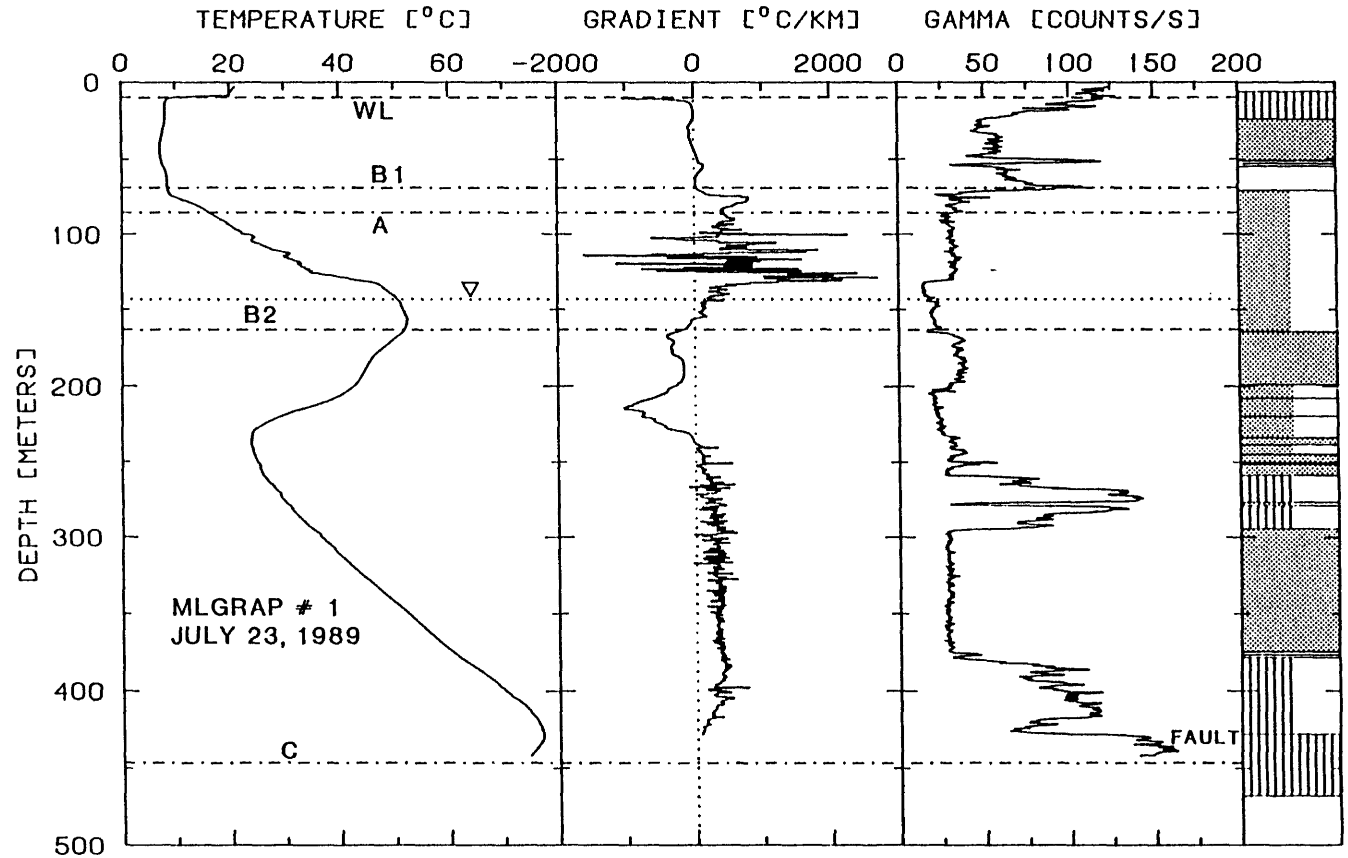


Figure 12. Temperature, temperature gradient, natural gamma-ray (corrected) and generalized lithologic logs for MLGRAP # 1. Goodwin's (1988) lithology generalized as follows: White, glacial till. Dots, basaltic rocks. Vertical pattern, rhyolitic rocks. See table 4 to distinguish flows, tuff, cinders, ash, breccia, lapilli, and tephra. Other symbols in figure are: WT (·····), water table, WL (– – – –), water level as measured in tubing. A, B1, B2, C (· – · – · –) top (if not surface) and bottom of casing strings. Total depth drilled is the bottom of the lithologic log. Temperatures above WL are inaccurate.

The deep temperature maximum at 430 m (1410 ft) occurs at a contact between a rhyolite tuff and a rhyolite (fig. 12). Goodwin (1988) regards this contact as a fault. The region immediately above it cooled slightly and that below warmed judging from the last two sets of temperatures (fig. 7a,b). These are weak data, but the fact that the gradient and aspect ratio plots are noteably irregular below the temperature maximum, especially near the bottom of the hole, suggest an interval of instability, perhaps associated with the fault. It is unusual to observe this degree of irregularity where the gradients are negative.

In MLGRAP # 2, there are no temperature reversals in the water column but the gradients above 250 m (820 ft) are anomalously high with respect to those in the lower part of the hole (fig. 13). A water entry was noted at about 277 m (910 ft) during drilling which caused the liquid level to rise about 84 m (275 ft) above the ambient liquid level of about 114 m (375 ft). The zone of entry is near the top of the early rhyolite tuff. As previously noted, a water entry also occurred near the same stratigraphic position in MLGRAP # 1, but the head differential was much smaller. It is possible that the bulge in the temperature profile in # 2 is caused by upward flow along the uncemented annulus from the zone of water entry and possibly from undetected entries from below, where the hydrostatic head seems to systematically increase with depth (weak data). The notion of upward flow is also supported by the temperature–time plots at various depths (figs. 8a and 8b) where the last point on many of the curves is high, particularly in the zone of the bulge as might be expected if the postulated flow were present. Again, these are weak data for reasons previously explained. Another possibility is that the bulge is due to upward flow through surrounding formations by a mechanism offered by Bredehoeft and Papadopulos (1965), but much additional data and analysis are required to test this hypothesis.

CONCLUSIONS

Single precision temperature logs in the two holes obtained 1.5 yr after drilling provide a fairly accurate description of the subsurface thermal regime in the vicinity of each hole. These logs coupled with those obtained by Goodwin (1988) at 6 m (20 ft) depth intervals shortly after drilling provide an additional basis for identifying fluid-flow along the bore-hole complex, and show that segments of the annulus between hole and casing were not effectively sealed (a nearly impossible operation in such lithology). This conclusion could have been drawn from the precision temperature logs alone. However, the case is more credible when the earlier data are incorporated in the analysis. Ideally, more numerous sets of precision temperatures in each hole obtained with the same logging system would have been desirable.

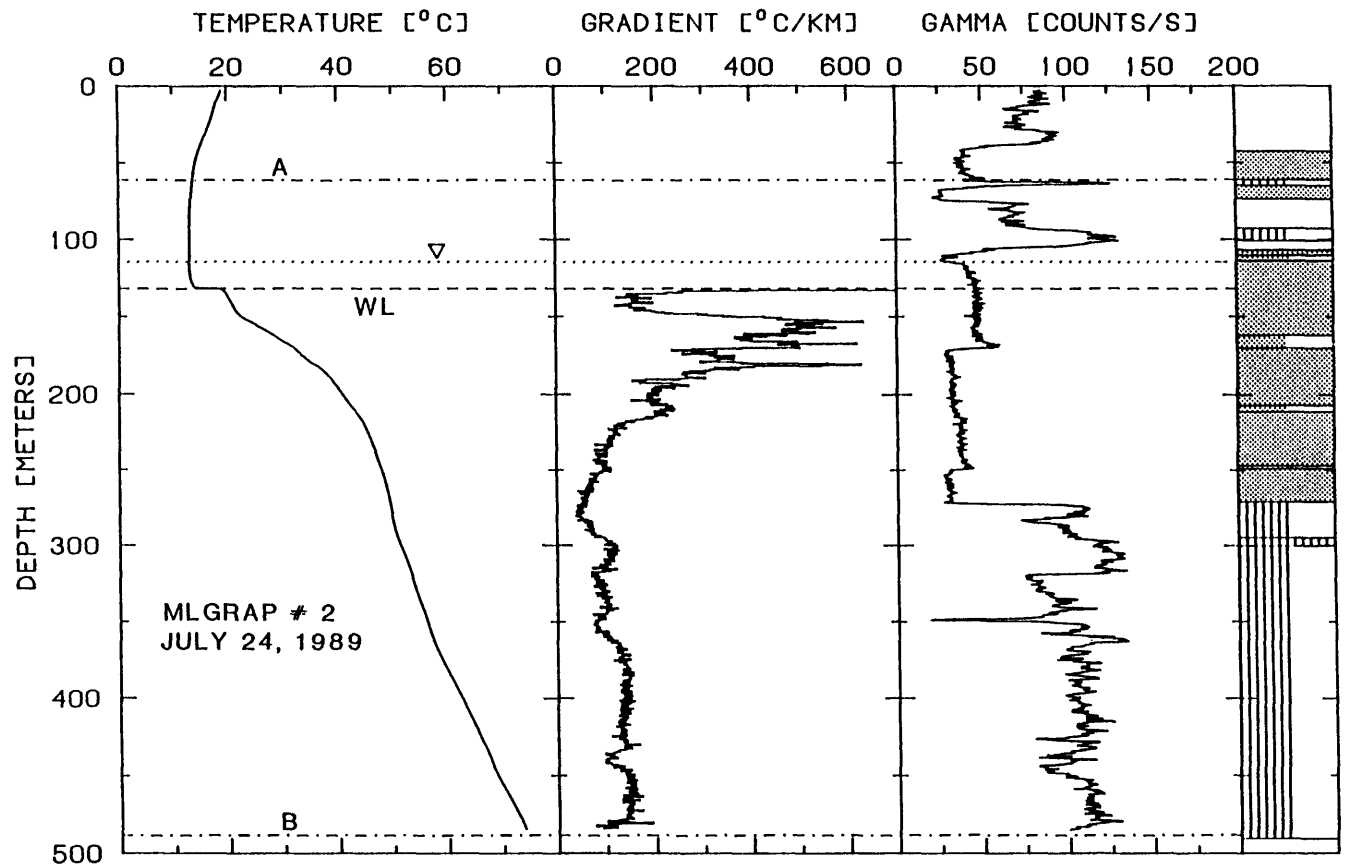


Figure 13. Temperature, temperature gradient, natural gamma-ray (corrected) and generalized lithologic logs for MLGRAP # 2. Goodwin's (1988) lithology generalized as follows: White, glacial till. Dots, basaltic rocks. Vertical pattern, rhyolitic rocks. See table 5 to distinguish flows, tuff, cinders, ash, breccia, lapilli, and tephra. Other symbols in figure are: WT (·····), water table, WL (– – – –), water level as measured in tubing. A, B (· – · – · –) bottom of casing strings. Total depth drilled is the bottom of the lithologic log. Temperatures above WL are inaccurate.

Additional precision temperature logging in these holes over a period of years might prove rewarding. The flow of fluid through the vadose zone is not well understood. The temperature log in MLGRAP # 1 above the water table is a clear indication of this (fig. 12). The area is tectonically unstable and some hydrothermal changes have been attributed to recent earthquake shaking and deformation (e.g., Diment, *et al.*, 1985; Urban, *et al.*, 1987a, 1987b). Indeed the July 1989 logs were obtained during a noteably prolonged (6 months) swarm of small earthquakes under Mammoth Mountain (Hill, *et al.*, 1990) a few kilometers west of Mammoth Lakes. What effect such shaking has on the hydrothermal regime is unknown, and shall remain so, unless efforts are made to monitor borehole temperatures over time. The recent history of unrest in the Long Valley caldera, as well as in other calderas, has been partly recorded by Newhall and Dzurisin (1988), who show that unrest is often episodic.

The natural γ – ray logs nicely discriminate between rocks of basaltic and rhyolitic composition, simply because their contrasts in radioactivity are so large that they partially over–ride the effects of variations in hole diameter due to washouts. We think we see further correlations, such as interfaces between basalt flows. The γ – ray anomalies are real but whether they are due to contrasts in radioactivity or variations in hole diameter or hydrothermal alteration remains to be investigated. This requires a far more detailed examination than that presented here.

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APPENDIX I

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 0 - 30 °C

CALIBRATION RESISTANCE RANGE: 425513 - 2107375 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
2107580	0.017	0.024	-0.007
2107508	0.017	0.025	-0.008
2107458	0.023	0.025	-0.002
2107412	0.023	0.026	-0.003
2107375	0.025	0.026	-0.001
2107342	0.027	0.026	0.001
2107294	0.031	0.027	0.004
2107273	0.033	0.027	0.006
2107261	0.033	0.027	0.006
2107249	0.033	0.027	0.006
1192166	10.209	10.210	-0.001
1190138	10.243	10.242	0.001
1187575	10.283	10.281	0.002
1184098	10.335	10.335	0.000
1180043	10.398	10.398	0.000
1175622	10.466	10.467	-0.001
1170918	10.542	10.541	0.001
1166020	10.618	10.619	-0.001
1160966	10.696	10.699	-0.003
1155882	10.778	10.780	-0.002
709960.0	20.003	20.004	-0.001
707600.0	20.067	20.068	-0.001
703157.0	20.188	20.191	-0.003
701021.0	20.252	20.250	0.002
698926.0	20.310	20.308	0.002
696881.0	20.366	20.365	0.001
694860.0	20.424	20.421	0.003
692858.0	20.478	20.477	0.001
690871.0	20.532	20.533	-0.001
688118.0	20.612	20.611	0.001
429471.0	30.020	30.022	-0.002
428700.0	30.060	30.059	0.001
427917.0	30.098	30.096	0.002
426323.0	30.174	30.173	0.001
425513.0	30.212	30.212	0.000
424720.0	30.250	30.250	0.000
423932.0	30.286	30.288	-0.002
423149.0	30.326	30.326	0.000
422351.0	30.364	30.364	0.000
421568.0	30.400	30.403	-0.003

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 0 - 30 °C

CALIBRATION RESISTANCE RANGE: 425513 - 2107375 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	5111.5764	S. DEV. C1 =	9.0408
C2 =	-351.0106	S. DEV. C3 =	0.6215
C3 =	5.6447	S. DEV. C3 =	0.0329

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 30 - 60 °C

CALIBRATION RESISTANCE RANGE: 108609 - 425513 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
429471.0	30.020	30.024	-0.004
428700.0	30.060	30.060	0.000
427917.0	30.098	30.098	0.000
426323.0	30.174	30.174	0.000
425513.0	30.212	30.213	-0.001
424720.0	30.250	30.251	-0.001
423932.0	30.286	30.289	-0.003
423149.0	30.326	30.327	-0.001
422351.0	30.364	30.365	-0.001
421568.0	30.400	30.403	-0.003
266950.0	40.006	40.001	0.005
266538.0	40.040	40.034	0.006
265980.0	40.086	40.079	0.007
265327.0	40.138	40.132	0.006
263858.0	40.258	40.252	0.006
263090.0	40.317	40.315	0.002
262331.0	40.379	40.377	0.002
261577.0	40.439	40.439	0.000
260832.0	40.503	40.501	0.002
260192.0	40.557	40.554	0.003
169054.0	50.101	50.107	-0.006
167847.9	50.265	50.269	-0.004
166584.9	50.435	50.441	-0.006
165427.2	50.597	50.600	-0.003
164373.8	50.738	50.745	-0.007
163388.9	50.880	50.882	-0.002
162446.2	51.012	51.014	-0.002
161527.5	51.142	51.144	-0.002
160601.7	51.272	51.275	-0.003
159718.2	51.399	51.401	-0.002
110477.4	60.011	60.013	-0.002
109992.9	60.121	60.118	0.003
109524.3	60.221	60.220	0.001
109060.7	60.321	60.321	0.000
108609.3	60.421	60.420	0.001
108156.3	60.520	60.521	-0.001
107703.3	60.624	60.621	0.003
107253.1	60.722	60.721	0.001
106804.0	60.824	60.822	0.002
106355.8	60.928	60.923	0.005

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 30 - 60 °C

CALIBRATION RESISTANCE RANGE: 108609 - 425513 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	4955.0164	S. DEV. C1 =	11.9764
C2 =	-340.0962	S. DEV. C3 =	0.8368
C3 =	5.1443	S. DEV. C3 =	0.0378

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 60 - 90 °C

CALIBRATION RESISTANCE RANGE: 33911 - 108609 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
110477.4	60.011	60.014	-0.003
109992.9	60.121	60.119	0.002
109524.3	60.221	60.221	0.000
109060.7	60.321	60.322	-0.001
108609.3	60.421	60.421	0.000
108156.3	60.520	60.521	-0.001
107703.3	60.624	60.622	0.002
107253.1	60.722	60.722	0.000
106804.0	60.824	60.823	0.001
106355.8	60.928	60.924	0.004
73378.8	70.033	70.032	0.001
73160.9	70.107	70.106	0.001
72728.6	70.256	70.255	0.001
72515.5	70.328	70.329	-0.001
72302.2	70.402	70.403	-0.001
71657.4	70.628	70.628	0.000
71458.9	70.696	70.698	-0.002
71170.5	70.794	70.800	-0.006
70330.9	71.093	71.099	-0.006
70131.9	71.171	71.171	0.000
49758.7	80.020	80.017	0.003
49639.7	80.082	80.081	0.001
49474.6	80.168	80.168	0.000
49414.5	80.202	80.200	0.002
49209.1	80.310	80.310	0.000
49089.4	80.376	80.374	0.002
48812.8	80.524	80.523	0.001
48691.0	80.590	80.589	0.001
48564.7	80.659	80.658	0.001
48436.6	80.731	80.728	0.003
34347.0	90.010	90.010	0.000
34242.1	90.090	90.095	-0.005
34139.0	90.178	90.178	0.000
34030.0	90.268	90.266	0.002
33911.4	90.362	90.363	-0.001
33810.5	90.445	90.445	0.000
33693.1	90.541	90.541	0.000
33589.6	90.625	90.627	-0.002
33479.6	90.717	90.717	0.000
33379.6	90.803	90.800	0.003

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 60 - 90 °C

CALIBRATION RESISTANCE RANGE: 33911 - 108609 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	4956.4810	S. DEV. C1 =	8.4205
C2 =	-340.2229	S. DEV. C3 =	0.6044
C3 =	5.1440	S. DEV. C3 =	0.0235

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 90 - 120 °C

CALIBRATION RESISTANCE RANGE: 12306 - 33911 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
34347.0	90.010	90.009	0.001
34242.1	90.090	90.094	-0.004
34139.0	90.178	90.177	0.001
34030.0	90.268	90.266	0.002
33911.4	90.362	90.362	0.000
33810.5	90.445	90.445	0.000
33693.1	90.541	90.541	0.000
33589.6	90.625	90.626	-0.001
33479.6	90.717	90.717	0.000
33379.6	90.803	90.800	0.003
24108.8	100.018	100.021	-0.003
24039.2	100.108	100.104	0.004
23973.9	100.181	100.183	-0.002
23897.4	100.277	100.276	0.001
23757.5	100.447	100.446	0.001
23688.1	100.531	100.531	0.000
23615.9	100.617	100.620	-0.003
23545.7	100.703	100.706	-0.003
23236.6	101.086	101.090	-0.004
23114.2	101.246	101.244	0.002
17207.9	110.011	110.012	-0.001
17164.3	110.089	110.089	0.000
17121.6	110.167	110.164	0.003
17076.0	110.245	110.245	0.000
17034.3	110.319	110.320	-0.001
16987.5	110.407	110.403	0.004
16946.1	110.481	110.477	0.004
16901.0	110.558	110.558	0.000
16860.4	110.630	110.631	-0.001
16817.8	110.710	110.708	0.002
12434.0	120.089	120.088	0.001
12401.9	120.167	120.170	-0.003
12370.6	120.247	120.250	-0.003
12338.2	120.332	120.333	-0.001
12306.5	120.414	120.415	-0.001
12274.9	120.494	120.496	-0.002
12118.0	120.908	120.906	0.002
12087.4	120.987	120.986	0.001
12005.0	121.207	121.204	0.003
11971.9	121.291	121.292	-0.001

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 90 - 120 °C

CALIBRATION RESISTANCE RANGE: 12306 - 33911 OHMS

THERMISTOR EQUATION: $T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$

C1 =	4831.0201	S. DEV. C1 =	8.8062
C2 =	-331.1772	S. DEV. C3 =	0.6539
C3 =	4.7999	S. DEV. C3 =	0.0220

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 120 - 150 °C

CALIBRATION RESISTANCE RANGE: 5082 - 12306 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
12434.0	120.089	120.087	0.002
12401.9	120.167	120.169	-0.002
12370.6	120.247	120.250	-0.003
12338.2	120.332	120.333	-0.001
12306.5	120.414	120.415	-0.001
12274.9	120.494	120.496	-0.002
12118.0	120.908	120.906	0.002
12087.4	120.987	120.986	0.001
12005.0	121.207	121.204	0.003
11971.9	121.291	121.292	-0.001
9135.2	130.089	130.088	0.001
9114.2	130.164	130.164	0.000
9091.5	130.248	130.247	0.001
9071.5	130.320	130.320	0.000
9046.6	130.412	130.412	0.000
9024.1	130.494	130.494	0.000
9001.4	130.582	130.578	0.004
8978.8	130.662	130.662	0.000
8956.3	130.743	130.745	-0.002
8920.4	130.881	130.879	0.002
6811.9	140.032	140.033	-0.001
6798.7	140.104	140.100	0.004
6784.6	140.172	140.172	0.000
6770.8	140.242	140.242	0.000
6757.9	140.308	140.309	-0.001
6744.5	140.376	140.377	-0.001
6730.5	140.446	140.449	-0.003
6717.4	140.515	140.517	-0.002
6703.6	140.585	140.588	-0.003
6690.0	140.659	140.659	0.000
5138.6	150.004	150.002	0.002
5127.3	150.084	150.081	0.003
5105.1	150.239	150.238	0.001
5093.8	150.319	150.318	0.001
5082.7	150.399	150.397	0.002
5071.0	150.481	150.481	0.000
5059.8	150.559	150.561	-0.002
5049.9	150.631	150.632	-0.001
5038.4	150.709	150.714	-0.005
4976.9	151.162	151.160	0.002

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 120 - 150 °C

CALIBRATION RESISTANCE RANGE: 5082 - 12306 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	4768.5045	S. DEV. C1 =	9.2358
C2 =	-326.4932	S. DEV. C3 =	0.7128
C3 =	4.6471	S. DEV. C3 =	0.0210

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 150 - 180 °C

CALIBRATION RESISTANCE RANGE: 2319 - 5082 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
5138.6	150.004	150.003	0.001
5127.3	150.084	150.082	0.002
5105.1	150.239	150.239	0.000
5093.8	150.319	150.319	0.000
5082.7	150.399	150.398	0.001
5071.0	150.481	150.482	-0.001
5059.8	150.559	150.562	-0.003
5049.9	150.631	150.633	-0.002
5038.4	150.709	150.715	-0.006
4976.9	151.162	151.161	0.001
3918.3	160.009	160.011	-0.002
3911.1	160.079	160.080	-0.001
3902.8	160.161	160.160	0.001
3893.6	160.253	160.249	0.004
3886.5	160.321	160.318	0.003
3878.8	160.399	160.393	0.006
3870.9	160.477	160.470	0.007
3863.2	160.549	160.545	0.004
3847.1	160.704	160.703	0.001
3828.9	160.882	160.883	-0.001
3022.4	170.005	170.007	-0.002
3016.0	170.093	170.091	0.002
3004.1	170.247	170.246	0.001
2997.6	170.335	170.332	0.003
2985.2	170.490	170.495	-0.005
2978.5	170.578	170.583	-0.005
2965.5	170.750	170.756	-0.006
2926.7	171.271	171.276	-0.005
2913.9	171.443	171.449	-0.006
2901.9	171.613	171.613	0.000
2355.5	180.017	180.013	0.004
2343.1	180.226	180.230	-0.004
2331.3	180.436	180.437	-0.001
2325.1	180.550	180.546	0.004
2319.4	180.646	180.647	-0.001
2313.9	180.750	180.744	0.006
2308.0	180.851	180.849	0.002
2302.1	180.959	180.955	0.004
2282.4	181.307	181.308	-0.001
2272.3	181.488	181.491	-0.003

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 150 - 180 °C

CALIBRATION RESISTANCE RANGE: 2319 - 5082 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	4594.9168	S. DEV. C1 =	15.7163
C2 =	-312.8635	S. DEV. C3 =	1.2647
C3 =	4.2662	S. DEV. C3 =	0.0328

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 180 - 210 °C

CALIBRATION RESISTANCE RANGE: 1165 - 2319 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
2355.5	180.017	180.016	0.001
2343.1	180.226	180.232	-0.006
2331.3	180.436	180.439	-0.003
2325.1	180.550	180.548	0.002
2319.4	180.646	180.649	-0.003
2313.9	180.750	180.746	0.004
2308.0	180.851	180.851	0.000
2302.1	180.959	180.956	0.003
2282.4	181.307	181.310	-0.003
2272.3	181.488	181.493	-0.005
1849.2	190.146	190.134	0.012
1843.6	190.276	190.263	0.013
1837.7	190.408	190.400	0.008
1832.3	190.540	190.526	0.014
1826.8	190.655	190.655	0.000
1816.8	190.889	190.890	-0.001
1811.8	191.003	191.008	-0.005
1807.8	191.097	191.102	-0.005
1793.4	191.440	191.445	-0.005
1785.7	191.624	191.630	-0.006
1472.6	200.052	200.052	0.000
1468.7	200.174	200.170	0.004
1465.1	200.280	200.279	0.001
1461.1	200.403	200.401	0.002
1449.4	200.757	200.759	-0.002
1441.4	201.008	201.005	0.003
1437.3	201.132	201.132	0.000
1428.3	201.402	201.413	-0.011
1424.5	201.520	201.532	-0.012
1420.7	201.641	201.651	-0.010
1181.7	210.012	210.025	-0.013
1176.4	210.225	210.233	-0.008
1173.5	210.341	210.347	-0.006
1170.9	210.445	210.450	-0.005
1165.5	210.669	210.664	0.005
1162.7	210.778	210.776	0.002
1160.1	210.886	210.880	0.006
1150.8	211.262	211.253	0.009
1148.3	211.363	211.354	0.009
1145.7	211.471	211.459	0.012

THERMISTOR CALIBRATION: PROBE 500-02 - 11 July 1989

NOMINAL TEMPERATURE RANGE: 180 - 210 °C

CALIBRATION RESISTANCE RANGE: 1165 - 2319 OHMS

THERMISTOR EQUATION: $T - \frac{C1 + C2\ x\ \ln(R)}{C3 + \ln(R)}$

C1 = 4447.3889	S. DEV. C1 = 32.0955
C2 = -300.6429	S. DEV. C3 = 2.6992
C3 = 3.9736	S. DEV. C3 = 0.0620

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 0 - 30 °C

CALIBRATION RESISTANCE RANGE: 424218 - 2108175 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
2108165	0.011	0.010	0.001
2108164	0.007	0.010	-0.003
2108169	0.011	0.010	0.001
2108176	0.011	0.010	0.001
2108175	0.013	0.010	0.003
2108179	0.007	0.010	-0.003
2108178	0.011	0.010	0.001
2108179	0.011	0.010	0.001
2108182	0.007	0.010	-0.003
2108182	0.013	0.010	0.003
1198196	10.101	10.105	-0.004
1192636	10.185	10.190	-0.005
1181800	10.361	10.358	0.003
1176534	10.438	10.440	-0.002
1171269	10.524	10.523	0.001
1165986	10.608	10.606	0.002
1155351	10.778	10.775	0.003
1142554	10.984	10.981	0.003
1137587	11.059	11.061	-0.002
1132679	11.141	11.141	0.000
708984.0	20.013	20.017	-0.004
705965.0	20.099	20.099	0.000
703418.0	20.168	20.170	-0.002
699178.0	20.290	20.287	0.003
697286.0	20.342	20.340	0.002
695510.0	20.390	20.389	0.001
692065.0	20.484	20.486	-0.002
690363.0	20.536	20.534	0.002
687917.0	20.606	20.603	0.003
686249.0	20.650	20.650	0.000
429484.0	30.006	30.009	-0.003
428591.0	30.052	30.051	0.001
427706.0	30.094	30.094	0.000
426819.0	30.136	30.136	0.000
424218.0	30.260	30.261	-0.001
422474.0	30.344	30.346	-0.002
421593.0	30.390	30.389	0.001
419060.0	30.514	30.512	0.002
417223.0	30.601	30.603	-0.002
416355.0	30.647	30.645	0.002

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 0 - 30 °C

CALIBRATION RESISTANCE RANGE: 424218 - 2108175 OHMS

THERMISTOR EQUATION: $T = \dfrac{C1 + C2 \; x \; \ln(R)}{C3 + \ln(R)}$

C1 =	5090.1942	S. DEV. C1 =	6.9258
C2 =	-349.5553	S. DEV. C3 =	0.4761
C3 =	5.5691	S. DEV. C3 =	0.0252

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 30 - 60 °C

CALIBRATION RESISTANCE RANGE: 104443 - 424218 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
429484.0	30.006	30.009	-0.003
428591.0	30.052	30.052	0.000
427706.0	30.094	30.094	0.000
426819.0	30.136	30.136	0.000
424218.0	30.260	30.261	-0.001
422474.0	30.344	30.346	-0.002
421593.0	30.390	30.388	0.002
419060.0	30.514	30.512	0.002
417223.0	30.601	30.602	-0.001
416355.0	30.647	30.644	0.003
257225.0	40.791	40.789	0.002
256662.7	40.837	40.836	0.001
256093.5	40.885	40.884	0.001
255512.6	40.928	40.933	-0.005
253797.5	41.076	41.079	-0.003
253242.1	41.126	41.127	-0.001
251718.8	41.260	41.257	0.003
251153.2	41.308	41.306	0.002
250606.3	41.354	41.354	0.000
250050.9	41.402	41.402	0.000
168866.0	50.117	50.119	-0.002
168108.5	50.219	50.221	-0.002
166605.9	50.425	50.425	0.000
165866.7	50.531	50.527	0.004
165123.4	50.629	50.629	0.000
164383.7	50.730	50.731	-0.001
163646.8	50.838	50.833	0.005
162916.7	50.936	50.935	0.001
161800.0	51.088	51.092	-0.004
161075.7	51.196	51.195	0.001
108353.1	60.451	60.465	-0.014
106177.7	60.958	60.951	0.007
105493.7	61.105	61.106	-0.001
104932.3	61.237	61.234	0.003
104443.4	61.347	61.346	0.001
103591.6	61.539	61.543	-0.004
103248.9	61.623	61.623	0.000
102802.8	61.730	61.727	0.003
102623.6	61.772	61.769	0.003

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 30 - 60 °C

CALIBRATION RESISTANCE RANGE: 104443 - 424218 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 = 4954.0380	S. DEV. C1 = 10.9306
C2 = -340.0484	S. DEV. C3 = 0.7639
C3 = 5.1407	S. DEV. C3 = 0.0344

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 60 - 90 °C

CALIBRATION RESISTANCE RANGE: 34021 - 104443 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
108353.1	60.451	60.466	-0.015
106177.7	60.958	60.951	0.007
105493.7	61.105	61.106	-0.001
104932.3	61.237	61.235	0.002
104443.4	61.347	61.347	0.000
103591.6	61.539	61.544	-0.005
103248.9	61.623	61.623	0.000
102802.8	61.730	61.728	0.002
102623.6	61.772	61.770	0.002
72954.7	70.167	70.161	0.006
72739.9	70.242	70.235	0.007
72525.1	70.314	70.309	0.005
72094.4	70.466	70.459	0.007
71881.7	70.534	70.533	0.001
71458.5	70.688	70.682	0.006
71083.1	70.818	70.814	0.004
70870.6	70.887	70.890	-0.003
70452.1	71.031	71.039	-0.008
70046.2	71.181	71.185	-0.004
49746.4	80.010	80.010	0.000
49575.4	80.104	80.101	0.003
49403.7	80.192	80.192	0.000
49234.0	80.278	80.283	-0.005
48731.2	80.550	80.554	-0.004
48565.1	80.645	80.644	0.001
48236.2	80.819	80.824	-0.005
47829.3	81.043	81.048	-0.005
47651.0	81.145	81.147	-0.002
47491.3	81.232	81.236	-0.004
34350.2	90.002	90.003	-0.001
34265.2	90.074	90.071	0.003
34181.7	90.138	90.139	-0.001
34100.8	90.208	90.204	0.004
34021.6	90.268	90.269	-0.001
33937.2	90.340	90.338	0.002
33854.9	90.407	90.405	0.002
33776.1	90.471	90.469	0.002
33611.6	90.603	90.605	-0.002
33347.7	90.823	90.823	0.000

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 60 - 90 °C

CALIBRATION RESISTANCE RANGE: 34021 - 104443 OHMS

THERMISTOR EQUATION: $T = \dfrac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$

C1 =	4877.0832	S. DEV. C1 =	18.6525
C2 =	-334.5633	S. DEV. C3 =	1.3399
C3 =	4.9194	S. DEV. C3 =	0.0519

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 90 - 120 °C

CALIBRATION RESISTANCE RANGE: 12375 - 34021 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
34350.2	90.002	90.004	-0.002
34265.2	90.074	90.072	0.002
34181.7	90.138	90.140	-0.002
34100.8	90.208	90.205	0.003
34021.6	90.268	90.270	-0.002
33937.2	90.340	90.338	0.002
33854.9	90.407	90.406	0.001
33776.1	90.471	90.470	0.001
33611.6	90.603	90.605	-0.002
33347.7	90.823	90.824	-0.001
24062.8	100.070	100.073	-0.003
23959.7	100.195	100.197	-0.002
23909.5	100.257	100.258	-0.001
23857.3	100.321	100.322	-0.001
23808.8	100.381	100.381	0.000
23757.0	100.447	100.444	0.003
23705.0	100.509	100.507	0.002
23653.4	100.573	100.571	0.002
23565.5	100.683	100.679	0.004
23514.6	100.741	100.742	-0.001
17175.4	110.063	110.066	-0.003
17140.2	110.129	110.129	0.000
17106.4	110.189	110.189	0.000
17071.6	110.251	110.250	0.001
17035.5	110.317	110.315	0.002
16999.9	110.379	110.378	0.001
16963.9	110.441	110.443	-0.002
16890.4	110.572	110.574	-0.002
16839.8	110.666	110.666	0.000
16804.6	110.728	110.729	-0.001
12462.2	120.013	120.014	-0.001
12441.2	120.067	120.067	0.000
12418.9	120.123	120.124	-0.001
12397.5	120.179	120.179	0.000
12375.0	120.239	120.236	0.003
12352.4	120.295	120.294	0.001
12331.5	120.352	120.348	0.004
12309.2	120.406	120.406	0.000
12285.0	120.468	120.468	0.000
12263.1	120.520	120.525	-0.005

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 90 - 120 °C

CALIBRATION RESISTANCE RANGE: 12375 - 34021 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 = 4824.9218	S. DEV. C1 = 8.4731
C2 = -330.7297	S. DEV. C3 = 0.6290
C3 = 4.7845	S. DEV. C3 = 0.0212

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 120 - 150 °C

CALIBRATION RESISTANCE RANGE: 5099 - 12375 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
12462.2	120.013	120.014	-0.001
12441.2	120.067	120.067	0.000
12418.9	120.123	120.124	-0.001
12397.5	120.179	120.179	0.000
12375.0	120.239	120.237	0.002
12352.4	120.295	120.295	0.000
12331.5	120.352	120.348	0.004
12309.2	120.406	120.406	0.000
12285.0	120.468	120.468	0.000
12263.1	120.520	120.525	-0.005
9155.6	130.009	130.009	0.000
9134.0	130.089	130.087	0.002
9114.5	130.158	130.158	0.000
9092.9	130.236	130.237	-0.001
9072.3	130.312	130.312	0.000
9051.3	130.390	130.389	0.001
9028.6	130.474	130.472	0.002
9007.6	130.548	130.550	-0.002
8985.4	130.634	130.632	0.002
8962.9	130.711	130.715	-0.004
6815.3	140.008	140.009	-0.001
6802.6	140.072	140.073	-0.001
6790.0	140.140	140.138	0.002
6775.0	140.212	140.214	-0.002
6760.5	140.288	140.289	-0.001
6734.5	140.424	140.422	0.002
6721.1	140.491	140.491	0.000
6707.4	140.563	140.562	0.001
6693.5	140.631	140.634	-0.003
6673.2	140.741	140.740	0.001
5137.6	150.008	150.003	0.005
5127.7	150.078	150.073	0.005
5118.1	150.142	150.141	0.001
5108.5	150.210	150.209	0.001
5099.2	150.275	150.275	0.000
5089.2	150.341	150.346	-0.005
5079.6	150.407	150.414	-0.007
5070.1	150.481	150.482	-0.001
5061.0	150.543	150.547	-0.004
5051.2	150.621	150.617	0.004

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 120 - 150 °C

CALIBRATION RESISTANCE RANGE: 5099 - 12375 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	4735.3079	S. DEV. C1 =	11.3454
C2 =	-323.9212	S. DEV. C3 =	0.8752
C3 =	4.5728	S. DEV. C3 =	0.0258

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 150 - 180 °C

CALIBRATION RESISTANCE RANGE: 2333 - 5099 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
5137.6	150.008	150.004	0.004
5127.7	150.078	150.074	0.004
5118.1	150.142	150.142	0.000
5108.5	150.210	150.210	0.000
5099.2	150.275	150.275	0.000
5089.2	150.341	150.346	-0.005
5079.6	150.407	150.415	-0.008
5070.1	150.481	150.483	-0.002
5061.0	150.543	150.548	-0.005
5051.2	150.621	150.618	0.003
3918.4	160.007	160.005	0.002
3911.7	160.073	160.069	0.004
3904.2	160.147	160.142	0.005
3896.5	160.221	160.216	0.005
3882.8	160.351	160.349	0.002
3868.5	160.491	160.489	0.002
3861.5	160.559	160.557	0.002
3854.4	160.628	160.627	0.001
3844.6	160.722	160.723	-0.001
3837.2	160.796	160.796	0.000
3020.9	170.019	170.018	0.001
3008.9	170.177	170.174	0.003
3003.3	170.247	170.248	-0.001
2996.6	170.335	170.336	-0.001
2972.6	170.652	170.652	0.000
2966.5	170.728	170.733	-0.005
2954.7	170.888	170.890	-0.002
2948.6	170.968	170.972	-0.004
2940.6	171.069	171.079	-0.010
2935.2	171.147	171.152	-0.005
2354.7	180.009	180.009	0.000
2349.7	180.099	180.096	0.003
2344.9	180.186	180.180	0.006
2339.3	180.282	180.278	0.004
2333.9	180.372	180.372	0.000
2328.8	180.458	180.462	-0.004
2323.4	180.556	180.557	-0.001
2318.4	180.646	180.646	0.000
2313.6	180.734	180.731	0.003
2308.7	180.815	180.818	-0.003

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 150 - 180 °C

CALIBRATION RESISTANCE RANGE: 2333 - 5099 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 = 4667.7623	S. DEV. C1 = 17.2459
C2 = -318.6637	S. DEV. C3 = 1.3872
C3 = 4.4219	S. DEV. C3 = 0.0360

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 180 - 210 °C

CALIBRATION RESISTANCE RANGE: 1144 - 2333 OHMS

THERMISTOR RESISTANCE (OHMS)	OBSERVED TEMPERATURE (°C)	CALCULATED TEMPERATURE (°C)	TEMPERATURE DIFFERENCE (°C)
2354.7	180.009	180.012	-0.003
2349.7	180.099	180.099	0.000
2344.9	180.186	180.183	0.003
2339.3	180.282	180.281	0.001
2333.9	180.372	180.375	-0.003
2328.8	180.458	180.465	-0.007
2323.4	180.556	180.560	-0.004
2318.4	180.646	180.649	-0.003
2313.6	180.734	180.734	0.000
2308.7	180.815	180.821	-0.006
1853.9	190.008	190.002	0.006
1849.1	190.112	190.112	0.000
1844.9	190.218	190.209	0.009
1840.3	190.324	190.316	0.008
1836.0	190.428	190.416	0.012
1827.5	190.621	190.614	0.007
1823.2	190.719	190.715	0.004
1818.9	190.827	190.816	0.011
1815.1	190.913	190.905	0.008
1807.7	191.085	191.080	0.005
1472.5	200.012	200.021	-0.009
1468.7	200.122	200.136	-0.014
1465.3	200.226	200.239	-0.013
1462.5	200.319	200.324	-0.005
1452.2	200.637	200.638	-0.001
1448.5	200.743	200.751	-0.008
1441.6	200.962	200.964	-0.002
1436.1	201.126	201.134	-0.008
1432.0	201.252	201.262	-0.010
1428.2	201.378	201.380	-0.002
1180.6	210.012	210.020	-0.008
1172.6	210.335	210.334	0.001
1164.2	210.671	210.667	0.004
1151.6	211.178	211.171	0.007
1144.1	211.475	211.474	0.001
1140.7	211.613	211.612	0.001
1138.1	211.717	211.718	-0.001
1135.9	211.803	211.808	-0.005
1133.7	211.909	211.898	0.011
1131.3	212.010	211.996	0.014

THERMISTOR CALIBRATION: PROBE 500-02 - 21 October 1989

NOMINAL TEMPERATURE RANGE: 180 - 210 °C

CALIBRATION RESISTANCE RANGE: 1144 - 2333 OHMS

THERMISTOR EQUATION: $$T = \frac{C1 + C2 \times \ln(R)}{C3 + \ln(R)}$$

C1 =	4506.2145	S. DEV. C1 =	31.6243
C2 =	-305.4364	S. DEV. C3 =	2.6592
C3 =	4.0948	S. DEV. C3 =	0.0611

APPENDIX II[1]

[1] Temperatures on July 23 and July 24, 1989 were obtained by the authors. The remainder of the temperatures for 1987 and 1988 were measured by D. Goodwin for the Town of Mammoth Lakes and were obtained from the California Division of Oil and Gas Geothermal Reports 051-90120 and 051-90121. The temperatures obtained by Goodwin were converted to degrees Celsius by the authors.

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - January 31, 1988
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90120)

DEPTH (FT)	TEMPERATURE (°C)
100	0.55
200	1.55
300	1.88
400	6.61
480	18.49
500	18.88
520	19.61
540	20.77
560	24.27
580	22.72
600	24.22
620	26.49
640	26.38
660	25.50
680	25.77
700	25.22
720	24.22
740	22.61
760	21.61
780	20.72
800	20.22
820	20.27
840	21.27
860	22.49
880	23.77
900	25.27
920	27.11
940	28.38
960	29.77
980	31.38
1000	33.61
1020	35.27
1040	36.99
1060	38.22
1080	40.27
1100	42.22
1120	43.88
1140	45.72
1160	47.88
1180	49.88
1200	51.61
1220	53.49
1240	53.99
1260	57.77
1280	60.38
1300	62.61
1320	65.22
1340	66.99
1360	68.38
1380	69.38
1400	69.72
1420	66.99
1440	69.38
1460	69.38

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - February 1, 1988
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90120)

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
20	4.88	1220	54.38
40	4.38	1240	55.61
60	4.38	1260	58.99
80	4.77	1280	61.99
100	4.27	1300	64.49
120	3.88	1320	66.77
140	3.61	1340	68.88
160	3.49	1360	70.27
180	4.38	1380	71.27
200	4.77	1400	71.99
220	5.11	1420	69.38
240	5.11	1440	71.11
260	5.61	1460	70.61
280	5.61		
300	6.22		
320	7.38		
340	9.27		
360	11.61		
380	13.88		
400	16.77		
420	18.22		
440	21.88		
460	24.49		
480	28.27		
500	29.11		
520	28.61		
540	26.99		
560	29.49		
580	28.77		
600	29.77		
620	32.22		
640	32.72		
660	28.61		
680	28.88		
700	28.00		
720	25.38		
740	22.38		
760	20.50		
780	19.72		
800	19.22		
820	20.77		
840	22.38		
860	23.49		
880	25.22		
900	26.88		
920	28.38		
940	29.61		
960	31.27		
980	32.77		
1000	34.72		
1020	35.99		
1040	38.00		
1060	39.27		
1080	40.99		
1100	43.38		
1120	45.94		
1140	47.22		
1160	49.27		
1180	50.99		
1200	52.22		

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - February 4, 1988
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90120)

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
20	4.88	1000	35.27
40	5.11	1020	37.11
60	5.22	1040	38.99
80	5.22	1060	40.88
100	4.77	1080	42.77
120	4.38	1100	44.88
140	4.11	1120	46.72
160	3.99	1140	48.77
180	4.72	1160	50.99
200	5.50	1180	52.72
220	5.72	1200	54.49
240	5.77	1220	55.99
260	6.38	1240	58.00
280	6.38	1260	60.77
300	10.22	1280	63.61
320	13.00	1300	66.22
340	16.22	1320	68.61
360	17.72	1340	70.77
380	19.88	1360	72.49
400	24.22	1370	73.27
420	28.77	1380	73.72
440	29.49	1390	74.22
450	30.11	1400	74.27
460	32.22	1410	75.11
470	33.88	1420	73.88
480	36.22	1430	70.38
490	37.11	1440	73.22
500	37.27	1450	72.88
510	37.22	1460	72.88
520	35.38		
530	35.61		
540	36.61		
550	33.11		
560	34.11		
570	34.77		
580	34.61		
590	32.88		
600	34.22		
610	35.11		
620	35.77		
630	36.49		
640	36.77		
650	34.38		
660	32.27		
680	32.72		
700	31.88		
720	28.49		
740	24.77		
760	21.88		
780	20.61		
800	20.11		
820	20.77		
840	22.61		
860	23.72		
880	25.22		
900	26.72		
920	28.11		
940	29.88		
960	31.61		
980	33.49		

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - February 14, 1988
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90120)

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
20	5.50	1220	58.27
40	4.88	1240	60.27
60	5.11	1260	63.22
80	5.11	1280	65.72
100	4.61	1300	68.22
120	4.22	1320	70.72
140	3.88	1340	72.77
160	3.77	1360	75.50
180	4.77	1380	76.49
200	5.38	1400	77.11
220	5.61	1410	77.49
240	5.99	1420	75.77
260	6.61	1440	73.88
280	8.61	1460	74.38
300	14.27		
320	15.72		
340	18.00		
360	19.49		
380	24.22		
400	29.61		
420	36.11		
440	40.11		
460	41.72		
480	42.88		
500	43.77		
520	41.72		
540	41.38		
560	41.22		
580	39.11		
600	39.11		
620	40.27		
640	40.11		
660	36.22		
680	36.49		
700	34.27		
720	29.11		
740	24.88		
760	22.49		
780	21.61		
800	21.11		
820	22.49		
840	24.11		
860	25.11		
880	26.88		
900	28.38		
920	29.99		
940	31.49		
960	33.38		
980	35.38		
1000	36.99		
1020	38.38		
1040	40.27		
1060	42.11		
1080	44.11		
1100	46.27		
1120	48.22		
1140	50.61		
1160	52.49		
1180	54.88		
1200	56.49		

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - JULY 23, 1989

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
10	21.033	70	8.064	130	7.179	190	8.130	250	10.714
11	20.967	71	8.065	131	7.170	191	8.156	251	10.957
12	20.902	72	8.066	132	7.161	192	8.181	252	11.200
13	20.837	73	8.067	133	7.152	193	8.204	253	11.434
14	20.770	74	8.068	134	7.146	194	8.226	254	11.673
15	20.698	75	8.069	135	7.140	195	8.246	255	11.913
16	20.630	76	8.068	136	7.134	196	8.264	256	12.148
17	20.557	77	8.068	137	7.130	197	8.280	257	12.386
18	20.487	78	8.068	138	7.126	198	8.295	258	12.615
19	20.418	79	8.065	139	7.124	199	8.307	259	12.839
20	20.348	80	8.061	140	7.122	200	8.319	260	13.048
21	20.281	81	8.056	141	7.121	201	8.328	261	13.238
22	20.221	82	8.049	142	7.121	202	8.336	262	13.429
23	20.160	83	8.042	143	7.122	203	8.345	263	13.612
24	20.101	84	8.034	144	7.123	204	8.352	264	13.792
25	20.044	85	8.025	145	7.125	205	8.359	265	13.969
26	19.988	86	8.016	146	7.126	206	8.365	266	14.144
27	19.933	87	8.005	147	7.129	207	8.371	267	14.316
28	19.880	88	7.993	148	7.134	208	8.377	268	14.481
29	19.825	89	7.980	149	7.139	209	8.382	269	14.633
30	17.893	90	7.966	150	7.146	210	8.387	270	14.777
31	13.296	91	7.949	151	7.153	211	8.392	271	14.910
32	11.096	92	7.931	152	7.162	212	8.397	272	15.036
33	9.951	93	7.912	153	7.171	213	8.403	273	15.164
34	9.316	94	7.891	154	7.181	214	8.408	274	15.289
35	8.927	95	7.867	155	7.191	215	8.414	275	15.416
36	8.683	96	7.840	156	7.201	216	8.420	276	15.531
37	8.525	97	7.813	157	7.212	217	8.427	277	15.648
38	8.418	98	7.785	158	7.226	218	8.434	278	15.767
39	8.343	99	7.759	159	7.239	219	8.441	279	15.889
40	8.290	100	7.735	160	7.253	220	8.448	280	16.023
41	8.250	101	7.712	161	7.268	221	8.455	281	16.165
42	8.220	102	7.691	162	7.283	222	8.462	282	16.286
43	8.196	103	7.671	163	7.299	223	8.471	283	16.414
44	8.177	104	7.652	164	7.316	224	8.480	284	16.521
45	8.161	105	7.633	165	7.333	225	8.489	285	16.653
46	8.148	106	7.615	166	7.352	226	8.501	286	16.788
47	8.137	107	7.597	167	7.369	227	8.513	287	16.926
48	8.128	108	7.580	168	7.388	228	8.527	288	17.071
49	8.120	109	7.561	169	7.405	229	8.543	289	17.226
50	8.113	110	7.542	170	7.424	230	8.560	290	17.363
51	8.108	111	7.525	171	7.443	231	8.580	291	17.504
52	8.103	112	7.505	172	7.464	232	8.603	292	17.653
53	8.099	113	7.486	173	7.488	233	8.630	293	17.818
54	8.094	114	7.466	174	7.517	234	8.663	294	17.980
55	8.090	115	7.444	175	7.551	235	8.699	295	18.157
56	8.086	116	7.420	176	7.588	236	8.738	296	18.339
57	8.082	117	7.397	177	7.629	237	8.782	297	18.519
58	8.079	118	7.373	178	7.673	238	8.829	298	18.699
59	8.075	119	7.351	179	7.716	239	8.878	299	18.869
60	8.073	120	7.330	180	7.759	240	8.929	300	19.031
61	8.071	121	7.309	181	7.800	241	8.989	301	19.148
62	8.069	122	7.290	182	7.840	242	9.071	302	19.281
63	8.067	123	7.273	183	7.878	243	9.177	303	19.390
64	8.066	124	7.257	184	7.917	244	9.309	304	19.501
65	8.065	125	7.242	185	7.956	245	9.502	305	19.581
66	8.064	126	7.228	186	7.997	246	9.734	306	19.708
67	8.064	127	7.215	187	8.035	247	9.980	307	19.885
68	8.064	128	7.202	188	8.070	248	10.226	308	20.061
69	8.065	129	7.190	189	8.102	249	10.474	309	20.198

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310	20.343	370	30.964	430	44.256	490	51.606	550	50.553
311	20.431	371	30.803	431	44.714	491	51.652	551	50.425
312	20.509	372	31.045	432	45.457	492	51.695	552	50.301
313	20.608	373	30.438	433	45.832	493	51.734	553	50.178
314	20.686	374	30.669	434	46.207	494	51.770	554	50.059
315	20.790	375	30.395	435	46.551	495	51.808	555	49.940
316	20.902	376	29.683	436	46.705	496	51.844	556	49.828
317	21.021	377	30.100	437	47.025	497	51.869	557	49.721
318	21.208	378	30.241	438	47.175	498	51.882	558	49.618
319	21.443	379	29.912	439	47.340	499	51.892	559	49.522
320	21.632	380	30.726	440	47.456	500	51.923	560	49.427
321	21.766	381	30.604	441	47.638	501	51.957	561	49.332
322	21.876	382	30.489	442	47.825	502	51.992	562	49.241
323	22.107	383	31.403	443	47.922	503	52.023	563	49.148
324	22.118	384	31.451	444	48.010	504	52.054	564	49.055
325	22.134	385	31.387	445	48.098	505	52.090	565	48.962
326	22.171	386	31.749	446	48.148	506	52.138	566	48.866
327	22.260	387	32.314	447	48.229	507	52.191	567	48.771
328	22.642	388	32.338	448	48.378	508	52.245	568	48.674
329	23.624	389	32.835	449	48.582	509	52.301	569	48.573
330	24.020	390	32.618	450	48.666	510	52.352	570	48.465
331	24.147	391	32.416	451	48.695	511	52.388	571	48.361
332	24.226	392	33.134	452	48.877	512	52.404	572	48.255
333	24.305	393	32.614	453	48.969	513	52.408	573	48.151
334	24.443	394	32.439	454	49.004	514	52.402	574	48.047
335	24.594	395	33.020	455	49.107	515	52.391	575	47.939
336	24.534	396	32.709	456	49.205	516	52.377	576	47.833
337	24.325	397	33.004	457	49.317	517	52.360	577	47.731
338	24.154	398	33.229	458	49.448	518	52.343	578	47.631
339	24.079	399	33.078	459	49.602	519	52.327	579	47.534
340	23.993	400	33.734	460	49.757	520	52.309	580	47.431
341	23.947	401	33.697	461	49.893	521	52.292	581	47.328
342	23.898	402	33.647	462	50.010	522	52.274	582	47.228
343	23.919	403	33.665	463	50.068	523	52.257	583	47.128
344	24.101	404	34.580	464	50.180	524	52.238	584	47.027
345	24.181	405	34.240	465	50.216	525	52.217	585	46.925
346	24.324	406	34.114	466	50.318	526	52.195	586	46.821
347	24.714	407	34.291	467	50.359	527	52.170	587	46.722
348	25.056	408	35.074	468	50.429	528	52.143	588	46.623
349	25.252	409	34.827	469	50.495	529	52.113	589	46.526
350	25.596	410	34.744	470	50.552	530	52.082	590	46.433
351	25.935	411	34.696	471	50.617	531	52.050	591	46.346
352	26.077	412	34.762	472	50.704	532	52.017	592	46.263
353	26.185	413	35.360	473	50.850	533	51.982	593	46.187
354	26.364	414	36.220	474	50.955	534	51.945	594	46.114
355	26.572	415	36.583	475	51.019	535	51.904	595	46.044
356	26.762	416	37.066	476	51.055	536	51.858	596	45.978
357	26.952	417	37.719	477	51.100	537	51.806	597	45.915
358	27.226	418	38.314	478	51.127	538	51.748	598	45.853
359	27.474	419	38.805	479	51.151	539	51.684	599	45.793
360	27.466	420	39.281	480	51.181	540	51.615	600	45.737
361	27.627	421	39.675	481	51.221	541	51.541	601	45.682
362	27.694	422	39.905	482	51.275	542	51.463	602	45.627
363	28.235	423	41.294	483	51.306	543	51.372	603	45.572
364	28.802	424	41.547	484	51.342	544	51.269	604	45.520
365	29.245	425	41.852	485	51.375	545	51.160	605	45.465
366	29.650	426	42.183	486	51.411	546	51.048	606	45.414
367	29.963	427	42.586	487	51.454	547	50.928	607	45.361
368	30.652	428	42.930	488	51.502	548	50.803	608	45.309
369	31.002	429	43.792	489	51.557	549	50.677	609	45.257

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610	45.206	670	41.014	730	27.394	790	24.026	850	26.014
611	45.155	671	40.885	731	27.211	791	24.017	851	26.087
612	45.105	672	40.749	732	27.031	792	24.033	852	26.125
613	45.054	673	40.609	733	26.848	793	24.046	853	26.236
614	45.005	674	40.470	734	26.670	794	24.046	854	26.338
615	44.954	675	40.326	735	26.496	795	24.051	855	26.390
616	44.905	676	40.173	736	26.333	796	24.065	856	26.483
617	44.855	677	40.017	737	26.176	797	24.086	857	26.539
618	44.806	678	39.853	738	26.023	798	24.110	858	26.575
619	44.757	679	39.685	739	25.876	799	24.123	859	26.639
620	44.707	680	39.512	740	25.731	800	24.140	860	26.692
621	44.658	681	39.331	741	25.593	801	24.162	861	26.759
622	44.609	682	39.146	742	25.460	802	24.186	862	26.831
623	44.560	683	38.959	743	25.327	803	24.213	863	26.900
624	44.511	684	38.761	744	25.197	804	24.238	864	26.958
625	44.463	685	38.559	745	25.068	805	24.269	865	27.065
626	44.413	686	38.339	746	24.942	806	24.300	866	27.200
627	44.363	687	38.115	747	24.821	807	24.353	867	27.259
628	44.314	688	37.883	748	24.701	808	24.426	868	27.330
629	44.264	689	37.647	749	24.587	809	24.444	869	27.606
630	44.215	690	37.398	750	24.484	810	24.487	870	27.676
631	44.166	691	37.149	751	24.390	811	24.525	871	27.717
632	44.117	692	36.889	752	24.309	812	24.557	872	27.718
633	44.067	693	36.624	753	24.239	813	24.591	873	27.839
634	44.017	694	36.362	754	24.180	814	24.623	874	27.895
635	43.966	695	36.086	755	24.128	815	24.654	875	27.835
636	43.915	696	35.813	756	24.083	816	24.676	876	27.837
637	43.863	697	35.538	757	24.044	817	24.715	877	27.995
638	43.810	698	35.252	758	24.010	818	24.752	878	28.135
639	43.756	699	34.958	759	23.981	819	24.784	879	28.220
640	43.702	700	34.653	760	23.954	820	24.812	880	28.303
641	43.647	701	34.350	761	23.929	821	24.846	881	28.370
642	43.591	702	34.044	762	23.907	822	24.879	882	28.394
643	43.533	703	33.735	763	23.887	823	25.031	883	28.428
644	43.475	704	33.413	764	23.867	824	25.203	884	28.607
645	43.413	705	33.094	765	23.850	825	25.276	885	28.661
646	43.354	706	32.789	766	23.834	826	25.283	886	28.791
647	43.294	707	32.499	767	23.818	827	25.305	887	28.906
648	43.232	708	32.237	768	23.804	828	25.315	888	28.965
649	43.164	709	31.987	769	23.791	829	25.322	889	29.049
650	43.089	710	31.737	770	23.780	830	25.321	890	29.059
651	43.010	711	31.502	771	23.770	831	25.322	891	29.064
652	42.933	712	31.274	772	23.761	832	25.337	892	29.056
653	42.856	713	31.046	773	23.752	833	25.364	893	29.064
654	42.774	714	30.824	774	23.743	834	25.388	894	29.100
655	42.693	715	30.598	775	23.735	835	25.424	895	29.118
656	42.609	716	30.369	776	23.728	836	25.455	896	29.152
657	42.515	717	30.138	777	23.722	837	25.486	897	29.169
658	42.418	718	29.907	778	23.717	838	25.548	898	29.194
659	42.315	719	29.674	779	23.713	839	25.568	899	29.276
660	42.209	720	29.441	780	23.711	840	25.606	900	29.341
661	42.096	721	29.202	781	23.711	841	25.644	901	29.450
662	41.982	722	28.965	782	23.714	842	25.678	902	29.569
663	41.865	723	28.739	783	23.721	843	25.720	903	29.634
664	41.746	724	28.518	784	23.735	844	25.739	904	29.683
665	41.626	725	28.317	785	23.754	845	25.762	905	29.738
666	41.507	726	28.127	786	23.775	846	25.805	906	29.843
667	41.379	727	27.945	787	23.801	847	25.841	907	29.895
668	41.261	728	27.764	788	23.828	848	25.921	908	29.977
669	41.140	729	27.579	789	24.013	849	25.991	909	30.065

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910	30.059	970	35.204	1030	40.712	1090	46.369	1150	52.443
911	30.210	971	35.395	1031	40.785	1091	46.503	1151	52.565
912	30.270	972	35.528	1032	40.773	1092	46.622	1152	52.667
913	30.416	973	35.656	1033	40.879	1093	46.752	1153	52.773
914	30.517	974	35.753	1034	41.017	1094	46.817	1154	52.834
915	30.616	975	35.941	1035	41.117	1095	46.924	1155	52.908
916	30.785	976	36.112	1036	41.127	1096	47.069	1156	53.014
917	30.856	977	36.224	1037	41.239	1097	47.252	1157	53.103
918	30.913	978	36.287	1038	41.338	1098	47.322	1158	53.179
919	30.978	979	36.253	1039	41.528	1099	47.326	1159	53.276
920	30.968	980	36.270	1040	41.657	1100	47.414	1160	53.405
921	31.025	981	36.295	1041	41.648	1101	47.602	1161	53.491
922	31.159	982	36.320	1042	41.634	1102	47.673	1162	53.588
923	31.249	983	36.448	1043	41.708	1103	47.752	1163	53.700
924	31.274	984	36.448	1044	41.833	1104	47.814	1164	53.776
925	31.272	985	36.476	1045	41.866	1105	47.946	1165	53.899
926	31.300	986	36.581	1046	42.031	1106	48.060	1166	54.020
927	31.335	987	36.772	1047	42.139	1107	48.146	1167	54.110
928	31.484	988	36.859	1048	42.243	1108	48.228	1168	54.217
929	31.608	989	36.999	1049	42.346	1109	48.315	1169	54.318
930	31.652	990	37.084	1050	42.392	1110	48.390	1170	54.413
931	31.742	991	37.093	1051	42.489	1111	48.539	1171	54.492
932	31.812	992	37.135	1052	42.605	1112	48.620	1172	54.601
933	31.870	993	37.284	1053	42.688	1113	48.724	1173	54.692
934	31.944	994	37.337	1054	42.847	1114	48.865	1174	54.778
935	32.156	995	37.426	1055	42.894	1115	48.964	1175	54.872
936	32.201	996	37.513	1056	42.999	1116	49.059	1176	54.970
937	32.247	997	37.673	1057	43.101	1117	49.157	1177	55.082
938	32.356	998	37.806	1058	43.184	1118	49.263	1178	55.159
939	32.488	999	37.908	1059	43.263	1119	49.402	1179	55.255
940	32.489	1000	37.954	1060	43.352	1120	49.506	1180	55.352
941	32.520	1001	38.062	1061	43.404	1121	49.524	1181	55.469
942	32.722	1002	38.139	1062	43.451	1122	49.633	1182	55.550
943	32.798	1003	38.289	1063	43.619	1123	49.767	1183	55.648
944	32.839	1004	38.329	1064	43.767	1124	49.868	1184	55.771
945	32.946	1005	38.420	1065	43.853	1125	50.009	1185	55.882
946	32.996	1006	38.537	1066	43.914	1126	50.094	1186	55.996
947	33.084	1007	38.631	1067	44.007	1127	50.294	1187	56.087
948	33.187	1008	38.740	1068	44.085	1128	50.318	1188	56.171
949	33.342	1009	38.849	1069	44.159	1129	50.473	1189	56.269
950	33.460	1010	38.860	1070	44.255	1130	50.562	1190	56.399
951	33.510	1011	38.902	1071	44.428	1131	50.708	1191	56.495
952	33.500	1012	38.976	1072	44.517	1132	50.823	1192	56.572
953	33.582	1013	39.116	1073	44.599	1133	50.861	1193	56.676
954	33.662	1014	39.216	1074	44.718	1134	50.919	1194	56.785
955	33.685	1015	39.291	1075	44.906	1135	51.039	1195	56.900
956	33.900	1016	39.298	1076	45.080	1136	51.154	1196	57.007
957	33.991	1017	39.307	1077	45.153	1137	51.271	1197	57.106
958	33.998	1018	39.362	1078	45.178	1138	51.383	1198	57.206
959	34.086	1019	39.499	1079	45.255	1139	51.504	1199	57.291
960	34.138	1020	39.624	1080	45.398	1140	51.564	1200	57.377
961	34.170	1021	39.709	1081	45.476	1141	51.678	1201	57.510
962	34.333	1022	39.874	1082	45.571	1142	51.761	1202	57.625
963	34.463	1023	39.927	1083	45.600	1143	51.825	1203	57.716
964	34.592	1024	40.070	1084	45.741	1144	51.977	1204	57.807
965	34.807	1025	40.106	1085	45.853	1145	52.041	1205	57.878
966	34.839	1026	40.157	1086	45.958	1146	52.097	1206	57.945
967	34.929	1027	40.253	1087	46.041	1147	52.158	1207	58.043
968	35.018	1028	40.422	1088	46.174	1148	52.246	1208	58.150
969	35.146	1029	40.572	1089	46.251	1149	52.348	1209	58.275

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1210	58.386	1270	65.534	1330	72.186	1390	76.613	1450	74.557
1211	58.461	1271	65.658	1331	72.318	1391	76.646		
1212	58.538	1272	65.776	1332	72.440	1392	76.676		
1213	58.638	1273	65.897	1333	72.550	1393	76.705		
1214	58.742	1274	66.008	1334	72.662	1394	76.737		
1215	58.863	1275	66.141	1335	72.767	1395	76.770		
1216	58.982	1276	66.229	1336	72.864	1396	76.797		
1217	59.077	1277	66.327	1337	72.971	1397	76.822		
1218	59.196	1278	66.450	1338	73.087	1398	76.842		
1219	59.314	1279	66.568	1339	73.195	1399	76.866		
1220	59.445	1280	66.688	1340	73.320	1400	76.887		
1221	59.543	1281	66.811	1341	73.436	1401	76.914		
1222	59.625	1282	66.940	1342	73.541	1402	76.939		
1223	59.733	1283	67.075	1343	73.632	1403	76.965		
1224	59.868	1284	67.199	1344	73.715	1404	76.985		
1225	59.986	1285	67.317	1345	73.799	1405	77.001		
1226	60.083	1286	67.436	1346	73.881	1406	77.009		
1227	60.195	1287	67.542	1347	73.962	1407	77.012		
1228	60.298	1288	67.662	1348	74.045	1408	77.005		
1229	60.418	1289	67.768	1349	74.133	1409	76.993		
1230	60.526	1290	67.907	1350	74.215	1410	76.977		
1231	60.635	1291	68.022	1351	74.298	1411	76.959		
1232	60.733	1292	68.132	1352	74.374	1412	76.936		
1233	60.858	1293	68.240	1353	74.454	1413	76.908		
1234	60.969	1294	68.339	1354	74.526	1414	76.877		
1235	61.089	1295	68.453	1355	74.594	1415	76.842		
1236	61.216	1296	68.545	1356	74.660	1416	76.798		
1237	61.333	1297	68.653	1357	74.730	1417	76.746		
1238	61.439	1298	68.735	1358	74.807	1418	76.681		
1239	61.576	1299	68.820	1359	74.875	1419	76.624		
1240	61.693	1300	68.898	1360	74.934	1420	76.582		
1241	61.807	1301	68.980	1361	74.998	1421	76.544		
1242	61.912	1302	69.062	1362	75.075	1422	76.484		
1243	62.034	1303	69.140	1363	75.154	1423	76.428		
1244	62.175	1304	69.215	1364	75.227	1424	76.379		
1245	62.305	1305	69.372	1365	75.293	1425	76.322		
1246	62.460	1306	69.678	1366	75.358	1426	76.242		
1247	62.583	1307	69.802	1367	75.484	1427	76.165		
1248	62.666	1308	69.882	1368	75.593	1428	76.101		
1249	62.788	1309	69.936	1369	75.679	1429	76.032		
1250	62.900	1310	69.978	1370	75.745	1430	75.964		
1251	62.998	1311	70.022	1371	75.798	1431	75.906		
1252	63.149	1312	70.090	1372	75.854	1432	75.838		
1253	63.284	1313	70.206	1373	75.898	1433	75.741		
1254	63.405	1314	70.342	1374	75.939	1434	75.667		
1255	63.542	1315	70.483	1375	75.983	1435	75.614		
1256	63.658	1316	70.638	1376	76.036	1436	75.556		
1257	63.811	1317	70.739	1377	76.082	1437	75.508		
1258	63.954	1318	70.817	1378	76.122	1438	75.457		
1259	64.086	1319	70.905	1379	76.167	1439	75.377		
1260	64.197	1320	70.984	1380	76.214	1440	75.296		
1261	64.341	1321	71.056	1381	76.256	1441	75.237		
1262	64.495	1322	71.128	1382	76.300	1442	75.202		
1263	64.622	1323	71.204	1383	76.362	1443	75.165		
1264	64.747	1324	71.296	1384	76.417	1444	75.073		
1265	64.881	1325	71.416	1385	76.465	1445	74.965		
1266	65.029	1326	71.544	1386	76.501	1446	74.895		
1267	65.153	1327	71.692	1387	76.528	1447	74.831		
1268	65.273	1328	71.865	1388	76.552	1448	74.771		
1269	65.412	1329	72.035	1389	76.580	1449	74.719		

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - December 10, 1987
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90121)

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
340	8.88	1540	54.22
360	9.38	1560	55.27
380	11.11	1580	55.27
400	12.49	1600	55.27
420	14.38		
440	16.38		
460	17.38		
480	17.88		
500	19.11		
520	20.27		
540	21.49		
560	22.61		
580	24.11		
600	25.50		
620	26.61		
640	27.61		
660	28.38		
680	29.27		
700	30.50		
720	31.38		
740	32.11		
760	33.00		
780	33.61		
800	34.27		
820	34.77		
840	36.11		
860	36.99		
880	37.61		
900	38.22		
920	39.11		
940	39.72		
960	39.99		
980	40.27		
1000	40.77		
1020	41.61		
1040	42.27		
1060	42.61		
1080	42.88		
1100	43.22		
1120	43.77		
1140	44.49		
1160	44.49		
1180	44.77		
1200	44.11		
1220	44.27		
1240	44.88		
1260	45.38		
1280	45.72		
1300	45.61		
1320	45.77		
1340	46.11		
1360	46.49		
1380	47.49		
1400	48.11		
1420	48.72		
1440	49.49		
1460	50.38		
1480	51.11		
1500	52.11		
1520	52.49		

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - December 12, 1987
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90121)

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
220	6.16	1420	63.38
240	6.61	1440	64.99
260	7.27	1460	64.99
280	8.11	1480	65.22
300	8.49	1500	66.22
320	8.77	1520	67.11
340	8.99	1540	68.11
360	9.11	1560	69.11
380	12.27	1580	70.61
400	15.27	1600	71.49
420	16.99		
440	17.49		
460	18.11		
480	18.72		
500	20.27		
520	22.72		
540	24.88		
560	26.61		
580	28.61		
600	31.11		
620	32.88		
640	34.49		
660	35.61		
680	36.38		
700	37.49		
720	39.11		
740	40.11		
760	40.99		
780	41.72		
800	42.38		
820	42.77		
840	43.61		
860	44.22		
880	44.72		
900	45.27		
920	45.77		
940	45.88		
960	46.27		
980	46.61		
1000	47.61		
1020	48.27		
1040	49.22		
1060	49.99		
1080	50.77		
1100	51.77		
1120	52.22		
1140	52.11		
1160	53.11		
1180	52.77		
1200	53.11		
1220	53.72		
1240	54.49		
1260	55.22		
1280	56.49		
1300	57.49		
1320	58.49		
1340	58.99		
1360	59.99		
1380	60.88		
1400	61.99		

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - December 16, 1987
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90121)

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
380	8.00	1580	72.72
400	16.27	1600	73.61
420	17.38		
440	17.88		
460	18.61		
480	19.27		
500	21.27		
520	24.11		
540	26.38		
560	28.61		
580	30.77		
600	33.38		
620	35.27		
640	36.61		
660	37.88		
680	38.61		
700	39.77		
720	41.27		
740	42.27		
760	43.00		
780	43.72		
800	44.27		
820	44.77		
840	45.50		
860	45.99		
880	46.49		
900	46.99		
920	47.38		
940	47.61		
960	48.11		
980	48.38		
1000	49.27		
1020	49.99		
1040	50.77		
1060	51.38		
1080	52.11		
1100	52.88		
1120	53.49		
1140	53.72		
1160	54.61		
1180	54.61		
1200	55.22		
1220	55.99		
1240	56.77		
1260	57.72		
1280	58.77		
1300	59.72		
1320	60.72		
1340	61.38		
1360	62.49		
1380	63.27		
1400	64.27		
1420	65.27		
1440	66.61		
1460	66.99		
1480	67.72		
1500	68.72		
1520	69.61		
1540	70.61		
1560	71.72		

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - January 9, 1988
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P.I. No. 051-90121)

DEPTH (FT)	TEMPERATURE (°C)
420	17.61
440	18.22
460	18.72
480	19.61
500	21.99
520	25.27
540	27.61
560	30.38
580	32.22
600	34.88
620	36.77
640	38.11
660	39.27
680	40.50
700	41.88
720	43.00
740	43.88
760	44.61
780	45.22
800	45.88
820	46.27
840	46.99
860	47.38
880	47.77
900	48.22
920	48.27
940	48.88
960	49.27
980	49.88
1000	50.72
1020	51.38
1040	51.99
1060	52.49
1080	53.11
1100	53.77
1120	54.49
1140	54.99
1160	55.61
1180	56.11
1200	56.77
1220	57.61
1240	58.38
1260	59.27
1280	60.27
1300	61.22
1320	62.11
1340	63.00
1360	63.88
1380	64.72
1400	65.61
1420	66.49
1440	67.38
1460	68.00
1480	68.77
1500	69.77
1520	70.77
1540	71.72
1560	72.72
1580	73.61
1600	74.22

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - January 29, 1988
Temperatures measured by D. Goodwin for the Town of Mammoth Lakes.
Data obtained from California Division of Oil and Gas Geothermal Report (A.P. I. No. 051-90121)

DEPTH (FT)	TEMPERATURE (°C)
420	17.38
460	18.72
500	21.72
550	29.11
600	34.99
650	38.88
700	41.99
750	44.38
800	45.99
850	47.38
900	48.38
950	49.27
1000	50.77
1050	52.49
1100	53.88
1150	55.50
1200	56.99
1250	59.11
1300	61.38
1350	63.61
1400	65.72
1450	67.77
1500	69.99
1550	72.38
1600	74.22

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - JULY 24, 1989

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
10	19.045	76	16.977	136	14.925	196	13.649	256	13.103
11	19.012	77	16.943	137	14.893	197	13.638	257	13.097
14	18.933	78	16.909	138	14.861	198	13.627	258	13.091
15	18.883	79	16.876	139	14.828	199	13.616	259	13.085
16	18.849	80	16.842	140	14.796	200	13.605	260	13.079
17	18.819	81	16.808	141	14.764	201	13.595	261	13.074
18	18.790	82	16.774	142	14.734	202	13.584	262	13.068
19	18.756	83	16.740	143	14.702	203	13.574	263	13.063
20	18.711	84	16.706	144	14.672	204	13.563	264	13.058
21	18.679	85	16.672	145	14.643	205	13.553	265	13.053
22	18.649	86	16.639	146	14.613	206	13.543	266	13.049
23	18.614	87	16.606	147	14.583	207	13.533	267	13.043
24	18.574	88	16.572	148	14.555	208	13.523	268	13.039
25	18.522	89	16.538	149	14.527	209	13.514	269	13.034
26	18.466	90	16.503	150	14.500	210	13.505	270	13.029
27	18.430	91	16.467	151	14.473	211	13.495	271	13.025
32	18.311	92	16.433	152	14.448	212	13.486	272	13.021
33	18.188	93	16.398	153	14.423	213	13.477	273	13.016
34	18.122	94	16.364	154	14.398	214	13.468	274	13.012
35	18.083	95	16.331	155	14.373	215	13.459	275	13.008
36	18.053	96	16.298	156	14.349	216	13.450	276	13.004
37	18.025	97	16.265	157	14.325	217	13.440	277	13.001
38	17.997	98	16.231	158	14.301	218	13.431	278	12.998
39	17.971	99	16.197	159	14.278	219	13.422	279	12.994
40	17.945	100	16.163	160	14.254	220	13.413	280	12.991
41	17.920	101	16.129	161	14.230	221	13.403	281	12.987
42	17.895	102	16.094	162	14.206	222	13.394	282	12.984
43	17.870	103	16.059	163	14.182	223	13.385	283	12.981
44	17.845	104	16.026	164	14.158	224	13.376	284	12.978
45	17.820	105	15.992	165	14.135	225	13.367	285	12.975
46	17.795	106	15.957	166	14.113	226	13.358	286	12.972
47	17.771	107	15.922	167	14.093	227	13.350	287	12.969
48	17.747	108	15.887	168	14.072	228	13.340	288	12.966
49	17.722	109	15.853	169	14.053	229	13.331	289	12.963
50	17.697	110	15.819	170	14.034	230	13.322	290	12.960
51	17.673	111	15.785	171	14.015	231	13.313	291	12.957
52	17.649	112	15.749	172	13.997	232	13.303	292	12.954
53	17.625	113	15.714	173	13.979	233	13.294	293	12.951
54	17.601	114	15.680	174	13.961	234	13.284	294	12.948
55	17.576	115	15.644	175	13.943	235	13.275	295	12.945
56	17.552	116	15.611	176	13.926	236	13.266	296	12.942
57	17.527	117	15.575	177	13.910	237	13.257	297	12.940
58	17.502	118	15.539	178	13.893	238	13.248	298	12.937
59	17.478	119	15.506	179	13.877	239	13.239	299	12.935
60	17.452	120	15.471	180	13.861	240	13.231	300	12.923
61	17.425	121	15.437	181	13.845	241	13.222	301	12.932
62	17.398	122	15.402	182	13.830	242	13.213	302	12.931
63	17.371	123	15.367	183	13.816	243	13.205	303	12.930
64	17.344	124	15.332	184	13.801	244	13.196	304	12.930
65	17.317	125	15.299	185	13.787	245	13.187	305	12.931
66	17.290	126	15.264	186	13.773	246	13.178	306	12.931
67	17.263	127	15.229	187	13.760	247	13.170	307	12.931
68	17.235	128	15.195	188	13.747	248	13.161	308	12.931
69	17.207	129	15.161	189	13.734	249	13.153	309	12.932
70	17.177	130	15.127	190	13.721	250	13.144	310	12.932
71	17.146	131	15.093	191	13.708	251	13.137	311	12.932
72	17.112	132	15.059	192	13.696	252	13.129	312	12.932
73	17.077	133	15.025	193	13.684	253	13.122	313	12.932
74	17.043	134	14.992	194	13.672	254	13.116	314	12.932
75	17.011	135	14.958	195	13.660	255	13.109	315	12.932

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - JULY 24, 1989

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
316	12.932	376	12.908	436	18.990	496	22.919	556	31.763
317	12.932	377	12.909	437	19.137	497	23.061	557	31.936
318	12.932	378	12.911	438	19.231	498	23.196	558	32.068
319	12.933	379	12.912	439	19.310	499	23.353	559	32.198
320	12.932	380	12.914	440	19.384	500	23.524	560	32.299
321	12.932	381	12.916	441	19.465	501	23.669	561	32.386
322	12.932	382	12.918	442	19.542	502	23.865	562	32.469
323	12.932	383	12.921	443	19.615	503	24.065	563	32.538
324	12.932	384	12.923	444	19.680	504	24.250	564	32.613
325	12.932	385	12.926	445	19.727	505	24.417	565	32.712
326	12.932	386	12.929	446	19.769	506	24.549	566	32.793
327	12.931	387	12.933	447	19.799	507	24.761	567	32.908
328	12.931	388	12.938	448	19.858	508	24.883	568	32.994
329	12.931	389	12.942	449	19.907	509	25.032	569	33.088
330	12.931	390	12.948	450	19.960	510	25.171	570	33.165
331	12.931	391	12.954	451	20.006	511	25.312	571	33.241
332	12.930	392	12.961	452	20.036	512	25.473	572	33.322
333	12.930	393	12.968	453	20.102	513	25.626	573	33.409
334	12.929	394	12.975	454	20.155	514	25.796	574	33.514
335	12.929	395	12.982	455	20.206	515	25.971	575	33.646
336	12.929	396	12.990	456	20.252	516	26.147	576	33.737
337	12.928	397	12.998	457	20.293	517	26.281	577	33.832
338	12.928	398	13.006	458	20.347	518	26.454	578	33.935
339	12.928	399	13.013	459	20.405	519	26.569	579	34.044
340	12.927	400	13.022	460	20.449	520	26.740	580	34.142
341	12.927	401	13.030	461	20.499	521	26.891	581	34.261
342	12.926	402	13.040	462	20.550	522	27.023	582	34.364
343	12.926	403	13.051	463	20.619	523	27.165	583	34.461
344	12.926	404	13.062	464	20.671	524	27.319	584	34.567
345	12.925	405	13.075	465	20.728	525	27.468	585	34.666
346	12.925	406	13.089	466	20.763	526	27.644	586	34.769
347	12.924	407	13.104	467	20.802	527	27.825	587	34.858
348	12.924	408	13.121	468	20.848	528	27.960	588	34.949
349	12.923	409	13.138	469	20.891	529	28.078	589	35.047
350	12.923	410	13.156	470	20.922	530	28.196	590	35.181
351	12.922	411	13.174	471	20.971	531	28.334	591	35.340
352	12.922	412	13.193	472	21.017	532	28.485	592	35.521
353	12.921	413	13.213	473	21.052	533	28.616	593	35.732
354	12.920	414	13.233	474	21.109	534	28.749	594	35.903
355	12.919	415	13.253	475	21.151	535	28.867	595	36.095
356	12.919	416	13.275	476	21.220	536	28.978	596	36.235
357	12.918	417	13.300	477	21.269	537	29.122	597	36.354
358	12.917	418	13.326	478	21.322	538	29.202	598	36.483
359	12.916	419	13.356	479	21.358	539	29.313	599	36.609
360	12.915	420	13.388	480	21.420	540	29.447	600	36.713
361	12.914	421	13.422	481	21.476	541	29.572	601	36.838
362	12.913	422	13.458	482	21.539	542	29.678	602	36.911
363	12.912	423	13.497	483	21.589	543	29.817	603	37.023
364	12.911	424	13.536	484	21.664	544	29.922	604	37.139
365	12.909	425	13.577	485	21.726	545	30.073	605	37.239
366	12.908	426	13.623	486	21.800	546	30.224	606	37.331
367	12.907	427	13.671	487	21.907	547	30.371	607	37.409
368	12.906	428	13.720	488	21.977	548	30.510	608	37.498
369	12.906	429	13.769	489	22.070	549	30.706	609	37.587
370	12.906	430	13.821	490	22.167	550	30.887	610	37.657
371	12.906	431	13.876	491	22.268	551	31.029	611	37.753
372	12.906	432	15.472	492	22.376	552	31.165	612	37.843
373	12.906	433	17.653	493	22.494	553	31.313	613	37.910
374	12.906	434	18.458	494	22.637	554	31.467	614	38.000
375	12.907	435	18.811	495	22.793	555	31.574	615	38.090

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - JULY 24, 1989

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
616	38.161	676	42.014	736	45.294	796	47.212	856	48.776
617	38.252	677	42.085	737	45.331	797	47.236	857	48.798
618	38.323	678	42.152	738	45.370	798	47.266	858	48.820
619	38.404	679	42.205	739	45.410	799	47.287	859	48.836
620	38.486	680	42.270	740	45.442	800	47.312	860	48.860
621	38.579	681	42.343	741	45.486	801	47.346	861	48.877
622	38.672	682	42.415	742	45.520	802	47.370	862	48.896
623	38.753	683	42.475	743	45.560	803	47.399	863	48.915
624	38.825	684	42.553	744	45.599	804	47.433	864	48.942
625	38.888	685	42.622	745	45.632	805	47.457	865	48.962
626	38.936	686	42.690	746	45.666	806	47.482	866	48.979
627	38.986	687	42.757	747	45.695	807	47.510	867	48.992
628	39.031	688	42.838	748	45.732	808	47.532	868	49.005
629	39.084	689	42.894	749	45.767	809	47.560	869	49.028
630	39.140	690	42.968	750	45.803	810	47.594	870	49.050
631	39.182	691	43.025	751	45.840	811	47.623	871	49.071
632	39.244	692	43.114	752	45.875	812	47.652	872	49.091
633	39.318	693	43.177	753	45.905	813	47.678	873	49.103
634	39.389	694	43.236	754	45.939	814	47.709	874	49.120
635	39.473	695	43.305	755	45.971	815	47.741	875	49.137
636	39.540	696	43.371	756	46.004	816	47.777	876	49.158
637	39.616	697	43.428	757	46.033	817	47.812	877	49.182
638	39.705	698	43.503	758	46.067	818	47.844	878	49.198
639	39.770	699	43.566	759	46.100	819	47.876	879	49.212
640	39.835	700	43.626	760	46.137	820	47.902	880	49.233
641	39.902	701	43.700	761	46.169	821	47.934	881	49.254
642	39.958	702	43.765	762	46.206	822	47.964	882	49.271
643	40.029	703	43.827	763	46.234	823	47.995	883	49.287
644	40.106	704	43.890	764	46.273	824	48.032	884	49.301
645	40.161	705	43.949	765	46.304	825	48.055	885	49.321
646	40.226	706	44.002	766	46.321	826	48.086	886	49.339
647	40.290	707	44.064	767	46.351	827	48.111	887	49.353
648	40.357	708	44.122	768	46.391	828	48.143	888	49.371
649	40.429	709	44.180	769	46.424	829	48.159	889	49.391
650	40.488	710	44.231	770	46.457	830	48.185	890	49.409
651	40.553	711	44.280	771	46.487	831	48.216	891	49.423
652	40.608	712	44.330	772	46.517	832	48.237	892	49.442
653	40.672	713	44.371	773	46.552	833	48.262	893	49.460
654	40.730	714	44.417	774	46.582	834	48.284	894	49.479
655	40.782	715	44.469	775	46.613	835	48.313	895	49.493
656	40.844	716	44.514	776	46.644	836	48.334	896	49.509
657	40.910	717	44.557	777	46.665	837	48.358	897	49.527
658	40.972	718	44.600	778	46.691	838	48.383	898	49.546
659	41.024	719	44.644	779	46.722	839	48.407	899	49.558
660	41.086	720	44.677	780	46.753	840	48.432	900	49.571
661	41.138	721	44.721	781	46.784	841	48.456	901	49.589
662	41.199	722	44.762	782	46.815	842	48.473	902	49.607
663	41.253	723	44.789	783	46.853	843	48.499	903	49.621
664	41.319	724	44.834	784	46.879	844	48.518	904	49.633
665	41.379	725	44.875	785	46.907	845	48.545	905	49.651
666	41.434	726	44.915	786	46.928	846	48.560	906	49.664
667	41.495	727	44.954	787	46.958	847	48.586	907	49.675
668	41.564	728	44.996	788	46.991	848	48.612	908	49.694
669	41.610	729	45.039	789	47.014	849	48.631	909	49.706
670	41.658	730	45.084	790	47.042	850	48.653	910	49.721
671	41.714	731	45.116	791	47.068	851	48.679	911	49.736
672	41.770	732	45.149	792	47.105	852	48.693	912	49.745
673	41.828	733	45.185	793	47.131	853	48.714	913	49.759
674	41.897	734	45.223	794	47.159	854	48.738	914	49.778
675	41.954	735	45.258	795	47.187	855	48.757	915	49.798

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - JULY 24, 1989

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
916	49.808	976	51.068	1036	53.032	1096	54.657	1156	56.397
917	49.820	977	51.096	1037	53.058	1097	54.686	1157	56.425
918	49.833	978	51.132	1038	53.088	1098	54.714	1158	56.446
919	49.845	979	51.169	1039	53.125	1099	54.742	1159	56.470
920	49.860	980	51.197	1040	53.154	1100	54.770	1160	56.496
921	49.871	981	51.235	1041	53.184	1101	54.803	1161	56.520
922	49.884	982	51.269	1042	53.213	1102	54.832	1162	56.548
923	49.904	983	51.294	1043	53.232	1103	54.860	1163	56.571
924	49.914	984	51.328	1044	53.255	1104	54.896	1164	56.596
925	49.931	985	51.370	1045	53.278	1105	54.925	1165	56.622
926	49.946	986	51.403	1046	53.305	1106	54.959	1166	56.648
927	49.962	987	51.439	1047	53.333	1107	54.989	1167	56.673
928	49.977	988	51.477	1048	53.353	1108	55.018	1168	56.697
929	49.997	989	51.511	1049	53.372	1109	55.048	1169	56.727
930	50.015	990	51.551	1050	53.401	1110	55.080	1170	56.760
931	50.030	991	51.588	1051	53.424	1111	55.110	1171	56.783
932	50.041	992	51.619	1052	53.443	1112	55.147	1172	56.807
933	50.061	993	51.650	1053	53.465	1113	55.176	1173	56.834
934	50.085	994	51.677	1054	53.495	1114	55.211	1174	56.870
935	50.106	995	51.715	1055	53.520	1115	55.239	1175	56.898
936	50.119	996	51.754	1056	53.544	1116	55.277	1176	56.926
937	50.140	997	51.789	1057	53.566	1117	55.301	1177	56.958
938	50.160	998	51.823	1058	53.591	1118	55.330	1178	56.987
939	50.179	999	51.857	1059	53.616	1119	55.371	1179	57.021
940	50.199	1000	51.886	1060	53.642	1120	55.405	1180	57.053
941	50.221	1001	51.924	1061	53.669	1121	55.439	1181	57.077
942	50.244	1002	51.958	1062	53.700	1122	55.466	1182	57.110
943	50.262	1003	51.991	1063	53.726	1123	55.498	1183	57.142
944	50.282	1004	52.032	1064	53.753	1124	55.535	1184	57.173
945	50.301	1005	52.066	1065	53.781	1125	55.566	1185	57.205
946	50.324	1006	52.094	1066	53.802	1126	55.599	1186	57.241
947	50.345	1007	52.133	1067	53.834	1127	55.628	1187	57.276
948	50.366	1008	52.165	1068	53.857	1128	55.660	1188	57.303
949	50.388	1009	52.195	1069	53.882	1129	55.692	1189	57.345
950	50.412	1010	52.231	1070	53.919	1130	55.722	1190	57.377
951	50.425	1011	52.266	1071	53.942	1131	55.752	1191	57.414
952	50.447	1012	52.296	1072	53.975	1132	55.783	1192	57.449
953	50.471	1013	52.335	1073	53.996	1133	55.804	1193	57.485
954	50.491	1014	52.366	1074	54.021	1134	55.827	1194	57.516
955	50.513	1015	52.398	1075	54.046	1135	55.858	1195	57.553
956	50.531	1016	52.424	1076	54.080	1136	55.886	1196	57.594
957	50.557	1017	52.459	1077	54.101	1137	55.916	1197	57.639
958	50.577	1018	52.495	1078	54.133	1138	55.943	1198	57.672
959	50.602	1019	52.521	1079	54.161	1139	55.971	1199	57.716
960	50.625	1020	52.554	1080	54.189	1140	55.994	1200	57.749
961	50.644	1021	52.586	1081	54.224	1141	56.019	1201	57.789
962	50.668	1022	52.616	1082	54.246	1142	56.046	1202	57.828
963	50.690	1023	52.645	1083	54.275	1143	56.080	1203	57.865
964	50.716	1024	52.677	1084	54.311	1144	56.106	1204	57.901
965	50.743	1025	52.709	1085	54.335	1145	56.128	1205	57.947
966	50.771	1026	52.743	1086	54.369	1146	56.159	1206	57.982
967	50.797	1027	52.769	1087	54.398	1147	56.186	1207	58.015
968	50.818	1028	52.796	1088	54.417	1148	56.206	1208	58.068
969	50.848	1029	52.823	1089	54.450	1149	56.230	1209	58.106
970	50.878	1030	52.858	1090	54.478	1150	56.256	1210	58.143
971	50.908	1031	52.885	1091	54.512	1151	56.281	1211	58.184
972	50.939	1032	52.914	1092	54.539	1152	56.303	1212	58.224
973	50.970	1033	52.934	1093	54.567	1153	56.329	1213	58.261
974	51.000	1034	52.958	1094	54.589	1154	56.352	1214	58.298
975	51.037	1035	52.997	1095	54.623	1155	56.375	1215	58.333

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - JULY 1989

DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
1216	58.377	1276	60.914	1336	63.453	1396	65.876	1456	68.102
1217	58.421	1277	60.959	1337	63.495	1397	65.911	1457	68.143
1218	58.457	1278	61.002	1338	63.530	1398	65.954	1458	68.184
1219	58.506	1279	61.047	1339	63.572	1399	65.991	1459	68.218
1220	58.547	1280	61.089	1340	63.619	1400	66.030	1460	68.253
1221	58.586	1281	61.129	1341	63.663	1401	66.074	1461	68.296
1222	58.628	1282	61.170	1342	63.702	1402	66.114	1462	68.332
1223	58.667	1283	61.210	1343	63.735	1403	66.157	1463	68.375
1224	58.708	1284	61.247	1344	63.781	1404	66.200	1464	68.413
1225	58.751	1285	61.293	1345	63.823	1405	66.232	1465	68.452
1226	58.784	1286	61.339	1346	63.871	1406	66.281	1466	68.504
1227	58.820	1287	61.376	1347	63.914	1407	66.322	1467	68.540
1228	58.860	1288	61.420	1348	63.953	1408	66.364	1468	68.581
1229	58.908	1289	61.463	1349	63.990	1409	66.407	1469	68.627
1230	58.951	1290	61.507	1350	64.029	1410	66.449	1470	68.669
1231	58.983	1291	61.543	1351	64.062	1411	66.499	1471	68.716
1232	59.021	1292	61.588	1352	64.111	1412	66.550	1472	68.757
1233	59.063	1293	61.633	1353	64.158	1413	66.587	1473	68.799
1234	59.106	1294	61.673	1354	64.198	1414	66.634	1474	68.840
1235	59.142	1295	61.713	1355	64.238	1415	66.680	1475	68.889
1236	59.182	1296	61.751	1356	64.281	1416	66.716	1476	68.934
1237	59.217	1297	61.794	1357	64.318	1417	66.756	1477	68.978
1238	59.265	1298	61.842	1358	64.366	1418	66.799	1478	69.024
1239	59.308	1299	61.880	1359	64.403	1419	66.849	1479	69.062
1240	59.347	1300	61.920	1360	64.443	1420	66.890	1480	69.109
1241	59.389	1301	61.959	1361	64.481	1421	66.932	1481	69.159
1242	59.433	1302	62.001	1362	64.526	1422	66.974	1482	69.202
1243	59.476	1303	62.048	1363	64.565	1423	67.008	1483	69.246
1244	59.519	1304	62.092	1364	64.601	1424	67.049	1484	69.288
1245	59.559	1305	62.132	1365	64.641	1425	67.082	1485	69.332
1246	59.606	1306	62.175	1366	64.677	1426	67.125	1486	69.377
1247	59.643	1307	62.220	1367	64.715	1427	67.160	1487	69.427
1248	59.692	1308	62.267	1368	64.759	1428	67.196	1488	69.474
1249	59.739	1309	62.308	1369	64.803	1429	67.223	1489	69.510
1250	59.782	1310	62.352	1370	64.848	1430	67.264	1490	69.561
1251	59.826	1311	62.392	1371	64.892	1431	67.293	1491	69.605
1252	59.863	1312	62.440	1372	64.927	1432	67.322	1492	69.646
1253	59.910	1313	62.482	1373	64.968	1433	67.352	1493	69.697
1254	59.952	1314	62.521	1374	64.999	1434	67.386	1494	69.736
1255	59.993	1315	62.569	1375	65.038	1435	67.416	1495	69.789
1256	60.035	1316	62.612	1376	65.079	1436	67.454	1496	69.832
1257	60.077	1317	62.651	1377	65.116	1437	67.487	1497	69.878
1258	60.129	1318	62.688	1378	65.157	1438	67.523	1498	69.922
1259	60.168	1319	62.736	1379	65.201	1439	67.562	1499	69.969
1260	60.215	1320	62.783	1380	65.239	1440	67.596	1500	70.016
1261	60.259	1321	62.817	1381	65.280	1441	67.629	1501	70.064
1262	60.295	1322	62.861	1382	65.324	1442	67.657	1502	70.111
1263	60.342	1323	62.902	1383	65.367	1443	67.687	1503	70.151
1264	60.389	1324	62.951	1384	65.403	1444	67.716	1504	70.194
1265	60.429	1325	62.989	1385	65.440	1445	67.747	1505	70.247
1266	60.478	1326	63.034	1386	65.481	1446	67.778	1506	70.291
1267	60.521	1327	63.070	1387	65.518	1447	67.804	1507	70.339
1268	60.567	1328	63.113	1388	65.565	1448	67.838	1508	70.387
1269	60.609	1329	63.158	1389	65.609	1449	67.865	1509	70.436
1270	60.657	1330	63.199	1390	65.642	1450	67.896	1510	70.477
1271	60.705	1331	63.240	1391	65.685	1451	67.932	1511	70.518
1272	60.747	1332	63.277	1392	65.727	1452	67.962	1512	70.564
1273	60.789	1333	63.314	1393	65.758	1453	67.990	1513	70.604
1274	60.833	1334	63.360	1394	65.794	1454	68.028	1514	70.652
1275	60.871	1335	63.412	1395	65.837	1455	68.066	1515	70.700

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - JULY 1989

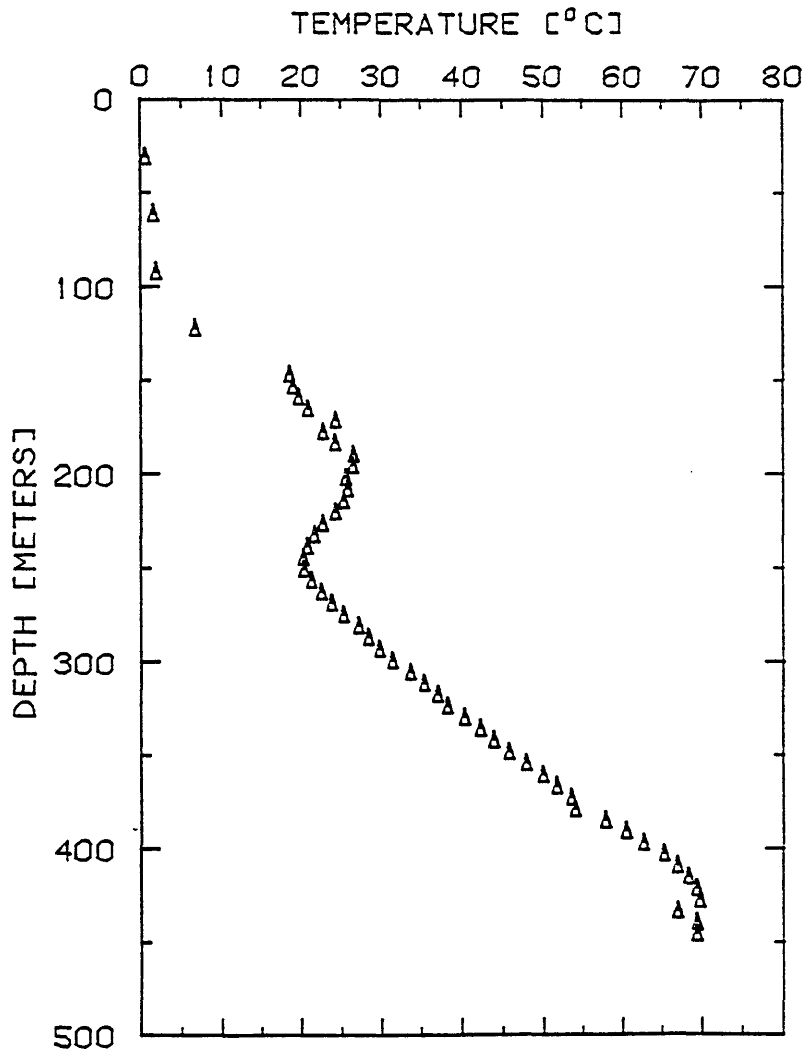
DEPTH (FT)	TEMPERATURE (°C)	DEPTH (FT)	TEMPERATURE (°C)
1516	70.750	1576	73.366
1517	70.794	1577	73.402
1518	70.838	1578	73.482
1519	70.876	1579	73.533
1520	70.918	1580	73.557
1521	70.966	1581	73.589
1522	71.022	1582	73.618
1523	71.065	1583	73.643
1524	71.111	1584	73.664
1525	71.157	1585	73.686
1526	71.200	1586	73.718
1527	71.239	1587	73.759
1528	71.279	1588	73.790
1529	71.328	1589	73.812
1530	71.379	1590	73.845
1531	71.424	1591	73.907
1532	71.472		
1533	71.514		
1534	71.551		
1535	71.596		
1536	71.641		
1537	71.688		
1538	71.734		
1539	71.777		
1540	71.823		
1541	71.870		
1542	71.912		
1543	71.958		
1544	71.998		
1545	72.038		
1546	72.089		
1547	72.134		
1548	72.178		
1549	72.221		
1550	72.262		
1551	72.317		
1552	72.366		
1553	72.408		
1554	72.453		
1555	72.497		
1556	72.544		
1557	72.589		
1558	72.630		
1559	72.668		
1560	72.718		
1561	72.759		
1562	72.802		
1563	72.850		
1564	72.888		
1565	72.934		
1566	72.974		
1567	73.024		
1568	73.066		
1569	73.108		
1570	73.145		
1571	73.183		
1572	73.220		
1573	73.255		
1574	73.280		
1575	73.304		

APPENDIX III[1]

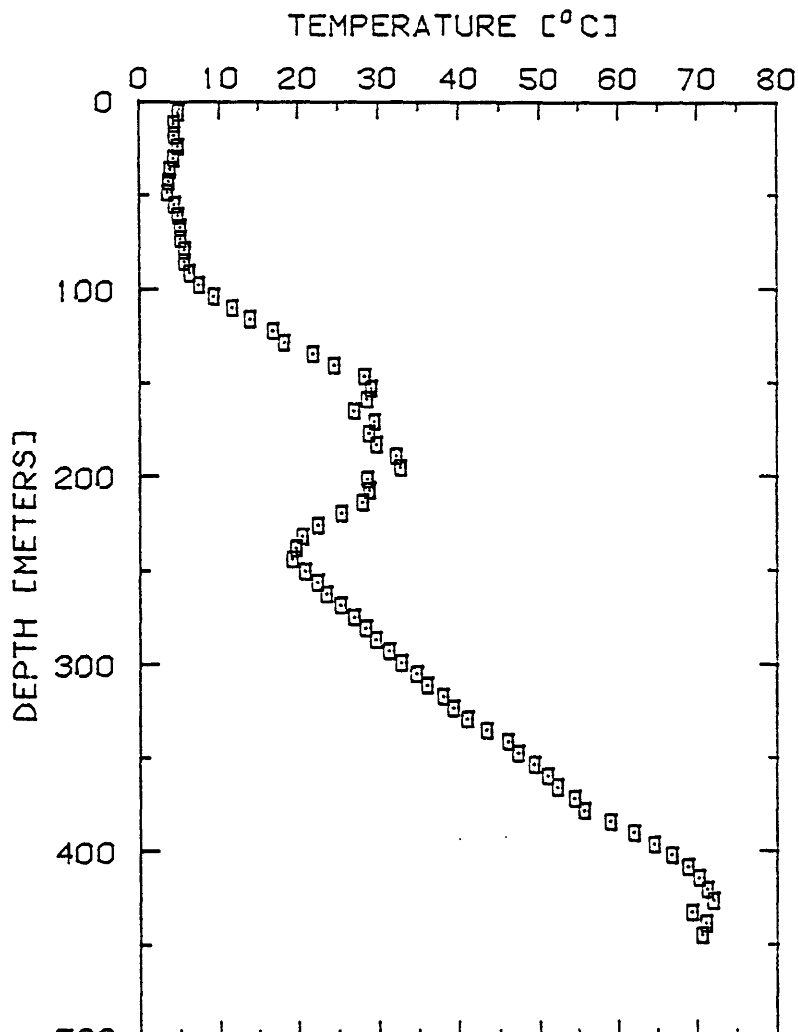
MLGRAP # 1 - Temperature plots

MLGRAP # 2 - Temperature plots

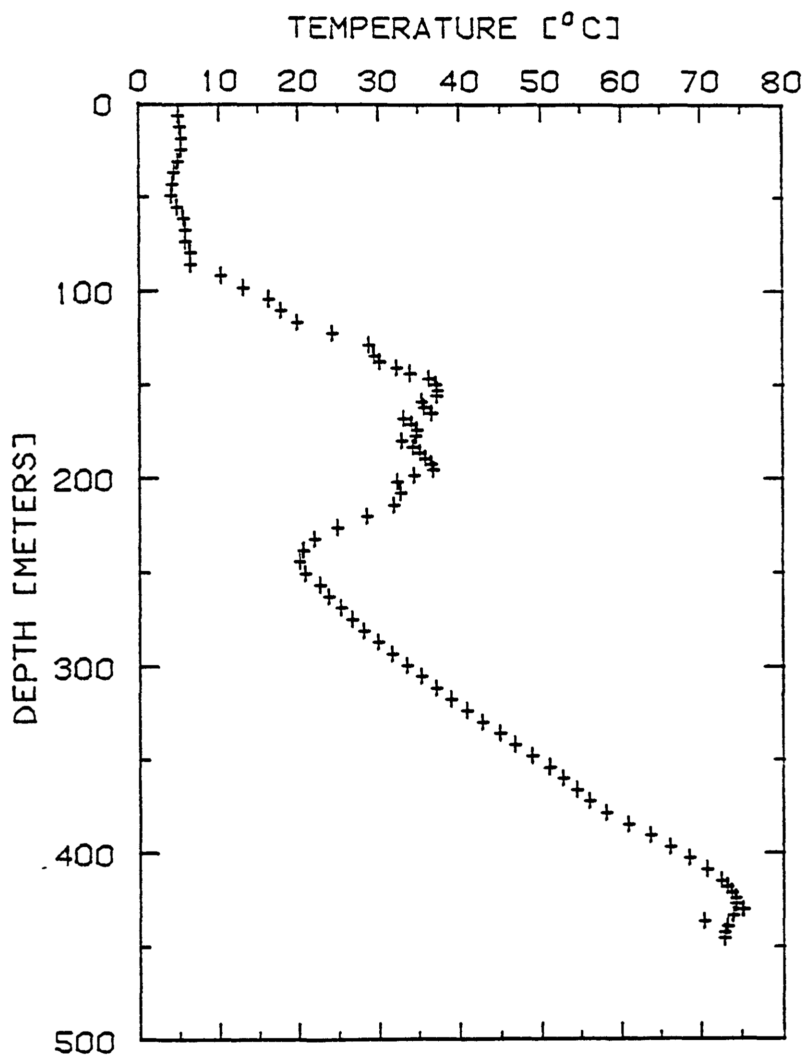
[1] Temperatures on July 23 and July 24, 1989 were obtained by the authors. The remainder of the temperatures for 1987 and 1988 were measured by D. Goodwin for the Town of Mammoth Lakes and were obtained from the California Division of Oil and Gas Geothermal Reports 051-90120 and 051-90121. The temperatures obtained by Goodwin were converted to degrees Celsius by the authors.



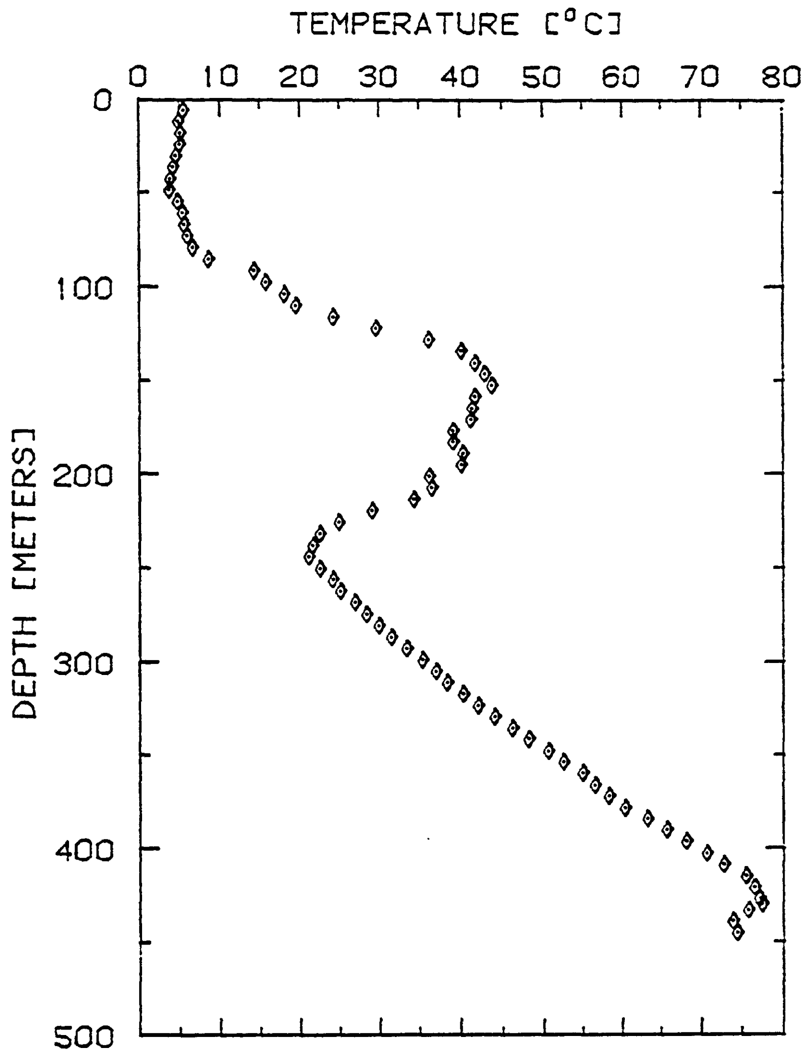
MLGRAP # 1 - LONG VALLEY, CA
31 JANUARY 1988



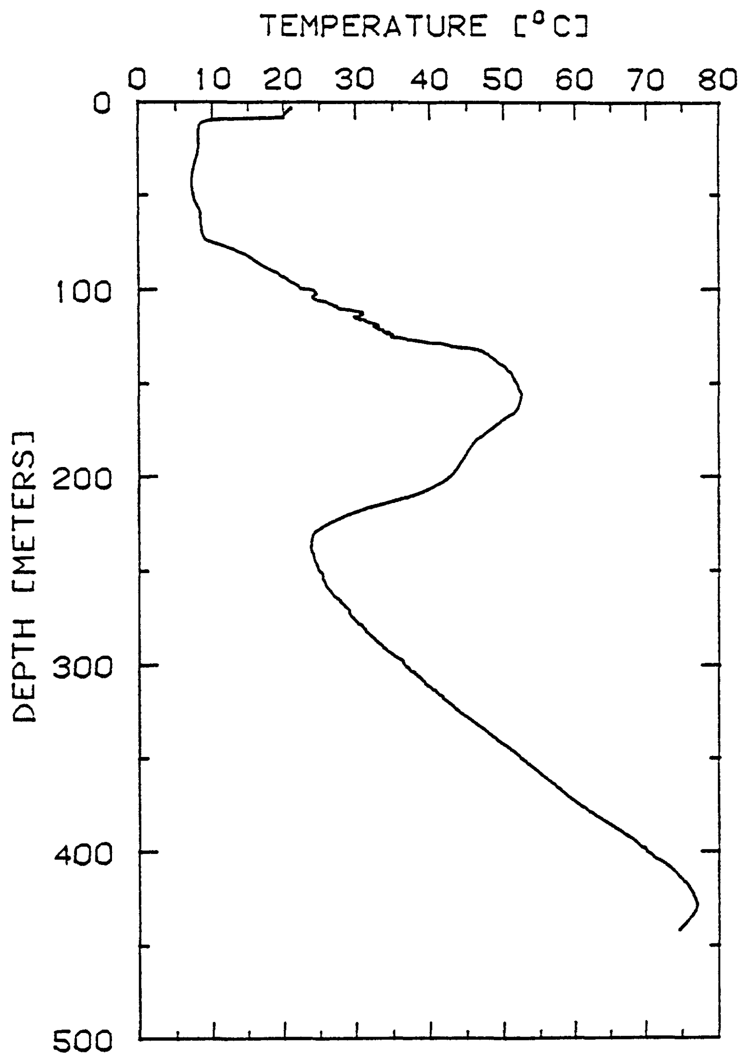
MLGRAP # 1 - LONG VALLEY, CA
1 FEBRUARY 1988



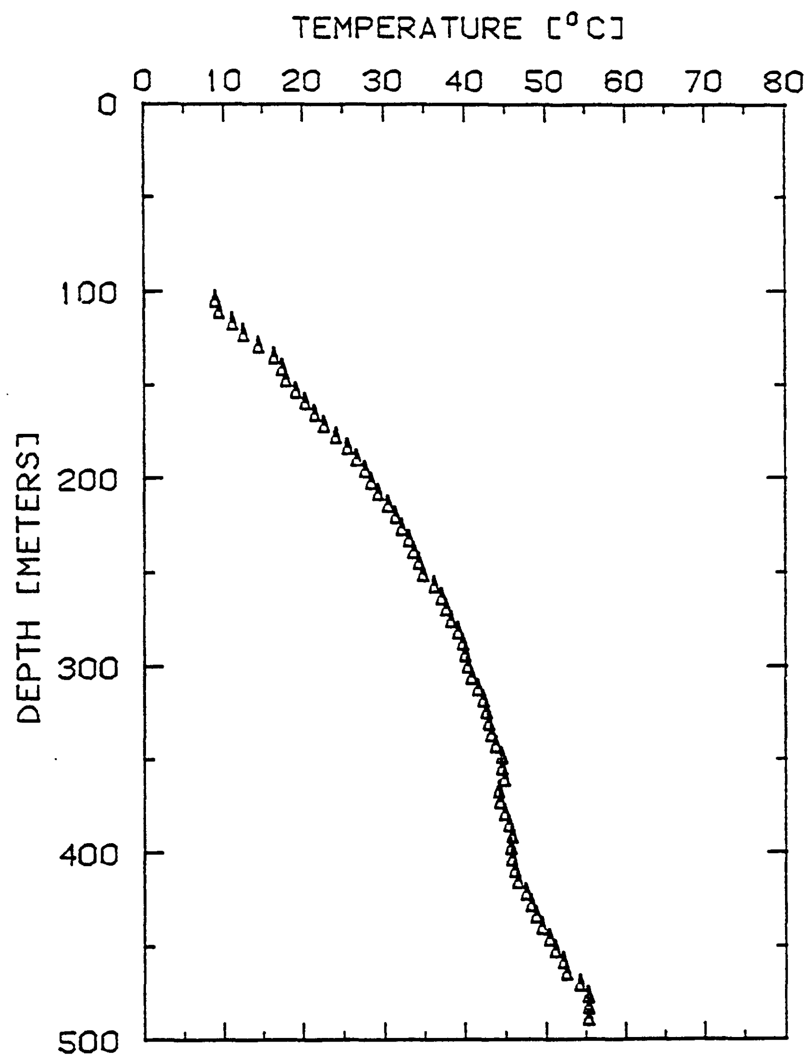
MLGRAP # 1 - LONG VALLEY, CA
4 FEBRUARY 1988



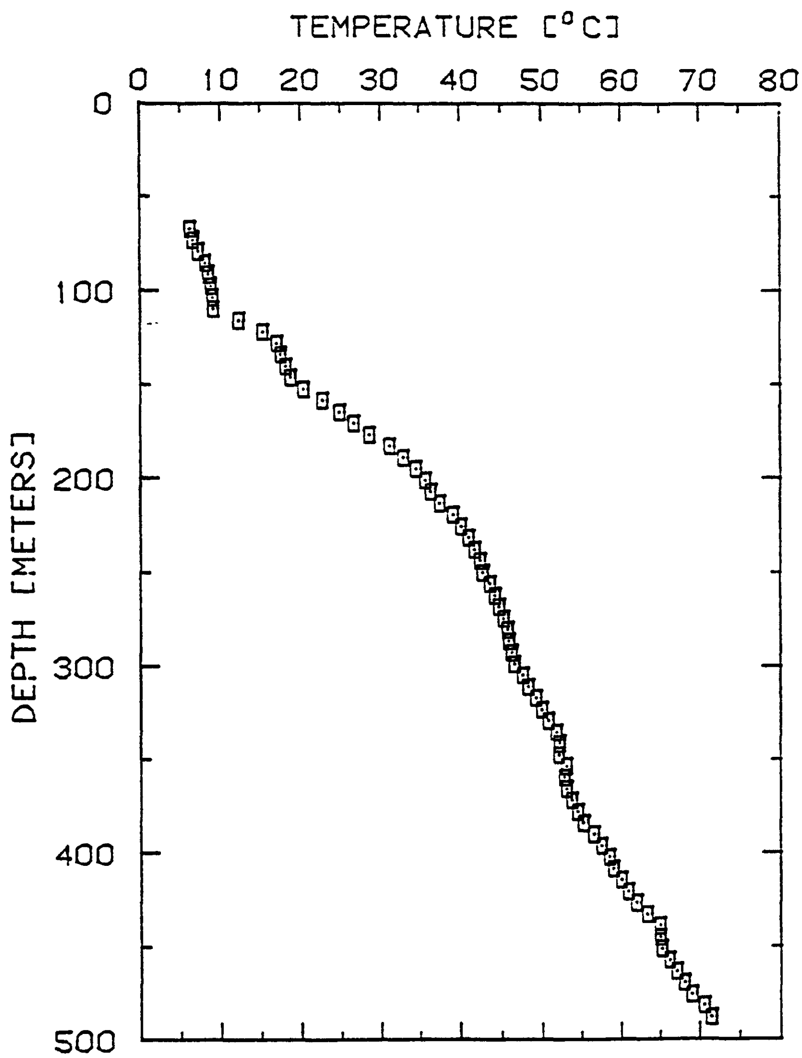
MLGRAP # 1 - LONG VALLEY, CA
14 FEBRUARY 1988



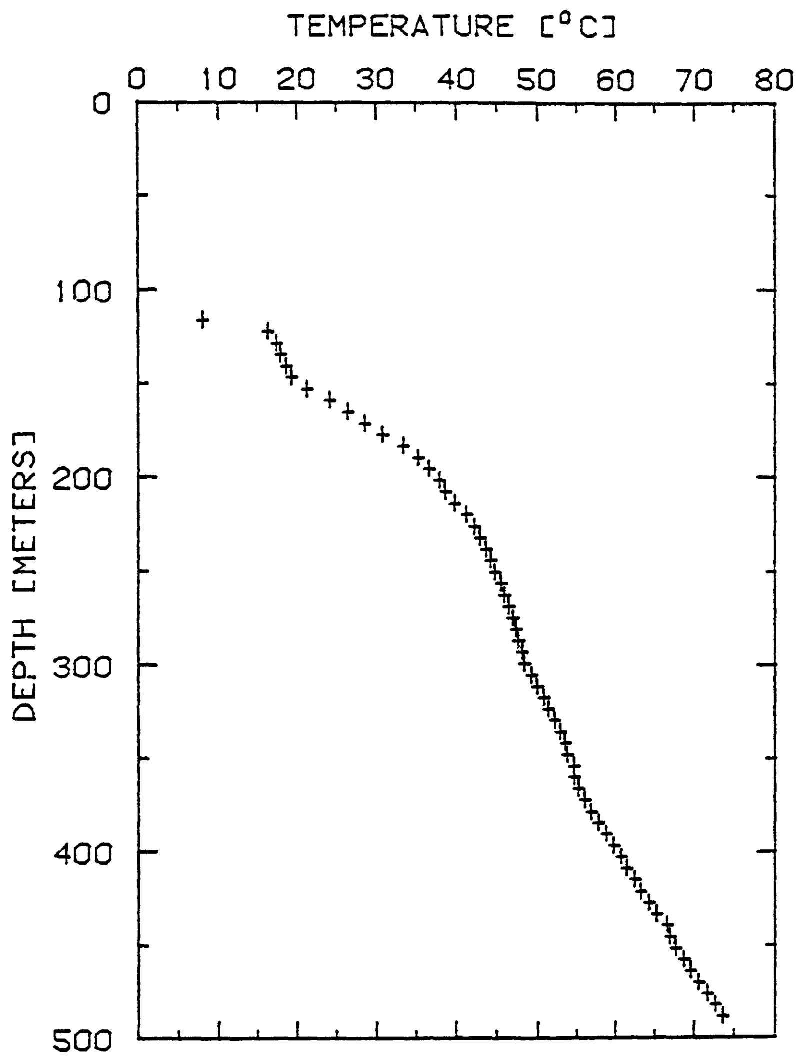
MLGRAP # 1 - LONG VALLEY, CA
23 JULY 1989



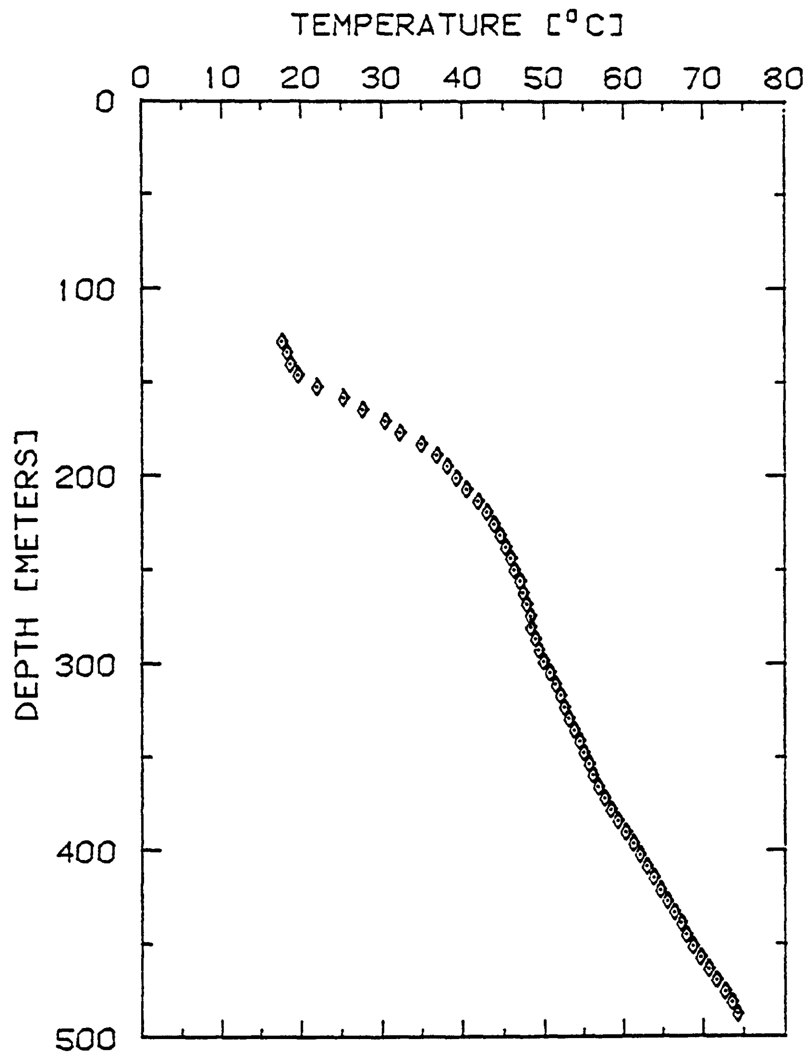
MLGRAP # 2 - LONG VALLEY, CA
10 DECEMBER 1987



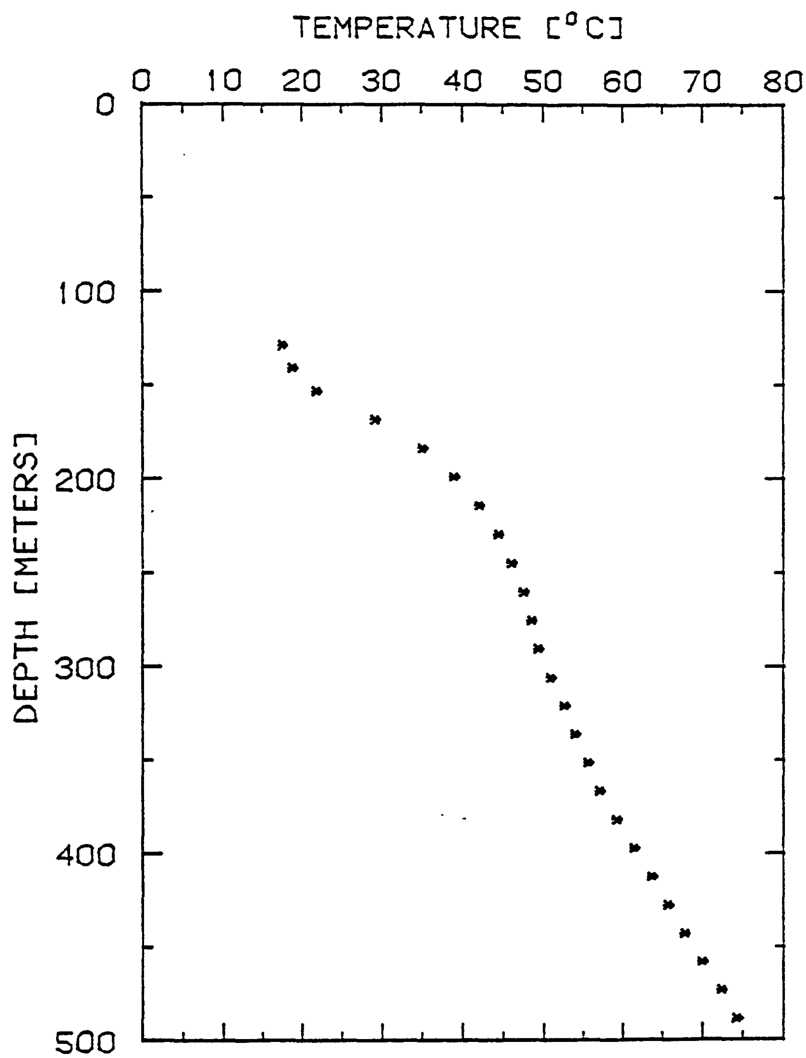
MLGRAP # 2 - LONG VALLEY, CA
12 DECEMBER 1987



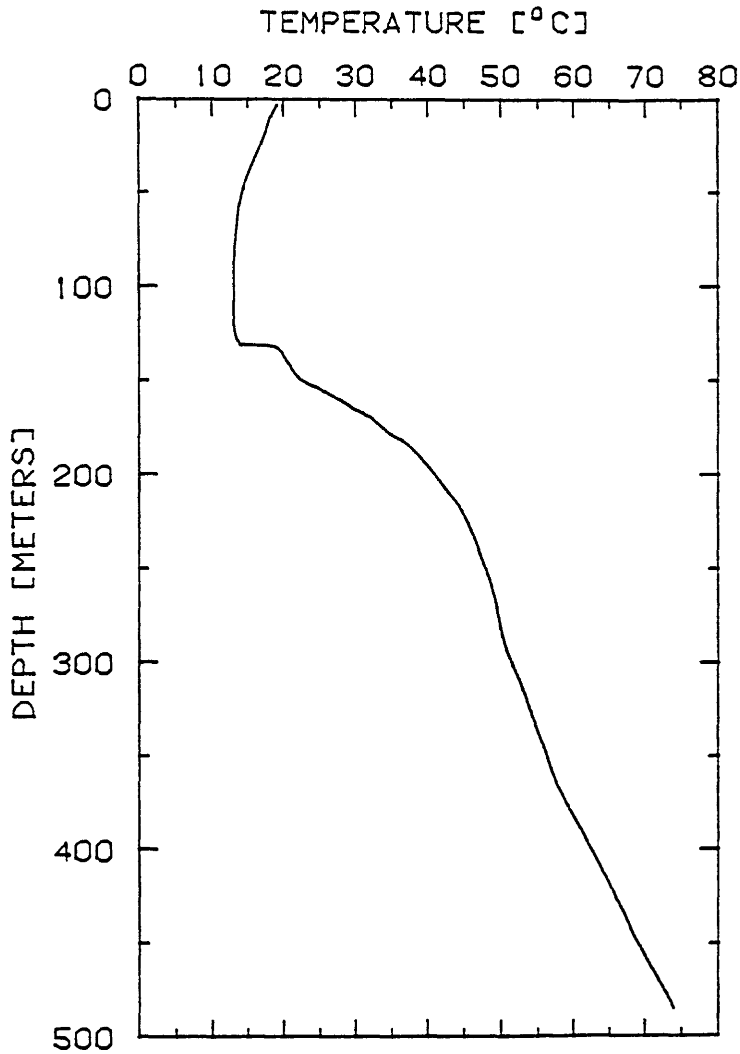
MLGRAP # 2 - LONG VALLEY, CA
16 DECEMBER 1987



MLGRAP # 2 - LONG VALLEY, CA
9 JANUARY 1988



MLGRAP # 2 - LONG VALLEY, CA
29 JANUARY 1988



MLGRAP # 2 - LONG VALLEY, CA
24 JULY 1989

APPENDIX IV

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - July 23, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
10	107.0	70	57.0	130	44.0	190	51.0	250	33.0
11	106.0	71	55.0	131	42.0	191	51.0	251	30.0
12	104.0	72	55.0	132	42.0	192	51.0	252	30.0
13	104.0	73	52.0	133	45.0	193	52.0	253	34.0
14	99.0	74	49.0	134	48.0	194	49.0	254	36.0
15	95.0	75	49.0	135	48.0	195	47.0	255	38.0
16	93.0	76	47.0	136	46.0	196	48.0	256	40.0
17	96.0	77	46.0	137	49.0	197	49.0	257	42.0
18	101.0	78	42.0	138	50.0	198	51.0	258	41.0
19	104.0	79	42.0	139	48.0	199	52.0	259	36.0
20	97.0	80	40.0	140	48.0	200	50.0	260	35.0
21	95.0	81	39.0	141	44.0	201	50.0	261	34.0
22	95.0	82	38.0	142	41.0	202	54.0	262	32.0
23	92.0	83	38.0	143	43.0	203	53.0	263	30.0
24	90.0	84	38.0	144	47.0	204	55.0	264	28.0
25	100.0	85	39.0	145	46.0	205	56.0	265	29.0
26	99.0	86	40.0	146	49.0	206	55.0	266	28.0
27	97.0	87	40.0	147	48.0	207	56.0	267	28.0
28	100.0	88	40.0	148	49.0	208	51.0	268	30.0
29	104.0	89	40.0	149	47.0	209	53.0	269	33.0
30	104.0	90	40.0	150	44.0	210	55.0	270	34.0
31	101.0	91	38.0	151	45.0	211	59.0	271	34.0
32	98.0	92	37.0	152	47.0	212	60.0	272	33.0
33	97.0	93	39.0	153	43.0	213	60.0	273	32.0
34	94.0	94	44.0	154	40.0	214	61.0	274	33.0
35	95.0	95	43.0	155	40.0	215	61.0	275	34.0
36	97.0	96	42.0	156	36.0	216	64.0	276	35.0
37	98.0	97	40.0	157	33.0	217	62.0	277	37.0
38	95.0	98	38.0	158	33.0	218	61.0	278	38.0
39	94.0	99	38.0	159	36.0	219	65.0	279	37.0
40	89.0	100	38.0	160	40.0	220	68.0	280	34.0
41	85.0	101	37.0	161	45.0	221	81.0	281	32.0
42	83.0	102	37.0	162	51.0	222	88.0	282	31.0
43	81.0	103	36.0	163	59.0	223	80.0	283	28.0
44	81.0	104	35.0	164	70.0	224	81.0	284	26.0
45	77.0	105	35.0	165	80.0	225	70.0	285	27.0
46	75.0	106	36.0	166	90.0	226	62.0	286	28.0
47	71.0	107	38.0	167	94.0	227	56.0	287	29.0
48	71.0	108	39.0	168	92.0	228	56.0	288	27.0
49	76.0	109	41.0	169	97.0	229	51.0	289	25.0
50	84.0	110	43.0	170	93.0	230	50.0	290	27.0
51	89.0	111	47.0	171	84.0	231	45.0	291	31.0
52	95.0	112	46.0	172	70.0	232	36.0	292	28.0
53	94.0	113	46.0	173	56.0	233	32.0	293	28.0
54	91.0	114	48.0	174	43.0	234	28.0	294	28.0
55	74.0	115	47.0	175	34.0	235	24.0	295	28.0
56	60.0	116	48.0	176	28.0	236	22.0	296	29.0
57	72.0	117	50.0	177	25.0	237	22.0	297	26.0
58	76.0	118	49.0	178	26.0	238	23.0	298	24.0
59	79.0	119	47.0	179	35.0	239	22.0	299	26.0
60	82.0	120	47.0	180	40.0	240	20.0	300	30.0
61	78.0	121	48.0	181	48.0	241	22.0	301	33.0
62	73.0	122	45.0	182	50.0	242	23.0	302	31.0
63	62.0	123	43.0	183	51.0	243	24.0	303	27.0
64	61.0	124	44.0	184	51.0	244	25.0	304	25.0
65	58.0	125	47.0	185	47.0	245	28.0	305	26.0
66	58.0	126	50.0	186	51.0	246	41.0	306	28.0
67	55.0	127	49.0	187	58.0	247	54.0	307	28.0
68	55.0	128	48.0	188	54.0	248	52.0	308	29.0
69	57.0	129	46.0	189	52.0	249	37.0	309	30.0

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - July 23, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
310	30.0	370	33.0	430	25.0	490	21.0	550	0.0
311	30.0	371	33.0	431	22.0	491	21.0	551	42.0
312	31.0	372	32.0	432	18.0	492	20.0	552	43.0
313	32.0	373	31.0	433	15.0	493	19.0	553	44.0
314	33.0	374	31.0	434	15.0	494	19.0	554	45.0
315	33.0	375	31.0	435	15.0	495	20.0	555	45.0
316	33.0	376	32.0	436	15.0	496	20.0	556	46.0
317	33.0	377	34.0	437	15.0	497	20.0	557	46.0
318	32.0	378	36.0	438	14.0	498	18.0	558	47.0
319	32.0	379	37.0	439	14.0	499	18.0	559	47.0
320	32.0	380	36.0	440	14.0	500	18.0	560	47.0
321	30.0	381	34.0	441	14.0	501	19.0	561	44.0
322	29.0	382	34.0	442	14.0	502	19.0	562	43.0
323	31.0	383	33.0	443	14.0	503	19.0	563	44.0
324	32.0	384	35.0	444	14.0	504	19.0	564	43.0
325	31.0	385	36.0	445	15.0	505	19.0	565	41.0
326	31.0	386	35.0	446	15.0	506	19.0	566	39.0
327	30.0	387	33.0	447	15.0	507	19.0	567	39.0
328	31.0	388	31.0	448	14.0	508	19.0	568	39.0
329	31.0	389	30.0	449	14.0	509	19.0	569	39.0
330	31.0	390	29.0	450	14.0	510	20.0	570	38.0
331	32.0	391	31.0	451	15.0	511	20.0	571	38.0
332	32.0	392	33.0	452	16.0	512	20.0	572	38.0
333	31.0	393	34.0	453	15.0	513	20.0	573	42.0
334	30.0	394	32.0	454	14.0	514	20.0	574	45.0
335	30.0	395	32.0	455	14.0	515	21.0	575	43.0
336	29.0	396	31.0	456	15.0	516	21.0	576	42.0
337	29.0	397	33.0	457	15.0	517	21.0	577	43.0
338	28.0	398	33.0	458	14.0	518	21.0	578	46.0
339	28.0	399	32.0	459	15.0	519	21.0	579	45.0
340	31.0	400	30.0	460	16.0	520	21.0	580	43.0
341	33.0	401	31.0	461	16.0	521	21.0	581	41.0
342	32.0	402	33.0	462	17.0	522	20.0	582	43.0
343	33.0	403	34.0	463	16.0	523	20.0	583	42.0
344	31.0	404	35.0	464	15.0	524	20.0	584	42.0
345	31.0	405	35.0	465	18.0	525	21.0	585	42.0
346	30.0	406	35.0	466	18.0	526	21.0	586	42.0
347	30.0	407	34.0	467	21.0	527	21.0	587	40.0
348	31.0	408	33.0	468	20.0	528	21.0	588	41.0
349	32.0	409	34.0	469	19.0	529	22.0	589	39.0
350	32.0	410	33.0	470	18.0	530	23.0	590	39.0
351	32.0	411	32.0	471	18.0	531	24.0	591	40.0
352	33.0	412	32.0	472	18.0	532	24.0	592	41.0
353	34.0	413	32.0	473	16.0	533	24.0	593	43.0
354	35.0	414	33.0	474	16.0	534	23.0	594	45.0
355	35.0	415	31.0	475	19.0	535	23.0	595	47.0
356	34.0	416	31.0	476	22.0	536	23.0	596	46.0
357	34.0	417	30.0	477	23.0	537	24.0	597	44.0
358	32.0	418	30.0	478	22.0	538	23.0	598	45.0
359	30.0	419	32.0	479	22.0	539	21.0	599	47.0
360	31.0	420	32.0	480	22.0	540	20.0	600	47.0
361	32.0	421	31.0	481	21.0	541	22.0	601	48.0
362	32.0	422	31.0	482	22.0	542	26.0	602	48.0
363	32.0	423	32.0	483	22.0	543	30.0	603	48.0
364	32.0	424	31.0	484	22.0	544	34.0	604	48.0
365	30.0	425	30.0	485	24.0	545	36.0	605	47.0
366	27.0	426	31.0	486	23.0	546	38.0	606	43.0
367	28.0	427	32.0	487	22.0	547	39.0	607	42.0
368	29.0	428	30.0	488	21.0	548	39.0	608	43.0
369	31.0	429	27.0	489	20.0	549	39.0	609	45.0

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - July 23, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
610	46.0	670	24.0	730	30.0	790	37.0	850	53.0
611	46.0	671	22.0	731	30.0	791	38.0	851	61.0
612	45.0	672	21.0	732	30.0	792	39.0	852	73.0
613	45.0	673	22.0	733	29.0	793	42.0	853	77.0
614	46.0	674	24.0	734	28.0	794	46.0	854	86.0
615	47.0	675	24.0	735	26.0	795	45.0	855	94.0
616	48.0	676	24.0	736	28.0	796	46.0	856	99.0
617	49.0	677	26.0	737	30.0	797	47.0	857	94.0
618	48.0	678	26.0	738	29.0	798	47.0	858	90.0
619	47.0	679	26.0	739	29.0	799	47.0	859	85.0
620	45.0	680	25.0	740	30.0	800	48.0	860	87.0
621	43.0	681	27.0	741	30.0	801	46.0	861	85.0
622	42.0	682	27.0	742	33.0	802	45.0	862	80.0
623	42.0	683	26.0	743	30.0	803	44.0	863	85.0
624	43.0	684	24.0	744	29.0	804	41.0	864	92.0
625	44.0	685	25.0	745	29.0	805	40.0	865	93.0
626	46.0	686	25.0	746	32.0	806	38.0	866	92.0
627	48.0	687	25.0	747	31.0	807	36.0	867	83.0
628	42.0	688	25.0	748	29.0	808	39.0	868	71.0
629	42.0	689	26.0	749	27.0	809	37.0	869	79.0
630	41.0	690	26.0	750	27.0	810	36.0	870	84.0
631	41.0	691	26.0	751	28.0	811	37.0	871	85.0
632	43.0	692	27.0	752	29.0	812	38.0	872	85.0
633	44.0	693	25.0	753	30.0	813	36.0	873	94.0
634	44.0	694	24.0	754	31.0	814	34.0	874	100.0
635	45.0	695	24.0	755	31.0	815	34.0	875	100.0
636	46.0	696	24.0	756	32.0	816	35.0	876	112.0
637	44.0	697	25.0	757	30.0	817	34.0	877	118.0
638	44.0	698	25.0	758	32.0	818	35.0	878	109.0
639	41.0	699	26.0	759	32.0	819	39.0	879	142.0
640	39.0	700	27.0	760	30.0	820	63.0	880	150.0
641	41.0	701	31.0	761	32.0	821	69.0	881	159.0
642	42.0	702	31.0	762	32.0	822	56.0	882	163.0
643	42.0	703	30.0	763	34.0	823	46.0	883	163.0
644	43.0	704	26.0	764	37.0	824	48.0	884	157.0
645	46.0	705	25.0	765	41.0	825	57.0	885	162.0
646	47.0	706	25.0	766	41.0	826	50.0	886	163.0
647	44.0	707	27.0	767	43.0	827	44.0	887	162.0
648	40.0	708	27.0	768	42.0	828	45.0	888	159.0
649	36.0	709	26.0	769	40.0	829	40.0	889	160.0
650	36.0	710	26.0	770	37.0	830	37.0	890	151.0
651	36.0	711	27.0	771	38.0	831	37.0	891	149.0
652	36.0	712	27.0	772	38.0	832	36.0	892	157.0
653	36.0	713	28.0	773	37.0	833	36.0	893	162.0
654	38.0	714	27.0	774	36.0	834	38.0	894	167.0
655	37.0	715	26.0	775	35.0	835	34.0	895	170.0
656	35.0	716	28.0	776	35.0	836	36.0	896	172.0
657	35.0	717	27.0	777	37.0	837	35.0	897	167.0
658	37.0	718	28.0	778	40.0	838	34.0	898	169.0
659	37.0	719	28.0	779	40.0	839	33.0	899	170.0
660	36.0	720	27.0	780	40.0	840	33.0	900	174.0
661	33.0	721	27.0	781	40.0	841	33.0	901	170.0
662	30.0	722	28.0	782	40.0	842	33.0	902	170.0
663	26.0	723	28.0	783	40.0	843	34.0	903	171.0
664	24.0	724	28.0	784	41.0	844	35.0	904	171.0
665	30.0	725	30.0	785	40.0	845	35.0	905	169.0
666	38.0	726	30.0	786	37.0	846	34.0	906	152.0
667	40.0	727	31.0	787	36.0	847	33.0	907	120.0
668	31.0	728	30.0	788	37.0	848	32.0	908	89.0
669	28.0	729	30.0	789	36.0	849	33.0	909	57.0

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - July 23, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
910	47.0	970	38.0	1030	35.0	1090	35.0	1150	34.0
911	41.0	971	36.0	1031	34.0	1091	34.0	1151	34.0
912	36.0	972	34.0	1032	35.0	1092	34.0	1152	34.0
913	36.0	973	34.0	1033	35.0	1093	34.0	1153	34.0
914	45.0	974	34.0	1034	34.0	1094	34.0	1154	34.0
915	81.0	975	35.0	1035	34.0	1095	34.0	1155	36.0
916	125.0	976	35.0	1036	35.0	1096	34.0	1156	36.0
917	144.0	977	34.0	1037	36.0	1097	34.0	1157	35.0
918	146.0	978	32.0	1038	36.0	1098	34.0	1158	34.0
919	152.0	979	35.0	1039	34.0	1099	35.0	1159	35.0
920	158.0	980	36.0	1040	35.0	1100	34.0	1160	36.0
921	162.0	981	34.0	1041	38.0	1101	36.0	1161	35.0
922	161.0	982	34.0	1042	38.0	1102	37.0	1162	35.0
923	164.0	983	35.0	1043	37.0	1103	38.0	1163	34.0
924	158.0	984	36.0	1044	36.0	1104	37.0	1164	33.0
925	151.0	985	35.0	1045	36.0	1105	36.0	1165	32.0
926	151.0	986	35.0	1046	35.0	1106	37.0	1166	33.0
927	148.0	987	37.0	1047	34.0	1107	38.0	1167	33.0
928	148.0	988	37.0	1048	32.0	1108	36.0	1168	35.0
929	139.0	989	37.0	1049	34.0	1109	36.0	1169	37.0
930	138.0	990	37.0	1050	33.0	1110	36.0	1170	38.0
931	127.0	991	35.0	1051	34.0	1111	36.0	1171	37.0
932	118.0	992	35.0	1052	37.0	1112	37.0	1172	35.0
933	107.0	993	34.0	1053	38.0	1113	38.0	1173	35.0
934	104.0	994	34.0	1054	38.0	1114	36.0	1174	31.0
935	104.0	995	35.0	1055	35.0	1115	35.0	1175	31.0
936	102.0	996	36.0	1056	34.0	1116	35.0	1176	31.0
937	109.0	997	34.0	1057	36.0	1117	34.0	1177	32.0
938	109.0	998	35.0	1058	36.0	1118	34.0	1178	34.0
939	107.0	999	35.0	1059	37.0	1119	34.0	1179	34.0
940	106.0	1000	34.0	1060	36.0	1120	34.0	1180	32.0
941	102.0	1001	33.0	1061	36.0	1121	33.0	1181	32.0
942	98.0	1002	34.0	1062	35.0	1122	34.0	1182	32.0
943	97.0	1003	33.0	1063	35.0	1123	37.0	1183	32.0
944	103.0	1004	33.0	1064	35.0	1124	37.0	1184	36.0
945	109.0	1005	32.0	1065	33.0	1125	38.0	1185	37.0
946	109.0	1006	32.0	1066	34.0	1126	36.0	1186	37.0
947	104.0	1007	33.0	1067	39.0	1127	34.0	1187	36.0
948	98.0	1008	34.0	1068	42.0	1128	33.0	1188	36.0
949	90.0	1009	33.0	1069	41.0	1129	34.0	1189	35.0
950	89.0	1010	33.0	1070	40.0	1130	35.0	1190	34.0
951	84.0	1011	32.0	1071	39.0	1131	35.0	1191	33.0
952	84.0	1012	34.0	1072	37.0	1132	33.0	1192	34.0
953	85.0	1013	35.0	1073	34.0	1133	31.0	1193	34.0
954	83.0	1014	34.0	1074	35.0	1134	32.0	1194	34.0
955	85.0	1015	35.0	1075	35.0	1135	34.0	1195	33.0
956	93.0	1016	36.0	1076	34.0	1136	34.0	1196	34.0
957	104.0	1017	39.0	1077	34.0	1137	34.0	1197	34.0
958	107.0	1018	39.0	1078	34.0	1138	34.0	1198	35.0
959	109.0	1019	36.0	1079	34.0	1139	35.0	1199	35.0
960	103.0	1020	34.0	1080	34.0	1140	34.0	1200	34.0
961	104.0	1021	34.0	1081	33.0	1141	32.0	1201	34.0
962	98.0	1022	34.0	1082	32.0	1142	34.0	1202	35.0
963	93.0	1023	35.0	1083	33.0	1143	35.0	1203	35.0
964	90.0	1024	35.0	1084	37.0	1144	34.0	1204	35.0
965	85.0	1025	34.0	1085	37.0	1145	34.0	1205	35.0
966	80.0	1026	35.0	1086	34.0	1146	34.0	1206	31.0
967	64.0	1027	35.0	1087	36.0	1147	33.0	1207	34.0
968	48.0	1028	35.0	1088	38.0	1148	32.0	1208	35.0
969	41.0	1029	35.0	1089	38.0	1149	32.0	1209	38.0

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, CA - July 23, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
1210	37.0	1270	106.0	1330	121.0	1390	90.0	1450	171.0
1211	36.0	1271	96.0	1331	120.0	1391	86.0		
1212	34.0	1272	92.0	1332	116.0	1392	80.0		
1213	34.0	1273	95.0	1333	119.0	1393	80.0		
1214	34.0	1274	99.0	1334	120.0	1394	84.0		
1215	35.0	1275	102.0	1335	125.0	1395	82.0		
1216	36.0	1276	105.0	1336	127.0	1396	81.0		
1217	36.0	1277	113.0	1337	129.0	1397	77.0		
1218	37.0	1278	116.0	1338	143.0	1398	80.0		
1219	37.0	1279	114.0	1339	139.0	1399	85.0		
1220	38.0	1280	95.0	1340	139.0	1400	91.0		
1221	37.0	1281	92.0	1341	135.0	1401	97.0		
1222	36.0	1282	84.0	1342	131.0	1402	107.0		
1223	35.0	1283	87.0	1343	129.0	1403	118.0		
1224	34.0	1284	92.0	1344	127.0	1404	135.0		
1225	34.0	1285	89.0	1345	130.0	1405	159.0		
1226	35.0	1286	87.0	1346	133.0	1406	161.0		
1227	34.0	1287	90.0	1347	137.0	1407	164.0		
1228	34.0	1288	93.0	1348	141.0	1408	173.0		
1229	35.0	1289	89.0	1349	141.0	1409	178.0		
1230	37.0	1290	91.0	1350	138.0	1410	178.0		
1231	41.0	1291	99.0	1351	137.0	1411	178.0		
1232	48.0	1292	106.0	1352	139.0	1412	173.0		
1233	54.0	1293	112.0	1353	144.0	1413	173.0		
1234	54.0	1294	116.0	1354	147.0	1414	175.0		
1235	52.0	1295	117.0	1355	146.0	1415	169.0		
1236	57.0	1296	117.0	1356	143.0	1416	168.0		
1237	50.0	1297	122.0	1357	141.0	1417	174.0		
1238	42.0	1298	130.0	1358	141.0	1418	184.0		
1239	40.0	1299	130.0	1359	135.0	1419	187.0		
1240	37.0	1300	120.0	1360	137.0	1420	186.0		
1241	37.0	1301	111.0	1361	136.0	1421	186.0		
1242	37.0	1302	107.0	1362	135.0	1422	183.0		
1243	42.0	1303	104.0	1363	137.0	1423	185.0		
1244	45.0	1304	101.0	1364	143.0	1424	179.0		
1245	46.0	1305	98.0	1365	143.0	1425	175.0		
1246	53.0	1306	99.0	1366	139.0	1426	166.0		
1247	58.0	1307	104.0	1367	135.0	1427	177.0		
1248	64.0	1308	111.0	1368	130.0	1428	187.0		
1249	66.0	1309	111.0	1369	121.0	1429	194.0		
1250	71.0	1310	108.0	1370	109.0	1430	189.0		
1251	74.0	1311	115.0	1371	103.0	1431	184.0		
1252	72.0	1312	115.0	1372	99.0	1432	191.0		
1253	70.0	1313	114.0	1373	98.0	1433	190.0		
1254	86.0	1314	125.0	1374	96.0	1434	193.0		
1255	98.0	1315	143.0	1375	96.0	1435	195.0		
1256	97.0	1316	144.0	1376	92.0	1436	191.0		
1257	94.0	1317	139.0	1377	92.0	1437	187.0		
1258	96.0	1318	133.0	1378	91.0	1438	196.0		
1259	105.0	1319	120.0	1379	98.0	1439	198.0		
1260	109.0	1320	118.0	1380	98.0	1440	197.0		
1261	107.0	1321	118.0	1381	97.0	1441	193.0		
1262	103.0	1322	120.0	1382	111.0	1442	187.0		
1263	108.0	1323	126.0	1383	110.0	1443	183.0		
1264	122.0	1324	125.0	1384	104.0	1444	184.0		
1265	130.0	1325	119.0	1385	99.0	1445	184.0		
1266	134.0	1326	117.0	1386	92.0	1446	182.0		
1267	131.0	1327	122.0	1387	89.0	1447	182.0		
1268	123.0	1328	123.0	1388	88.0	1448	181.0		
1269	110.0	1329	126.0	1389	91.0	1449	171.0		

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, California - July 23, 1989
Measured with 2 in scintillation tool - corrected using Table 2

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
10	125.2	70	70.1	130	54.1	190	62.7	250	33.0
11	124.0	71	67.7	131	51.7	191	62.7	251	30.0
12	121.7	72	67.7	132	51.7	192	62.7	252	30.0
13	121.7	73	64.0	133	55.4	193	64.0	253	34.0
14	115.8	74	60.3	134	59.0	194	60.3	254	36.0
15	111.2	75	60.3	135	59.0	195	57.8	255	38.0
16	108.8	76	57.8	136	56.6	196	59.0	256	40.0
17	112.3	77	56.6	137	60.3	197	60.3	257	42.0
18	118.2	78	51.7	138	61.5	198	62.7	258	41.0
19	121.7	79	51.7	139	59.0	199	64.0	259	36.0
20	113.5	80	49.2	140	59.0	200	61.5	260	35.0
21	111.2	81	48.0	141	54.1	201	61.5	261	34.0
22	111.2	82	46.7	142	50.4	202	66.4	262	32.0
23	107.6	83	46.7	143	52.9	203	65.2	263	30.0
24	105.3	84	46.7	144	57.8	204	67.7	264	28.0
25	117.0	85	48.0	145	56.6	205	68.9	265	29.0
26	115.8	86	49.2	146	60.3	206	67.7	266	28.0
27	113.5	87	49.2	147	59.0	207	68.9	267	28.0
28	117.0	88	49.2	148	60.3	208	62.7	268	30.0
29	121.7	89	49.2	149	57.8	209	65.2	269	33.0
30	127.9	90	49.2	150	54.1	210	67.7	270	34.0
31	124.2	91	46.7	151	55.4	211	72.6	271	34.0
32	120.5	92	45.5	152	57.8	212	73.8	272	33.0
33	119.3	93	48.0	153	52.9	213	73.8	273	32.0
34	115.6	94	54.1	154	49.2	214	75.0	274	33.0
35	116.9	95	52.9	155	49.2	215	75.0	275	34.0
36	119.3	96	51.7	156	44.3	216	78.7	276	35.0
37	120.5	97	49.2	157	40.6	217	76.3	277	37.0
38	116.9	98	46.7	158	40.6	218	75.0	278	38.0
39	115.6	99	46.7	159	44.3	219	79.9	279	37.0
40	109.5	100	46.7	160	49.2	220	83.6	280	34.0
41	104.6	101	45.5	161	55.4	221	99.6	281	32.0
42	102.1	102	45.5	162	62.7	222	108.2	282	31.0
43	99.6	103	44.3	163	72.6	223	98.4	283	28.0
44	99.6	104	43.1	164	86.1	224	99.6	284	26.0
45	94.7	105	43.1	165	98.4	225	115.5	285	27.0
46	92.2	106	44.3	166	110.7	226	102.3	286	28.0
47	87.3	107	46.7	167	115.6	227	92.4	287	29.0
48	87.3	108	48.0	168	113.2	228	92.4	288	27.0
49	93.5	109	50.4	169	119.3	229	84.1	289	25.0
50	103.3	110	52.9	170	114.4	230	82.5	290	27.0
51	109.5	111	57.8	171	103.3	231	74.2	291	31.0
52	116.9	112	56.6	172	86.1	232	59.4	292	28.0
53	115.6	113	56.6	173	68.9	233	52.8	293	28.0
54	111.9	114	59.0	174	52.9	234	46.2	294	28.0
55	91.0	115	57.8	175	41.8	235	39.6	295	28.0
56	73.8	116	59.0	176	34.4	236	36.3	296	29.0
57	88.6	117	61.5	177	30.8	237	36.3	297	26.0
58	93.5	118	60.3	178	32.0	238	38.0	298	24.0
59	97.2	119	57.8	179	43.1	239	36.3	299	26.0
60	100.9	120	57.8	180	49.2	240	33.0	300	30.0
61	95.9	121	59.0	181	59.0	241	22.0	301	33.0
62	89.8	122	55.4	182	61.5	242	23.0	302	31.0
63	76.3	123	52.9	183	62.7	243	24.0	303	27.0
64	75.0	124	54.1	184	62.7	244	25.0	304	25.0
65	71.3	125	57.8	185	57.8	245	28.0	305	26.0
66	71.3	126	61.5	186	62.7	246	41.0	306	28.0
67	67.7	127	60.3	187	71.3	247	54.0	307	28.0
68	67.7	128	59.0	188	66.4	248	52.0	308	29.0
69	70.1	129	56.6	189	64.0	249	37.0	309	30.0

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, California - July 23, 1989
Measured with 2 in scintillation tool - corrected using Table 2

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
310	30.0	370	33.0	430	25.0	490	21.4	550	32.8
311	30.0	371	33.0	431	22.0	491	21.4	551	34.4
312	31.0	372	32.0	432	18.0	492	20.4	552	35.3
313	32.0	373	31.0	433	15.0	493	19.4	553	36.1
314	33.0	374	31.0	434	15.0	494	19.4	554	36.9
315	33.0	375	31.0	435	15.0	495	20.4	555	36.9
316	33.0	376	32.0	436	15.0	496	20.4	556	37.7
317	33.0	377	34.0	437	15.0	497	20.4	557	37.7
318	32.0	378	36.0	438	14.0	498	18.4	558	38.5
319	32.0	379	37.0	439	14.0	499	18.4	559	38.5
320	32.0	380	36.0	440	14.0	500	18.4	560	38.5
321	30.0	381	34.0	441	14.0	501	19.4	561	36.1
322	29.0	382	34.0	442	14.0	502	19.4	562	35.3
323	31.0	383	33.0	443	14.0	503	19.4	563	36.1
324	32.0	384	35.0	444	14.0	504	19.4	564	35.3
325	31.0	385	36.0	445	15.0	505	19.4	565	33.6
326	31.0	386	35.0	446	15.0	506	19.4	566	32.0
327	30.0	387	33.0	447	15.0	507	19.4	567	32.0
328	31.0	388	31.0	448	14.0	508	19.4	568	32.0
329	31.0	389	30.0	449	14.0	509	19.4	569	32.0
330	31.0	390	29.0	450	14.0	510	20.4	570	31.2
331	32.0	391	31.0	451	15.0	511	20.4	571	31.2
332	32.0	392	33.0	452	16.0	512	20.4	572	31.2
333	31.0	393	34.0	453	15.0	513	20.4	573	34.4
334	30.0	394	32.0	454	14.0	514	20.4	574	36.9
335	30.0	395	32.0	455	14.0	515	21.4	575	35.3
336	29.0	396	31.0	456	15.0	516	21.4	576	34.4
337	29.0	397	33.0	457	15.0	517	21.4	577	35.3
338	28.0	398	33.0	458	14.0	518	21.4	578	37.7
339	28.0	399	32.0	459	15.0	519	21.4	579	36.9
340	31.0	400	30.0	460	16.0	520	21.4	580	35.3
341	33.0	401	31.0	461	16.0	521	21.4	581	33.6
342	32.0	402	33.0	462	17.0	522	20.4	582	35.3
343	33.0	403	34.0	463	16.0	523	20.4	583	34.4
344	31.0	404	35.0	464	15.0	524	20.4	584	34.4
345	31.0	405	35.0	465	18.0	525	21.4	585	34.4
346	30.0	406	35.0	466	18.0	526	21.4	586	34.4
347	30.0	407	34.0	467	21.0	527	21.4	587	32.8
348	31.0	408	33.0	468	20.0	528	21.4	588	33.6
349	32.0	409	34.0	469	19.0	529	22.4	589	32.0
350	32.0	410	33.0	470	18.4	530	23.5	590	32.0
351	32.0	411	32.0	471	18.4	531	24.5	591	32.8
352	33.0	412	32.0	472	18.4	532	24.5	592	33.6
353	34.0	413	32.0	473	16.3	533	24.5	593	35.3
354	35.0	414	33.0	474	16.3	534	23.5	594	36.9
355	35.0	415	31.0	475	19.4	535	18.9	595	38.5
356	34.0	416	31.0	476	22.4	536	18.9	596	37.7
357	34.0	417	30.0	477	23.5	537	19.7	597	36.1
358	32.0	418	30.0	478	22.4	538	18.9	598	36.9
359	30.0	419	32.0	479	22.4	539	17.2	599	38.5
360	31.0	420	32.0	480	22.4	540	16.4	600	38.5
361	32.0	421	31.0	481	21.4	541	18.0	601	39.4
362	32.0	422	31.0	482	22.4	542	21.3	602	39.4
363	32.0	423	32.0	483	22.4	543	24.6	603	39.4
364	32.0	424	31.0	484	22.4	544	27.9	604	39.4
365	30.0	425	30.0	485	24.5	545	29.5	605	38.5
366	27.0	426	31.0	486	23.5	546	31.2	606	35.3
367	28.0	427	32.0	487	22.4	547	32.0	607	34.4
368	29.0	428	30.0	488	21.4	548	32.0	608	35.3
369	31.0	429	27.0	489	20.4	549	32.0	609	36.9

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, California - July 23, 1989
Measured with 2 in scintillation tool - corrected using Table 2

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
610	37.7	670	19.7	730	24.6	790	30.3	850	43.5
611	37.7	671	18.0	731	24.6	791	31.2	851	50.0
612	36.9	672	17.2	732	24.6	792	32.0	852	59.9
613	36.9	673	18.0	733	23.8	793	34.4	853	63.1
614	37.7	674	19.7	734	23.0	794	37.7	854	70.5
615	38.5	675	19.7	735	21.3	795	36.9	855	77.1
616	39.4	676	19.7	736	23.0	796	37.7	856	81.2
617	40.2	677	21.3	737	24.6	797	38.5	857	77.1
618	39.4	678	21.3	738	23.8	798	38.5	858	73.8
619	38.5	679	21.3	739	23.8	799	38.5	859	69.7
620	36.9	680	20.5	740	24.6	800	39.4	860	71.3
621	35.3	681	22.1	741	24.6	801	37.7	861	69.7
622	34.4	682	22.1	742	27.1	802	36.9	862	65.6
623	34.4	683	21.3	743	24.6	803	36.1	863	69.7
624	35.3	684	19.7	744	23.8	804	33.6	864	75.4
625	36.1	685	20.5	745	23.8	805	32.8	865	76.3
626	37.7	686	20.5	746	26.2	806	31.2	866	75.4
627	39.4	687	20.5	747	25.4	807	29.5	867	68.1
628	34.4	688	20.5	748	23.8	808	32.0	868	58.2
629	34.4	689	21.3	749	22.1	809	30.3	869	64.8
630	33.6	690	21.3	750	22.1	810	29.5	870	68.9
631	33.6	691	21.3	751	23.0	811	30.3	871	69.7
632	35.3	692	22.1	752	23.8	812	31.2	872	69.7
633	36.1	693	20.5	753	24.6	813	29.5	873	77.1
634	36.1	694	19.7	754	25.4	814	27.9	874	82.0
635	36.9	695	19.7	755	25.4	815	27.9	875	82.0
636	37.7	696	19.7	756	26.2	816	28.7	876	91.8
637	36.1	697	20.5	757	24.6	817	27.9	877	96.8
638	36.1	698	20.5	758	26.2	818	28.7	878	89.4
639	33.6	699	21.3	759	26.2	819	32.0	879	116.4
640	32.0	700	22.1	760	24.6	820	51.7	880	123.0
641	33.6	701	25.4	761	26.2	821	56.6	881	130.4
642	34.4	702	25.4	762	26.2	822	45.9	882	133.7
643	34.4	703	24.6	763	27.9	823	37.7	883	133.7
644	35.3	704	21.3	764	30.3	824	39.4	884	128.7
645	37.7	705	20.5	765	33.6	825	46.7	885	132.8
646	38.5	706	20.5	766	33.6	826	41.0	886	133.7
647	36.1	707	22.1	767	35.3	827	36.1	887	132.8
648	32.8	708	22.1	768	34.4	828	36.9	888	130.4
649	29.5	709	21.3	769	32.8	829	32.8	889	131.2
650	29.5	710	21.3	770	30.3	830	30.3	890	123.8
651	29.5	711	22.1	771	31.2	831	30.3	891	122.2
652	29.5	712	22.1	772	31.2	832	29.5	892	128.7
653	29.5	713	23.0	773	30.3	833	29.5	893	132.8
654	31.2	714	22.1	774	29.5	834	31.2	894	136.9
655	30.3	715	21.3	775	28.7	835	27.9	895	139.4
656	28.7	716	23.0	776	28.7	836	29.5	896	141.0
657	28.7	717	22.1	777	30.3	837	28.7	897	136.9
658	30.3	718	23.0	778	32.8	838	27.9	898	138.6
659	30.3	719	23.0	779	32.8	839	27.1	899	139.4
660	29.5	720	22.1	780	32.8	840	27.1	900	142.7
661	27.1	721	22.1	781	32.8	841	27.1	901	139.4
662	24.6	722	23.0	782	32.8	842	27.1	902	139.4
663	21.3	723	23.0	783	32.8	843	27.9	903	140.2
664	19.7	724	23.0	784	33.6	844	28.7	904	140.2
665	24.6	725	24.6	785	32.8	845	28.7	905	138.6
666	31.2	726	24.6	786	30.3	846	27.9	906	124.6
667	32.8	727	25.4	787	29.5	847	27.1	907	98.4
668	25.4	728	24.6	788	30.3	848	26.2	908	73.0
669	23.0	729	24.6	789	29.5	849	27.1	909	46.7

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, California - July 23, 1989
Measured with 2 in scintillation tool - corrected using Table 2

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
910	38.5	970	31.2	1030	28.7	1090	28.7	1150	27.9
911	33.6	971	29.5	1031	27.9	1091	27.9	1151	27.9
912	29.5	972	27.9	1032	28.7	1092	27.9	1152	27.9
913	29.5	973	27.9	1033	28.7	1093	27.9	1153	27.9
914	36.9	974	27.9	1034	27.9	1094	27.9	1154	27.9
915	66.4	975	28.7	1035	27.9	1095	27.9	1155	29.5
916	102.5	976	28.7	1036	28.7	1096	27.9	1156	29.5
917	118.1	977	27.9	1037	29.5	1097	27.9	1157	28.7
918	119.7	978	26.2	1038	29.5	1098	27.9	1158	27.9
919	124.6	979	28.7	1039	27.9	1099	28.7	1159	28.7
920	129.6	980	29.5	1040	28.7	1100	27.9	1160	29.5
921	132.8	981	27.9	1041	31.2	1101	29.5	1161	28.7
922	132.0	982	27.9	1042	31.2	1102	30.3	1162	28.7
923	134.5	983	28.7	1043	30.3	1103	31.2	1163	27.9
924	129.6	984	29.5	1044	29.5	1104	30.3	1164	27.1
925	123.8	985	28.7	1045	29.5	1105	29.5	1165	26.2
926	123.8	986	28.7	1046	28.7	1106	30.3	1166	27.1
927	121.4	987	30.3	1047	27.9	1107	31.2	1167	27.1
928	121.4	988	30.3	1048	26.2	1108	29.5	1168	28.7
929	114.0	989	30.3	1049	27.9	1109	29.5	1169	30.3
930	113.2	990	30.3	1050	27.1	1110	29.5	1170	31.2
931	104.1	991	28.7	1051	27.9	1111	29.5	1171	30.3
932	96.8	992	28.7	1052	30.3	1112	30.3	1172	28.7
933	87.7	993	27.9	1053	31.2	1113	31.2	1173	28.7
934	85.3	994	27.9	1054	31.2	1114	29.5	1174	25.4
935	85.3	995	28.7	1055	28.7	1115	28.7	1175	25.4
936	83.6	996	29.5	1056	27.9	1116	28.7	1176	25.4
937	89.4	997	27.9	1057	29.5	1117	27.9	1177	26.2
938	89.4	998	28.7	1058	29.5	1118	27.9	1178	27.9
939	87.7	999	28.7	1059	30.3	1119	27.9	1179	27.9
940	86.9	1000	27.9	1060	29.5	1120	27.9	1180	26.2
941	83.6	1001	27.1	1061	29.5	1121	27.1	1181	26.2
942	80.4	1002	27.9	1062	28.7	1122	27.9	1182	26.2
943	79.5	1003	27.1	1063	28.7	1123	30.3	1183	26.2
944	84.5	1004	27.1	1064	28.7	1124	30.3	1184	29.5
945	89.4	1005	26.2	1065	27.1	1125	31.2	1185	30.3
946	89.4	1006	26.2	1066	27.9	1126	29.5	1186	30.3
947	85.3	1007	27.1	1067	32.0	1127	27.9	1187	29.5
948	80.4	1008	27.9	1068	34.4	1128	27.1	1188	29.5
949	73.8	1009	27.1	1069	33.6	1129	27.9	1189	28.7
950	73.0	1010	27.1	1070	32.8	1130	28.7	1190	27.9
951	68.9	1011	26.2	1071	32.0	1131	28.7	1191	27.1
952	68.9	1012	27.9	1072	30.3	1132	27.1	1192	27.9
953	69.7	1013	28.7	1073	27.9	1133	25.4	1193	27.9
954	68.1	1014	27.9	1074	28.7	1134	26.2	1194	27.9
955	69.7	1015	28.7	1075	28.7	1135	27.9	1195	27.1
956	76.3	1016	29.5	1076	27.9	1136	27.9	1196	27.9
957	85.3	1017	32.0	1077	27.9	1137	27.9	1197	27.9
958	87.7	1018	32.0	1078	27.9	1138	27.9	1198	28.7
959	89.4	1019	29.5	1079	27.9	1139	28.7	1199	28.7
960	84.5	1020	27.9	1080	27.9	1140	27.9	1200	27.9
961	85.3	1021	27.9	1081	27.1	1141	26.2	1201	27.9
962	80.4	1022	27.9	1082	26.2	1142	27.9	1202	28.7
963	76.3	1023	28.7	1083	27.1	1143	28.7	1203	28.7
964	73.8	1024	28.7	1084	30.3	1144	27.9	1204	28.7
965	69.7	1025	27.9	1085	30.3	1145	27.9	1205	28.7
966	65.6	1026	28.7	1086	27.9	1146	27.9	1206	25.4
967	52.5	1027	28.7	1087	29.5	1147	27.1	1207	27.9
968	39.4	1028	28.7	1088	31.2	1148	26.2	1208	28.7
969	33.6	1029	28.7	1089	31.2	1149	26.2	1209	31.2

MLGRAP # 1 - Long Valley Caldera, Mammoth Lakes, California - July 23, 1989
Measured with 2 in scintillation tool - corrected using Table 2

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
1210	30.3	1270	86.9	1330	99.2	1390	73.8	1450	140.2
1211	29.5	1271	78.7	1331	98.4	1391	70.5		
1212	27.9	1272	75.4	1332	95.1	1392	65.6		
1213	27.9	1273	77.9	1333	97.6	1393	65.6		
1214	27.9	1274	81.2	1334	98.4	1394	68.9		
1215	28.7	1275	83.6	1335	102.5	1395	67.2		
1216	29.5	1276	86.1	1336	104.1	1396	66.4		
1217	29.5	1277	92.7	1337	105.8	1397	63.1		
1218	30.3	1278	95.1	1338	117.3	1398	65.6		
1219	30.3	1279	93.5	1339	114.0	1399	69.7		
1220	31.2	1280	77.9	1340	114.0	1400	74.6		
1221	30.3	1281	75.4	1341	110.7	1401	79.5		
1222	29.5	1282	68.9	1342	107.4	1402	87.7		
1223	28.7	1283	71.3	1343	105.8	1403	96.8		
1224	27.9	1284	75.4	1344	104.1	1404	110.7		
1225	27.9	1285	73.0	1345	106.6	1405	130.4		
1226	28.7	1286	71.3	1346	109.1	1406	132.0		
1227	27.9	1287	73.8	1347	112.3	1407	134.5		
1228	27.9	1288	76.3	1348	115.6	1408	141.9		
1229	28.7	1289	73.0	1349	115.6	1409	146.0		
1230	30.3	1290	74.6	1350	113.2	1410	146.0		
1231	33.6	1291	81.2	1351	112.3	1411	146.0		
1232	39.4	1292	86.9	1352	114.0	1412	141.9		
1233	44.3	1293	91.8	1353	118.1	1413	141.9		
1234	44.3	1294	95.1	1354	120.5	1414	143.5		
1235	42.6	1295	95.9	1355	119.7	1415	138.6		
1236	46.7	1296	95.9	1356	117.3	1416	137.8		
1237	41.0	1297	100.0	1357	115.6	1417	142.7		
1238	34.4	1298	106.6	1358	115.6	1418	150.9		
1239	32.8	1299	106.6	1359	110.7	1419	153.3		
1240	30.3	1300	98.4	1360	112.3	1420	152.5		
1241	30.3	1301	91.0	1361	111.5	1421	152.5		
1242	30.3	1302	87.7	1362	110.7	1422	150.1		
1243	34.4	1303	85.3	1363	112.3	1423	151.7		
1244	36.9	1304	82.8	1364	117.3	1424	146.8		
1245	37.7	1305	80.4	1365	117.3	1425	143.5		
1246	43.5	1306	81.2	1366	114.0	1426	136.1		
1247	47.6	1307	85.3	1367	110.7	1427	145.1		
1248	52.5	1308	91.0	1368	106.6	1428	153.3		
1249	54.1	1309	91.0	1369	99.2	1429	159.1		
1250	58.2	1310	88.6	1370	89.4	1430	155.0		
1251	60.7	1311	94.3	1371	84.5	1431	150.9		
1252	59.0	1312	94.3	1372	81.2	1432	156.6		
1253	57.4	1313	93.5	1373	80.4	1433	155.8		
1254	70.5	1314	102.5	1374	78.7	1434	158.3		
1255	80.4	1315	117.3	1375	78.7	1435	159.9		
1256	79.5	1316	118.1	1376	75.4	1436	156.6		
1257	77.1	1317	114.0	1377	75.4	1437	153.3		
1258	78.7	1318	109.1	1378	74.6	1438	160.7		
1259	86.1	1319	98.4	1379	80.4	1439	162.4		
1260	89.4	1320	96.8	1380	80.4	1440	161.5		
1261	87.7	1321	96.8	1381	79.5	1441	158.3		
1262	84.5	1322	98.4	1382	91.0	1442	153.3		
1263	88.6	1323	103.3	1383	90.2	1443	150.1		
1264	100.0	1324	102.5	1384	85.3	1444	150.9		
1265	106.6	1325	97.6	1385	81.2	1445	150.9		
1266	109.9	1326	95.9	1386	75.4	1446	149.2		
1267	107.4	1327	100.0	1387	73.0	1447	149.2		
1268	100.9	1328	100.9	1388	72.2	1448	148.4		
1269	90.2	1329	103.3	1389	74.6	1449	140.2		

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - July 24, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
10	74.0	70	61.0	130	43.0	190	40.0	250	88.0
11	73.0	71	64.0	131	44.0	191	39.0	251	97.0
12	71.0	72	61.0	132	47.0	192	41.0	252	102.0
13	71.0	73	60.0	133	42.0	193	43.0	253	98.0
14	71.0	74	60.0	134	40.0	194	42.0	254	91.0
15	76.0	75	62.0	135	38.0	195	41.0	255	92.0
16	77.0	76	61.0	136	35.0	196	45.0	256	90.0
17	77.0	77	59.0	137	34.0	197	48.0	257	90.0
18	73.0	78	56.0	138	33.0	198	49.0	258	89.0
19	72.0	79	59.0	139	35.0	199	49.0	259	86.0
20	73.0	80	63.0	140	34.0	200	52.0	260	87.0
21	70.0	81	64.0	141	34.0	201	57.0	261	79.0
22	75.0	82	64.0	142	34.0	202	56.0	262	75.0
23	74.0	83	66.0	143	34.0	203	53.0	263	71.0
24	68.0	84	66.0	144	35.0	204	67.0	264	76.0
25	69.0	85	64.0	145	35.0	205	116.0	265	84.0
26	72.0	86	56.0	146	34.0	206	146.0	266	87.0
27	73.0	87	56.0	147	34.0	207	158.0	267	88.0
28	78.0	88	55.0	148	34.0	208	163.0	268	90.0
29	72.0	89	57.0	149	35.0	209	164.0	269	92.0
30	72.0	90	64.0	150	38.0	210	163.0	270	99.0
31	74.0	91	64.0	151	38.0	211	140.0	271	93.0
32	69.0	92	64.0	152	35.0	212	95.0	272	93.0
33	70.0	93	61.0	153	34.0	213	83.0	273	92.0
34	69.0	94	70.0	154	31.0	214	77.0	274	91.0
35	68.0	95	73.0	155	30.0	215	69.0	275	94.0
36	69.0	96	72.0	156	33.0	216	64.0	276	89.0
37	74.0	97	74.0	157	34.0	217	62.0	277	86.0
38	77.0	98	77.0	158	33.0	218	55.0	278	90.0
39	79.0	99	83.0	159	35.0	219	51.0	279	90.0
40	75.0	100	77.0	160	36.0	220	45.0	280	83.0
41	73.0	101	79.0	161	35.0	221	38.0	281	83.0
42	66.0	102	77.0	162	38.0	222	35.0	282	83.0
43	64.0	103	78.0	163	37.0	223	33.0	283	80.0
44	62.0	104	79.0	164	36.0	224	33.0	284	79.0
45	63.0	105	80.0	165	32.0	225	33.0	285	79.0
46	62.0	106	82.0	166	34.0	226	33.0	286	84.0
47	59.0	107	81.0	167	35.0	227	33.0	287	92.0
48	57.0	108	81.0	168	35.0	228	34.0	288	98.0
49	55.0	109	79.0	169	37.0	229	35.0	289	95.0
50	56.0	110	77.0	170	36.0	230	34.0	290	92.0
51	56.0	111	77.0	171	34.0	231	34.0	291	81.0
52	62.0	112	79.0	172	36.0	232	35.0	292	87.0
53	70.0	113	79.0	173	37.0	233	34.0	293	84.0
54	73.0	114	75.0	174	36.0	234	35.0	294	88.0
55	73.0	115	81.0	175	34.0	235	36.0	295	94.0
56	66.0	116	80.0	176	37.0	236	34.0	296	99.0
57	67.0	117	76.0	177	39.0	237	31.0	297	88.0
58	66.0	118	77.0	178	41.0	238	29.0	298	84.0
59	65.0	119	78.0	179	40.0	239	28.0	299	88.0
60	67.0	120	73.0	180	37.0	240	29.0	300	90.0
61	68.0	121	72.0	181	38.0	241	31.0	301	93.0
62	64.0	122	69.0	182	37.0	242	34.0	302	98.0
63	62.0	123	74.0	183	36.0	243	34.0	303	100.0
64	60.0	124	72.0	184	38.0	244	36.0	304	102.0
65	60.0	125	70.0	185	38.0	245	38.0	305	106.0
66	62.0	126	60.0	186	37.0	246	46.0	306	110.0
67	62.0	127	54.0	187	35.0	247	69.0	307	114.0
68	60.0	128	49.0	188	38.0	248	77.0	308	128.0
69	60.0	129	47.0	189	40.0	249	82.0	309	139.0

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - July 24, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
310	139.0	370	35.0	430	52.0	490	48.0	550	64.0
311	143.0	371	34.0	431	52.0	491	43.0	551	65.0
312	147.0	372	34.0	432	52.0	492	45.0	552	64.0
313	149.0	373	34.0	433	52.0	493	48.0	553	60.0
314	148.0	374	35.0	434	52.0	494	51.0	554	57.0
315	149.0	375	37.0	435	50.0	495	53.0	555	63.0
316	149.0	376	39.0	436	51.0	496	53.0	556	64.0
317	147.0	377	42.0	437	50.0	497	52.0	557	61.0
318	153.0	378	45.0	438	49.0	498	49.0	558	61.0
319	160.0	379	45.0	439	49.0	499	49.0	559	53.0
320	162.0	380	44.0	440	48.0	500	51.0	560	45.0
321	163.0	381	45.0	441	50.0	501	53.0	561	41.0
322	168.0	382	45.0	442	54.0	502	53.0	562	36.0
323	155.0	383	45.0	443	52.0	503	50.0	563	35.0
324	149.0	384	45.0	444	52.0	504	50.0	564	32.0
325	147.0	385	47.0	445	50.0	505	50.0	565	31.0
326	152.0	386	48.0	446	51.0	506	51.0	566	31.0
327	156.0	387	48.0	447	52.0	507	52.0	567	31.0
328	163.0	388	47.0	448	50.0	508	49.0	568	31.0
329	164.0	389	47.0	449	48.0	509	51.0	569	32.0
330	170.0	390	46.0	450	49.0	510	49.0	570	32.0
331	169.0	391	45.0	451	49.0	511	51.0	571	30.0
332	163.0	392	47.0	452	53.0	512	52.0	572	30.0
333	160.0	393	48.0	453	51.0	513	49.0	573	30.0
334	156.0	394	48.0	454	53.0	514	49.0	574	31.0
335	149.0	395	47.0	455	54.0	515	48.0	575	33.0
336	145.0	396	48.0	456	52.0	516	47.0	576	35.0
337	147.0	397	51.0	457	52.0	517	47.0	577	34.0
338	146.0	398	52.0	458	51.0	518	48.0	578	31.0
339	140.0	399	53.0	459	50.0	519	49.0	579	34.0
340	136.0	400	53.0	460	49.0	520	49.0	580	35.0
341	134.0	401	47.0	461	50.0	521	49.0	581	34.0
342	131.0	402	47.0	462	50.0	522	51.0	582	34.0
343	123.0	403	49.0	463	48.0	523	49.0	583	35.0
344	116.0	404	48.0	464	55.0	524	49.0	584	32.0
345	103.0	405	48.0	465	56.0	525	48.0	585	31.0
346	86.0	406	50.0	466	53.0	526	48.0	586	31.0
347	75.0	407	50.0	467	51.0	527	50.0	587	36.0
348	67.0	408	50.0	468	49.0	528	52.0	588	36.0
349	72.0	409	47.0	469	51.0	529	54.0	589	35.0
350	75.0	410	47.0	470	53.0	530	54.0	590	36.0
351	66.0	411	52.0	471	53.0	531	52.0	591	34.0
352	66.0	412	53.0	472	48.0	532	48.0	592	33.0
353	69.0	413	50.0	473	48.0	533	48.0	593	35.0
354	70.0	414	51.0	474	54.0	534	53.0	594	35.0
355	62.0	415	53.0	475	55.0	535	51.0	595	35.0
356	57.0	416	56.0	476	50.0	536	54.0	596	34.0
357	56.0	417	53.0	477	49.0	537	54.0	597	33.0
358	58.0	418	54.0	478	50.0	538	52.0	598	35.0
359	50.0	419	53.0	479	51.0	539	54.0	599	35.0
360	47.0	420	51.0	480	53.0	540	52.0	600	34.0
361	45.0	421	52.0	481	52.0	541	50.0	601	35.0
362	40.0	422	54.0	482	49.0	542	51.0	602	35.0
363	35.0	423	51.0	483	50.0	543	50.0	603	36.0
364	36.0	424	51.0	484	50.0	544	55.0	604	35.0
365	41.0	425	48.0	485	49.0	545	55.0	605	34.0
366	47.0	426	51.0	486	48.0	546	55.0	606	35.0
367	43.0	427	53.0	487	50.0	547	56.0	607	33.0
368	40.0	428	52.0	488	53.0	548	59.0	608	31.0
369	37.0	429	52.0	489	52.0	549	61.0	609	33.0

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - July 24, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
610	35.0	670	41.0	730	40.0	790	41.0	850	35.0
611	35.0	671	39.0	731	40.0	791	41.0	851	35.0
612	34.0	672	36.0	732	43.0	792	41.0	852	33.0
613	34.0	673	34.0	733	44.0	793	41.0	853	32.0
614	35.0	674	38.0	734	40.0	794	41.0	854	31.0
615	37.0	675	37.0	735	40.0	795	41.0	855	32.0
616	37.0	676	37.0	736	39.0	796	41.0	856	32.0
617	36.0	677	37.0	737	39.0	797	42.0	857	33.0
618	39.0	678	36.0	738	39.0	798	44.0	858	35.0
619	40.0	679	35.0	739	42.0	799	43.0	859	34.0
620	39.0	680	34.0	740	41.0	800	41.0	860	33.0
621	38.0	681	33.0	741	39.0	801	40.0	861	31.0
622	36.0	682	34.0	742	38.0	802	41.0	862	32.0
623	35.0	683	35.0	743	37.0	803	42.0	863	32.0
624	34.0	684	35.0	744	38.0	804	43.0	864	32.0
625	34.0	685	36.0	745	39.0	805	41.0	865	33.0
626	34.0	686	35.0	746	38.0	806	42.0	866	34.0
627	34.0	687	35.0	747	39.0	807	45.0	867	34.0
628	34.0	688	36.0	748	40.0	808	45.0	868	35.0
629	34.0	689	38.0	749	41.0	809	44.0	869	37.0
630	33.0	690	36.0	750	43.0	810	44.0	870	37.0
631	35.0	691	35.0	751	42.0	811	46.0	871	35.0
632	35.0	692	35.0	752	40.0	812	45.0	872	34.0
633	36.0	693	35.0	753	40.0	813	42.0	873	33.0
634	34.0	694	36.0	754	40.0	814	43.0	874	33.0
635	37.0	695	37.0	755	40.0	815	46.0	875	33.0
636	37.0	696	37.0	756	39.0	816	48.0	876	33.0
637	36.0	697	39.0	757	38.0	817	47.0	877	31.0
638	34.0	698	39.0	758	39.0	818	44.0	878	31.0
639	35.0	699	38.0	759	38.0	819	40.0	879	32.0
640	35.0	700	38.0	760	39.0	820	34.0	880	33.0
641	36.0	701	38.0	761	41.0	821	34.0	881	34.0
642	35.0	702	36.0	762	43.0	822	33.0	882	34.0
643	34.0	703	36.0	763	44.0	823	33.0	883	34.0
644	35.0	704	36.0	764	43.0	824	33.0	884	34.0
645	33.0	705	38.0	765	41.0	825	33.0	885	33.0
646	33.0	706	41.0	766	40.0	826	34.0	886	33.0
647	33.0	707	43.0	767	41.0	827	34.0	887	34.0
648	34.0	708	44.0	768	41.0	828	33.0	888	34.0
649	36.0	709	43.0	769	40.0	829	32.0	889	33.0
650	37.0	710	42.0	770	37.0	830	32.0	890	31.0
651	35.0	711	40.0	771	37.0	831	29.0	891	29.0
652	34.0	712	40.0	772	39.0	832	29.0	892	32.0
653	35.0	713	43.0	773	40.0	833	30.0	893	40.0
654	34.0	714	43.0	774	41.0	834	30.0	894	52.0
655	34.0	715	42.0	775	42.0	835	30.0	895	78.0
656	36.0	716	43.0	776	43.0	836	31.0	896	102.0
657	37.0	717	43.0	777	39.0	837	31.0	897	106.0
658	36.0	718	40.0	778	38.0	838	30.0	898	111.0
659	36.0	719	37.0	779	38.0	839	31.0	899	117.0
660	35.0	720	35.0	780	38.0	840	33.0	900	117.0
661	35.0	721	40.0	781	39.0	841	34.0	901	117.0
662	33.0	722	40.0	782	40.0	842	33.0	902	120.0
663	32.0	723	40.0	783	41.0	843	32.0	903	119.0
664	31.0	724	40.0	784	41.0	844	31.0	904	121.0
665	33.0	725	41.0	785	40.0	845	32.0	905	121.0
666	35.0	726	39.0	786	39.0	846	30.0	906	121.0
667	35.0	727	39.0	787	40.0	847	30.0	907	117.0
668	36.0	728	39.0	788	39.0	848	30.0	908	119.0
669	39.0	729	39.0	789	40.0	849	34.0	909	118.0

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - July 24, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
910	116.0	970	112.0	1030	126.0	1090	94.0	1150	100.0
911	111.0	971	119.0	1031	124.0	1091	94.0	1151	104.0
912	118.0	972	125.0	1032	124.0	1092	97.0	1152	110.0
913	116.0	973	128.0	1033	129.0	1093	95.0	1153	112.0
914	116.0	974	135.0	1034	132.0	1094	96.0	1154	116.0
915	110.0	975	135.0	1035	134.0	1095	96.0	1155	118.0
916	107.0	976	139.0	1036	139.0	1096	99.0	1156	117.0
917	111.0	977	134.0	1037	144.0	1097	100.0	1157	117.0
918	117.0	978	132.0	1038	144.0	1098	108.0	1158	120.0
919	117.0	979	127.0	1039	134.0	1099	111.0	1159	120.0
920	118.0	980	129.0	1040	133.0	1100	113.0	1160	115.0
921	120.0	981	128.0	1041	129.0	1101	112.0	1161	115.0
922	114.0	982	125.0	1042	129.0	1102	105.0	1162	117.0
923	105.0	983	127.0	1043	133.0	1103	99.0	1163	119.0
924	99.0	984	128.0	1044	130.0	1104	100.0	1164	117.0
925	93.0	985	124.0	1045	119.0	1105	104.0	1165	113.0
926	96.0	986	123.0	1046	101.0	1106	103.0	1166	110.0
927	95.0	987	132.0	1047	88.0	1107	109.0	1167	108.0
928	88.0	988	130.0	1048	82.0	1108	107.0	1168	114.0
929	80.0	989	126.0	1049	84.0	1109	106.0	1169	114.0
930	78.0	990	131.0	1050	80.0	1110	102.0	1170	111.0
931	80.0	991	130.0	1051	80.0	1111	99.0	1171	110.0
932	81.0	992	133.0	1052	82.0	1112	98.0	1172	103.0
933	82.0	993	134.0	1053	83.0	1113	99.0	1173	91.0
934	84.0	994	131.0	1054	84.0	1114	97.0	1174	90.0
935	86.0	995	130.0	1055	82.0	1115	100.0	1175	96.0
936	95.0	996	130.0	1056	82.0	1116	102.0	1176	102.0
937	98.0	997	129.0	1057	81.0	1117	107.0	1177	110.0
938	100.0	998	135.0	1058	82.0	1118	115.0	1178	119.0
939	104.0	999	138.0	1059	84.0	1119	119.0	1179	136.0
940	107.0	1000	142.0	1060	86.0	1120	125.0	1180	132.0
941	108.0	1001	143.0	1061	91.0	1121	124.0	1181	120.0
942	106.0	1002	140.0	1062	91.0	1122	116.0	1182	127.0
943	107.0	1003	141.0	1063	89.0	1123	103.0	1183	139.0
944	101.0	1004	141.0	1064	88.0	1124	102.0	1184	142.0
945	101.0	1005	138.0	1065	90.0	1125	106.0	1185	141.0
946	106.0	1006	140.0	1066	88.0	1126	101.0	1186	143.0
947	107.0	1007	139.0	1067	89.0	1127	99.0	1187	139.0
948	108.0	1008	141.0	1068	86.0	1128	96.0	1188	141.0
949	104.0	1009	139.0	1069	84.0	1129	95.0	1189	145.0
950	104.0	1010	140.0	1070	88.0	1130	98.0	1190	145.0
951	107.0	1011	143.0	1071	89.0	1131	100.0	1191	140.0
952	108.0	1012	142.0	1072	89.0	1132	99.0	1192	135.0
953	109.0	1013	140.0	1073	91.0	1133	95.0	1193	124.0
954	107.0	1014	136.0	1074	92.0	1134	92.0	1194	123.0
955	106.0	1015	133.0	1075	93.0	1135	91.0	1195	121.0
956	104.0	1016	130.0	1076	92.0	1136	91.0	1196	123.0
957	104.0	1017	128.0	1077	88.0	1137	91.0	1197	121.0
958	111.0	1018	131.0	1078	88.0	1138	91.0	1198	118.0
959	113.0	1019	135.0	1079	87.0	1139	86.0	1199	117.0
960	112.0	1020	135.0	1080	90.0	1140	82.0	1200	117.0
961	111.0	1021	129.0	1081	90.0	1141	79.0	1201	116.0
962	109.0	1022	131.0	1082	88.0	1142	57.0	1202	112.0
963	109.0	1023	129.0	1083	87.0	1143	35.0	1203	109.0
964	109.0	1024	129.0	1084	89.0	1144	24.0	1204	109.0
965	107.0	1025	131.0	1085	96.0	1145	20.0	1205	109.0
966	113.0	1026	128.0	1086	97.0	1146	31.0	1206	109.0
967	115.0	1027	125.0	1087	98.0	1147	53.0	1207	108.0
968	115.0	1028	128.0	1088	95.0	1148	85.0	1208	106.0
969	112.0	1029	127.0	1089	93.0	1149	93.0	1209	107.0

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - July 24, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
1210	107.0	1270	126.0	1330	117.0	1390	116.0	1450	109.0
1211	111.0	1271	123.0	1331	116.0	1391	117.0	1451	109.0
1212	117.0	1272	117.0	1332	117.0	1392	119.0	1452	105.0
1213	121.0	1273	109.0	1333	115.0	1393	118.0	1453	105.0
1214	117.0	1274	107.0	1334	113.0	1394	110.0	1454	101.0
1215	116.0	1275	113.0	1335	116.0	1395	106.0	1455	96.0
1216	118.0	1276	112.0	1336	113.0	1396	107.0	1456	92.0
1217	119.0	1277	115.0	1337	110.0	1397	105.0	1457	89.0
1218	118.0	1278	111.0	1338	110.0	1398	92.0	1458	88.0
1219	113.0	1279	115.0	1339	109.0	1399	91.0	1459	91.0
1220	108.0	1280	111.0	1340	114.0	1400	86.0	1460	91.0
1221	105.0	1281	112.0	1341	119.0	1401	91.0	1461	91.0
1222	103.0	1282	111.0	1342	117.0	1402	99.0	1462	95.0
1223	105.0	1283	111.0	1343	109.0	1403	103.0	1463	100.0
1224	103.0	1284	114.0	1344	111.0	1404	108.0	1464	95.0
1225	102.0	1285	109.0	1345	116.0	1405	120.0	1465	94.0
1226	114.0	1286	113.0	1346	119.0	1406	126.0	1466	92.0
1227	116.0	1287	113.0	1347	117.0	1407	126.0	1467	94.0
1228	116.0	1288	114.0	1348	120.0	1408	122.0	1468	97.0
1229	112.0	1289	115.0	1349	123.0	1409	118.0	1469	97.0
1230	104.0	1290	120.0	1350	125.0	1410	116.0	1470	95.0
1231	100.0	1291	120.0	1351	125.0	1411	117.0	1471	93.0
1232	114.0	1292	118.0	1352	119.0	1412	115.0	1472	100.0
1233	113.0	1293	119.0	1353	118.0	1413	112.0	1473	105.0
1234	110.0	1294	118.0	1354	120.0	1414	116.0	1474	107.0
1235	114.0	1295	116.0	1355	123.0	1415	121.0	1475	105.0
1236	126.0	1296	118.0	1356	128.0	1416	121.0	1476	106.0
1237	128.0	1297	119.0	1357	126.0	1417	120.0	1477	106.0
1238	120.0	1298	124.0	1358	119.0	1418	124.0	1478	110.0
1239	120.0	1299	121.0	1359	118.0	1419	123.0	1479	112.0
1240	119.0	1300	122.0	1360	121.0	1420	123.0	1480	111.0
1241	119.0	1301	119.0	1361	133.0	1421	119.0	1481	108.0
1242	119.0	1302	118.0	1362	136.0	1422	114.0	1482	105.0
1243	118.0	1303	110.0	1363	128.0	1423	117.0	1483	110.0
1244	120.0	1304	109.0	1364	124.0	1424	115.0	1484	116.0
1245	115.0	1305	107.0	1365	118.0	1425	110.0	1485	116.0
1246	119.0	1306	105.0	1366	116.0	1426	108.0	1486	118.0
1247	118.0	1307	107.0	1367	116.0	1427	110.0	1487	122.0
1248	115.0	1308	106.0	1368	112.0	1428	110.0	1488	120.0
1249	118.0	1309	108.0	1369	113.0	1429	110.0	1489	118.0
1250	120.0	1310	111.0	1370	115.0	1430	104.0	1490	120.0
1251	126.0	1311	114.0	1371	112.0	1431	101.0	1491	120.0
1252	127.0	1312	114.0	1372	119.0	1432	103.0	1492	120.0
1253	124.0	1313	110.0	1373	117.0	1433	98.0	1493	120.0
1254	120.0	1314	113.0	1374	116.0	1434	93.0	1494	119.0
1255	119.0	1315	113.0	1375	112.0	1435	97.0	1495	123.0
1256	115.0	1316	108.0	1376	114.0	1436	108.0	1496	125.0
1257	116.0	1317	107.0	1377	115.0	1437	107.0	1497	123.0
1258	113.0	1318	111.0	1378	113.0	1438	107.0	1498	120.0
1259	110.0	1319	112.0	1379	115.0	1439	88.0	1499	121.0
1260	109.0	1320	114.0	1380	117.0	1440	95.0	1500	121.0
1261	105.0	1321	114.0	1381	123.0	1441	104.0	1501	119.0
1262	109.0	1322	113.0	1382	128.0	1442	118.0	1502	117.0
1263	111.0	1323	113.0	1383	131.0	1443	124.0	1503	119.0
1264	114.0	1324	116.0	1384	126.0	1444	117.0	1504	118.0
1265	116.0	1325	117.0	1385	121.0	1445	110.0	1505	115.0
1266	120.0	1326	116.0	1386	118.0	1446	108.0	1506	110.0
1267	123.0	1327	121.0	1387	122.0	1447	111.0	1507	118.0
1268	125.0	1328	120.0	1388	121.0	1448	110.0	1508	124.0
1269	119.0	1329	115.0	1389	115.0	1449	108.0	1509	126.0

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, CA - July 24, 1989
Measured with 2 in scintillation tool

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
1510	122.0	1570	125.0
1511	126.0	1571	120.0
1512	128.0	1572	134.0
1513	126.0	1573	140.0
1514	124.0	1574	133.0
1515	127.0	1575	131.0
1516	129.0	1576	132.0
1517	122.0	1577	130.0
1518	119.0	1578	126.0
1519	121.0	1579	124.0
1520	121.0	1580	123.0
1521	122.0	1581	118.0
1522	122.0	1582	118.0
1523	121.0	1583	120.0
1524	120.0	1584	119.0
1525	118.0	1585	118.0
1526	120.0	1586	111.0
1527	122.0	1587	112.0
1528	121.0	1588	113.0
1529	121.0	1589	113.0
1530	120.0	1590	111.0
1531	117.0	1591	109.0
1532	119.0	1592	107.0
1533	122.0		
1534	118.0		
1535	118.0		
1536	121.0		
1537	125.0		
1538	122.0		
1539	117.0		
1540	123.0		
1541	126.0		
1542	123.0		
1543	122.0		
1544	123.0		
1545	126.0		
1546	119.0		
1547	118.0		
1548	116.0		
1549	119.0		
1550	120.0		
1551	123.0		
1552	119.0		
1553	125.0		
1554	128.0		
1555	128.0		
1556	123.0		
1557	120.0		
1558	116.0		
1559	125.0		
1560	129.0		
1561	133.0		
1562	129.0		
1563	123.0		
1564	126.0		
1565	123.0		
1566	124.0		
1567	123.0		
1568	123.0		
1569	125.0		

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, California - July 24, 1989
Measured with 2 in scintillation tool - corrected using Table 3.

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
10	85.8	70	70.8	130	49.9	190	42.8	250	67.8
11	84.7	71	74.2	131	51.0	191	41.7	251	74.7
12	82.4	72	70.8	132	54.5	192	43.9	252	78.5
13	82.4	73	69.6	133	48.7	193	46.0	253	75.5
14	82.4	74	69.6	134	46.4	194	44.9	254	70.1
15	88.2	75	71.9	135	44.1	195	43.9	255	70.8
16	89.3	76	70.8	136	40.6	196	48.2	256	69.3
17	89.3	77	68.4	137	39.4	197	51.4	257	69.3
18	84.7	78	65.0	138	38.3	198	52.4	258	68.5
19	83.5	79	68.4	139	40.6	199	52.4	259	66.2
20	84.7	80	73.1	140	39.4	200	40.0	260	67.0
21	81.2	81	74.2	141	39.4	201	43.9	261	60.8
22	87.0	82	74.2	142	39.4	202	43.1	262	57.8
23	85.8	83	76.6	143	39.4	203	40.8	263	54.7
24	78.9	84	76.6	144	40.6	204	51.6	264	58.5
25	80.0	85	74.2	145	40.6	205	89.3	265	64.7
26	83.5	86	65.0	146	39.4	206	112.4	266	67.0
27	84.7	87	65.0	147	39.4	207	121.7	267	67.8
28	90.5	88	63.8	148	39.4	208	125.5	268	69.3
29	83.5	89	66.1	149	40.6	209	126.3	269	70.8
30	83.5	90	74.2	150	44.1	210	125.5	270	76.2
31	85.8	91	74.2	151	44.1	211	107.8	271	71.6
32	80.0	92	74.2	152	40.6	212	73.1	272	71.6
33	81.2	93	70.8	153	39.4	213	63.9	273	70.8
34	80.0	94	81.2	154	36.0	214	59.3	274	70.1
35	78.9	95	84.7	155	34.8	215	53.1	275	72.4
36	80.0	96	83.5	156	38.3	216	49.3	276	68.5
37	85.8	97	85.8	157	36.4	217	47.7	277	66.2
38	89.3	98	89.3	158	35.3	218	42.4	278	69.3
39	91.6	99	96.3	159	37.5	219	39.3	279	69.3
40	87.0	100	89.3	160	38.5	220	34.7	280	63.9
41	84.7	101	91.6	161	37.5	221	29.3	281	63.9
42	76.6	102	89.3	162	40.7	222	27.0	282	63.9
43	74.2	103	90.5	163	39.6	223	25.4	283	61.6
44	71.9	104	91.6	164	38.5	224	25.4	284	60.8
45	73.1	105	92.8	165	34.2	225	25.4	285	60.8
46	71.9	106	95.1	166	36.4	226	25.4	286	64.7
47	68.4	107	94.0	167	37.5	227	25.4	287	70.8
48	66.1	108	94.0	168	37.5	228	26.2	288	75.5
49	63.8	109	91.6	169	39.6	229	27.0	289	73.1
50	65.0	110	89.3	170	38.5	230	26.2	290	70.8
51	65.0	111	89.3	171	36.4	231	26.2	291	62.4
52	71.9	112	91.6	172	38.5	232	27.0	292	67.0
53	81.2	113	91.6	173	39.6	233	26.2	293	64.7
54	84.7	114	87.0	174	38.5	234	27.0	294	67.8
55	84.7	115	94.0	175	36.4	235	27.7	295	72.4
56	76.6	116	92.8	176	39.6	236	26.2	296	76.2
57	77.7	117	88.2	177	41.7	237	23.9	297	67.8
58	76.6	118	89.3	178	43.9	238	22.3	298	64.7
59	75.4	119	90.5	179	42.8	239	21.6	299	67.8
60	77.7	120	84.7	180	39.6	240	22.3	300	69.3
61	78.9	121	83.5	181	40.7	241	23.9	301	71.6
62	74.2	122	80.0	182	39.6	242	26.2	302	75.5
63	71.9	123	85.8	183	38.5	243	26.2	303	77.0
64	69.6	124	83.5	184	40.7	244	27.7	304	78.5
65	69.6	125	81.2	185	40.7	245	29.3	305	81.6
66	71.9	126	69.6	186	39.6	246	35.4	306	84.7
67	71.9	127	62.6	187	37.5	247	53.1	307	87.8
68	69.6	128	56.8	188	40.7	248	59.3	308	98.6
69	69.6	129	54.5	189	42.8	249	63.1	309	107.0

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DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
310	107.0	370	27.0	430	45.8	490	44.6	550	59.5
311	110.1	371	26.2	431	45.8	491	40.0	551	60.5
312	113.2	372	26.2	432	48.4	492	41.9	552	59.5
313	114.7	373	26.2	433	48.4	493	44.6	553	55.8
314	114.0	374	27.0	434	48.4	494	47.4	554	53.0
315	114.7	375	28.5	435	46.5	495	49.3	555	58.6
316	114.7	376	30.0	436	47.4	496	49.3	556	59.5
317	113.2	377	32.3	437	46.5	497	48.4	557	56.7
318	117.8	378	34.7	438	45.6	498	45.6	558	56.7
319	123.2	379	34.7	439	45.6	499	45.6	559	49.3
320	124.7	380	38.7	440	44.6	500	47.4	560	41.9
321	125.5	381	39.6	441	46.5	501	49.3	561	38.1
322	129.4	382	39.6	442	50.2	502	49.3	562	33.5
323	119.4	383	39.6	443	48.4	503	46.5	563	32.6
324	114.7	384	39.6	444	48.4	504	46.5	564	29.8
325	113.2	385	41.4	445	46.5	505	46.5	565	28.8
326	117.0	386	42.2	446	47.4	506	47.4	566	28.8
327	120.1	387	42.2	447	48.4	507	48.4	567	28.8
328	125.5	388	41.4	448	46.5	508	45.6	568	28.8
329	126.3	389	41.4	449	44.6	509	47.4	569	29.8
330	130.9	390	40.5	450	45.6	510	45.6	570	29.8
331	130.1	391	39.6	451	45.6	511	47.4	571	27.9
332	125.5	392	41.4	452	49.3	512	48.4	572	27.9
333	123.2	393	42.2	453	47.4	513	45.6	573	27.9
334	120.1	394	42.2	454	49.3	514	45.6	574	28.8
335	114.7	395	41.4	455	50.2	515	44.6	575	30.7
336	111.7	396	42.2	456	48.4	516	43.7	576	32.6
337	113.2	397	44.9	457	48.4	517	43.7	577	31.6
338	112.4	398	45.8	458	47.4	518	44.6	578	28.8
339	107.8	399	46.6	459	46.5	519	45.6	579	31.6
340	104.7	400	46.6	460	45.6	520	45.6	580	32.6
341	103.2	401	41.4	461	46.5	521	45.6	581	31.6
342	100.9	402	41.4	462	46.5	522	47.4	582	31.6
343	94.7	403	43.1	463	44.6	523	45.6	583	32.6
344	89.3	404	42.2	464	51.2	524	45.6	584	29.8
345	79.3	405	42.2	465	52.1	525	44.6	585	28.8
346	66.2	406	44.0	466	49.3	526	44.6	586	28.8
347	57.8	407	44.0	467	47.4	527	46.5	587	33.5
348	51.6	408	44.0	468	45.6	528	48.4	588	33.5
349	55.4	409	41.4	469	47.4	529	50.2	589	32.6
350	57.8	410	41.4	470	49.3	530	50.2	590	33.5
351	50.8	411	45.8	471	49.3	531	48.4	591	31.6
352	50.8	412	46.6	472	44.6	532	44.6	592	30.7
353	53.1	413	44.0	473	44.6	533	44.6	593	32.6
354	53.9	414	44.9	474	50.2	534	49.3	594	32.6
355	47.7	415	46.6	475	51.2	535	47.4	595	32.6
356	43.9	416	49.3	476	46.5	536	50.2	596	31.6
357	43.1	417	46.6	477	45.6	537	50.2	597	30.7
358	44.7	418	47.5	478	46.5	538	48.4	598	32.6
359	38.5	419	46.6	479	47.4	539	50.2	599	32.6
360	36.2	420	44.9	480	49.3	540	48.4	600	31.6
361	34.7	421	45.8	481	48.4	541	46.5	601	32.6
362	30.8	422	47.5	482	45.6	542	47.4	602	32.6
363	27.0	423	44.9	483	46.5	543	46.5	603	33.5
364	27.7	424	44.9	484	46.5	544	51.2	604	32.6
365	31.6	425	42.2	485	45.6	545	51.2	605	31.6
366	36.2	426	44.9	486	44.6	546	51.2	606	32.6
367	33.1	427	46.6	487	46.5	547	52.1	607	30.7
368	30.8	428	45.8	488	49.3	548	54.9	608	28.8
369	28.5	429	45.8	489	48.4	549	56.7	609	30.7

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DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
610	32.6	670	38.1	730	37.2	790	38.1	850	32.6
611	32.6	671	36.3	731	37.2	791	38.1	851	32.6
612	31.6	672	33.5	732	40.0	792	38.1	852	30.7
613	31.6	673	31.6	733	40.9	793	38.1	853	29.8
614	32.6	674	35.3	734	37.2	794	38.1	854	28.8
615	34.4	675	34.4	735	37.2	795	38.1	855	29.8
616	34.4	676	34.4	736	36.3	796	38.1	856	29.8
617	33.5	677	34.4	737	36.3	797	39.1	857	30.7
618	36.3	678	33.5	738	36.3	798	40.9	858	32.6
619	37.2	679	32.6	739	39.1	799	40.0	859	31.6
620	36.3	680	31.6	740	38.1	800	38.1	860	30.7
621	35.3	681	30.7	741	36.3	801	37.2	861	28.8
622	33.5	682	31.6	742	35.3	802	38.1	862	29.8
623	32.6	683	32.6	743	34.4	803	39.1	863	29.8
624	31.6	684	32.6	744	35.3	804	40.0	864	29.8
625	31.6	685	33.5	745	36.3	805	38.1	865	30.7
626	31.6	686	32.6	746	35.3	806	39.1	866	31.6
627	31.6	687	32.6	747	36.3	807	41.9	867	31.6
628	31.6	688	33.5	748	37.2	808	41.9	868	32.6
629	31.6	689	35.3	749	38.1	809	40.9	869	34.4
630	30.7	690	33.5	750	40.0	810	40.9	870	34.4
631	32.6	691	32.6	751	39.1	811	42.8	871	32.6
632	32.6	692	32.6	752	37.2	812	41.9	872	31.6
633	33.5	693	32.6	753	37.2	813	39.1	873	30.7
634	31.6	694	33.5	754	37.2	814	40.0	874	30.7
635	34.4	695	34.4	755	37.2	815	42.8	875	30.7
636	34.4	696	34.4	756	36.3	816	44.6	876	30.7
637	33.5	697	36.3	757	35.3	817	43.7	877	28.8
638	31.6	698	36.3	758	36.3	818	40.9	878	28.8
639	32.6	699	35.3	759	35.3	819	37.2	879	29.8
640	32.6	700	35.3	760	36.3	820	31.6	880	30.7
641	33.5	701	35.3	761	38.1	821	31.6	881	31.6
642	32.6	702	33.5	762	40.0	822	30.7	882	31.6
643	31.6	703	33.5	763	40.9	823	30.7	883	31.6
644	32.6	704	33.5	764	40.0	824	30.7	884	31.6
645	30.7	705	35.3	765	38.1	825	30.7	885	30.7
646	30.7	706	38.1	766	37.2	826	31.6	886	30.7
647	30.7	707	40.0	767	38.1	827	31.6	887	31.6
648	31.6	708	40.9	768	38.1	828	30.7	888	31.6
649	33.5	709	40.0	769	37.2	829	29.8	889	30.7
650	34.4	710	39.1	770	34.4	830	29.8	890	28.8
651	32.6	711	37.2	771	34.4	831	27.0	891	27.0
652	31.6	712	37.2	772	36.3	832	27.0	892	29.8
653	32.6	713	40.0	773	37.2	833	27.9	893	37.2
654	31.6	714	40.0	774	38.1	834	27.9	894	48.4
655	31.6	715	39.1	775	39.1	835	27.9	895	72.5
656	33.5	716	40.0	776	40.0	836	28.8	896	94.9
657	34.4	717	40.0	777	36.3	837	28.8	897	98.6
658	33.5	718	37.2	778	35.3	838	27.9	898	103.2
659	33.5	719	34.4	779	35.3	839	28.8	899	108.8
660	32.6	720	32.6	780	35.3	840	30.7	900	108.8
661	32.6	721	37.2	781	36.3	841	31.6	901	108.8
662	30.7	722	37.2	782	37.2	842	30.7	902	111.6
663	29.8	723	37.2	783	38.1	843	29.8	903	110.7
664	28.8	724	37.2	784	38.1	844	28.8	904	112.5
665	30.7	725	38.1	785	37.2	845	29.8	905	112.5
666	32.6	726	36.3	786	36.3	846	27.9	906	112.5
667	32.6	727	36.3	787	37.2	847	27.9	907	108.8
668	33.5	728	36.3	788	36.3	848	27.9	908	110.7
669	36.3	729	36.3	789	37.2	849	31.6	909	109.7

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DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
910	107.9	970	104.2	1030	117.2	1090	87.4	1150	93.0
911	103.2	971	110.7	1031	115.3	1091	87.4	1151	96.7
912	109.7	972	116.3	1032	115.3	1092	90.2	1152	102.3
913	107.9	973	119.0	1033	120.0	1093	88.4	1153	104.2
914	107.9	974	125.6	1034	122.8	1094	89.3	1154	107.9
915	102.3	975	125.6	1035	124.6	1095	89.3	1155	109.7
916	99.5	976	129.3	1036	129.3	1096	92.1	1156	108.8
917	103.2	977	124.6	1037	133.9	1097	93.0	1157	108.8
918	108.8	978	122.8	1038	133.9	1098	100.4	1158	111.6
919	108.8	979	118.1	1039	124.6	1099	103.2	1159	111.6
920	109.7	980	120.0	1040	123.7	1100	105.1	1160	107.0
921	111.6	981	119.0	1041	120.0	1101	104.2	1161	107.0
922	106.0	982	116.3	1042	120.0	1102	97.7	1162	108.8
923	97.7	983	118.1	1043	123.7	1103	92.1	1163	110.7
924	92.1	984	119.0	1044	120.9	1104	93.0	1164	108.8
925	86.5	985	115.3	1045	110.7	1105	96.7	1165	105.1
926	89.3	986	114.4	1046	93.9	1106	95.8	1166	102.3
927	88.4	987	122.8	1047	81.8	1107	101.4	1167	100.4
928	81.8	988	120.9	1048	76.3	1108	99.5	1168	106.0
929	74.4	989	117.2	1049	78.1	1109	98.6	1169	106.0
930	72.5	990	121.8	1050	74.4	1110	94.9	1170	103.2
931	74.4	991	120.9	1051	74.4	1111	92.1	1171	102.3
932	75.3	992	123.7	1052	76.3	1112	91.1	1172	95.8
933	76.3	993	124.6	1053	77.2	1113	92.1	1173	84.6
934	78.1	994	121.8	1054	78.1	1114	90.2	1174	83.7
935	80.0	995	120.9	1055	76.3	1115	93.0	1175	89.3
936	88.4	996	120.9	1056	76.3	1116	94.9	1176	94.9
937	91.1	997	120.0	1057	75.3	1117	99.5	1177	102.3
938	93.0	998	125.6	1058	76.3	1118	107.0	1178	110.7
939	96.7	999	128.3	1059	78.1	1119	110.7	1179	126.5
940	99.5	1000	132.1	1060	80.0	1120	116.3	1180	122.8
941	100.4	1001	133.0	1061	84.6	1121	115.3	1181	111.6
942	98.6	1002	130.2	1062	84.6	1122	107.9	1182	118.1
943	99.5	1003	131.1	1063	82.8	1123	95.8	1183	129.3
944	93.9	1004	131.1	1064	81.8	1124	94.9	1184	132.1
945	93.9	1005	128.3	1065	83.7	1125	98.6	1185	131.1
946	98.6	1006	130.2	1066	81.8	1126	93.9	1186	133.0
947	99.5	1007	129.3	1067	82.8	1127	92.1	1187	129.3
948	100.4	1008	131.1	1068	80.0	1128	89.3	1188	131.1
949	96.7	1009	129.3	1069	78.1	1129	88.4	1189	134.9
950	96.7	1010	130.2	1070	81.8	1130	91.1	1190	134.9
951	99.5	1011	133.0	1071	82.8	1131	93.0	1191	130.2
952	100.4	1012	132.1	1072	82.8	1132	92.1	1192	125.6
953	101.4	1013	130.2	1073	84.6	1133	88.4	1193	115.3
954	99.5	1014	126.5	1074	85.6	1134	85.6	1194	114.4
955	98.6	1015	123.7	1075	86.5	1135	84.6	1195	112.5
956	96.7	1016	120.9	1076	85.6	1136	84.6	1196	114.4
957	96.7	1017	119.0	1077	81.8	1137	84.6	1197	112.5
958	103.2	1018	121.8	1078	81.8	1138	84.6	1198	109.7
959	105.1	1019	125.6	1079	80.9	1139	80.0	1199	108.8
960	104.2	1020	125.6	1080	83.7	1140	76.3	1200	108.8
961	103.2	1021	120.0	1081	83.7	1141	73.5	1201	107.9
962	101.4	1022	121.8	1082	81.8	1142	53.0	1202	104.2
963	101.4	1023	120.0	1083	80.9	1143	32.6	1203	101.4
964	101.4	1024	120.0	1084	82.8	1144	22.3	1204	101.4
965	99.5	1025	121.8	1085	89.3	1145	18.6	1205	101.4
966	105.1	1026	119.0	1086	90.2	1146	28.8	1206	101.4
967	107.0	1027	116.3	1087	91.1	1147	49.3	1207	100.4
968	107.0	1028	119.0	1088	88.4	1148	79.1	1208	98.6
969	104.2	1029	118.1	1089	86.5	1149	86.5	1209	99.5

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, California - July 24, 1989
Measured with 2 in scintillation tool - corrected using Table 3.

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
1210	99.5	1270	117.2	1330	108.8	1390	107.9	1450	101.4
1211	103.2	1271	114.4	1331	107.9	1391	108.8	1451	101.4
1212	108.8	1272	108.8	1332	108.8	1392	110.7	1452	97.7
1213	112.5	1273	101.4	1333	107.0	1393	109.7	1453	97.7
1214	108.8	1274	99.5	1334	105.1	1394	102.3	1454	93.9
1215	107.9	1275	105.1	1335	107.9	1395	98.6	1455	89.3
1216	109.7	1276	104.2	1336	105.1	1396	99.5	1456	85.6
1217	110.7	1277	107.0	1337	102.3	1397	97.7	1457	82.8
1218	109.7	1278	103.2	1338	102.3	1398	85.6	1458	81.8
1219	105.1	1279	107.0	1339	101.4	1399	84.6	1459	84.6
1220	100.4	1280	103.2	1340	106.0	1400	80.0	1460	84.6
1221	97.7	1281	104.2	1341	110.7	1401	84.6	1461	84.6
1222	95.8	1282	103.2	1342	108.8	1402	92.1	1462	88.4
1223	97.7	1283	103.2	1343	101.4	1403	95.8	1463	93.0
1224	95.8	1284	106.0	1344	103.2	1404	100.4	1464	88.4
1225	94.9	1285	101.4	1345	107.9	1405	111.6	1465	87.4
1226	106.0	1286	105.1	1346	110.7	1406	117.2	1466	85.6
1227	107.9	1287	105.1	1347	108.8	1407	117.2	1467	87.4
1228	107.9	1288	106.0	1348	111.6	1408	113.5	1468	90.2
1229	104.2	1289	107.0	1349	114.4	1409	109.7	1469	90.2
1230	96.7	1290	111.6	1350	116.3	1410	107.9	1470	88.4
1231	93.0	1291	111.6	1351	116.3	1411	108.8	1471	86.5
1232	106.0	1292	109.7	1352	110.7	1412	107.0	1472	93.0
1233	105.1	1293	110.7	1353	109.7	1413	104.2	1473	97.7
1234	102.3	1294	109.7	1354	111.6	1414	107.9	1474	99.5
1235	106.0	1295	107.9	1355	114.4	1415	112.5	1475	97.7
1236	117.2	1296	109.7	1356	119.0	1416	112.5	1476	98.6
1237	119.0	1297	110.7	1357	117.2	1417	111.6	1477	98.6
1238	111.6	1298	115.3	1358	110.7	1418	115.3	1478	102.3
1239	111.6	1299	112.5	1359	109.7	1419	114.4	1479	104.2
1240	110.7	1300	113.5	1360	112.5	1420	114.4	1480	103.2
1241	110.7	1301	110.7	1361	123.7	1421	110.7	1481	100.4
1242	110.7	1302	109.7	1362	126.5	1422	106.0	1482	97.7
1243	109.7	1303	102.3	1363	119.0	1423	108.8	1483	102.3
1244	111.6	1304	101.4	1364	115.3	1424	107.0	1484	107.9
1245	107.0	1305	99.5	1365	109.7	1425	102.3	1485	107.9
1246	110.7	1306	97.7	1366	107.9	1426	100.4	1486	109.7
1247	109.7	1307	99.5	1367	107.9	1427	102.3	1487	113.5
1248	107.0	1308	98.6	1368	104.2	1428	102.3	1488	111.6
1249	109.7	1309	100.4	1369	105.1	1429	102.3	1489	109.7
1250	111.6	1310	103.2	1370	107.0	1430	96.7	1490	111.6
1251	117.2	1311	106.0	1371	104.2	1431	93.9	1491	111.6
1252	118.1	1312	106.0	1372	110.7	1432	95.8	1492	111.6
1253	115.3	1313	102.3	1373	108.8	1433	91.1	1493	111.6
1254	111.6	1314	105.1	1374	107.9	1434	86.5	1494	110.7
1255	110.7	1315	105.1	1375	104.2	1435	90.2	1495	114.4
1256	107.0	1316	100.4	1376	106.0	1436	100.4	1496	116.3
1257	107.9	1317	99.5	1377	107.0	1437	99.5	1497	114.4
1258	105.1	1318	103.2	1378	105.1	1438	99.5	1498	111.6
1259	102.3	1319	104.2	1379	107.0	1439	81.8	1499	112.5
1260	101.4	1320	106.0	1380	108.8	1440	88.4	1500	112.5
1261	97.7	1321	106.0	1381	114.4	1441	96.7	1501	110.7
1262	101.4	1322	105.1	1382	119.0	1442	109.7	1502	108.8
1263	103.2	1323	105.1	1383	121.8	1443	115.3	1503	110.7
1264	106.0	1324	107.9	1384	117.2	1444	108.8	1504	109.7
1265	107.9	1325	108.8	1385	112.5	1445	102.3	1505	107.0
1266	111.6	1326	107.9	1386	109.7	1446	100.4	1506	102.3
1267	114.4	1327	112.5	1387	113.5	1447	103.2	1507	109.7
1268	116.3	1328	111.6	1388	112.5	1448	102.3	1508	115.3
1269	110.7	1329	107.0	1389	107.0	1449	100.4	1509	117.2

MLGRAP # 2 - Long Valley Caldera, Mammoth Lakes, California - July 24, 1989
Measured with 2 in scintillation tool - corrected using Table 3.

DEPTH (FT)	GAMMA RAY (COUNTS/S)	DEPTH (FT)	GAMMA RAY (COUNTS/S)
1510	113.5	1570	116.3
1511	117.2	1571	111.6
1512	119.0	1572	124.6
1513	117.2	1573	130.2
1514	115.3	1574	123.7
1515	118.1	1575	121.8
1516	120.0	1576	122.8
1517	113.5	1577	120.9
1518	110.7	1578	117.2
1519	112.5	1579	115.3
1520	112.5	1580	114.4
1521	113.5	1581	109.7
1522	113.5	1582	109.7
1523	112.5	1583	111.6
1524	111.6	1584	110.7
1525	109.7	1585	109.7
1526	111.6	1586	103.2
1527	113.5	1587	104.2
1528	112.5	1588	105.1
1529	112.5	1589	105.1
1530	111.6	1590	103.2
1531	108.8	1591	101.4
1532	110.7	1592	99.5
1533	113.5		
1534	109.7		
1535	109.7		
1536	112.5		
1537	116.3		
1538	113.5		
1539	108.8		
1540	114.4		
1541	117.2		
1542	114.4		
1543	113.5		
1544	114.4		
1545	117.2		
1546	110.7		
1547	109.7		
1548	107.9		
1549	110.7		
1550	111.6		
1551	114.4		
1552	110.7		
1553	116.3		
1554	119.0		
1555	119.0		
1556	114.4		
1557	111.6		
1558	107.9		
1559	116.3		
1560	120.0		
1561	123.7		
1562	120.0		
1563	114.4		
1564	117.2		
1565	114.4		
1566	115.3		
1567	114.4		
1568	114.4		
1569	116.3		

APPENDIX V

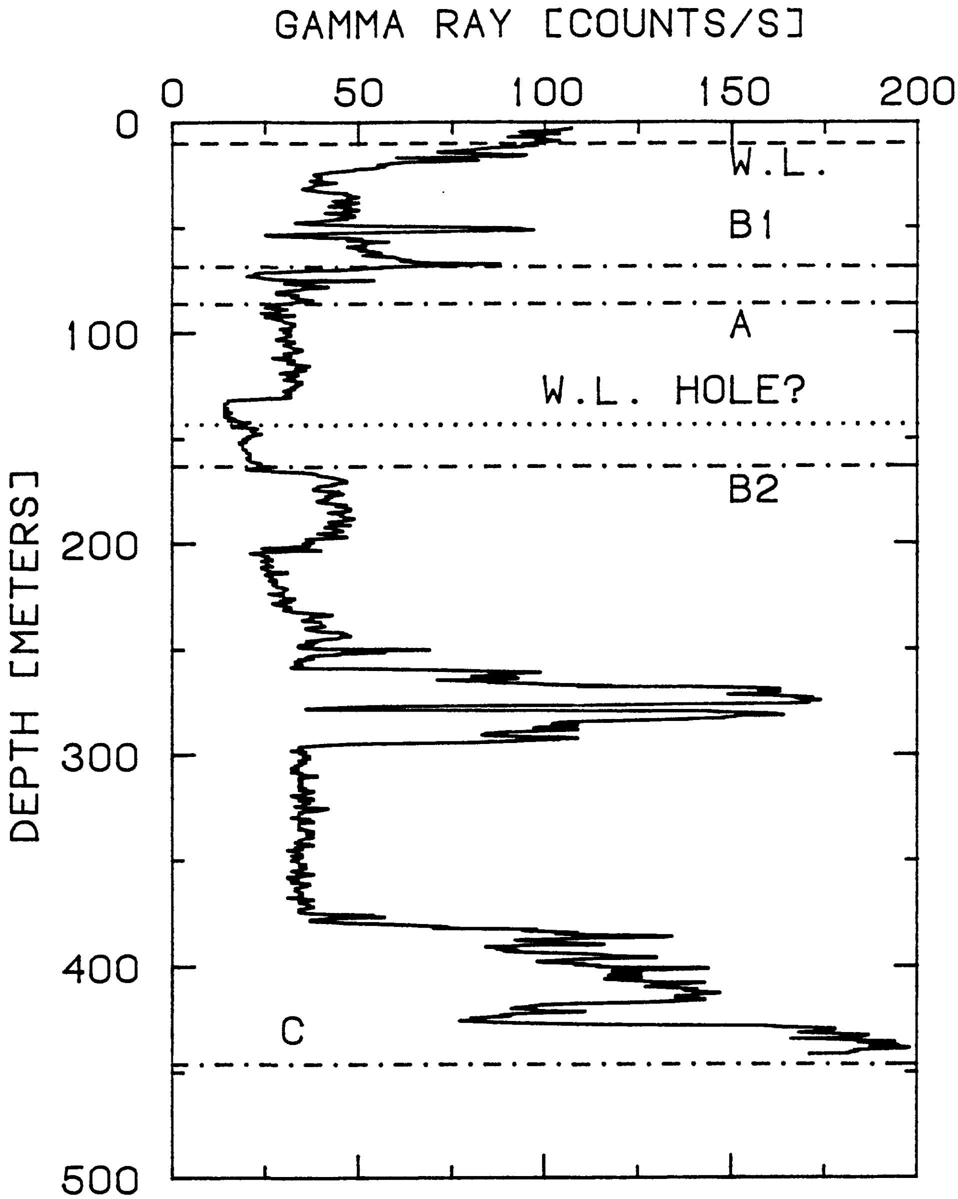

Figure V–1. Plot of natural γ-ray in counts/s for MLGRAP # 1. Data digitized at 1 ft (0.3 m) intervals from a strip-chart recording. Symbols shown: W.L. (– – – –) - water level (at 10 m) measured in 2.75 in outside diameter (O.D.) tubing; A (– • – • –) - bottom (at 86 m) of 4.50 in O.D. tubing; B1 and B2 (– • • – • • –) - top (at 68.6 m) and bottom (at 163 m) of 3.50 in O.D. tubing; C (– • – • –) - bottom (at 446 m) of 2.375 in O.D. tubing; W.L. HOLE? (••••) - apparent water level (at 143 m) in uncased hole. Top of casings A and C at surface. Multiply counts/s by 0.9 to convert to API units. Data obtained July 23, 1989.

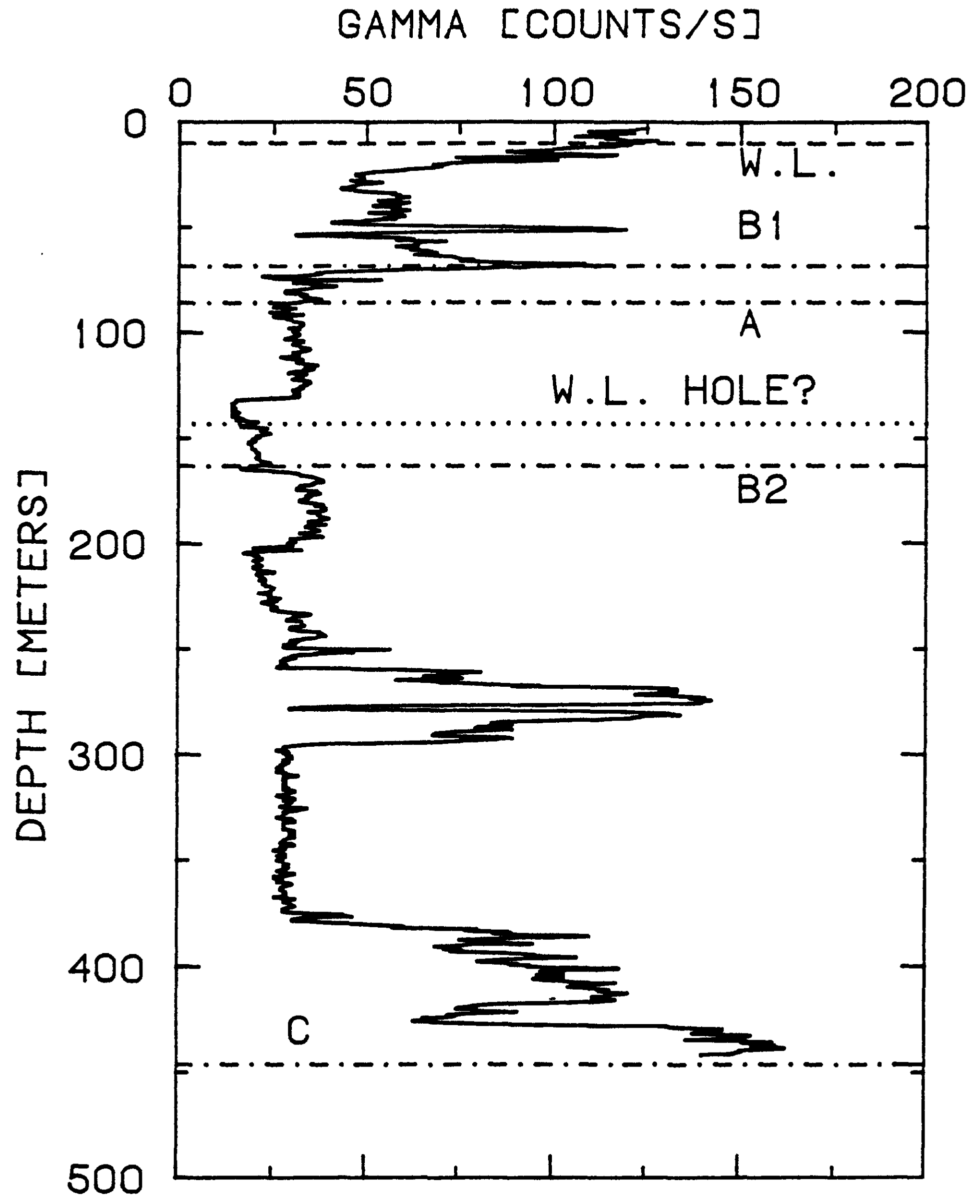

Figure V–2. Plot of natural γ-ray in counts/s for MLGRAP # 1 from figure V–1 corrected for hole diameter, casing and cement (Schlumberger, 1975, p. 66). Parameters used to determine corrections listed in Table 2. Symbols as in figure V–1.

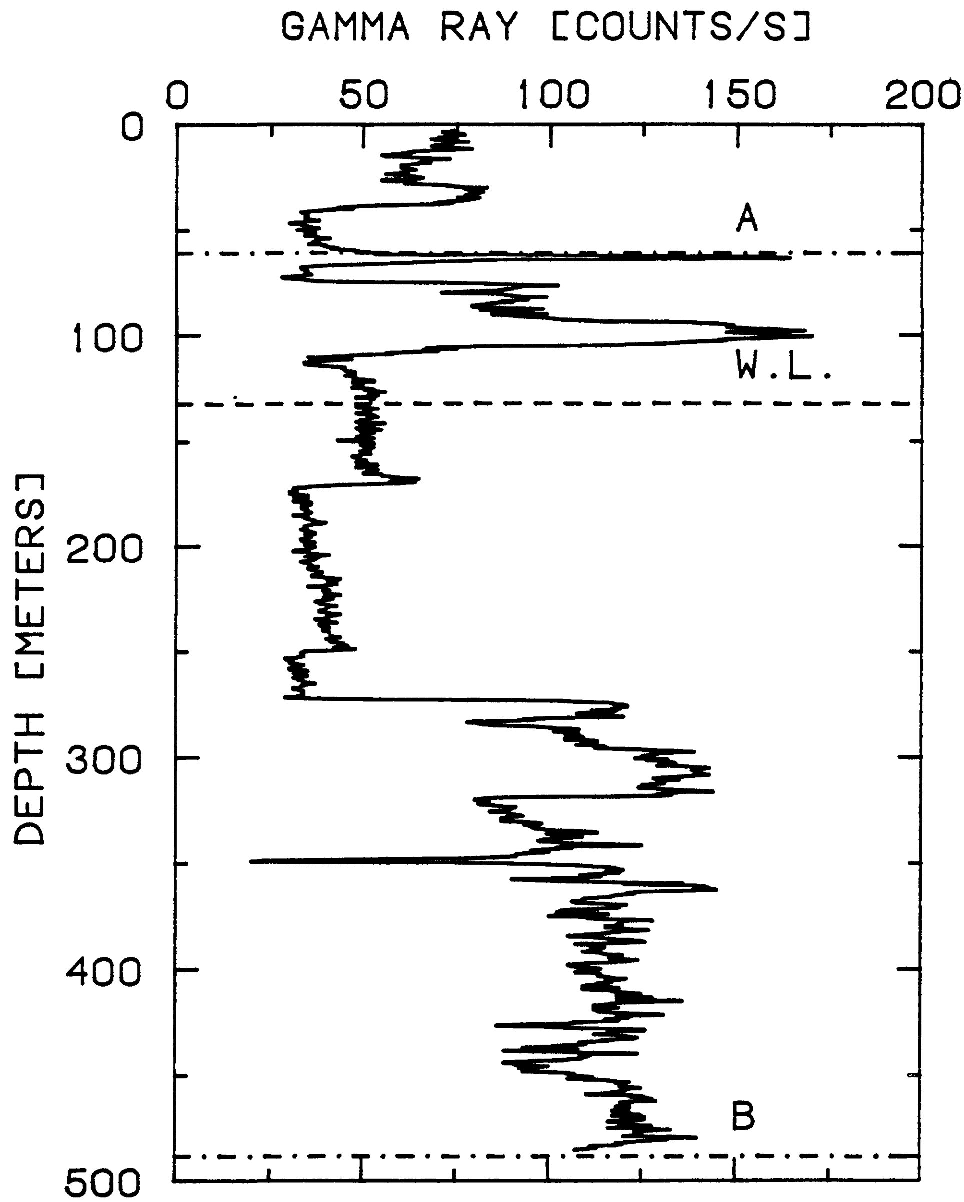

Figure V–3. Plot of natural γ-ray in counts/s for MLGRAP # 2. Data digitized at 1 ft (0.3 m) intervals from a strip-chart recording. Symbols shown: W.L. (– – – –) - water level (at 132 m) measured in 2.75 in outside diameter (O.D.) tubing; A (– • – • –) - bottom (at 61 m) of 4.50 in O.D. tubing; B (– • – • –) - bottom (at 488 m) of 2.75 in O.D. tubing. Top of tubings A and B at surface. Multiply counts/s by 0.9 to convert to API units. Data obtained July 24, 1989.

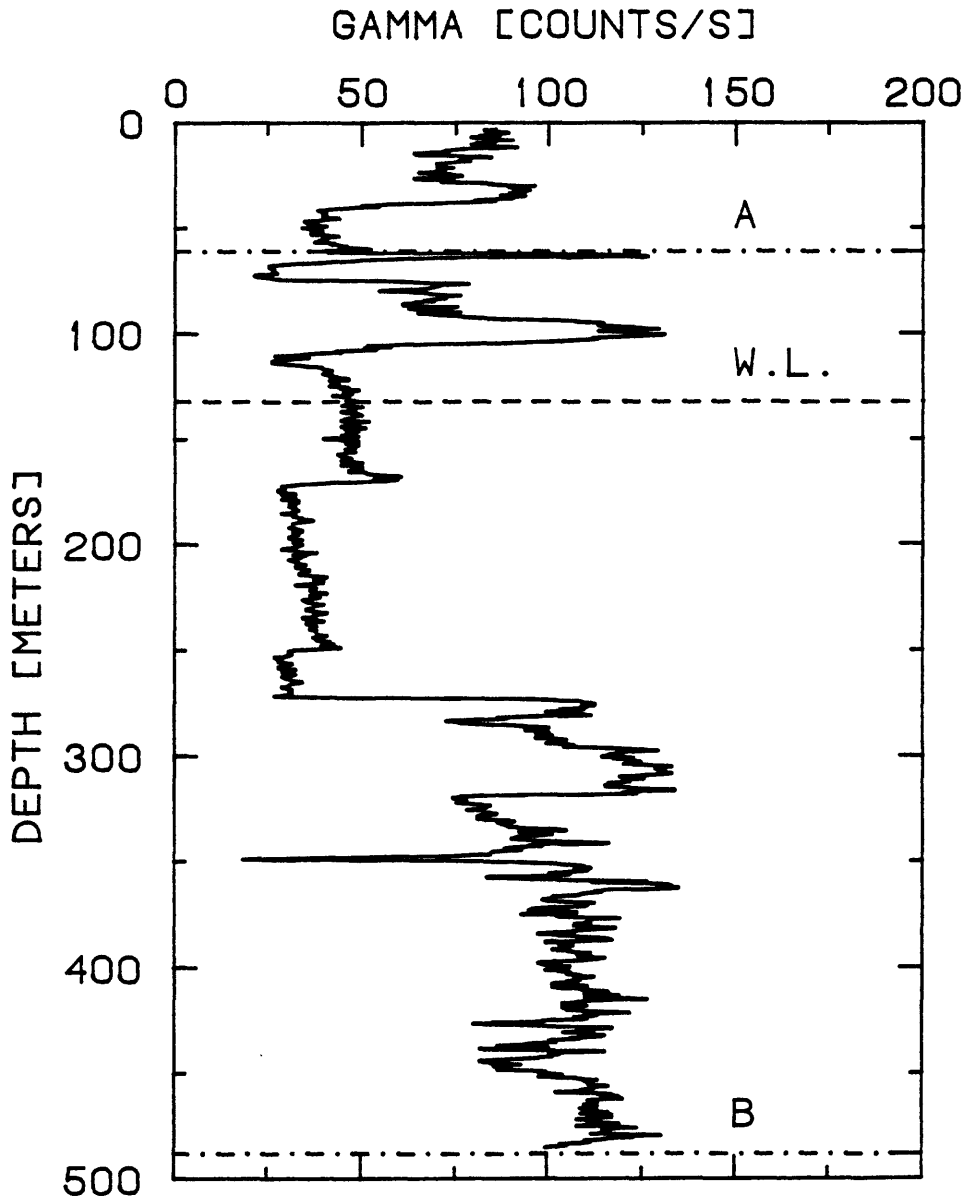

Figure V–4. Plot of natural γ-ray in counts/s for MLGRAP # 2 from figure V–3 corrected for hole diameter, casing and cement (Schlumberger, 1975, p. 66). Parameters used to determine corrections listed in Table 3. Symbols as in figure V–3.

APPENDIX VI

Guildline Calibration Services
A Prime Standards Laboratory

C E R T I F I C A T E   O F   C O N F O R M A N C E

CUSTOMER NAME.............. U.S. GEOLOGICAL SURVEY
INSTRUMENT MANUFACTURER.... GUILDLINE INSTRUMENT INC.
TYPE NUMBER................ 9540
SERIAL NUMBER.............. 53198

TEMPERATURE................ 23°C ± .5°C
HUMIDITY................... 50% ± 5%

INSTRUMENT RECEIVED........ IN TOLERANCE X OUT OF TOL. ___

GUILDLINE INSTRUMENTS INCORPORATED Certifies that the above listed instrument complies with the published Manufacturer's specifications and has been calibrated against standards maintained in Guildline's Orlando, Fl., Standards laboratory. These Standards are directly traceable to the U.S. DEPT. OF COMMERCE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) and are used and maintained in accordance with MIL-STANDARD 45662A.

Methods of manufacture and test ensure conformity with the highest Quality Control Standards consistent with the operational requirements of the instrument. Test results are maintained on file and are available for inspections.

Applicable NBS Test numbers are :

DC VOLTAGE............521/243031 01/19/89
AC VOLTAGE............521/240585 11/02/87
RESISTANCE............521/242831 11/30/88
TEMPERATURE...........521/241688 05/16/88

Out of tolerance data (if applicable) is shown on attached sheet.

DATE CALIBRATED............ FEB. 28, 1989
DATE DUE................... FEB. 28, 1990

CALIBRATED BY.............. PCK

APPROVED BY................ [signature]
Ian King, Chief Metrologist.

REPORT # 018

Guildline Instruments Inc., 4403 Vineland Road, Suite B10, Orlando, Florida 32811-7335 • (407) 423-8215 • Telex: 856443 • FAX (407) 422-5987

HONEYWELL INSTRUMENTATION SUPPORT SERVICES

Certificate #: 8606055100001
PAGE 1 OF 1

CERTIFICATE OF CALIBRATION

Submitted By: U.S. GEOLOGICAL SURVEY
GOLDEN, CO

Manufacturer: FLUKE
Nomenclature: DIGITAL MULTIMETER
Model Number: 8502A
Serial Number: 2165006
Asset Number:

HONEYWELL INC. certifies that this instrument has been calibrated using standards and instruments which are traceable to the U.S. National Bureau of Standards. The standards and instruments used in the calibration are supported by a system which meets or exceeds the requirements of MIL-STD-45662. Supporting documentation relative to traceability is on file at this office, and is available for examination upon request.

MANUFACTURER	MODEL	DESC	S/N	DATE DUE
GOULD	9152A	STD CELL ENCLOSURE	21971	08-02-89
HONEYWELL	1190	STD RES 1. Ohm	M3075	11-07-91

This instrument has been calibrated in terms of the standards maintained at this laboratory, and was returned:

(XX) within manufacturer's specified accuracy

(   )

Calibration date: 02-14-89
% Rel. Humidity: 18 %
Temperature: 73 F
Test Report #: 860.43300
Recall Date : 08-14-89

TEST REPORT NUMBERS

AC VOLTAGE	236984	11-12-87
CAPACITANCE	238278	01-07-87
DC VOLTAGE	240688	02-02-88
INDUCTANCE	241075	02-10-88
MAGNETICS	721/221693	10-04-79
RESISTANCE	240735	12-30-87
TEMPERATURE	231405	10-02-83
TIME & FREQ	NBS XMISSION	

By: REVELS, LARRY

Approved: [signature]
Service Manager