SUMMARY OF LITHOLOGIC LOGGING OF NEW AND EXISTING BOREHOLES AT YUCCA MOUNTAIN, NEVADA, MARCH 1994 TO JUNE 1994

by Jeffrey K. Geslin and Thomas C. Moyer

U.S. GEOLOGICAL SURVEY

Open-File Report 94-451

Prepared in cooperation with the
NEVADA OPERATIONS OFFICE,
U.S. DEPARTMENT OF ENERGY under
Interagency Agreement DE-AI08-92NV10874

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Denver, Colorado
1995

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

MASTER

U.S. DEPARTMENT OF THE INTERIOR

BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY

Gordon P. Eaton, Director

The use of trade, product, industry, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

For additional information write to:
Chief, Earth Science Investigations
Program
Yucca Mountain Project Branch
U.S. Geological Survey
Box 25046, MS 421
Denver Federal Center
Denver, CO 80225

Copies of this report can be purchased from:
U.S. Geological Survey
Earth Science Information Center
Open-File Reports Section
Box 25286, MS 517
Denver Federal Center
Denver, CO 80225

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

CONTENTS

Abstract	1
Introduction	1
Study methods	1
Continuing logging	2
References	7
Appendix 1. Graphical lithologic logs for boreholes at Yucca Mountain, Nevada	10
Notes for graphical lithologic logs	10
UE-25 NRG #2C	10
UE-25 NRG #2D	10
USW NRG-7/7A	10
All graphical lithologic logs	10

FIGURES

1. Borehole location map	3
--------------------------------	---

TABLES

1. Location and information for boreholes logged at Yucca Mountain, March 1994 to June 1994	2
2. Lithostratigraphic nomenclature of the Paintbrush Group at Yucca Mountain	4
3. Generalized lithostratigraphy of boreholes at Yucca Mountain, Nevada	5
4. Summary of depths to basal contacts for boreholes at Yucca Mountain, Nevada	6

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
millimeter (mm)	0.03937	inch
centimeter (cm)	0.3937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Summary of Lithologic Logging of New and Existing Boreholes at Yucca Mountain, Nevada, March 1994 to June 1994

By Jeffrey K. Geslin and Thomas C. Moyer

Abstract

This report summarizes lithologic logging of core from boreholes at Yucca Mountain, Nevada, conducted from March 1994 to June 1994. Units encountered during logging include Quaternary-Tertiary alluvium and colluvium, Tertiary Rainier Mesa Tuff, all units in the Tertiary Paintbrush Group, and Tertiary Calico Hills Formation. Logging results are presented in a table of contact depths for core from unsaturated zone neutron (UZN) boreholes and graphic lithologic logs for core from north ramp geology (NRG) boreholes.

INTRODUCTION

Yucca Mountain, Nevada, is being investigated as a potential site for a high-level radioactive waste repository. This report summarizes the lithologic logging of new and existing boreholes at Yucca Mountain that was done from March to June 1994, by the Yucca Mountain Project Branch of the U.S. Geological Survey (USGS). This logging was undertaken with the objective to determine the spatial distribution and characteristics of stratigraphic units within the Yucca Mountain site area. Stratigraphic data obtained from lithologic logging are used in a preliminary three-dimensional lithostratigraphic model of Yucca Mountain. These data also can be integrated into hydrologic studies at Yucca Mountain and applied to engineering and construction of the Exploratory Studies Facility.

Lithostratigraphic units identified during logging include Quaternary-Tertiary alluvium and colluvium, the Tertiary Rainier Mesa Tuff of the Timber Mountain Group, all units in the Tertiary Paintbrush Group, and the Tertiary Calico Hills Formation. Criteria used to identify contacts between these units, and between lithostratigraphic units within the Paintbrush Group, are discussed in Geslin and others (in press). Stratigraphic nomenclature and lithologic descriptions of stratigraphic units in the Tiva Canyon, Yucca Mountain, Pah Canyon, and Topopah Spring Tuffs of the Paintbrush Group are from Sawyer and others (in

press) and also are summarized in Buesch and others (USGS, written commun., 1994).

The boreholes logged from March to June 1994 are listed, with their location and elevation, in table 1. Table 1 also lists the Data Tracking Number (DTN) for stratigraphic data from each borehole that have been released to the Yucca Mountain Project, submitted to the USGS Local Records Center in Denver, Colorado, and stored in the Yucca Mountain Project Central Records Facility in Las Vegas, Nevada. The locations of these boreholes are shown in figure 1. Cores from boreholes logged during this study are stored at the Yucca Mountain Project Sample Management Facility at the Nevada Test Site.

STUDY METHODS

Lithostratigraphic units identified in core follow the stratigraphic hierarchy and nomenclature for the Paintbrush Group defined in Sawyer and others (in press) and followed by Buesch and others (USGS written commun., 1994) (table 2). The criteria used to identify contacts between stratigraphic units are described in Geslin and others (in press). Lithologic logging includes either identification of the depths of stratigraphic contacts (herein referred to as type 1 logging) or identification of the depths of contacts and detailed unit descriptions (herein referred to as type 2 logging). The lithostratigraphic units encountered during type 1 and type 2 logging of core from boreholes are summarized in table 3. The results of type 1 logging are reported as tables of contact depths (summarized in table 4), whereas the results of type 2 logging are reported in graphical form (appendix 1).

Type 1 logs were completed for core recovered from unsaturated zone neutron (UZN series) boreholes (table 4). Core recovered from UZN-series boreholes is stored in lexan tubing that limits viewing of the core and modifies colors by retaining moisture. Contacts that are difficult to identify through lexan or that were removed by sampling were confirmed or constrained by examination of processed samples at the Hydrologic Research Facility or by viewing videotapes of core photographed prior to sample removal.

Table 1. Location and information for boreholes logged at Yucca Mountain, March 1994 to June 1994

[Northing, easting, and elevation data are from EG&G and were provided as information to the Yucca Mountain Project. Northing and easting are based on the Nevada State Coordinate System. Locations and elevations are in feet.]

Borehole number	Northing	Easting	Elevation	Data tracking number
Identification of lithologic contacts (type 1 logging)				
USW UZ-N11	780,573.93	559,020.93	5,224.0	GS940308314211.010
USW UZ-N15	778,090.54	559,551.76	5,109.4	GS940308314211.019
USW UZ-N16	778,150.80	559,625.98	5,116.6	GS940308314211.019
USW UZ-N17	778,224.12	559,995.10	5,127.9	GS940308314211.019
USW UZ-N36	773,899.50	563,582.66	4,642.0	GS940308314211.018
USW UZ-N38	767,466.37	563,343.41	4,148.9	GS940308314211.011
UE-25 UZN #63	768,836.54	566,169.39	3,944.1	GS940308314211.017
USW UZ-N64	765,728.46	559,435.76	4,790.9	GS940308314211.016
Detailed lithologic logging (type 2 logging)				
UE-25 NRG #2C	765,771.68	569,189.76	3,801.2	GS940308314211.012
UE-25 NRG #2D	765,825.10	569,132.29	3,792.1	GS940308314211.013
USW NRG-7A	768,879.96	562,984.13	4,207.0	GS940408314211.020

Type 2 lithologic logs (appendix 1) were created for core recovered from north ramp geology (NRG) boreholes. These logs use the criteria of Buesch and others (USGS, written commun., 1994) to identify the welding and crystallization zones in each unit. Accompanying lithologic unit descriptions include the phenocryst content and assemblage; lithophysae content and size; pumice content, size, and composition; lithic clast content, size, and composition; and matrix color and content. The percentage of phenocrysts, lithic clasts, pumice clasts and lithophysae are visually estimated using charts included in the Munsell Soil Color Charts (Kollmorgen Instruments Corp., 1992). Phenocryst, pumice, and lithic clast types are identified with the aid of a hand lens. Phenocryst, pumice, and lithic clast types are identified with the aid of a hand lens or binocular microscope. The maximum and minimum dimensions of pumice, lithic clast, and lithophysae (void) sizes are measured along two perpendicular axes and recorded as either typical or maximum sizes observed. Pumice, lithic clast, and matrix colors are determined on dry core using Munsell Color Charts

(Geological Society of America, 1991; Kollmorgen Instruments Corp., 1992). Other features of the core, including fracture geometry and morphology, fracture mineralization, and development and orientation of foliation (dip angle measured from horizontal), also are recorded and included in unit descriptions.

CONTINUING LOGGING

Continued logging in 1994 and 1995 will produce a table of contact depths for boreholes NRG #5A, SD-9, SD-10, SD-12, UZ-7A, SRG-1, SRG-2, SRG-3, and SRG-4 (depending on drilling progress) that will be submitted to the USGS Yucca Mountain Project Branch Local Records Center upon completion of drilling and following internal review. Graphical lithologic logs that summarize detailed logging will be prepared for UZ-14, SD-9, SD-12, and UZ-7A (depending on drilling progress). These data will be integrated into the preliminary three-dimensional lithostratigraphic model of Yucca Mountain.

Figure 1. Borehole location map (modified from Nelson and others, 1991).

Table 2. Lithostratigraphic nomenclature of the Paintbrush Group at Yucca Mountain (from Sawyer and others, in press; Buesch and others, USGS, written commun., 1994)

Tuff unit "x" (Tpk1)	
Pre-Tuff unit "x" bedded tuff (Tpbt5)	
Tiva Canyon Tuff (Tpc)	
crystal-rich member (Tpcr) (quartz latite)	
vitric zone (rv)	
non- to partially welded subzone (rv3)	
moderately welded subzone (rv2)	
vitrophyre subzone (rv1)	
nonlithophysal zone (rn)	
subvitrophyre transition subzone (rn4)	
pumice-poor subzone (rn3)	
mixed pumice subzone (rn2)	
crystal transition subzone (rn1)	
lithophysal zone (rl)	
crystal transition subzone (rl1)	
crystal-poor member (Tpcp) (high-silica rhyolite)	
upper lithophysal zone (pul)	
spherulite-rich subzone (pul1)	
middle nonlithophysal zone (pmn)	
upper subzone (pmn3)	
lithophysae-bearing subzone (pmn2)	
lower subzone (pmn1)	
lower lithophysal zone (pll)	
lower nonlithophysal zone (pln)	
hackly subzone (plnh)	
columnar subzone (plnc)	
spherulitic pumice interval (plnc3)	
argillic pumice interval (plnc2)	
vitric pumice interval (plnc1)	
vitric zone (pv)	
vitrophyre subzone (pv3)	
moderately welded subzone (pv2)	
non- to partially welded subzone (pv1)	
Pre Tiva Canyon Tuff bedded tuff (Tpbt4)	
Yucca Mountain Tuff (Tpy)	
Pre-Yucca Mountain Tuff bedded tuff (Tpbt3)	
Pah Canyon Tuff (Tpp)	
Pre-Pah Canyon Tuff bedded tuff (Tpbt2)	
<hr/>	
	Topopah Spring Tuff (Tpt)
	crystal-rich member (Tptr) (quartz latite)
	vitric zone (rv)
	non- to partially welded subzone (rv3)
	moderately welded subzone (rv2)
	vitrophyre subzone (rv1)
	nonlithophysal zone (rn)
	crystal transition subzone (rn1)
	lithophysal zone (rl)
	crystal transition subzone (rl1)
	crystal-poor member (Tptp) (high-silica rhyolite)
	upper lithophysal zone (pul)
	cavernous lithophysae subzone (pul2)
	small lithophysae subzone (pul1)
	middle nonlithophysal zone (pmn)
	upper subzone (pmn3)
	lithophysae-bearing subzone (pmn2)
	lower subzone (pmn1)
	lower lithophysal zone (pll)
	lower nonlithophysal zone (pln)
	vitric zone (pv)
	vitrophyre subzone (pv3)
	moderately welded subzone (pv2)
	non- to partially welded subzone (pv1)
	Pre-Topopah Spring Tuff bedded tuff (Tpbt1)

Table 3. Generalized lithostratigraphy of boreholes at Yucca Mountain, Nevada

	Borehole number										
	UZ-N 11	UZ-N 15	UZ-N 16	UZ-N 17	UZ-N 36	UZ-N 38	UZN #63	UZ-N 64	NRG #2C	NRG #2D	NRG -77A
Rainier Mesa Tuff (Tmr)									I	I	
Pre-Rainier Mesa Tuff bedded tuff (Tmbt1)									I	I	
Tuff unit "x" (Tpki)									I	I	
Pre-Tuff unit "x" bedded tuff (Tpbt5)									I	I	
Tiva Canyon Tuff (Tpc)											
crystal-rich member (Tpcr)											
vitric zone (rv)											
nonlithophysal zone (rn)		I	I	I	I			I			
lithophysal zone (rl)											
crystal-poor member (Tpcp)											
upper lithophysal zone (pul)											
middle nonlithophysal zone (pmn)											
lower lithophysal zone (pll)											
lower nonlithophysal zone (pln)											
hackly subzone (plnh)							I	I			
columnar subzone (plnc)	I						I	I			
vitric zone (pv)											
Pre-Tiva Canyon Tuff bedded tuff (Tpbt4)											
Yucca Mountain Tuff (Tpy)											
Pre-Yucca Mountain Tuff bedded tuff (Tpbt3)											
Pah Canyon Tuff (Tpp)											
Pre-Pah Canyon Tuff bedded tuff (Tpbt2)											
Topopah Spring Tuff (Tpt)											
crystal-rich member (Tpctr)											
vitric zone (rv)											
nonlithophysal zone (rn)											
lithophysal zone (rl)											
crystal-poor member (Tptp)											
upper lithophysal zone (pul)											
middle nonlithophysal zone (pmn)											
lower lithophysal zone (pll)											
lower nonlithophysal zone (pln)											
vitric zone (pv)											
Pre-Topopah Spring Tuff bedded tuff (Tpbt1)											
Calico Hills Formation (Tac)											

Table 4. Summary of depths to basal contacts for boreholes at Yucca Mountain, Nevada

UNIT* no core	USW UZ-N11	USW UZ-N15	USW UZ-N16	USW UZ-N17	USW UZ-N36	USW UZ-N38	UE-25 UZN #63	USW UZ-N64
Alluvium/colluvium (QTac)	1.7	2.3	4.2	2.5	0.9	17.9	4.4	1.8
Tiva Canyon Tuff (Tpc)							8.6†	
crystal-rich member (Tpcr)								
nonlithophysal zone (rn)								
subvitrophyre transition subzone (rn4)		16.2†		19.3†	16.1†			
pumice-poor subzone (rn3)		57.6	36.5†		47.5			
mixed pumice subzone (rn2)								39.8†
crystal transition subzone (rn1)								
crystal-poor member (Tpcp)								
lower nonlithophysal zone (pln)								
hackly subzone (plnh)						27.3†	25.0††	
columnar subzone (plnc)								
spherulitic pumice interval (c3)						49.1	44.3	
argillic pumice interval (c2)	25.2†					80.9		
vitric zone (pv)								
moderately welded subzone (pv2)	29.7							
non- to partially welded subzone (pv1)	46.4							
Bedded tuff (Tpbt4)	60.6							
Yucca Mountain Tuff (Tpy)								
Total depth	84.4	59.9	60.0	59.9	59.8	89.4	60.0	60.0

* Stratigraphic subdivisions follow the nomenclature defined by Buesch and others (USGS, written commun., 1994). All measurements are in feet.

† The first unit encountered in the borehole.

†† The contact between the hackly and columnar subzones of the crystal-poor lower nonlithophysal zone is gradational from 25.0 to 37.3 feet. This unit is overlain by alluvium or colluvium.

REFERENCES

- Geological Society of America, 1991, Rock-color chart: Boulder, Colo., Geologic Society of America. (MOL.19940810.0002)
- Geslin, J.K., Moyer, T.C., and Buesch, D.C., 1994, Summary of lithologic logging of new and existing boreholes at Yucca Mountain, Nevada, August 1993 to February 1994: U.S. Geological Survey Open-File Report 94-342, in press. (MOL.19940810.0011)
- Kollmorgen Instruments Corporation, 1992, Munsell soil color charts: New York, Kollmorgen Instruments Corporation. (MOL.19940810.0003)
- Nelson, P.H., Muller, D.C., Schimschal, Ulrich, and Kibler, J.E., 1991, Geophysical logs and core measure-

ments from forty boreholes at Yucca Mountain, Nevada: U.S. Geological Survey, Geophysical Investigations Map GP-1001, 64 p. (NNA.920211.0022)

Sawyer, D.A., Fleck, R.J., Lanphere, M.A., Warren, R.G., Broxton, D.E., and Hudson, M.R., Episodic caldera volcanism in the Miocene southwestern Nevada volcanic field—Revised stratigraphic framework, $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology, and implications for magmatism and extension: Geological Society of America Bulletin, in press. (MOL.19940725.0004)

NOTE: Parenthesized numbers following each cited reference are for U.S. Department of Energy OCRWM Records Management purposes only and should not be used when ordering the publication.

APPENDIX

APPENDIX 1. GRAPHICAL LITHOLOGIC LOGS FOR BOREHOLES AT YUCCA MOUNTAIN, NEVADA

Notes for Graphical Lithologic Logs

UE-25 NRG #2C

Core was recovered from the borehole with a hollow-stem auger, and includes nonlithified pyroclastic-flow and fall deposits of the Rainier Mesa Tuff (Timber Mountain Group), nonlithified bedded tuffs that underlie Rainier Mesa Tuff, and lithified tuff unit "x" (Paintbrush Group).

UE-25 NRG #2D

Core that was recovered from the borehole with a hollow-stem auger includes nonlithified pyroclastic-flow and fall deposits of the Rainier Mesa Tuff (Timber Mountain Group), nonlithified bedded tuffs that underlie Rainier Mesa Tuff, and lithified tuff unit "x" (Paintbrush Group).

USW NRG-7/7A

NRG-7 is a vertical hole located at approximately 768,846.20 N; 563,004.90 E that was drilled from the surface to 17.0 ft and then abandoned. NRG-7A is an adjacent vertical hole located at approximately 768,879.96 N; 562,984.13 E that was cored from 17.0 to 1513.4 ft (total depth). Samples were collected from NRG-7, however, it is not known if these samples represent colluvium or bedrock. Therefore, surface to 17 ft depth was not included in this log. Lithostratigraphic units in the core include the lower zones of the Tiva Canyon Tuff, Yucca Mountain Tuff, Pah Canyon Tuff, Topopah Spring Tuff, interbedded

nonwelded tuffs of the Paintbrush Group, and the upper part of the Calico Hills Formation.

(V)—Contacts depths designated with this symbol were identified using videotape of the core prior to sample removal.

*—The top of the Topopah Spring Tuff is typically marked by a 2-cm-thick lithic-rich fallout deposit. This deposit apparently is represented by an unrecovered interval at approximately 280 ft. This depth is estimated from stratigraphic relationships in adjacent NRG boreholes.

All Graphical Lithologic Logs

Welding Definitions

Nonwelded = nondeformed pumice, no to slight sintering of matrix.

Partially welded = nondeformed pumice, sintered/incipiently welded matrix (some macroscopic porosity).

Moderately welded = partial deformation of pumice (some macroscopic porosity), densely welded matrix (no porosity).

Densely welded = collapsed pumice (no macroscopic porosity), densely welded matrix.

Mineral Notation

qtz = quartz

san = sanidine

plag = plagioclase

feld = sanidine and plagioclase, undifferentiated

hbld = hornblende

cpx = clinopyroxene

bio = biotite

(oxy)bio = partially oxidized biotite

oxybio = completely oxidized biotite

Zones of welding (W)

Zones of crystallization (C)

Phenocryst content (P)

Rainier Mesa Tuff (Tmr) -

Nonlithified pyroclastic-flow deposit: 50.0-96.4 ft

Matrix, which changes downward from pale yellowish brown to pinkish white, contains distinctive colorless, bubble-wall glass shards. Pumice clasts (10-15 percent) are vitric, colorless, light gray, light brown, or brownish orange. Crystals (10-15 percent) include qtz, plag, san, and bio. Deposit may be lithified above 51.5 ft.

Bedded Tuff (Tmbt1) -

96.4-113.6 ft: *Nonlithified fallout tephra.* White, vitric pumice lapilli and volcanic lithic clasts. Moderately sorted. Lithic content is 10-20 percent above 108.5 ft, but less than 2 percent below 108.5 ft. Pumice clasts are typically less than 3 mm diameter. Grades upward into a light brown paleosol (96.4-100.8 ft). 113.6-124.0 ft: *Nonlithified pumice-rich fallout.* Moderately well sorted, normally graded. Pumice grades upward from less than 5 mm to less than 3 mm diameter. Contains grayish yellow-green lithic clasts. Crystals of feld, qtz, bio. Light brown paleosol from 113.6-118.8 ft. 124.0-139.9 ft: *Nonlithified pyroclastic-flow (?) deposit.* Light brown with glass shards and white pumice less than 5 mm. Crystals of feld, qtz, bio. Pumice fallout from 139.0 to 139.9 ft. 139.9-150.1 ft: *Nonlithified pyroclastic-flow (?) deposit.* Medium brown with glass shards and 10-20 percent white pumice, most less than 5 mm. Crystals of feld, qtz, bio. Poorly consolidated.

Tuff Unit "x" (Tpki) (?) -

Lithified pyroclastic-flow deposit: 150.1 ft-Total Depth

Pumice clasts (10-15 percent), white to pale yellowish or greenish (zeolitized?), in a brownish gray altered matrix. Volcanic lithic clasts (5-7 percent) are dark gray, dark reddish gray, or medium light gray.

Borehole : UE-25 NRG #2D
Data Tracking Number: GS940308314211.013

Compiled: 7 March 94

Zones of welding (W)

- Moderately to Densely (o-lithophysae)
- Partially to Moderately
- Non- to Partially
- Nonwelded

Zones of crystallization (C)

- Devitrified / Devit. + vapor-phase mins.
- Vitric / Vitric + vapor-phase mins.
- Altered (a) / to clay (c) / to zeolite (z)

Phenocryst content (P)

- greater than 10 percent
- 5 - 10 percent
- less than 5 percent

Rainier Mesa Tuff (Tmr) -

Nonlithified pyroclastic-flow deposit: 38.1-69.8 ft

Matrix, which changes downward from pale yellowish brown to pinkish white, contains distinctive colorless, bubble-wall glass shards. Pumice clasts (10-20 percent) are vitric, colorless, white, light brown, or brownish orange. Crystals (10-15 percent) include qtz, plag, san, and bio.

Bedded Tuff (Tmbt1) -

69.8-86.0 ft: *Nonlithified fallout tephra*. White, vitric pumice lapilli and volcanic lithic clasts. Moderately sorted, lithic content increases from about 5 percent to about 20 percent upward, pumice clasts are typically less than 3 mm diameter. Grades upward into a light brown paleosol (69.8-74.0 ft). 86.0-96.7 ft: *Nonlithified pumice-rich fallout*. Moderately well sorted, normally graded. Pumice grades upward from less than 5 mm to less than 3 mm diameter. Crystals of feld, qtz, bio. Light brown paleosol from 86.0-91.0 ft. 96.7-112.5 ft: *Nonlithified pyroclastic-flow (?) deposit*. Light brown with glass shards and white pumice less than 5 mm. Crystals of feld, qtz, bio. Pumice-rich fallout from 109.8 to 112.5 ft. 112.5-125.9 ft: *Nonlithified pyroclastic-flow (?) deposit*. Medium brown with glass shards and 10-20 percent white pumice, most less than 5 mm. Crystals of feld, qtz, bio. Poorly consolidated below 118.0 ft.

* Core run marker notes lithified material at 127.4 ft.

Tuff Unit "x" (Tpki) -

Lithified pyroclastic-flow deposit: 133.7 ft-Total Depth

Pumice clasts (10-15 percent), white to pale yellowish or greenish (zeolitized?), in a brownish gray altered matrix. Volcanic lithic clasts (5-7 percent) are dark gray, dark reddish gray, or medium light gray.

Borehole :USW NRG-7/7A

Borehole :USW NRG-7/7A

Borehole : USW NRG-7/7A