

# USW WT-11

U.S. Geological Survey Porosity and Water Content Stratigraphy Original Logs and Fractures PHIWDIEL PHIWENP WELDNG 10 DIEL CAL Depth ENP 10000 PHITDIEL PHITENP 40 TVNFRC De **DBCBND** \_\_BIT\_ \_\_60 Depth TOPS SWENP ENPBND 10000 SWDIEL 100 RHOG **PHYSZONE** RILD 10000 Comments (Feet) ZEOLZONE TVNDAZ - 400 **ZERO** Alluvium (0-40(?)); composed of densely welded tuff (Tiva Canyon Member); few fragments coated with caliche Paintbrush Tuff; Tiva Canyon Member 5 Tuff (40(?)-259), ash-flow, light-brownish-gray to brownish-240 gray, densely welded, devitrified, appears slightly glassy below 220 ft (67.1 m); pumice, light-brownish-gray, devitrified; less than 1 percent phenocrysts (sanidine and biotite); rare to moderate lithophysae from 160 to 195 ft (48.8-59.4 m) and possiblebasal vitrophyre from 216 (65.8 m) to base of unit identified from television camera 30 45 60 Tuff (259–269), ash-flow, light—brown, partially to nonwelded, vitric; pumice, grayish—orange, vitric; abundant 960 dark-yellowish-orange and black glass shards; rare sanidine and biotite phenocrysts; conspicuous black glass lithic fragments; base of interval corresponds to abrupt absence of \_ \_\_\_ black lithic fragments on television log and a density minimum on density log Bedded Tuff; Tuff (269–316), ash-fall, white, moderateorange-pink, and yellowish-gray, poorly consolidated to 200 unconsolidated, vitric; dominantly composed of grayish-yellow and white vitric pumice clasts and abundant phenocrysts of sanidine, biotite, and pyroxene and abundant grayish- red crystal-poor volcanic lithic clasts; based on television camera observations most of interval is composed of coarse-grained fragments except for intrval from 303 to 311 ft (92.4-94.8 m), which appears very fine grained; 91 abrupt change in textural characteristics of borehole wall 440 marks the base of the interval Topopah Spring Member Tuff (316-323), ash-flow, light-brown, nonwelded to partially welded, vitric; abundant black vitrophyre 106 ragments; base of unit identified on television camera log at an abrupt change in reflectance characteristics of WYY 680 Tuff (323-355), ash-flow, grayish-red, densely welded, devitrified; pumice, pale-red, devitrified; sparse phenocrysts of sanidine and biotite (cuttings are too fine-grained to estimate percentage); black and 12 dark-reddish-brown vitrophyre between 323 and 327 ft (98.5-99.7 m) based on bit cutting samples and television camera observations Tuff (355-1061), ash-flow, light-brown, pale-red, and medium-light-gray (mottled); densely welded, devitrified; pumice, light-gray, devitrified (some vapor-phase crystallization); 1 percent phenocrysts (sanidine); fine 137 grained (commonly less than 2 mm in size) and contaminated cuttings obscure zonal variations within the densely welded zone, density log characteristics and television camera observations suggest that the upper lithophysal zone occurs between 430 and 653 ft (133.5-199.0 m) and the lower lithophysal zone between 784 and 875 ft (239.0-266.7 m) 400 167 640 182 880 120 213 600 243 840 080 274 320 560 302 Tuff (1061-1086), ash-flow, black, densely welded, glassy, (vitrophyre); television camera observations indicate that the interval is partially altered and contains abundant 320 040 Tuff (1086-1146), ash-flow, black and light-olive-gray, moderately welded near top becoming partially welded near base of unit; vitric; almost entirely composed of black glass shards; base of interval identified from density log 100 280 where density begins to decrease significantly and on television camera log where borehole wall becomes lighter Tuff (1146-1205), ash-flow, light-brown, nonwelded, vitric; pumice, light-brown, vitric; abundant dark- yellowish-orange 150 and black glass shards; base of interval inferred from 520 density log as an abrupt deflection Bedded Tuff; Tuff (1205-1270), ash-fall, light-brown and 760 medium-light-gray to light-gray, poorly consolidated, coarse- grained, vitric; composed of vitric pumice fragments (subrounded), abundant sanidine phenocrysts and moderate-reddish-brown volcanic lithic fragments (phenocryst-poor) 381,. 000 Rhyolite Lavas and Tuffs of Calico Hills; Tuffaceous beds of Calico Hills (informal) Tuff (1270-1446 T.D.), ash-flow, moderate-orange-pink, grayish-orange-pink, light-olive-gray, and light- brown, nonwelded, zeolitic(?); pumice, light- greenish-gray, 300 grayish-yellow, yellowish- gray, and grayish-orange-pink, 240 zeolitic(?): 1 percent phenocrysts (sanidine); abundant grayish-red and medium- light-gray volcanic lithic fragments; cuttings very fine grained; cored from 1440 to 1446 ft (438.9-440.7 m); recovered 5.4 ft (1.6 m) 480 400 720

BOREHOLE USW WT-11, YUCCA MOUNTAIN, NEVADA

Compiled by Philip H. Nelson and Joyce E. Kibler U.S. Geological Survey, Denver, Colorado

Borehole USW WT-11 was completed in August, 1983 to a total depth of 1446 feet. The hole was rotary drilled using air foam consisting of air, detergent, and water (Muller and Kibler, 1985). Depth on the plot is measured along hole, and has not been corrected for deviation. Hole deviation is as great as 3.1 degrees at 1375 feet. (Plate 24 in Nelson and others, 1991): at a measured depth of 1375 feet, the computed true vertical depth is 1374.4 feet, and the computed horizontal offset is 32.4 feet.

Original logs in columns 1-3, acquired on August 7-8, 1983, were described and presented by Nelson and others, 1991. USW WT-11 was drilled for the purpose of monitoring water levels; the static water level is indicated by a cyan bar in column 1 (Robison, 1984).

Porosity and water content computed from the dielectric and density logs are shown in column 4 as phitdiel and phiwdiel, using a method described by Nelson, 1993. Porosity and water content computed from the epithermal neutron and density logs are shown in column 5 as phitenp and phiwenp (Nelson, 1994). Green hatching between the porosity and water content curves denotes air-filled porosity. Red hatching appears where water content exceeds porosity, often indicating the presence of zeolitic minerals.

Saturation (swdiel in column 4, swenp in column 5) is computed as the ratio of water content to porosity. It has been nulled in zones flagged as zeolzone. The flags physzone and zeolzone (green and red bars in column 5) denote the presence of abundant lithophysae and extensive alteration, respectively. Their depth extent is taken from inspection of the green and red hatch areas in columns 4 and 5 and from consideration of other logs, especially resistivity, rild.

Stratigraphic tops and degree of welding, given in column 6, and the geologic description, in the text column, are from R. Spengler, U.S. Geological Survey, written communication, 1995. The degree of welding (welding) increases to the right, in accordance with the geologic description.

Plots of individual fractures. (tvndaz. column 1). observed on television logs are plotted to show the azimuth of the dip of each fracture. The same data are plotted as fracture density (tvnfrc) in column 6.

#### EXPLANATION OF CURVES AND SYMBOLS

Column 1 Caliper in cm, black curve. BIT Bit size in cm, black dash line SWL Static water level, vertical cyan bar.

TC Gamma ray in API units, red curve. Dip azimuth of fractures, from television, red squares **TVNDAZ** 

Undetermined azimuth is coded as 380 or 390 degrees.

### Column 2

Density in g/cc, red curve. Density bound in g/cc, red dash curve. DBCBOUND Grain density in g/cc, green curve.

#### Column 3 **ENP**

Epithermal neutron in counts/sec, red curve. Epithermal bound, red dash curve. **ENPBND** Induction resistivity in ohm-m, blue dot curve. RILD DIEL Dielectric permittivity, ratio, green curve.

Column 4 [fractional volume of whole rock, increasing to left] Water content, from DIEL and DBCBOUND logs, cyan curve. PHITDIEL Porosity, from DIEL and DBCBOUND logs, red curve. (green hatch where PHITDIEL > PHIWDIEL,

red hatch where PHITDIEL < PHIWDIEL ). Water saturation, ratio of PHIWDIEL to PHITDIEL, green curve. SWDIEL

[fractional volume of whole rock, increasing to left] Column 5 Water content, from ENPBND and DBCBOUND logs, cyan curve. PHIWENP Porosity, from ENPBND and DBCBOUND logs, red curve. PHITENP (green hatch where PHITENP > PHIWENP,

Water saturation, ratio of PHIWENP to PHITENP, green curve. Lithophysal zone, picked from logs, green bar. Zeolitic zone, picked from logs, red bar.

red hatch where PHITENP < PHIWENP).

#### Column 6 **TOPS**

Stratigraphic boundaries, black ticks. Degree of welding from core inspection, black slant. Number of fractures per 10 feet, from television, red

## NOTES

Date of last computation: May 1996 Plot Date: May 1996 Scientific Notebook: SN-0092

## REFERENCES

Muller, D. C., and Kibler, J. E., 1984, Preliminary analysis of geophysical logs from the WT series of drill holes, Yucca Mountain, Nye County, Nevada: U.S. Geological Open-File Report 86-46, p. 30.

Nelson, P.H., Muller, D.C., Schimschal, U., Kibler, J.E., 1991, Geophysical logs and core measurements from forty boreholes at Yucca Mountain, Nevada: Geophysical Investigations Map GP-1001, 64 p., 40 plates.

Nelson, P.H., 1993, Estimation of water-filled and air-filled porosity in the unsaturated zone, Yucca Mountain, Nevada, in Proc. of 4th Annual International Conf. on High Level Radioactive Waste Management, vol 1, Am. Nuclear Soc., p. 949-954.

Nelson, P.H., 1994, Saturation levels and trends in the unsaturated zone, Yucca Mountain, Nevada, Proceedings of the Fifth Annual International Conf. on High Level Radioactive Waste Management, Las Vegas, v. 4, p. 2774-2781.

Robison, J.H., 1984, Ground-water level data and preliminary potentiometricsurface maps, Yucca Mountain and vicinity, Nye County, Nevada: U.S. Geological Survey Water-Resources Investigations Report 84-4197, 8 p.

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