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21 October 1986
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TWS-ESS-1-10/86-21

Mr. James T. Neal
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Dear Jim:

We have partially completed substantial field, petrographic, and geochemical work to assign the stratigraphic position of tuffs above the Tiva Canyon petrologic zone (tpc) in Drill Hole UE-25 RF #3 and in Trench 14A, cut across the Bow Ridge fault. For comparison, we examined and sampled a sequence of tuff between the tpc and Rainier Mesa (tmr) petrologic zones in April with Paul Orkild of the USGS and Will Carr, consultant for Sandia, in Paul's Bare Mountain 15' quadrangle. We have partly completed petrographic analyses of grain mounts, which is the first stage in our petrochemical work on samples from this field work. This initial work allows us to define the important post-tpc, pre-tmr petrologic zones of the Yucca Mountain area (Attachment 1). Petrologic zones are generally the same as the standard lithostratigraphic units of the NTS (see USGS Professional Paper 919, Map I-891), except that nonwelded tuff is assigned to the same petrologic zone as its petrochemically similar ash-flow cooling unit or lava. We are able to assign all samples that we examined from UE-25 RF #3 and Trench 14A to units in Attachment 1. Below, we discuss these assignments, based on additional petrographic data (Attachment 2), and mineral chemistry from electron microprobe analyses (Attachments 3-5). These assignments refine initial assignments by Byers based on modal petrography alone, transmitted to you in letter TWS-ESS-1-5/86-28 on 20 May, 1986. The samples we examined from UE-25 RF #3, designated RF3-x, where x = depth in feet, include four thin sections between tpc and the base of the alluvium. We also examined two samples from Trench 14A, designated TR14A-1 and TR14A-5, which were collected by Schon Levy from the Bow Ridge fault zone, and a third, TR14A-2, collected from tmr in the hanging wall.

The mineral chemistry of sample RF3-115.2 is typical of lower Rainier Mesa (tmrl) petrologic zone, and matches that of sample TR14a-2, which we analyzed specifically for comparison with RF3-115.2. Except for the presence of sphene, the combined petrographic characteristics (Attachment 2) and feldspar chemistry for sample RF3-115.2 are uniquely and

distinctively those of tmrl, although the lithology is atypical. See Attachment 1 for a summary of sanidine chemistry for post-tpc petrologic zones, and USGS Professional Paper 919 for a summary of the petrographic characteristics of these units. The narrow ranges for feldspar compositions (Attachments 3 and 4) indicate that sample RF3-115.2 has not been reworked, and must represent the feather edge of the tmr ash flow.

Samples RF3-134.0 and RF3-185.9 have petrochemical characteristics typical for reworked tuff of the Pool petrologic zone (tnp in Attachment 1), which is defined from work by Warren at Pahute Mesa to include all post-tpc, pre-tmr reworked tuff. These samples have low contents of generally altered biotite relative to other mafic minerals (clinopyroxene and hornblende), and relatively high contents of both metamorphic minerals (such as epidote and garnet) and plagioclase (Attachment 2). Much of the plagioclase is highly Ca-rich (Attachment 4). Felsic phenocrysts have been highly comminuted by substantial subaerial transport. Sanidine compositions (Attachments 3a and 3b), however, indicate derivation primarily from the underlying unit (tphb).

Sample RF3-222.2 matches petrography (Attachment 2) and mineral chemistry with sample TR14a-5, which occurs as a pyroclastic fill or dike in the Bow Ridge fault zone. Both these samples match phenocryst contents of outcrop samples POG2b-2a and CS-5-86 (Attachment 6), which were collected just above tpc. We assign all four samples to the previously unrecognized hornblende-bearing petrologic zone (tphb) of the Paintbrush assemblage.

Sample TR14a-1 contains very Na-rich sanidine (Attachment 3a) typical of tpc and the overlying Pinyon Pass (tpn) petrologic zones (see "sanidine" column in Attachment 1). This sample also contains a rather high proportion of plagioclase (Attachment 2), which is Ca-rich (Attachment 4), and a high percentage of the sanidines are Ba-rich (Attachment 3b). Such high proportions of plagioclase occur at this stratigraphic level only for the Tuff of Chocolate Mountain, which we include within the uppermost part of the Tiva Canyon petrologic zone (tpcu). Although we have not presently characterized the mineral chemistry of the Tuff of Chocolate Mountain, Ca-rich plagioclase and Ba-rich sanidine are precisely what we would expect, and we confidently assign sample TR14a-1 to tpcu. Petrographic characteristics of sample TR14a-1 correlate well with those of sample RF3-261.0, previously assigned by Byers to Tuff of Chocolate Mountain.

We have completed work on UE-25 RF #3, and under separate cover are returning your thin sections from the RF drill holes, along with photographic enlargements and petrographic worksheets for the sections. Our continuing work to define the post-tpc stratigraphic sequence will include additional petrography, major and trace-element chemical analysis, and age-dating by Fred McDowell for samples from our field work. We anticipate some interesting results from this work, which we hope to summarize early next year. We are hopefull that our present and forthcoming work can shed some light on the post-tpc geology of Yucca Mountain.

Best Regards,

Richard G. Warren and Frank M. Byers, Jr.

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LIST OF ATTACHMENTS

1. Post-Tiva Canyon Petrologic Zones of Yucca Mountain Area.

2a. Summary of Petrography for Polished Thin Sections of Samples from Drill Hole UE-25 RF #3 and Trench 14a.

2b. Explanation of Symbols used in Attachment 2a.

3. Summary of Sanidine and Anorthoclase Phenocryst Compositions for Samples from Drill Hole UE-25 RF #3 and Trench 14a.

   a. Frequency Distribution for Or + Cn Contents.

   b. Frequency Distribution for BaO Contents.

4. Summary of Plagioclase Compositions for Samples from Drill Hole UE-25 RF #3 and Trench 14a.

5. Summary of Mafic Mineral Compositions for Samples from Drill Hole UE-25 RF #3 and Trench 14a.

6. Summary of Petrography for Selected Samples of post-Tiva Canyon, pre-Rainier Mesa units of Yucca Mountain Area.

ATTACHMENT 1. POST-TIVA CANYON PETROLOGIC ZONES OF YUCCA MOUNTAIN AREA.

Petrologic zones are presently not well characterized where entry is not given for lithology. Continuing work indicates that the stratigraphic position for Fortymile volcanic sequence (ta40) is uncertain, and may be post-tpc and pre-tmr, rather than post-tma, as shown and presently accepted. Stratigraphic framework is that of Warren, Byers, and Orkild, 3rd Containment Symposium Proceedings. Lithologies are l = lava; a = ash-flow cooling unit; b = nonwelded tuff, either well-sorted (bedded), or massive but not part of recognizable cooling unit; and rwt = reworked tuff. Dominant lithology is underlined. Range for Mg° of biotite, and Or + Ca of sanidine are median ±1σ for the number of samples given in parentheses. Petrologic zones have similar or identical names as lithostratigraphic units defined in USGS Prof. Paper 919; comments are included only for exceptions.

PETROLOGIC ASSEMBLAGE (symbol)	PETROLOGIC ZONE (symbol)	SUBZONE (symbol)	LITHOLOGIES	biotite Mg°	sanidine Or + Ca	Reference in USGS Prof. Paper 919 Fig.	Comments
POST-DOME MOUNTAIN (td)	Boundary Butte (tdbb)						Petrochemical characteristics are poorly known and stratigraphic relations for petrologic zones of post-Dome Mountain petrologic assemblage are presently unknown.
	North Dome Mountain (tdnd)						
	South Dome Mountain (tdsd)						
	Shoshone Mountain (tdsh)		1,b	0.61-0.63(1)			
	Dome Mountain (tadm)						See USGS Prof. Paper 501-D.
POST-TIMBER MOUNTAIN (ta)	Pinnacles Ridge (ta40pr)		1,b		61-65(1)	25	
	Comb Peak (ta40cp)		1,b	0.63-0.68(1)	58-61(1)	25	
	Waterpipe Butte (ta40wb)		1,b	0.58-0.63(1)	60-62(1)	25	
	Buried Canyon (ta40bc)		1,b	0.65-0.68(1)	57-61(1)	25	
	Delirium Canyon (ta40dc)		1,b	0.56-0.64(1)			
	Vent Pass	mafic-rich (ta40vpu)	1				Previously unrecognized.
		mafic-poor (ta40vp)	T,b	0.68-0.72(1)	38-48(1)	25	
	Beatty Wash (tabw)		1,a,b	0.61-0.65(3)	56-62(6)	25	Includes tuff of Cutoff Road.
	Rhyodacite (tar)		1	0.69-0.73(1)	38-50(1)	25	
TIMBER MOUNTAIN (tm)	Ammonia Tanks (tma)	mafic-rich (tmau)	a,b	0.66-0.68(2)	46-53(3)	15	
		mafic-poor (tmal)	a,b,l	0.61-0.69(7)	45-51(10)	15	Includes pre-Ammonia Tanks lava.
	Rainier Mesa (tmr)	mafic-rich (tmru)	a,b	0.60-0.65(7)	58-62(7)	15	
		mafic-poor (tmrl)	a,b	0.58-0.63(7)	57-63(8)	15	
	Tuff of Calico Hills (tmd)		b				Thin, persistent, previously unreported thin ash.
	Pre-Rainier Mesa (tmpr)		1,a,b		64-67(2)	15	High-silica pre-Rainier rhyolite.
	Windy Wash (tmw)		1,b	0.62-0.68(2)	52-55(2)	15	
UNASSIGNED (tu)	Pool (tup)		rwt	0.54-0.69(7)	47-63(8)		Includes all pre-tmr, post-tpc rwt.
PAINTBRUSH (tp) (upper part only)	Hornblende rhyolite (tphb)				44-51(2)		Defined from this work.
	Pinyon Pass (tpn)	mafic-rich (tpnu)	a,b	0.60-0.67(1)	37-46(1)	9	
		mafic-poor (tpnl)	a,b	0.59-0.67(1)	34-43(1)	9	
	Tiva Canyon (tpc)	cpx-bearing (tpcu)	a,b	0.64-0.69(8)	33-46(8)	9	Includes Tuff of Chocolate Mtn.
		mafic-poor (tpcl)	a,b	0.64-0.69(5)	33-44(6)	9	

ATTACHMENT 2a. SUMMARY OF PETROGRAPHY FOR POLISHED THIN SECTIONS OF SAMPLES FROM DRILL HOLE UE-25 RF #3 AND TRENCH 14A.

Symbols for units defined in Attachment 1; other symbols and procedures defined in Attachment 2b. Petrographic analyses 25 February to 1 April, 1986, by F. M. Byers, Jr., and R.G. Warren, with mineral identifications verified by electron microprobe analyses by R.G. Warren. Trench 14A samples, collected by S. S. Levy, are from locations west of the Bow Ridge fault. TR14a-1 and TR14a-5 are immediately adjacent to the fault, on the north and south trench walls, respectively, and TR14a-2 is several m west of the fault, on the north wall.

	DRILL HOLE UE-25 RF #3				TRENCH 14A		
Sample number	115.2	134.0	185.9	222.2	TR14a-1	TR14a-2	TR14a-5
Nevada North (m)	233348	233348	233348	233348	233286	233286	233282
Nevada East (m)	174072	174072	174072	174072	173483	173477	173483
Elevation (m)	1079.8	1074.1	1058.2	1047.2	1158	1155	1158
Petrologic Zone	tmrl	tnp	tnp	tphb	tpcu	tmrl	tphb
Sample Type	c	c	c	c	o	o	o
Rock Type	rwt	rwt	rwt	rwt	rwt	rwt	rwt
Alteration	Zc	Zc/O	Zc	Zc	Zc/O/mQc	Cl/mO/mQc	Cl
T.S. Area (mm^2)	887	749	938	811	871	815	970
Points Counted	6164[a]	463	580	6160[a]	6169[a]	6095[a]	6161[a]
Voids >30μ (%)	11[a]	2.7[a]	21	17[a]	1.1[a]	1.6[a]	
Pumice (%)		10[a]	30[a]	14[a]	47[a]	14[a]	
Lithics (%)	2.2[a]	1.9	0.5	13[a]	1.7[a]	0.3[a]	2.9[a]
Felsics (%)	7.2[a]	5.8	1.6	2.4[a]	6.6[a]	8.0[a]	3.4[a]
Q (% of felsics)	44	12	0.33*	0	0.003	34	4
K (% of felsics)	26	33	56*	73	62	44	59
P (% of felsics)	31	55	43*	27	38	22	37
Biot (ppmV)	420*	220*	190*	360	2300*	440	140*
Hbld (ppmV)	130*	210*	140*	900	110*	13	1200*
Opx (ppmV)	0	0	0	0	0	0	0
Cpx (ppmV)	47*	0	0	39	580*	1	70
Ol (ppmV)	0	0	0	0	0	0	0
Ac (ppmV)	0	0	0	0	0	0	0
Arf (ppmV)	0	3*	0	0	0	0	0
Mt/Hm (ppmV)	390*	140	170*	700*	260*	250*	1200*
Ilm/Psb (ppmV)	79*	2	7*	56*	15*	170*	25*
Sph (ppmV)	26	59	30	140	47	0	400
All (ppmV)	42	0	0	0	5	0	0
Per (ppmV)	6	3	4	6	18	0	14
Ap (ppmV)	26	5	3	29	1	0.5	46
Zr (ppmV)	22	24	11	24	76	19	52
other minerals	b	c	d	e	f	g	h

a. Values reported by Byers in TWS-ESS-1-5/86-28. All other values redetermined or modified from results of microprobe analyses.
b. Pyrrhotite = 0.2 ppmV; epidote = 38 ppmV; garnet = 19 ppmV; anatase = 3 ppmV. c. Epidote = 31* ppmV; garnet = 12* ppmV; muscovite = 7* ppmV; anatase = 1* ppmV; tourmaline = 0.9* ppmV. d. Epidote = 12 ppmV; garnet = 3 ppmV. e. Pyrite = 1 ppmV. f. Epidote = 4 ppmv; anatase = 0.7 ppmV; pyrrhotite = 0.5 ppmV; grossular = 0.3 ppmV. g. Monazite = 7 ppmV; grossular = 0.7 ppmV. h. Pyrrhotite = 0.4 ppmV; chalcopyrite = 0.4 ppmV.

ATTACHMENT 2b. SYMBOLS FOR SAMPLE TYPES, ROCK TYPES, ALTERATION, AND MINERALS, AND ABBREVIATED DESCRIPTION OF MODAL PETROGRAPHIC PROCEDURES.

Sample Type (outcrop, core, sidewall)

symbol	description
o	Outcrop
ol	Lithic from outcrop
op	Pumice from outcrop
om	Mineral separate from outcrop
c	Core
cl	Lithic from core
cp	Pumice from core
cm	Mineral separate from core
ps	Percussion sidewall
hs	Hunt sidewall
hsl	HS enriched in hard components
hsm	Mineral from Hunt sidewall

Sample Type (cuttings)

symbol	description of cuttings
da	Represent petrographic character of interval
db1	Enriched in hard components
db2	From interval different than that drilled
db3	Cuttings with combined characters of db1 and db2
db4	Intimate mixture of units
dp	Separate of pumice
dl	Separate of lithics
dm	Separated mineral

Rock Type

symbol	description	symbol	description
al	alluvium	l	lava
b	bedded tuff	pl	pumiceous (frothy) lava
rwt	reworked tuff	fb	flow breccia
nwt	nonwelded tuff	intl	pilotaxitic lava
pwt	partially welded tuff	tb	tuff breccia
mwt	moderately welded tuff	gr	granitoid
dwt	densely welded tuff	ar	argillite or shale
vt	vitrophyric tuff	ls	carbonate
i	intrusive	qtz	quartzite or sandstone

Alteration and Crystallinity
(minor alteration is indicated by an "m" preceding the symbol)

type	symbol	description	type	symbol	description
none	Gl	vitric		D	devitrified
				VP	vapor phase
	O	opaline		Gr	granophyric
	Ar	argillic	Primary	Sp	spherulitic
	Z	zeolitic		Ax	axiolitic
	Zc	clinoptilolite		G	microgranophyric
Secondary,	Za	analcime		S	microspherulitic
increasing	Q	silicic		Cx	cryptocrystalline
temperature	Qc	chalcedony			
	Qd	drusy quartz			
↓	cc	calcite		Eq	equigranular
	Ab	albitic	Holo-	Se	seriate
	K	potassic	crystalline	Sc	sericitic
	Ka	kaolinitic		Ae	albite/epidote
	Py	pyritic		Oph	ophitic

Method used to define alteration

symbol	description
h	hand sample inspection only
gm	grain mount
x	X-ray diffraction analysis
p	polished or glass-covered thin section study
pp	aided by qualitative microprobe analysis of groundmass phases
pq	aided by quantitative microprobe analysis of groundmass phases

Minerals

Percentages for major components (voids, pumice, lithics, and felsic phenocrysts) are generally estimated by point count, usually at 200X in reflected light. Relative proportions for felsic phenocrysts in phenocryst-poor rocks, estimated from relative areas of the largest phenocrysts, are marked with asterisks. Locations of felsics hit during the point count are marked on a photograph of the sample for later identification in transmitted light. Concentrations for all other minerals are estimated by locating all grains in the thin section, measuring their individual areas, summing these areas, and dividing by the thin section area obtained from the point count. For most samples, this is impractical for Fe-bearing minerals and concentrations are estimated for the 30 largest mafic phenocrysts and for the 20 largest Fe-Ti oxides, and these values are extrapolated to an estimated total concentration marked by an asterisk. Both comparison with high quality modal analyses in LA-10003-MS and scatter in the calibration data set indicate that the procedure is very accurate.

mineral type	symbol	description
felsic phenocrysts	Q	quartz
	K	sanidine (+ anorthoclase, if present)
	P	plagioclase
mafic phenocrysts	Biot	biotite
	Hbld	hornblende
	Opx	orthopyroxene
	Cpx	clinopyroxene
	Ol	olivine
groundmass mafics	Ac	acmite
	Arf	arfvedsonite
Fe-Ti oxides	Mt	magnetite
	Hm	hematite
	Ilm	ilmenite
	Psb	pseudobrookite
accessory minerals	Sph	sphene
	All	allanite
	Per	perrierite/chevkinite
	Ap	apatite
	Zr	zircon

ATTACHMENT 3a. FREQUENCY DISTRIBUTION OF Or+Cn CONTENTS FOR SANIDINE AND ANORTHOCLASE PHENOCRYSTS IN SAMPLES FROM DRILL HOLE UE-25 RF #3 AND TRENCH 14A.

Each value represents the number of sanidine and/or anorthoclase analyses with orthoclase + celsian (Or+Cn) end member contents within an interval of 2.00 Mol% Or+Cn, having the central value indicated. For example, the first sample listed gave 10 sanidine analyses between 60.00-62.00 Mol% Or+Cn. Underline indicates that all analyses within interval are for phenocryst rims.

UE-25 RF #3

Sample Number	Unit	Or+Cn, Mol% → sanidine										anorthoclase →				
		75	71	67	63	59	55	51	47	43	39	35	31	27	23	
115.2	tmrl				2	10	2									
134.0	tnp	1	1	1		3		2	3	4	2	2	2	1		1
185.9	tnp					1		1	1		4	2	1			
222.2	tphb			1						2	3	5	5	2	1	1

TRENCH 14A

Sample Number	Unit	Or+Cn, Mol% → sanidine										anorthoclase →					
		75	71	67	63	59	55	51	47	43	39	35	31	27	23	19	
TR14A-1	tpcu								1	2	2	3	3	3	2	2	2	3	1
TR14A-2	tmrl				1	4	7	1				1					
TR14A-5	tphb					1	1	1	4	7	1	2	2		1		

ATTACHMENT 3b. FREQUENCY DISTRIBUTION OF BaO CONTENTS FOR SANIDINE AND ANORTHOCLASE PHENOCRYSTS IN SAMPLES FROM DRILL HOLE UE-25 RF #3 AND TRENCH 14A.

Each value represents the number of sanidine and/or anorthoclase analyses with barium oxide (BaO) contents within an interval of 0.30 wt%, having the central value indicated. For example, the first sample listed gave 13 sanidine and/or anorthoclase analyses between 0.00-0.30 wt% BaO. Underline indicates that all analyses within interval are for phenocryst rims.

UE-25 RF #3

Sample Number	Unit	BaO, wt% .15	.75	1.4	2.0	2.6	3.2	3.8	4.4	5.0	5.6
115.2	tmrl	13	1								
134.0	tnp	17	2	1		1		1			1
185.9	tnp	8	2								
222.2	tphb	18	1	1							

TRENCH 14A

Sample Number	Unit	BaO, wt% .15	.75	1.4	2.0	2.6	3.2	3.8	4.4	5.0	5.6
TR14A-1	tpcu	16	2	1	2	2		1			
TR14A-2	tmrl	14									
TR14A-5	tphb	18			1		1				

ATTACHMENT 4. FREQUENCY DISTRIBUTION OF An CONTENTS FOR PLAGIOCLASE PHENOCRYSTS IN SAMPLES FROM DRILL HOLE UE-25 RF #3 AND TRENCH 14A.

Each value represents the number of plagioclase analyses with anorthite (An) end member contents within an interval of 2.00 Mol% An, having the central value indicated. For example, the first sample listed gave 11 plagioclase analyses between 12.00-14.00 Mol% An. Underline indicates that all analyses within interval are for phenocryst rims.

UE-25 RF #3

Sample Number	Unit	An, Mol% 9	13	17	21	25	29	33	37	41	45	49	53	57	61
115.2	tmrl		11 1			2 1									
134.0	tnp	1 3 1 1				2 2				2 1 1		1 1		1	1
185.9	tnp		3 6 1 2				1				2 1		1		
222.2	tphb		4		2 1										

TRENCH 14A

Sample Number	Unit	An, Mol% 9	13	17	21	25	29	33	37	41	45	49	53	57	61
TR14A-1	tpcu		1			1 2 2	4	2 1	1 2	2 2					
TR14A-2	tmrl		1 11	2 1					1						
TR14A-5	tphb	4 6		1						1			1 1		

ATTACHMENT 5. FREQUENCY DISTRIBUTION OF MOLECULAR Mg/(Mg+Fe) CONTENTS FOR MAFIC PHENOCRYSTS IN SAMPLES FROM DRILL HOLE UE-25 RF #3 AND TRENCH 14A.

Each value represents the number of mafic mineral analyses with molecular Mg/(Mg+Fe) contents within an interval of 0.02, having the central value indicated. For example, the second sample listed gave 2 biotite analyses with Mg/(Mg+Fe) between 0.66-0.68.

BIOTITE

Sample Number	Unit	Molecular Mg/(Mg+Fe) .41	.45	.49	.53	.57	.61	.65	.69	.73	.77
						UE-25 RF #3					
115.2	tmrl				1						
134.0	tnp			1		1	1 1		2 1		
185.9	tnp						1				
222.2	tphb		1						1		
						TRENCH 14A					
TR14A-1	tpcu							1	4 5		
TR14A-2	tmrl						1 1	1			
TR14A-5	tphb								1		

HORNBLENDE

Sample Number	Unit	Molecular Mg/(Mg+Fe) .41	.45	.49	.53	.57	.61	.65	.69	.73	.77
						UE-25 RF #3					
115.2	tmrl							3	2 1		1
134.0	tnp		1				1	1	1 1		
185.9	tnp			2 1				1	2 1 4		
222.2	tphb								2 5		
						TRENCH 14A					
TR14A-1	tpcu							3	1 1 2	1	
TR14A-2	tmrl								1 1		
TR14A-5	tphb								2 9	3	

(c) CLINOPYROXENE

Sample Number	Unit	Molecular Mg/(Mg+Fe) .41	.45	.49	.53	.57	.61	.65	.69	.73	.77
						UE-25 RF #3					
222.2	tphb									1	
						TRENCH 14A					
TR14A-1	tpcu								1	3 1	3 1
TR14A-5	tphb										2

ATTACHMENT 6. SUMMARY OF PETROGRAPHY FOR SELECTED SAMPLES OF POST-TIVA CANYON, PRE-RAINIER MESA UNITS OF YUCCA MOUNTAIN AREA.

Except for UE-25 RF #3, all samples are from outcrop. Samples are located by Nevada State coordinates (in m) and USGS topographic 7.5′ or 15′ quadrangle (BM15 = Bare Mountain; BM7 = Buckboard Mesa; TS7 = Topopah Spring; TSSW7 = Topopah Spring SW). Petrologic zones are defined in Attachment 1 and lithologies in Attachment 2b. Values for total felsic phenocrysts are from polished thin section; values for all other samples, estimated from grain mounts of crushed samples, are estimated: abundant = >15%, common = 3-15%, sparse = 1-3%, and rare = <1%. Data for concentrations of mafic minerals are in parts per million by volume (ppmV) for polished thin sections, and number of fragments observed (marked by asterisk) in grain mounts. Additional data for thin sections can be found in USGS OFR-77-724.

Sample number	Nevada State coordinates (m) N	E	USGS Quad	petrologic zone	lith.	felsic phenocrysts % total	relative % Q	K	P	mafic minerals (ppmV) or * = fragments in GM biot	hbld	px
POG2a-6c	238777	165116	BM15	tmd	b	com	12	22	66	0*	5*	3*
POG2a-6b	238777	165116	BM15	tmd	b	com	17	16	67	0*	10*	8*
POG2a-6a	238777	165116	BM15	tmd	b	ab	1	1	98	0*	210*	39*
POG2a-5	238771	165086	BM15	tmpr	nwt	com	30	53	17	1*	0*	0*
POG2b-9	243005	163946	BM15	tmpr	nwt	com	41	40	19	1*	0*	0*
					perlite	com	51	20	29	1*	0*	0*
					pumice	com	45	26	29	2*	0*	0*
POG2b-3	243118	163353	BM15	tmw	l	com	16	65	19	25*	4*	0*
POG2b-11	243307	164271	BM15	tmw	pl	com	33	33	34	117*	1*	0*
Ue25RF3-222.2	233348	174072	TSSW7	tphb	nwt	2.4	0	73	27	360	900	39
TR14a-5	233282	173483	TSSW7	tphb	nwt	3.4	4	59	37	140	1200	70
FB18c-4	255548	181204	BM7	tphb	b	com	4	78	18	4*	2*	0*
POG2b-2a	243162	163305	BM15	tphb	nwt	com	8	66	26	2*	7*	0*
CS-5-86	229880	174346	TSSW7	tphb	nwt	com	0	82	18	4*	8*	1*
TR14a-1	233286	173483	TSSW7	tpcu	nwt	6.6	0	62	38	2300	110	580
CS-4-86	245304	181270	TS7	tpcu	b	com	0	65	35	11*	0*	10*