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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF YUCCA MOUNTAIN NYE COUNTY, NEVADA WITH GEOLOGIC SECTIONS

By

ROBERT B. SCOTT AND JERRY BONK

Open-File Report 84-494

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U.S. Department of Energy
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This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature.

Denver, Colorado
1984

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PRELIMINARY GEOLOGIC MAP OF YUCCA MOUNTAIN NYE COUNTY, NEVADA

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DESCRIPTION OF MAP UNITS

[Color designations from E. N. Goddard and others, 1948, Rock-color chart: National Research Council, Washington, D.C. (reprinted by Geological Society of America, 1975)]

QTac ALLUVIUM AND COLLUVIUM. (0-45m)--stream, fan, and terrace deposits of sand, cobbles, and boulders, locally cemented by caliche. Locally includes eolian deposits. Boundary between QTac and bedrock drawn where interpolation between bedrock exposures is not feasible

RHYOLITE OF FORTYMILE CANYON:

RHYOLITE OF PINNACLES RIDGE:

Tfpf Lava flows. (0-75 m)--light-gray (N7) to dark-gray (N3) devitrified to vitrophyric lava flow; abundant phenocrysts of quartz, alkali feldspar, plagioclase, biotite, and magnetite

Tfpp Pyroclastic rocks. (0-45 m)--white (N9) to moderate-pink (5R 7/4) pyroclastic-fall and reworked tuff

RHYOLITE OF COMB PEAK:

Tfcf Lava flows. (0-100 m)--light-gray (N7) to grayish-pink (5R 8/2) devitrified and light-gray (N7) to black (N1) vitrophyric lava flow; phenocrysts of plagioclase, alkali feldspar, hornblende, quartz, magnetite, biotite, and sphene

Tfcp Pyroclastic rocks. (0-30 m)--white (N9) to moderate-pink (5R 7/4), locally zeolitized pyroclastic-fall and ash-flow tuff and tuff breccia

RHYOLITE OF VENT PASS:

Tfvf Lava flows. (0-60 m)--medium-light-gray (N6), moderate-pink (5R 7/4), and pale-red-purple (5RP 6/2) devitrified, and medium-gray (N5) to grayish-green (10GY 5/2) vitrophyric lava flow; partly brecciated and silicified; phenocrysts of alkali feldspar, plagioclase, hornblende, magnetite, and sphene

Tfvp Pyroclastic rocks. (0-8 m)--tuff breccia and zeolitized ash-fall and ash-flow tuff

RHYOLITE OF BLACK GLASS CANYON:

Tfbf Lava flows. (0-30 m)--medium-gray (N5) to brownish-gray (5YR 4/1), devitrified lava flows; phenocrysts of alkali feldspar, plagioclase, hornblende, and magnetite

Tfbp Pyroclastic rocks. (0-25 m)--tuff and tuff breccia

Tbd BASALT DIKES OF YUCCA MOUNTAIN:
Fine-grained, olivine-bearing; occurs as thin dikes, locally with scoria and palagonite and possible vent breccia; commonly intruded along faults.

TIMBER MOUNTAIN TUFF:
RAINIER MESA MEMBER:

Tmrw Welded ash-flow tuff. (0-40+ m)--partially welded to moderately welded, rhyolitic, devitrified interior of a simple cooling unit of a pumiceous ash-flow tuff. Color varies from very light gray (N8) to pinkish gray (5YR 8/1). Phenocrysts form 15-20 percent of the rock and consist principally of alkali feldspar and quartz with sparse plagioclase and biotite. Cognate pumice fragments range in size from 0.2 to 3 cm

Tmrn Nonwelded ash-flow tuff. (0-75+ m)--vitric envelope at base and top and at lateral margins of the cooling unit described above. Color is grayish pink (5R 8/2) to grayish orange pink (10R 8/2). Cognate pumice fragments range in size from 0.2 to 2 cm. Phenocrysts as described above comprise only about 10 percent of the rock

bt BEDDED TUFF:
Pyroclastic rocks. (0-60 m)--including pyroclastic-fall tuffs, minor nonwelded ash-flow tuffs, and reworked tuffs

RHYOLITE OF WINDY WASH:

Twf Lava flows. (0-110 m)--light-gray (N7) to dark-gray (N3) devitrified to vitrophyric lava flows; abundant phenocrysts of quartz, alkali feldspar, plagioclase, biotite, and sphene

Twp Pyroclastic rocks. (0-15 m)--zeolitized pyroclastic-fall tuff, tuff breccias, and reworked tuffs

PAINTBRUSH TUFF:
TIVA CANYON MEMBER:

cu Undifferentiated. (90-140 m)--multiple-flow compound cooling unit of a compositionally zoned rhyolitic to quartz latitic ash-flow tuff. See description of zones below

ccr Caprock zone. (25+ m)--quartz-latitic upper part of the cooling unit that caps Yucca Mountain. This zone consists of five subzones, from top to bottom: (1) a moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6) nonwelded to partially welded glassy top that is eroded except where locally preserved on downthrown fault blocks; (2) a grayish-brown (5YR 3/2) densely welded vitrophyre locally developed; (3) a pale-brown (5YR 5/2) to moderate-brown (5YR 4/4) densely welded subzone; near the northern end of Yucca Mountain, fragments of the upper lithophysal zone as much as 30 cm in diameter (see description below) are included; (4) a pale-yellowish-brown (10YR 6/2) moderately to densely welded subzone; and (5) a light-gray (N7) to light-brownish-gray (5YR 6/1) moderately welded subzone. Phenocrysts compose 15 percent of the rock and include abundant alkali feldspar, sparse plagioclase, rare quartz, and common mafic phases; mafic phenocryst

PAINTBRUSH TUFF--Continued

TIVA CANYON MEMBER--Continued

content decreases downward (common biotite, and rare clinopyroxene and hornblende). Sphene is a rare but distinctive accessory mineral. All subzones contain at least two compositions of pumice; the more mafic is medium light gray (N6) (<5-cm diameter) and the more silicic is very light gray (N8) to white (N9) (<30-cm diameter). In the upper subzones (1, 2, and 3) the more mafic pumice predominates. Small (<5-cm diameter) highly oblate lithophysae form 15 percent of subzone 5. Zones 4 and 5 commonly are cliff formers

cuc — Upper cliff zone. (0-11 m)--moderately to densely welded, devitrified, rhyolitic. Color is light gray (N7) to light brownish gray (5YR 6/1). Phenocryst content is 12-15 percent of the rock, and consists of abundant alkali feldspar, rare plagioclase, sparse biotite, and accessory sphene. Cognate pumice fragments range in size from 0.1 to 2 cm along foliation plane. This zone forms the base of the cliff under the caprock, contains 5 to 10 percent oblate lithophysae 10 to 50 cm in diameter, and has an exfoliated weathered surface

cul — Upper lithophysal zone. (5-35 m)--moderately welded, devitrified, rhyolitic. Color is light gray (N7) to grayish pink (5R 8/2). Phenocryst content is 10-12 percent of the rock, and consists largely of abundant alkali feldspar, sparse biotite, and accessory sphene. Cognate pumice fragments range in size from 0.2 to 2.5 cm along foliation plane. Lithophysae are abundant (10-20 percent), 10 to 30 cm diameter, and are convolute and oblate with very light gray (N8) margins. Rock has an exfoliated weathered surface

cks, clc, cgks, crks, cuks, cml, clks, crs — Clinkstone zone and laterally equivalent zones. (0-55 m)--the lower cliff (clc) is distinguished only by its cliff-forming character; the gray clinkstone (cgks) and red clinkstone (crks) zones are distinguished only by color; the upper clinkstone (cuks) and the lower clinkstone (clks) zones are distinguished by the intervening middle lithophysal (cml) zone; the rounded step (crs) zone is distinguished from other clinkstone zones by the presence of ledges. All these zones are moderately welded, devitrified, and rhyolitic. Color is light brownish gray (5YR 6/1) to light gray (N7) to pale red (10R 6/2). Phenocryst content, 8-12 percent of the rock, is largely abundant alkali feldspar and a trace of biotite and sphene. Cognate pumice fragments range in size from 0.2 to 2 cm along foliation planes. Conchoidal fractures, uniform textures, and sparse or no lithophysae characterize these zones

cll — Lower lithophysal zone. (0-25 m)--moderately to densely welded, devitrified rhyolitic portion of the cooling unit. Color is pale red (5R 6/2) to grayish red (5R 4/2) with pinkish-gray (5YR 8/1) margins around lithophysae.

PAINTBRUSH TUFF--Continued

TIVA CANYON MEMBER--Continued

Phenocrysts form 5-8 percent of the rock and consist largely of abundant alkali feldspar and traces of biotite and sphene. Cognate pumice fragments range in size from 0.2 to 1.5 cm along foliation plane. Lithophysae are abundant (10-15 percent), small (1- to 5-cm diameter), and spherical to oblate. Weathering surface is characterized by exfoliation over most of the zone except for hackly fractures near the base

chl ch — Lower lithophysal and hackly zones undifferentiated

Hackly zone. (2-26 m)--densely welded, devitrified rhyolitic. Color is grayish red (5R 4/2) to pale red (5R 6/2). Phenocrysts form 6-8 percent of the rock and consist largely of abundant alkali feldspar with a trace of biotite and accessory sphene. Cognate pumice fragments range in size from 0.2 to 2 cm along foliation plane. The rocks weather by breaking along irregular hackly fractures into pieces from 1 to 5 cm in diameter

cc — Columnar zone. (11-31 m)--nonwelded to densely welded, rhyolitic, basal, partially glassy part of the cooling unit. Zone is generally characterized by columnar joints. Three subzones are present from top to bottom: A locally developed densely welded vitrophyre subzone, a moderately to densely welded subzone with prominent flattened pumice fragments, and a nonwelded to partially welded basal subzone. Color of the vitrophyre is dark gray (N3) to grayish black (N2); the flattened pumice subzone grades downward from blackish red (5R 2/2) to pale red (5R 6/2) to pale red (10R 6/2); the basal subzone grades from pale red (10R 6/2) to grayish orange (10YR 7/4). Phenocrysts form 5-8 percent of the rock and consist of abundant alkali feldspar with rare accessory minerals. Cognate pumice fragments range in size from 0.2 to 1.5 cm along foliation plane. The welded part of the zone is characterized by thin, shingle-like partings parallel to the foliation plane

bt — BEDDED TUFF:

Pyroclastic rocks. (3 to 30 m)--vitric ash-fall tuffs, reworked tuffs, and thin nonwelded ash-flow tuffs. Colors vary widely, but are mostly white (N9) to pale yellowish orange (10YR 8/6) to light brown (5YR 6/4). Ash-fall tuffs are moderately to poorly bedded; reworked tuffs are well bedded and commonly crossbedded. Pumice content varies from 0 to 60 percent and phenocrysts are less than 5 percent of the rock. These units are interbedded with the ash-flow tuffs of the Yucca Mountain and Pah Canyon Members near their distal ends in southern Yucca Mountain

PAINTBRUSH TUFF-Continued

YUCCA MOUNTAIN MEMBER:

ym ymu yml — Ash-flow tuff. (0-60 m)--simple cooling unit, sparse phenocrysts of alkali feldspar and plagioclase; undifferentiated (ym); upper (ymu) zone, medium-light-gray (N6), nonwelded to partially welded, glassy with some

PAINTBRUSH TUFF--Continued
YUCCA MOUNTAIN MEMBER--Continued
vapor-phase crystals; middle (ymm) zone, pinkish-gray (5YR 8/1), light-brownish-gray (5YR 6/1), and medium-light-gray (N6), densely welded, devitrified, sparse lithophysae (3-5 percent); lower (yml) zone, light-gray (N7), partially welded to nonwelded, glassy

rz RHYOLITE FLOWS

bt BEDDED TUFF:
Lava flows. (0-25 m)--dark-gray (N3), vitrophyre
Pyroclastic rock. (0-40 m)--very light gray (N8), pumiceous pyroclastic-fall tuff

PAINTBRUSH TUFF-Continued
PAH CANYON MEMBER:

pc
pcu
pcm
pcl
Ash-flow tuff. (0-90 m)--simple cooling unit; moderately abundant small pumice and lithic inclusions, phenocrysts of biotite, alkali feldspar, plagioclase, and sparse quartz and clinopyroxene; undifferentiated upper (pcu) zone, moderate-pink (5R 7/4), nonwelded, glassy; middle (pcm) zone, grayish-orange-pink (5YR 7/2) to moderate-orange-pink (5YR 8/4), moderately welded, devitrified; lower (pcl) zone, very pale orange (10YR 8/2) to pale-yellowish-brown (10YR 6/2), partially welded to nonwelded, glassy or zeolitized

bt BEDDED TUFF:
Pyroclastic rocks. (0-25 m)--grayish-orange-pink (5YR 7/2) to grayish-pink (5R 8/2) to pale-yellowish-brown (10YR 6/2), nonwelded, reworked tuff and ash-fall tuff

PAINTBRUSH TUFF-Continued
TOPOPAH SPRING MEMBER:

tu
Undifferentiated. (45-130 m)--multiple-flow compound cooling unit of a compositionally zoned rhyolitic to quartz latitic ash-flow tuff. See description of zones below

tc
Caprock zone. (4-8 m)--quartz-latitic upper part. Caprock consists of three subzones, in downward order: A nonwelded to partly welded, light-brown (5YR 6/4) to brownish-gray (5YR 4/1) pumiceous tuff; a densely welded, black (N1) with lenses of moderate-red (5YR 4/2) vitrophyre; and a pale-red (5R 6/2) devitrified densely welded tuff. Phenocrysts form about 15 percent of the vitrophyre and devitrified subzones; alkali feldspar phenocrysts are common and some plagioclase and biotite are present. This zone forms cliffs

tr
ttl
Rounded zone. (20± m)--rhyolitic, devitrified, moderately to densely welded. Color is light gray (N7) to light brownish gray (5YR 6/1). Very light gray (N8), well-flattened cognate pumice fragments are common. Phenocrysts form 10 percent of the rock and consist primarily of alkali feldspar, plagioclase, and rare biotite. The zone forms rounded exfoliated slopes. Thin lithophysal (ttl) zone is locally present as a lateral equivalent of the uppermost rounded zone and is distinguished by 10-20 percent lobate lithophysal cavities 1-3 cm in long dimension

PAINTBRUSH TUFF--Continued

TOPOPAH SPRING MEMBER--Continued

trl, tul, tll, tl — Red lithophysal zone. (10-45 m)--rhyolitic, devitrified, moderately to densely welded, with laterally equivalent zones same as rounded zone above, except for pale-red (5R 6/2) color and for 5-15 percent convolute and oblate lithophysae 5 to 20 cm in diameter with pinkish-gray (5YR 8/1) margins; upper lithophysal (tul) and lower lithophysal (tll) zones are distinguished by a light-gray (N7) color in both and by smaller diameter (<10 cm) and more spherical lithophysae in the lower zone; the lithophysal (tl) zone is distinguished by the absence of the rounded exfoliation slopes characteristic elsewhere

tnl, tgnl, to, tb, tob, tobl, tob, tbob — Nonlithophysal zone and laterally equivalent zones. (10-25 m)--rhyolitic, devitrified, moderately to densely welded; distinguished by absence of lithophysal cavities and conchoidal-fractured weathered surfaces; phenocrysts of plagioclase, alkali feldspar, and biotite form less than 5 percent of the rock; the gray nonlithophysal (tgnl) zone is distinguished by a light-gray (N7) color; the orange (to) zone is distinguished by a grayish-orange (10YR 7/4) color; the brick (tb) and orange brick (tob) zones are distinguished from one another by a pale-red (5R 6/2) color and a grayish-orange (10YR 7/4) color; the orange brick lithophysal (tobl) zone is distinguished from the orange brick zone by the presence of 2 percent lithophysal cavities; the brownish-orange brick (tbob) zone is distinguished by a grayish-orange-pink (5YR 7/2) color

tgrl, torl, tml, tpbl, trbb, tbol — Grayish-red lithophysal zone and laterally equivalent zones. (8-30 m)--rhyolitic, devitrified, moderately to densely welded. Color is pale red (10R 6/2); lithophysae have grayish-orange-pink (10R 8/2) margins. Phenocrysts form about 2 percent of the rock and consist largely of alkali feldspar and plagioclase. Lithophysae form 10-15 percent of the rock, are 5-15 cm in diameter and have oblate spheroidal shapes. Exfoliated weathered surfaces are common; the orangish-red lithophysal (torl) zone is distinguished by a moderate-orange-pink (10R 7/4) to moderate-reddish-orange (10R 6/6) color; the mottled lithophysal (tml) zone is distinguished by mottling of pale-red (10R 6/2) and moderate-orange-pink (10R 7/4) colors; the purplish-brown lithophysal (tpbl), reddish-brown brick (trbb), and brownish-orange lithophysal (tbol) zones are distinguished by a grayish-red-purple (5RP 4/2) to light-brownish-gray (5YR 6/1) color, less than 2 percent lithophysal cavities, and a grayish-orange (10YR 7/4) to pale-brown (5YR 5/2) color, respectively

tm — Mottled zone. (9-20 m)--rhyolitic, devitrified, moderately to densely welded, 0 to less than 2 percent lithophysal cavities, mottled pale-red (10R 6/2) and moderate-orange-pink (10R 7/4); phenocrysts of plagioclase and alkali feldspar form less than 2 percent of the rock

PAINTBRUSH TUFF--Continued

TOPOPAH SPRING MEMBER--Continued

tv — Vitrophyre zone. (0-15 m)--rhyolitic, glassy, moderately to densely welded, dark-gray (N3) to brownish-black (5YR 2/1); phenocrysts of plagioclase and alkali feldspar form less than 2 percent of the rock; locally vitrophyre is poorly developed

tpw — Partially welded zone. (<4 m)--rhyolitic, glassy, nonwelded to partially welded, moderate-orange-pink (5YR 8/4) with black (N1) to brownish-gray (5YR 4/1) shards; phenocrysts of plagioclase and alkali feldspar form less than 2 percent of the rock, locally too thin to map

TUFFACEOUS BEDS OF CALICO HILLS:

Tht — Pyroclastic rocks. (10-100 m)--rhyolitic, zeolitized, nonwelded ash-flow tuffs with minor reworked and ash-fall bedded tuffs, very pale orange (10YR 8/2) to grayish-yellow (5Y 8/4) to pale-greenish-yellow (10Y 8/2), less than 3 percent phenocrysts of alkali feldspar, plagioclase, quartz, and biotite

Thf — Lava flows. (0-100 m)--rhyolitic, light-gray (N7), pale-purple (5P 6/2), and pale-pink (5 RP 8/2), devitrified, commonly brecciated and silicified, also light-gray (N7) to dark-gray (N3) to greenish-gray (5G 6/1) vitrophyre; phenocrysts of quartz, alkali feldspar, plagioclase, and sparse magnetite and biotite

Tha — Autobrecciated lavas. (0-10 m)--rhyolitic, includes tuff breccias; rocks have colors and phenocryst mineralogies similar to ash-flow tuffs and lava flows

CRATER FLAT TUFF:

PROW PASS MEMBER:

Tcpp, Tcpm, Tcpu — Ash-flow tuff. (15-200 m)--simple cooling unit; partially welded (Tcpp) zone of vapor-phase crystallization, medium-light-gray (N6); phenocrysts of plagioclase, alkali feldspar, quartz, orthopyroxene, biotite, and magnetite form about 8 percent of the rock; moderately welded (Tcpm) to nonwelded lower zone, devitrified, medium-light-gray (N6) to brownish-gray (5YR 4/1), same phenocrysts except about 12 percent of the rock; undifferentiated (Tcpu)

bt — BEDDED TUFF:

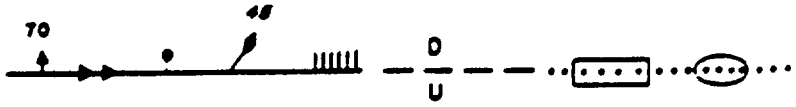
Pyroclastic rock. (0-7 m)--ash-fall and reworked tuff

CRATER FLAT TUFF-Continued

BULLFROG MEMBER:

Tcb — Ash-flow tuff. (30 to 150 m)--simple cooling unit; moderately to densely welded, devitrified, medium-light-gray (N6) to light-brownish-gray (5YR 6/1), phenocrysts of quartz, plagioclase, alkali feldspar, biotite, hornblende, and magnetite. Base of member unexposed in map area

CONTACT
Dashed where approximately located



FAULT, ARROW SHOWING DIRECTION AND DIP
Dashed where approximately located; queried where location uncertain, dotted where concealed; bar and ball on downthrown side, diamond shape showing trend and plunge of striations on slickensides, triangles showing tectonic breccia along fault; hachures indicate faults that cut alluvium, absence of hachures on fault traces separating bedrock and alluvium indicate alluvium deposited against fault scarps. D, downthrown side; U, upthrown side; rectangle over dots, location indicated by aeromagnetic anomalies; ellipses over dots or dashes, location indicated by electromagnetic surveys

FAULT, SHOWING STRIKE-SLIP DISPLACEMENT
Arrows showing direction of relative displacement dashed where approximately located; queried where doubtful, dotted where concealed; where ball and bar and strike-slip displacement arrows are both indicated, both types of movement are possible

TECTONIC BRECCIA
Not associated with planar discontinuities

FRACTURES
Trend observed on aerial photographs

FRACTURE SET
Strike of dominant near vertical fracture sets observed in the field

DIKE INTRUDED ALONG FAULT

Strike and Dip of beds or foliation in welded tuffs

Horizontal Beds or foliation

Strike and Dip
of vertical beds
or foliation

Strike and Dip
of overturned beds
or foliation

Strike and Dip
of flow banded foliation
in lava flows

USW G-1
Drill Hole

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J. Brigham-Grette

AMERICAN QUATERNARY ASSOCIATION

PROGRAM and ABSTRACTS of the ninth biennial meeting

2 – 4 June 1986

University of Illinois
Champaign – Urbana

PALEOCLIMATIC SIGNIFICANCE OF LATE WISCONSIN CRYOGENIC DEPOSITS IN THE CENTRAL GREAT BASIN, EASTERN NEVADA.

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Large-scale patterned ground and related cryogenic deposits, previously unreported in the literature, have been located on summits of basin ranges of eastern Nevada in the central Great Basin. The patterned ground, indicative of at least discontinuous permafrost, is considered late Wisconsin in age on the basis of weathering, degree of soil development, and retention of constructional microrelief. The deposits include 6.1 to 9.2 m diameter stone polygons at 3348 m elevation on Mt. Grafton in the Schell Creek Rnage; 3.7 to 4.0 m polygons at 3100 m on the Moriah Table in the North Snake Range; and stone nets of 12 m length at 3100 m on Snowflake Peak in the Ruby Mountains. Accompanying crogenic deposits and landforms include cryoplanation terraces, rock glaciers, and extensive talus.

Use of lapse rates and permafrost threshold temperatures permit calculation of the minimum lowering of the mean annual temperature (MAT) in the late Wisconsin. A temperature lapse rate of -0.57°C/100 m for elevations below 2000 m elevation and -0.76°C/100 m for elevations above 2000 m (Dohrenwend, 1984) and a discontinuous permafrost threshold of -3°C (Billings and Mooney, 1968) were used. An average MAT lowering of -5.9°C was calculated for the sites. Calculations were done with the assumption that full-glacial winter precipitation was no more than moderately greater than that of today in the Great Basin.

Billings, W. D., and H. A. Mooney. 1968. The ecology of arctic and alpine plants. Biological Reviews 43, 481-529.

Dohrenwend, J. C. 1984. Nivation landforms in the western Great Basin and their paleoclimatic significance. Quaternary Research 22, 275-288.