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PRELIMINARY ANALYSIS OF GEOPHYSICAL LOGS FROM THE WT SERIES OF DRILL HOLES, YUCCA MOUNTAIN, NYE COUNTY, NEVADA

BY

D. C. Muller and J. E. Kibler

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

Denver Colorado
1985

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ABSTRACT

Geophysical logs from the WT series of drill holes correlate well with similar logs from other drill holes at Yucca Mountain, Nevada in the unsaturated zone through the same geologic units. The in-situ physical properties of the rocks from well logs are consistent with laboratory-measured physical properties of core from other drill holes. The Topopah Spring Member is concluded to have zones that are highly fractured and lithophysal in holes where the density and neutron logs are very "spiky" as noted in other cored drill holes. Low levels on the uranium trace from the spectral gamma-ray log indicate that fractures are neither healed nor filled with materials that concentrate uranium. Therefore, fracture permeability is expected to be high. This conclusion is consistent with fracture analysis from other drill holes on Yucca Mountain. The dielectric constant and dielectric resistivity logs correlate well with the epithermal neutron, borehole compensated density, and induction resistivity logs in the unsaturated zone.

INTRODUCTION

The WT series of drill holes (fig. 1) were drilled at Yucca Mountain in 1983 and 1984 as part of the continuing exploration program for the U.S. Department of Energy (DOE) in the Nevada Nuclear Waste Storage Investigations (NNWSI) project. Holes #1-#7, #10-#18 were rotary drilled without coring to approximately 50 feet below the water table using air and detergent foam as the circulating medium. Geophysical logs were obtained in 15 of the WT drill holes. Drill hole UE-25 WT#5 was abandoned after completion of drilling when the hole began sloughing and could not be kept open for geophysical logging and hydrologic testing. Planned drill holes WT#8 and WT#9 have not yet been drilled. Additional geophysical log data from the WT series of drill holes will be published in supplements to this report when holes are drilled and logged, and when new data are obtained in the existing drill holes.

The primary purpose of the drill holes was for hydrologic studies. However, cuttings were sampled and logged, and geophysical logs were made to obtain additional geologic and geophysical data to characterize the Tertiary tuffs in the unsaturated zone at Yucca Mountain, Nevada. Tables 1 to 30 at the end of the report are summaries of drill hole construction and logging information and preliminary summaries of the lithostratigraphy. Plots comparing geophysical logs with lithostratigraphy for each hole are shown on Plates 1 to 3 in the pocket at the end of the report. This report presents a preliminary analysis of the geophysical logging which documents the log data for Quality Assurance (QA) required by the Nuclear Regulatory Commission (NRC) and for use by other investigators. Detailed analysis of the data is not contained in this report. All depths from log data are presented as received from the logging companies in feet. To convert to meters multiply feet by 0.3048.

ACKNOWLEDGMENTS

We wish to acknowledge and thank Fenix & Scisson Inc. for the operational support needed to obtain the required logs, and for monitoring the contract requirements on the logging companies who performed the geophysical logging in these drill holes, and also R. W. Spengler (USGS) for providing the lithologic contacts for comparison with the geophysical log data.

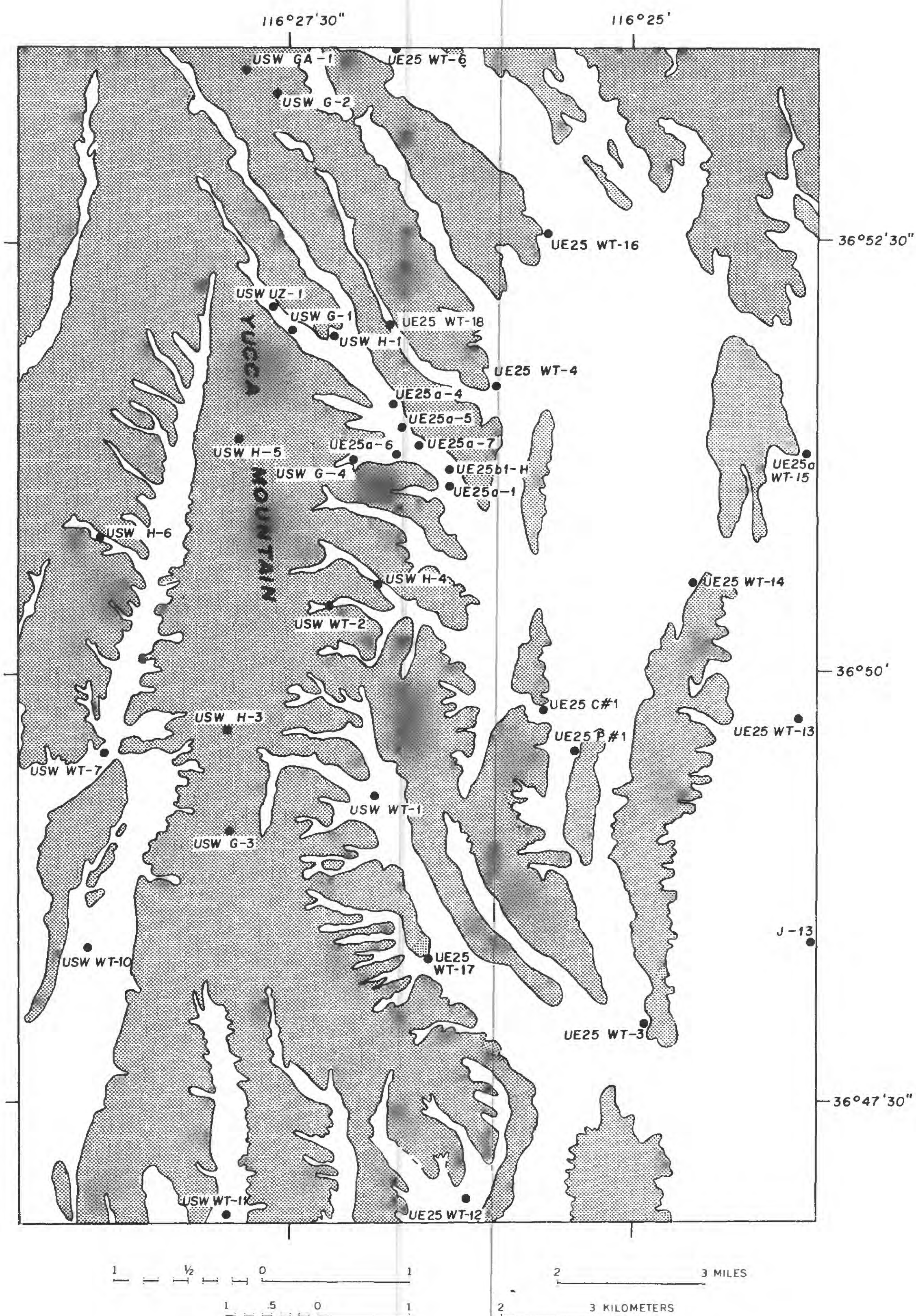

FIGURE 1. Map of Yucca Mountain showing the location of the WT series of drill holes.

GEOPHYSICAL LOGS

This section briefly discusses each type of geophysical log plotted on Plates 1 to 3 and describes logging methods and tool response characteristics. For more detailed discussion of logging tools and response characteristics the reader is referred to Asquith and Gibson (1982), Freedman and Vogiatzis (1979), Pirson (1963), Poley and others (1978), Rau and Wharton (1980), Schlumberger (1972), and Schlumberger (1974). Additional log data from Yucca Mountain have been described by Daniels and Scott (1981), and Hagstrum and others (1980).

Logging operations are monitored by Fenix & Scisson (F&S), the DOE designated contract monitor, and the logging procedures are documented by them in an effort to attain high-quality geophysical log data. Requirements for accuracy and precision of tools and data are defined by the DOE and U. S. Geological Survey (USGS) and then contracted for by F&S, the DOE prime contractor for logging. Specific information regarding the contracts and contracted standards are available from the F&S office in Mercury, Nevada. A representative of the USGS inspects all geophysical logs prior to installation of casing or any other operation that renders the drill hole unloggable. This representative recommends needed additional logging to confirm anomalies or to repeat any inconsistent or unusable log data.

Caliper

Caliper tools are used to measure the diameter of drill holes. Three types of caliper tools are used at Yucca Mountain: a three-arm tool which measures average diameter, a four-arm tool which measures two diameters at right angles as well as average diameter, and a six-arm tool which measures three equiangular diameters and the average diameter. The six-arm tool is used in holes greater than 10 centimeters in diameter, and the smaller four- and three-arm tools in holes 10 centimeters and less.

Data from caliper tools are used to calculate hole volumes for cementing casing, to identify unstable zones where the hole is washed out or caved, to indicate rugosity of the borehole wall, and to correct for borehole effects on data measured with other logging tools. Multi-diameter caliper data are used to determine borehole ellipticity, which indicates that the rocks are subject to unequal horizontal stresses or the rock hardness property is horizontally anisotropic.

Dielectric

The dielectric log measures dielectric permittivity (and incidental resistivity) inductively at a frequency of 47 megahertz. Dielectrics are considered to be nonconducting materials, and dielectric permittivity--also commonly known as dielectric constant--is a measure of the relative ability of a dielectric to store an electric charge for a given applied field strength. For an isotropic medium, the dielectric permittivity is the ratio of the capacitance of a capacitor filled with the medium to that of the same capacitor having a vacuum as dielectric (Society of Professional Well Log Analysts,1984). The dielectric permittivity of water (78-81) is much greater than that of most dry rocks (4-15), so changes in formation dielectric permittivity are due primarily to changes in water content, with only small secondary effects due to changes in rock type. Above the water table, the dielectric log can be used in conjunction with the density and neutron logs to estimate formation water content. Because the dielectric tool is relatively new, interpretation parameters and calibration curves have not been developed for many rocks. Laboratory measurements of dielectric permittivity on core samples of the tuffs of Yucca Mountain are needed to accurately relate the dielectric permittivity to porosity and water content. Core data from tuffs from Yucca Flat, Nevada (Eberle and Bigelow, 1973) are expected to be representative of the tuffs of Yucca Mountain.

Resistivity

Resistivity is a measure of the resistance to the transmission of an electric current. Borehole resistivity measurements sample the resistivity of the rocks surrounding the borehole and are made with two types of probes. One type uses contacting electrodes to pass a known direct current or low frequency current through the rock, and to detect the resulting potential using a specified electrode arrangement to determine apparent resistivity. The other type uses a probe containing a transmitting coil to induce current in the rock, and one or more receiving coils to detect the resulting electromagnetic field from which apparent resistivity is determined. Standard induction tools measure resistivity at frequencies in the 20 kHz range.

Standard induction resistivities are reliable below 200 ohm-meters, but are unreliable for higher resistivities. High frequency (47 MHz) dielectric tools respond well to higher resistivities, but are unreliable for resistivities lower than about 10 ohm-meters. Because resistivity is dispersive and varies with measurement frequency, comparisons among direct current or low frequency resistivities, induction resistivities and dielectric resistivities may show considerable disagreement.

The minerals in most rocks are insulators, so electric current is transmitted by ions in the fluid in the pore spaces, causing measured resistivity to respond to changes in formation porosity and water content. However, borehole geometry, borehole fluid resistivity, changes in formation water salinity, presence of alteration products such as zeolites and clays (which have cation exchange capacity and double layer electrochemical properties), presence of metallic minerals, and changes in rock type all have significant secondary effects on the measured resistivity. Anomalies are identified and interpreted by comparison with density, neutron, and velocity logs.

Gamma Ray

The gamma ray logs are obtained from two tools; one uses a standard gamma ray detector, and the other uses a spectral detector. Standard gamma ray logs measure the total count rate of gamma rays, in API units, of all energies emitted by the formation. The total count rate is recorded as one of four traces of the spectral gamma log. The potassium, uranium, and thorium logs from the spectral log are made by detecting gamma rays of distinctive energy levels which are emitted by radioactive potassium and by radioactive daughter elements of uranium and thorium. Daughter elements result from radioactive decay of a mother element, and the number of gamma rays emitted by a radioactive daughter can be related to the volume percent of mother element present in the rock.

The tuffs at Yucca Mountain characteristically exhibit high total gamma radiation levels compared with sedimentary rocks. Relatively high uranium radiation levels may mask the radiation from uranium concentrated in cemented and filled fractures so that individual fracture identification with the uranium trace has not been feasible. However, an overall increase in uranium level through a highly fractured interval would indicate cementing and filling of the fractures. Spectral gamma ray logs (particularly the potassium trace) exhibit similar character between drill holes in some lithostratigraphic units, making spectral gamma logs useful for lithologic identification and stratigraphic correlation. The standard gamma ray log is often run simultaneously with other logs, and is used to accurately correlate depths between logs in the same drill hole.

Neutron

Neutron tools have a source of high energy neutrons and one or two neutron detectors. The detectors count low-energy neutrons which are the result of back-scattering (from the formation) of the high energy neutrons. Two types of neutron logs are commonly used: one counts thermal neutrons which are in thermal equilibrium with the rock and the other counts epithermal neutrons which have a higher kinetic energy than the thermal neutrons. Thermal neutrons are easily captured by many elements so that formation effects are greater than on epithermal neutrons, which are harder to capture due to higher kinetic energy. Newer, borehole-compensated tools count thermal neutrons with two detectors at different distances from the source. The ratio of the count rates from the two detectors is the formation response compensated for borehole effects. Borehole-compensated neutron tools (and some single detector neutron tools) are sidewall tools designed to maintain contact with the side of the drill hole in order to minimize borehole effects and enhance formation response.

The primary mechanism for neutron scatter and loss of energy is collision with hydrogen nuclei. For most rocks, essentially all of the hydrogen is bound in water molecules which makes the neutron log a good indicator of the formation water content. In general, high neutron count rates correspond to low water content and low count rates to high water content. Below the static water level, where the assumption of total saturation is valid, borehole compensated neutron logs are calibrated to directly obtain reliable porosity for many rock types. Porosity from calibrated, single-detector neutron logs is generally not as reliable as compensated neutron porosity unless core data exist which either confirm the single detector neutron porosity, or can be used to develop corrected calibration curves for the specific rocks encountered in the drill hole.

Above the static water level, in the unsaturated zone, the neutron log count rate can be used as an indicator of relative variations in formation water content. Calibrations exist for many rock types to convert the count rate to volume fraction of water in the rock. If the value of either porosity or saturation can be determined by some other means, the unknown value can then be determined from the volume fraction of water obtained from the neutron log. In air-filled boreholes, the neutron log is very sensitive to the borehole diameter and rugosity. Air-filled boreholes with diameters larger than the separation between the neutron source and detector do not provide a valid relationship between count rate and water content, and in extreme cases, the relationship can be reversed. This situation is minimized by the use of sidewall tools.

Anomalous neutron-log responses can be attributed to changes in mineralogy, water of hydration, crystallization in altered zones, and the presence of neutron moderators such as chlorine and boron. Anomalies are detected and interpreted by comparing the neutron log to other logs that respond to formation water or porosity, such as the density, velocity, and resistivity logs.

Density

Density logs are obtained with borehole-compensated gamma-gamma tools, which beam gamma rays into the formation and detect the gamma rays that are scattered back from collisions with electrons. The compensated density tool has two gamma-ray detectors, one near the gamma-ray source and another farther away from the source. The response from the near detector is dominated by gamma rays scattered from the borehole and from the formation near the borehole where it may have been altered by the drilling. The response from the more remote detector, which is dominated by gamma rays scattered from rock about 15 cm from the borehole wall, is corrected for secondary borehole effects using the near detector response. Although the compensated density tool responds to the density of electrons in the formation, which depends on the formation's elemental distribution, it is calibrated to determine the bulk density of most earth materials including the tuffs of Yucca Mountain.

The density tool is a sidewall tool designed to maintain contact with the borehole wall to minimize borehole effects and enhance formation response. Often the tool cannot compensate for borehole effects in very rough walled boreholes or through badly caved or washed out intervals. This is particularly true in air or gas filled holes in which the most pronounced borehole effects usually occur. Comparing the density log with the caliper log can identify anomalies caused by borehole effects.

Changes in density are due primarily to changes in porosity and water content. Alteration that changes the grain density has a significant secondary effect on formation density. Anomalies are detected and interpreted by comparisons with neutron, velocity, and resistivity logs.

Velocity

The velocity of sound waves through the formation is determined by measuring the time interval for waves to travel a known distance along the borehole wall parallel to the borehole axis. This distance is divided by the elapsed time to obtain the velocity of the formation. Two kinds of formation velocity logs are normally made in boreholes at Yucca Mountain, sonic velocity throughout the fluid filled part of the hole, and seismic velocity throughout the entire hole. Sonic velocity logs were not made in the WT holes because less than 100 feet of the holes were filled with fluid.

Seismic velocity is determined by setting a wall-locking geophone at known depths within the borehole to detect the arrival time of a seismic signal. The seismic signal is generated near the borehole on the ground surface with a mechanical vibrator or other source of seismic energy. Seismic frequencies are relatively low, typically lower than 100 Hz. The resulting plot of velocity versus depth has a square, step-like appearance and indicates the average velocity of the formation through the interval between discrete geophone depths. Seismic velocity determined by this method is a large-volume measurement that includes average effects of fracturing, jointing, lithophysae, inhomogeneities, and in some cases, refraction effects due to stratigraphy and structure.

DISCUSSION

After completion of drilling operations, which used air and detergent foam as the circulating medium, alcohol (a defoaming agent) was poured into each hole prior to geophysical logging. The alcohol is purchased under various trade names specifically for use as a defoaming agent, and F&S lists the trade names and volumes of alcohol which were poured into each drill hole in drilling history records kept for QA purposes. In order to determine whether pouring alcohol into a drill hole has a discernable and undesirable effect on formation rock properties or on logging tool response, drill hole UE-25 WT#4 was logged before alcohol was added and again after 20 gallons of alcohol was poured down the drill hole (see Table 7). Comparison of the before and after logs did not indicate any significant systematic differences which could be attributed solely to alcohol. Table 31 at the end of the report lists the linear regression parameters from cross plots of the before and after logs, and it is evident that there are no significant differences between the logs. Figures 2 to 4 are cross plots of the before and after log data showing a nearly 1 to 1 correspondence between the before and after values at each corresponding depth. The scatter seen on the cross plots and the standard deviations from Table 31 are well within the anticipated variability which can be attributed to measurement uncertainty, system error, variation of tool position in the borehole, uncertainty of depth measurement or depth mismatch between logs, and statistical uncertainties associated with detection of radioactive events. The small bias apparant in the data toward lower density, higher neutron and resistivity values after the alcohol was added is caused by drying of the rock near the borehole during the nearly three day interim between before and after logging. This drying of the rock is expected as the rock returns to its natural state by dissipating moisture gained during the drilling process. If the alcohol had invaded the rock, since it is miscible with water, the densities would have increased slightly and the neutron values would have decreased. Whether the alcohol acted as a drying agent and enhanced or accelerated the drying of the rock cannot be determined from these data. However, the change is small and not considered significant. The absence of discernable systematic differences below the fluid level can be interpreted to mean that there are no significant effects on the geophysical logging tool response due to the presence of alcohol in the

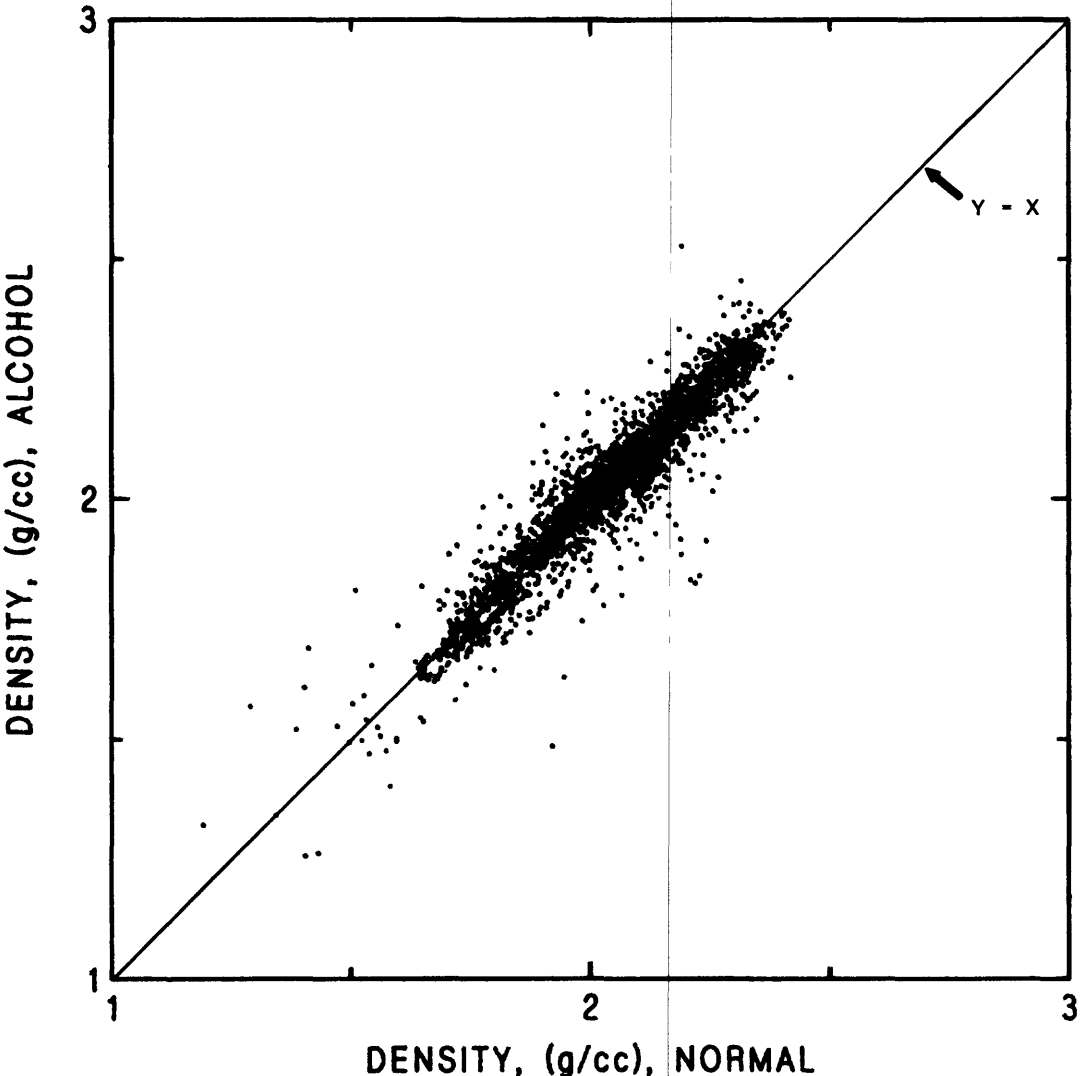

Figure 2. Cross plot of the borehole compensated density logs before alcohol was added to drill hole UE-25 WT #4 versus after alcohol was added.

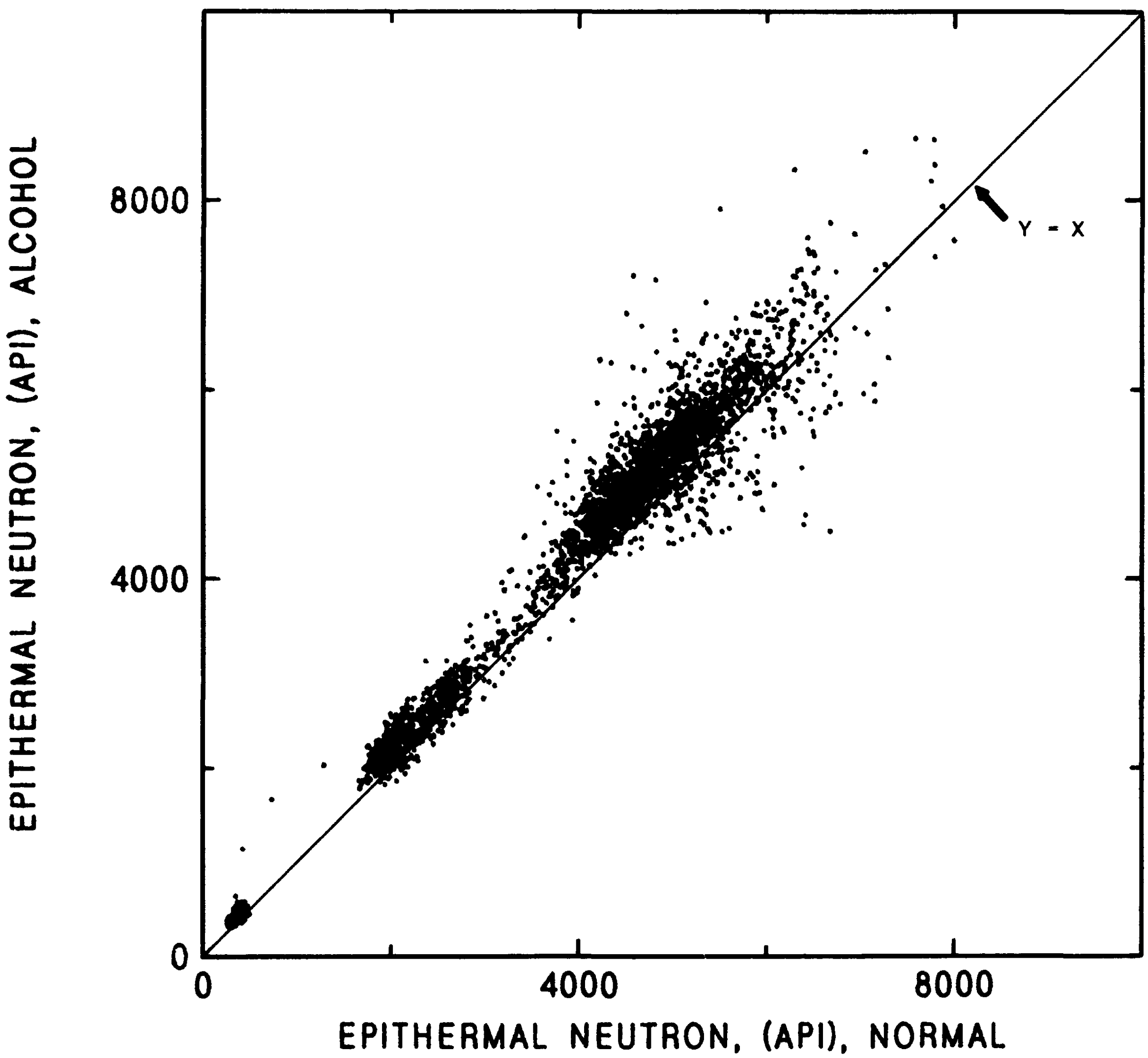

Figure 3. Cross plot of the epithermal neutron logs before alcohol was added to drill hole UE-25 WT #4 versus after alcohol was added.

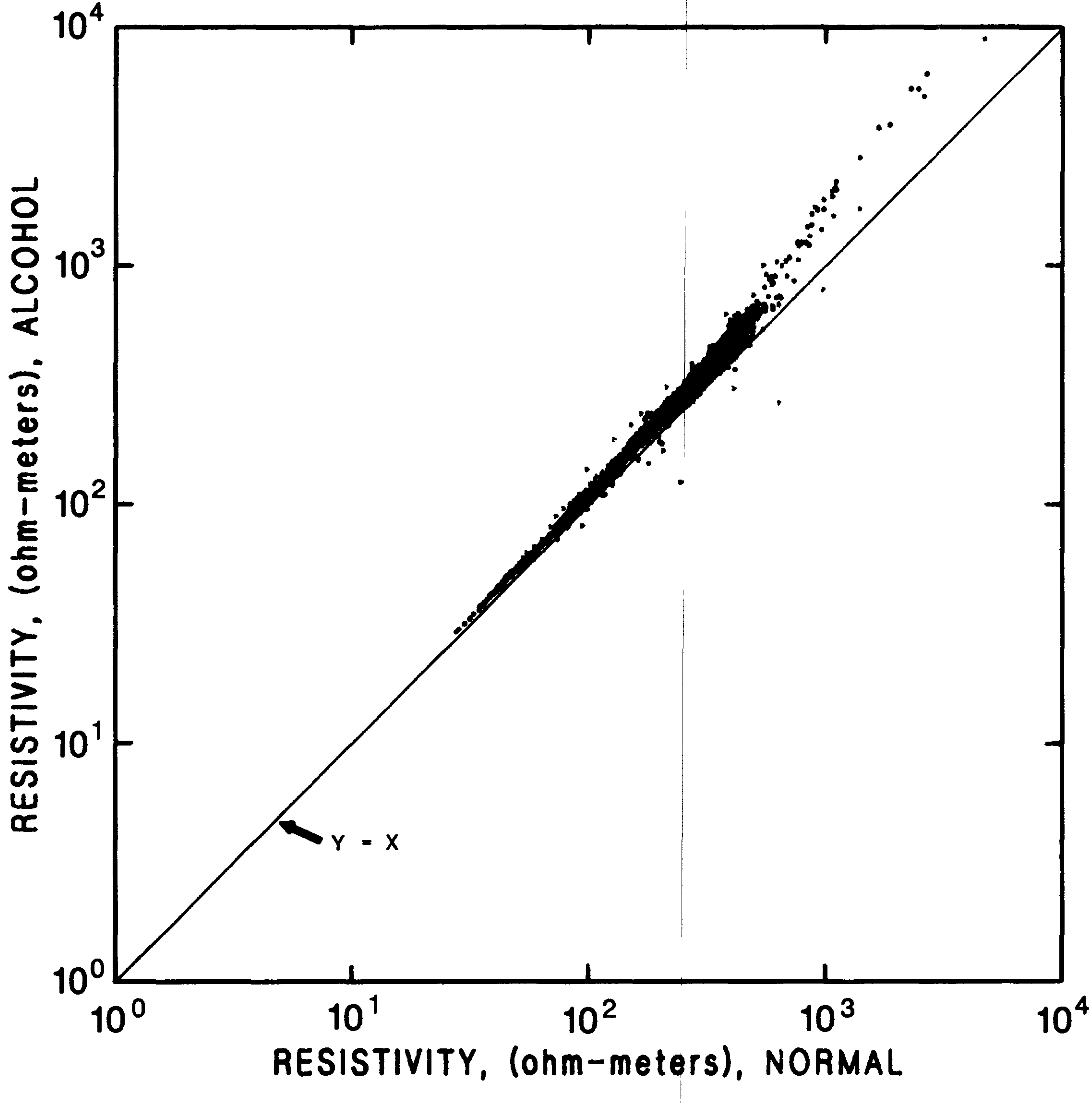

Figure 4. Cross plot of the induction resistivity logs before alcohol was added to drill hole UE-25 WT #4 versus after alcohol was added.

borehole fluid . The conclusions which can be drawn from this study are:

1. If the alcohol causes significant transient effects on the formation rock properties they dissapate too quickly to be discerned by subsequent geophysical logging.
2. Permanent or long term changes in the formation rock properties due to alcohol are either absent or cannot be discerned because they are within the range of normal anticipated uncertainty associated with geophysical log measurements.
3. Significant effects on the geophysical logging tool response due to alcohol are not discernable in these data.

The potassium, uranium, and thorium traces on the spectral gamma ray logs exhibit relatively high noise levels due to poor statistics resulting from low count rate levels. Consequently the potassium and thorium traces presented on Plates 1 to 3 have been smoothed with a Hamming cosine filter (Scott, 1984) using an 11-point window and the uranium trace smoothed with the same filter using a 21-point window. The logs were run by Dresser Atlas, Inc. at their minimum logging rate of 8-10 f/min with time constants of 4 to 6 s. Noise levels can be reduced by logging at slower rates with longer time constants, however, the reduction in noise level would not be a significant improvement over smoothed data for the purposes of lithologic recognition, correlation of stratigraphy between holes, and identification of significant anomalies. Smoothed data are fully satisfactory for the quantitative characterization of the natural radiation properties of volcanic tuffs, and for ratio studies for mineralogic correlations.

The spectral gamma log from USW WT#11 was made with a model of the tool which had been miscalibrated by Dresser Atlas. The error was detected by the USGS several weeks after the hole had been logged and was confirmed by Dresser Atlas to be a scaling problem. The data were corrected by rescaling the original data in the USGS data base using scaling factors previously determined by Dresser Atlas upon recalibrating this model of the spectral gamma tool. Dresser Atlas agreed to submit corrected copies to F&S for redistribution to users who had received field copies.

The uranium level is relatively low and consistant with uranium levels in other drill holes throughout the unsaturated zone, so we can infer that fractures, particularly in the Topopah Springs Member are not healed nor filled with materials that concentrate uranium. Fracture analysis of core from other drill holes (Spengler and others, 1979, Spengler and others, 1981, Spengler and Chornack, 1984) confirm that most of the fractures in the Topopah Springs Member are unhealed.

The caliper logs indicate that the drill hole walls are very rough and enlarged, particularly through the Topopah Springs Member of the Paintbrush Tuff, where the epithermal neutron and density logs are very noisy or "spiky". This spikiness results from the inability of the logging tools to compensate for the combined effect of the enlarged rough drill hole, intense fracturing, and lithophysae (Muller and Kibler, 1983; Spengler and Chornack, 1984). In these cored drill holes, for similarly rough and enlarged intervals below the Topopah Spring Member, lithophysae are absent, the rock is non- to moderately- fractured, and the intensity of the spikiness is much less. Accordingly, we can conclude that the occurrence of similar spikiness in the

WT drill holes in the Topopah Springs Member indicates lithophysae zones or zones of intense fracturing.

The fact that the borehole through the unsaturated zone in the volcanic tuffs of Yucca Mountain is a hostile environment for geophysical logging tools is evidenced by the character of the dielectric constant and the dielectric resistivity traces. Through highly fractured zones of high resistivity and low water content, the dielectric tool is unable to consistently maintain a stable response to the formation in the air filled rugose borehole. This accounts for the ragged and noisy character through some intervals on many of the traces shown on Plates 1 to 3. The worst of the spurious data has been edited from the dielectric constant traces, thus the remaining data are more reliable and correlate well with density, epithermal neutron, and induction resistivity data. For formation resistivity values greater than 100 ohm-m the dielectric resistivity is generally more accurate than the induction resistivity, and below 100 ohm-m the converse is generally true.

The geophysical logs from the Tertiary Tuffs penetrated by the WT drill holes correlate well with logs from other drill holes in the Yucca Mountain area as reported by Daniels and Scott, (1981), Hagstrum and others, (1980), Muller and Kibler, (1983), Muller and Kibler, (1984), Spengler and others, (1979) and Spengler and Chornack, (1984). Laboratory measured physical properties of core from other drill holes (Anderson, 1981; 1984; Eberle and Bigelow, 1973; Thordarson, 1983; and Rush and others, 1984) are consistent with the in-situ properties determined from geophysical logs obtained in these drill holes.

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Table 1.--Summary of geophysical logs from USW WT#1

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
05/16/83	1689	32.5	8.75	1543	30	1664	DEL DA	
05/16/83	1689	32.5	8.75	1543	0	1668	SPC DA	Filtered-- see Discussion
05/17/83	1689	32.5	8.75	1542	10	1665	CAL BW	Max T=81° F
05/17/83	1689	32.5	8.75	1540	20	1660	DBC BW	
05/17/83	1689	32.5	8.75	1540	20	1663	ENP BW	
05/17/83	1689	32.5	8.75	1544	20	1577	IES BW	Rm>10 ohm-m
05/17/83	1689	32.5	8.75	1544	1490	1672	IES BW	Max T=88° F

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 2.--Preliminary summary of major lithostratigraphic units and contacts in drill hole USW WT#1[1]

	Depth[2] of Interval meters	feet	Thickness[2] of Interval meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-144	0-473	144	473
Topopah Spring Member....	144-422	473-1384	278	911
Rhyolite Lavas and Tuffs of Calico Hills............	422-475	1384-1560	53	176
Crater Flat Tuff				
Bullfrog Member..........	475-515+	1560-1689+	40+	129+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 3.--Summary of geophysical logs from USW WT#2

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
07/13/83	2060	58	8.75	1873	60	2045	DEL DA	
07/13/83	2060	58	8.75	1873	0	2048	SPC DA	Filtered--see Discussion
07/14/83	2060	58	8.75	1873	5	2040	CAL BW	Max T=90° F
07/14/83	2060	58	8.75	1873	34	2047	DBC BW	
07/14/83	2060	58	8.75	1873	36	2040	IES BW	Rm=7 ohm-m @ 85° F Rm= 6.6 ohm-m @ 90° F
07/14/83	2060	58	8.75	1874	50	2045	ENP BW	
07/14/83	2060	58	8.75	U	100	2025	GS BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 4.--Preliminary summary of major lithostratigraphic units and contacts in drill hole USW WT#2[1]

	Depth[2] of Interval meters	Depth[2] of Interval feet	Thickness[2] of Interval meters	Thickness[2] of Interval feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-82	0-270	82	270
Topopah Spring Member....	82-397	270-1303	315	1133
Rhyolite Lavas and Tuffs of Calico Hills............	397-486	1303-1594	89	291
Crater Flat Tuff				
Prow Pass Member.........	486-628+	1594-2060+	142+	466+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 5.--Summary of geophysical logs from UE-25 WT#3

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
05/23/83	1142	40	8.75	986	0	1130	SPC DA	Filtered--see Discussion
05/24/83	1142	40	8.75	986	40	1126	DEL DA	Max T<100° F
05/24/83	1142	40	8.75	986	10	1124	CAL BW	Max T=79° F
05/24/83	1142	40	8.75	986	25	1126	IES BW	Rm=2.4 ohm-m @ 78° F
05/24/83	1142	40	8.75	983	25	1130	ENP BW	Max T=78° F
05/24/83	1142	40	8.75	983	25	1130	DBC BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 6.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#3[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Topopah Spring Member....	0-113	0-370	113	370
Rhyolite Lavas and Tuffs of Calico Hills............	113-154	370-505	41	135
Crater Flat Tuff				
Prow Pass Member.........	154-257	505-843	103	338
Bullfrog Member..........	257-348+	843-1142+	91+	299+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 7.--Summary of geophysical logs from UE-25 WT#4

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
06/02/83	1580	48	8.75	1438	10	1562	CAL BW	Max T=78° F
06/02/83	1580	48	8.75	1438	30	1571	DBC BW	
06/03/83	1580	48	8.75	1440	0	1571	SPC DA	Filtered-- see Discussion
06/03/83	1580	48	8.75	U	48	1567	DEL DA	
06/03/83	1580	48	8.75	1438	29	1565	ENP BW	
06/03/83	1580	48	8.75	1438	30	1561	IES BW	Rm>10 ohm-m
06/05/83	1580	48	8.75	1438	30	1567	DBC BW	Defoamer-- see Discussion
06/05/83	1580	48	8.75	1437	30	1565	ENP BW	Defoamer-- see Discussion
06/05/83	1580	48	8.75	1438	30	1560	IES BW	Defoamer-- see Discussion Rm>10 ohm-m, MaxT=77°F

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 8.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#4[1]

	Depth[2] of Interval meters	Depth[2] of Interval feet	Thickness[2] of Interval meters	Thickness[2] of Interval feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-86	0-283	86	283
Yucca Mountain Member....	86-103	283-339	17	56
Pah Canyon Member........	103-132	339-433	29	94
Topopah Spring Member....	132-352	433-1154	220	721
Rhyolite Lavas and Tuffs of Calico Hills............	352-482+	1154-1580+	130+	426+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 9.--Summary of geophysical logs from UE-25 WT#6

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
06/27/83	1256	251	6.75	U	250	1242	DEL DA	Max T<100° F
06/28/83	1256	251	6.75	U	0	1242	SPC DA	Filtered--see Discussion
06/28/83	1256	251	6.75	874	200	1233	CAL BW	Max T=84° F
06/28/83	1256	251	6.75	896	230	1235	IES BW	Max T=88° F Rm>10 ohm- m @ 78° F
06/28/83	1256	251	6.75	U	190	1241	DBC BW	Max T=90° F
06/28/83	1256	251	6.75	937	200	1241	ENP BW	
06/28/83	1256	251	6.75	U	100	1235	GS BW	Max T=99° F

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 10.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#6[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Topopah Spring Member....	0-117	0-383	117	383
Rhyolite Lavas and Tuffs				
of Calico Hills............	117-383+	383-1256+	266+	873+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 11.--Summary of geophysical logs from USW WT#7

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
07/24/83	1610	52	8.75	U	52	1594	DEL DA	Max T<100° F
07/24/83	1610	52	8.75	U	0	1599	SPC DA	Filtered--see Discussion
07/24/83	1610	52	8.75	1380	0	1587	CAL BW	Max T=98° F
07/25/83	1610	52	8.75	1380	44	1586	IES BW	Rm=20.3 ohm-m @ 74° F
07/25/83	1610	52	8.75	1380	35	1590	DBC BW	
07/25/83	1610	52	8.75	1380	41	1586	ENP BW	
07/25/83	1610	52	8.75	1380	100	1575	GS BW	Max T=80° F
07/25/83	1610	52	8.75	1380	39	947	ENP BW	Relogged-NP, Max T=90° F

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 12.--Preliminary summary of major lithostratigraphic units and contacts in drill hole USW WT#7[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-120	0-393	120	393
Topopah Spring Member....	120-438	393-1438	318	1045
Rhyolite Lavas and Tuffs of Calico Hills............	438-480	1438-1574	42	136
Crater Flat Tuff				
Prow Pass Member.........	480-491+	1574-1610+	11+	36+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 13.--Summary of geophysical logs from USW WT#10

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
07/30/83	1402	114	8.75	1141	113	1394	DEL DA	Max T>100° F
07/30/83	1402	114	8.75	1141	0	1392	SPC DA	Filtered--see Discussion
07/31/83	1412	114	8.75	1140	50	1382	CAL BW	Max T=98° F
07/31/83	1412	114	8.75	1138	30	1386	ENP BW	Max T=85° F
07/31/83	1412	114	8.75	1137	90	1385	DBC BW	
07/31/83	1412	114	8.75	1140	90	1380	IES BW	Rm=16.7 ohm-m @ 82° F
07/31/83	1412	114	8.75	1140	100	1355	GS BW	Max T=76° F

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 14.--Preliminary summary of major lithostratigraphic units and contacts in drill hole USW WT#10[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-291	0-954	291	954
Topopah Spring Member....	291-430+	954-1412+	139+	458+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 15.--Summary of geophysical logs from USW WT#11

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
08/07/83	1446	45	8.75	1236	0	1444	SPC DA	Filtered--see Discussion Scaled.--see Discussion
08/07/83	1446	45	8.75	1199	38	1443	DEL DA	Max T<100° F
08/08/83	1446	45	8.75	1193	20	1437	CAL BW	Max T=88° F
08/08/83	1446	45	8.75	1193	30	1439	IES BW	Rm=13.2 ohm-m @ 72° F Rm=10.8 ohm-m @ 88° F
08/08/83	1446	45	8.75	1193	30	1444	ENP BW	
08/08/83	1446	45	8.75	1192	30	1444	DBC BW	
08/08/83	1446	45	8.75	1193	50	1435	GS BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
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DBC = Borehole Compensated Density
DEL = Dielectric Log
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GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 16.--Preliminary summary of major lithostratigraphic units and contacts in drill hole USW WT#11[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-96	0-316	96	316
Topopah Spring Member....	96-387	316-1270	291	954
Rhyolite Lavas and Tuffs				
of Calico Hills............	387-441+	1270-1446+	54+	176+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 17.--Summary of geophysical logs from UE-25 WT#12

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
08/15/83	1308	70	8.75	U	0	1305	SPC DA	Filtered--see Discussion
08/15/83	1308	70	8.75	U	70	1300	DEL DA	Max T<100° F
08/15/83	1308	70	8.75	1133	30	1292	CAL BW	Max T=92° F
08/15/83	1308	70	8.75	1133	40	1298	DBC BW	
08/15/83	1308	70	8.75	1133	30	1297	ENP BW	
08/15/83	1308	70	8.75	1133	50	1292	IES BW	Rm=12.2 ohm-m @ 78° F Rm=10.3 ohm-m @ 92° F
08/15/83	1308	70	8.75	1133	100	1280	GS BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 18.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#12[1]

	Depth[2] of Interval meters	Depth[2] of Interval feet	Thickness[2] of Interval meters	Thickness[2] of Interval feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-110	0-362	110	362
Topopah Spring Member....	110-389	362-1275	279	913
Rhyolite Lavas and Tuffs of Calico Hills............	389-399+	1275-1308+	10+	33+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 19.--Summary of geophysical logs from UE-25 WT#13

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
07/05/83	1154	222	8.75	U	222	1126	DEL DA	Max T<100° F
07/05/83	1154	222	8.75	997	50	1123	CAL BW	Max T=84° F
07/06/83	1154	222	8.75	994	190	1130	DBC BW	
07/06/83	1154	222	8.75	994	180	1128	ENP BW	
07/06/83	1154	222	8.75	994	200	1124	IES BW	Rm>10 ohm-m @ 85° F
07/06/83	1154	222	8.75	U	0	1130	SPC DA	Filtered--see Discussion
07/06/83	1154	222	8.75	U	100	1125	GS BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 20.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#13[1]

	Depth[2] of Interval meters	feet	Thickness[2] of Interval meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-155	0-510	155	510
Topopah Spring Member....	155-352+	510-1154+	197+	644+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 21.--Summary of geophysical logs from UE-25 WT#14

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
09/26/83	1310	120	8.75	928	70	1296	CAL BW	Max T=82° F
09/26/83	1310	120	8.75	928	100	1303	DBC BW	
09/27/83	1310	120	8.75	1136	125	1302	ENP BW	
09/27/83	1310	120	8.75	1136	110	1297	IES BW	Rm=21 ohm-m @ 76° F
09/27/83	1310	120	8.75	U	120	1300	DEL DA	Max T<100° F
09/27/83	1310	120	8.75	1134	118	1303	SPC DA	Filtered--see Discussion
09/27/83	1310	120	8.75	1136	86	1290	GS BW	Max T=82° F

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 22.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#14[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Topopah Spring Member....	0-370	0-1215	370	1215
Rhyolite Lavas and Tuffs of Calico Hills............	370-399+	1215-1310+	29+	95+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 23.--Summary of geophysical logs from UE-25 WT#15

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
11/20/83	1360	127	8.75	1161	0	1348	SPC DA	Filtered--see Discussion
11/20/83	1360	127	8.75	U	127	1344	DEL DA	Max T<100° F
11/20/83	1360	127	8.75	1159	100	1347	GR BW	Max T=81° F
11/20/83	1360	127	8.75	U	120	1345	IES BW	Rm=19.3 ohm-m @ 45° F Rm=11.8 ohm-m @ 81° F
11/20/83	1360	127	8.75	1162	80	1341	CAL BW	
11/20/83	1360	127	8.75	1160	110	1348	DBC BW	
11/20/83	1360	127	8.75	1164	110	1348	ENP BW	
11/21/83	1360	127	8.75	1160	97	1335	GS BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 24.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#15[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-113	0-370	113	370
Pah Canyon Member........	113-128	370-421	15	51
Topopah Spring Member....	128-415+	421-1360+	287+	939+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 25.--Summary of geophysical logs from UE-25 WT#16

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
11/07/83	1710	102	8.75	U	100	1698	DEL DA	Max T<100° F
11/07/83	1710	102	8.75	U	0	1702	SPC DA	Filtered--see Discussion
11/08/83	1710	102	8.75	1548	50	1686	CAL BW	Max T=82° F
11/08/83	1710	102	8.75	1548	59	1687	IES BW	Rm=24.4 ohm-m @ 54° F Rm=17 ohm-m @ 82° F
11/08/83	1710	102	8.75	1548	108	1689	ENP BW	
11/08/83	1710	102	8.75	1550	80	1680	GS BW	
11/09/83	1710	102	8.75	1547	90	1689	DBC BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 26.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#16[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-139	0-455	139	455
Pah Canyon Member........	139-175	455-575	36	120
Topopah Spring Member....	175-326	575-1068	151	493
Rhyolite Lavas and Tuffs of Calico Hills............	326-521+	1068-1709+	195+	641+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 27.--Summary of geophysical logs from UE-25 WT#17

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
10/26/83	1453	55	8.75	U	20	1422	GR WW	NP
10/27/83	1453	55	8.75	1290	0	1392	SPC DA	Filtered--see Discussion
10/27/83	1453	55	8.75	U	55	1387	DEL DA	Max T<100° F
10/27/83	1453	55	8.75	1294	1	1384	CAL BW	Max T=81° F
10/27/83	1453	55	8.75	1294	40	1385	IES BW	Rm=20 ohm-m @81° F
10/27/83	1453	55	8.75	1293	88	1390	DBC BW	
10/27/83	1453	55	8.75	U	100	1375	GS BW	Max T=86° F
10/28/83	1453	55	8.75	1295	30	1387	ENP BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 28.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#17[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-75	0-245	75	245
Topopah Spring Member....	75-300	245-985	225	740
Rhyolite Lavas and Tuffs of Calico Hills............	300-371	985-1218	71	233
Crater Flat Tuff				
Prow Pass Member.........	371-442+	1218-1450+	71+	232+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

Table 29.--Summary of geophysical logs from UE-25 WT#18

Date	Drilled depth (feet)	Casing depth (feet)	Bit size (inches)	Fluid[1] level (feet)	Top of log (feet)	Bottom of log (feet)	Log[2]	Comments[3]
05/18/84	2043	86	8.75	U	0	2017	SPC DA	Filtered--see Discussion
05/18/84	2043	86	8.75	U	86	2014	DEL DA	
05/21/84	2043	86	8.75	1840	30	2012	CAL BW	Max T=89° F
05/21/84	2043	86	8.75	1834	70	1965	IES BW	
05/21/84	2043	86	8.75	1844	60	1965	ENP BW	
05/21/84	2043	86	8.75	1849	60	1965	DBC BW	
05/22/84	2043	86	8.75	1855	100	1950	GS BW	

[1]U=Unknown

[2]BW = Birdwell Inc
CAL = Caliper
DA = Dresser Atlas
DBC = Borehole Compensated Density
DEL = Dielectric Log
WW = Water Well Surveys Co.
GAM = Gamma Ray
GS = Geophone Survey
IES = Induction Electric Survey
SPC = Spectral Gamma Ray
ENP = Epithermal Neutron

[3]MAX T = Maximum Temperature
Rm = Mud Resistivity
NP = Not Plotted

Table 30.--Preliminary summary of major lithostratigraphic units and contacts in drill hole UE-25 WT#18[1]

	Depth[2] of Interval		Thickness[2] of Interval	
	meters	feet	meters	feet
Paintbrush Tuff				
Tiva Canyon Member.......	0-110	0-361	110	361
Yucca Canyon Member......	110-146	361-480	36	119
Pah Canyon Member........	146-214?	480-701?	68	221
Topopah Spring Member....	214?-494	701?-1620	280?	919?
Rhyolite Lavas and Tuffs of Calico Hills............	494-623+	1620-2043+	129+	423+

[1]Written communication R. W. Spengler, 1985.
[2]Includes the bedded tuff at the base of each unit.

TABLE 31. Linear regression parameters of cross plots of geophysical log data taken before versus data taken after 20 gallons of alcohol was added to drill hole UE-25 WT#4

Geophysical Log	Type of Fit	Number of Points	Slope	Intercept	Standard Error	Regression Coefficient
Compensated Density	Linear	2614	9.94E-1	-8.04E-3	+/-5.68E-2	9.49E-1
Epithermal Neutron	Linear	3033	1.06E 0	2.54E+1	+/-3.35E+2	9.81E-1
Induction Resistivity	Log/Log	3016	1.09E 0	-1.60E-1	+/-3.35E-2	9.94E-1

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