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Detailed Petrographic Descriptions and Microprobe Data for Drill Holes USW-G2 and UE25b-1H, Yucca Mountain, Nevada

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DETAILED PETROGRAPHIC DESCRIPTIONS AND MICROPROBE DATA FOR DRILL HOLES USW-G2 AND UE25b-1H, YUCCA MOUNTAIN, NEVADA

by

D. Broxton, D. Vaniman, F. Caporuscio, B. Arney, and G. Heiken

ABSTRACT

Drill holes USW-G2 and UE25b-1H at Yucca Mountain, Nevada penetrate a thick sequence of volcanic rocks consisting of voluminous ash-flow tuffs, intercalated with thin bedded tuffs and minor lavas. This report provides detailed petrologic descriptions that were summarized in an earlier report. Microprobe analyses of feldspars and mafic phenocrysts as well as secondary feldspars are tabulated for these drill holes for the first time in this report.

I. SUMMARY

This report is a companion volume to "Petrologic Studies of Core from Drill Hole USW-G2 and of the Lower Crater Flat Tuff in Core from Drill Hole UE25b-1H, Yucca Mountain, Nevada" by Caporuscio et al.[1] It provides detailed petrographic and microprobe data from which the petrographic summaries of Caporuscio et al. were prepared. Both reports are part of a series of studies, sponsored by the Nevada Nuclear Waste Storage Investigations, to determine the suitability of thick Tertiary ash flows underlying Yucca Mountain for an underground high-level nuclear waste repository. Yucca Mountain, located on the southwest portion of the Nevada Test Site in south-central Nevada, is one of several sites in the country currently being considered for such a repository.

Los Alamos geologists have characterized the mineralogy and petrology of core from drill holes J-13, UE25a-1, USW-G1, USW-G2, and UE25b-1H. These

studies have concentrated on the distribution, mineralogy, and composition of both primary and secondary mineral phases in the tuffs. Relatively few of the tuffs are pristine, and most of the original vitric materials have crystallized to secondary mineral phases caused by postemplacement processes such as devitrification, vapor phase alteration, and zeolitization. Therefore, most of our efforts have been directed towards characterizing the secondary mineral phases that now control the bulk physical and chemical properties of these rocks. Particular emphasis is placed on the distribution, mineralogy, and composition of zeolite and clay phases because these minerals are highly sorptive and provide important barriers to radionuclide migration. Primary phenocrysts, though less important for sorptive capability, are useful stratigraphic markers and provide data about the original nature of the tuffs before alteration. Studies of stratigraphic relations are conducted in cooperation with the US Geological Survey (USGS).

Drill hole USW-G2, located at the north end of Yucca Mountain (Fig. 1), bottomed at a depth of 6000 ft (1800 m). It was drilled to intersect a major bounding fault of Yucca Mountain at depth and to provide basic data about tuff stratigraphy and mineralogy north of the exploration block. Drill hole UE25b-1H, located 100 m north of UE25a-1, was sited to characterize the Crater Flat Tuff below the depth penetrated by UE25a-1. It was continuously cored from 2700 to 4000 ft (810 to 1200 m) and bottomed at the top of Lithic Ridge Tuff. Cores from UE25a-1 were described in an earlier report by Sykes et al.[2]

This report contains detailed petrographic descriptions of thin sections for USW-G2 and UE25b-1H. Core samples 3 to 10 cm long and 8 cm in diameter were obtained from the USGS core library in Mercury, Nevada. Using logs prepared by Maldonado and Spengler of the USGS, representative samples were collected for all major stratigraphic and lithologic subdivisions. Splits of all samples were submitted for mineralogic analysis by x-ray diffraction (see Ref. 1). Thin sections were examined using a combination of standard transmitted and reflected light microscope techniques. Microscope studies were integrated with electron microprobe analyses and scanning electron microscope studies to identify fine-grained phases with little optical character.

The drill hole report[1] includes microprobe analyses of glasses, zeolites, and clays. Appendix A of this report tabulates the microprobe data for feldspar phenocrysts from the two drill holes and includes the analyses of secondary feldspars such as vapor phase sanidine, low-temperature authigenic

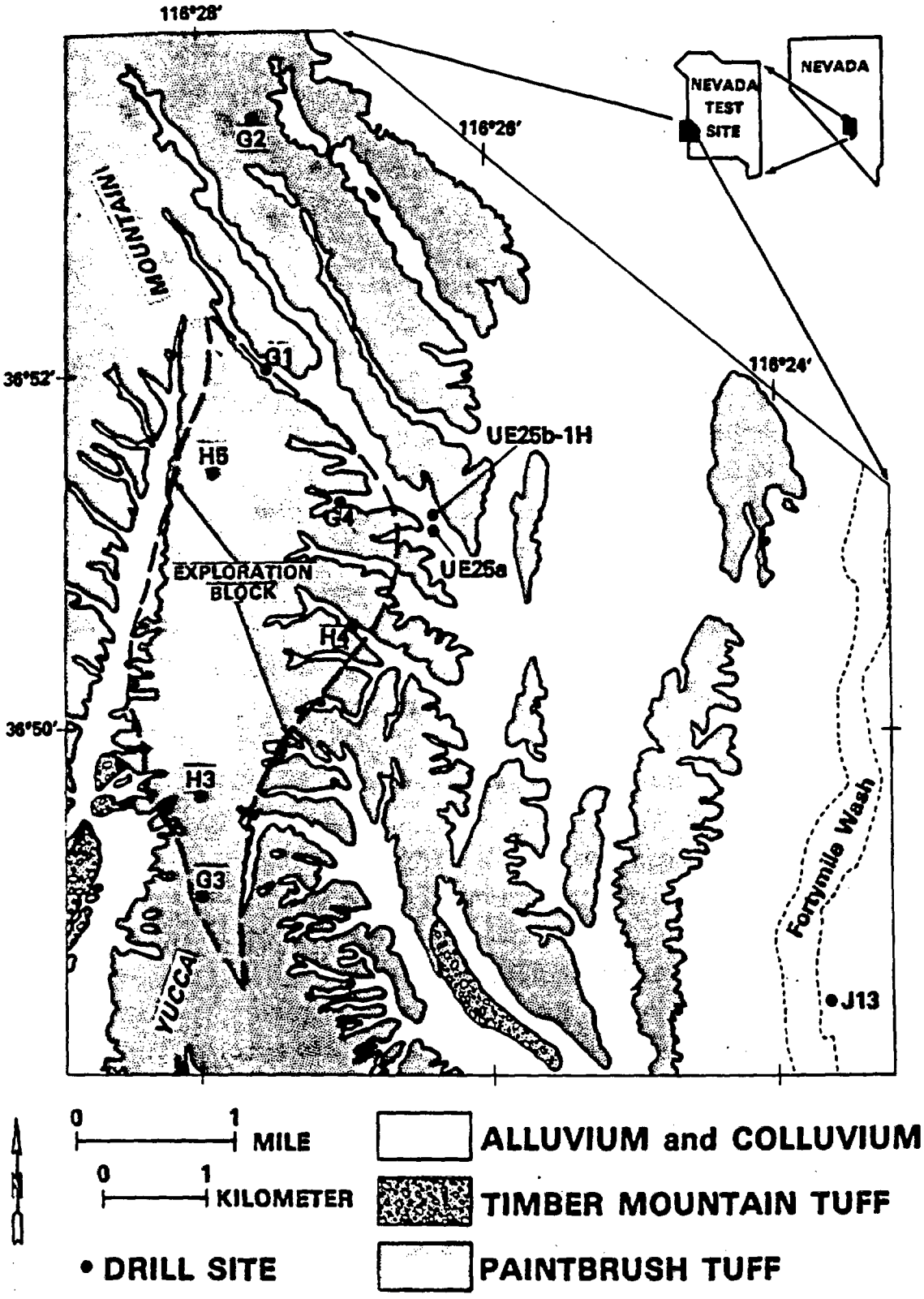

Fig. 1
Yucca Mountain exploration block.

alkali feldspars, and recrystallized feldspar phenocrysts (at depth) that were not reported in Caporuscio et al. Microprobe data for mafic phenocrysts (biotite, amphibole, and pyroxene) are tabulated in Appendix B. Triangular anorthite-albite-orthoclase plots and pyroxene Mg-CaMg-CaFe-Fe quadrilaterals summarize the microprobe data by sample and stratigraphic unit in Appendixes C and D.

II. THIN SECTION DESCRIPTIONS FOR DRILL HOLE USW-G2

A. Yucca Mountain Member of the Paintbrush Tuff

1. G2-304 (92.7 m) Moderately welded, devitrified, ash-flow tuff

The groundmass is made up of devitrified material ranging in size from fine dust to small, broken, axiolitic glass shards. The nature of devitrification in the groundmass is difficult to determine because of the fine-grained nature of the material. Glass in relict shards is replaced by alkali feldspar and cristobalite. The shards are flattened and have 4:1 to 6:1 length to breadth ratios. The moderate flattening of shards imparts a well-defined planar foliation to the thin section. Though flattened, devitrified shards retain many of their original features, including Y-shaped junctions between vesicles. Individual shards have a wide range of sizes with maximum dimensions generally <2.5 mm.

Pumice lapilli make up approximately 10 to 15% of the rock. All lapilli are thoroughly devitrified and the original glassy framework is replaced by coarse-grained devitrification products. Most pumice fragments are flattened and have axiolitic textures. Circular or oblate pumice lapilli are less common and have more of a granophyric texture than flattened axiolitic pumice. The difference between these pumice types might be the result of devitrification of long tube pumice to an axiolitic texture vs devitrification of open honeycomb types to granophyric texture. Phenocrysts of plagioclase and sanidine (<0.30 mm in size) are common in the pumice fragments.

Phenocrysts are generally small (<0.35 mm) and broken, though a few crystals are subhedral to euhedral. The principal phenocrysts are plagioclase and sanidine, which occur in subequal amounts. No quartz was identified in the thin section. Together, the plagioclase and sanidine make up ~1% of the section. Trace amounts of magnetite, sphene, and zircon are accessory phases.

Lithics make up <1% of the thin section. They are small, altered, reddish-brown fragments with no phenocrysts. They are generally <0.4 mm in diameter and are tentatively identified as aphanitic lavas.

2. G2-331 (100.9 m) Slightly to moderately welded, devitrified, ash-flow tuff

Glass shards are thoroughly devitrified and have well-developed axiolitic texture. They are generally uniform in size, ranging between 0.3 and 0.6 mm in their long dimension, though some are up to 1 mm across. The relict shards are slightly flattened and slightly bent around the phenocrysts. The degree of welding appears to be less than that found in section G2-304 but notably greater than G2-338. Many Y-shaped junctions and vesicle cross-sections are well preserved. Growth of axiolitic minerals clearly begins at the outer edge of the shard wall and extends inward towards the interior. In some cases, staining by iron-oxide enhances the contrast between individual phases in the axiolitic shards. Secondary mineral growth outward from the outer edge of the shards is also common in half of this thin section. This outward-growing material is different from the normal inward-growing axiolitic material, and it is tentatively identified as clay. Clay is also probably an important constituent of the groundmass. Small spherulites are occasionally nested along inner shard walls.

Pumice lapilli make up ~5% of the thin section and range in size from 0.5 to 3.0 mm in their maximum dimension. Some are rounded and contain phenocrysts of plagioclase, sanidine, or biotite, whereas others are extremely flattened. All pumice fragments are altered to (1) fine-grained, granular devitrification minerals, (2) axiolites, (3) spherulites, and (4) clay. The pumice lapilli are principally made up of the fine-grained, granular material with little fabric; the devitrification products in these pumice fragments are notably more fine-grained than those in section G2-304.

The principal phenocrysts are subequal amounts of sanidine and plagioclase. Both phases are generally anhedral to subhedral and 0.3 mm or less in diameter. A few rare grains are up to 1 mm in diameter. Biotite laths are generally <0.15 mm long and occur in trace amounts. No quartz phenocrysts were found. Sphene(?), zircon(?), and opaques are accessory phases. Phenocrysts make up ~1% of the section.

3. G2-338 (103.0 m) Nonwelded, vitric ash-flow tuff

The groundmass is made up of glass shards that display varying degrees of fragmentation. The larger shards are supported by a matrix of fine ash in which the majority of grains are <0.05 mm in diameter. Clay and glass are the principal components of this matrix, although some opal might also be present. The presence of opal is suspected as dusky material in intergranular areas. Shard forms include Y-shaped junctions marking the boundaries between several adjacent vesicles. Numerous circular, unbroken vesicles are present in the shards. The shards are randomly oriented and up to 1 mm in maximum dimension. Some are relatively massive and contain up to 0.5 mm of glassy material in the framework between adjacent vesicles. Many delicate features in the shards are remarkably well preserved and show little sign of internal fracturing. Unbroken bubbles are partially to totally filled with pale brownish, dusky material tentatively identified as opal. Glass in shard fragments appears fresh for the most part, although some incipient growth of clay has taken place on outer walls. Small clay balls partially fill the centers of some vesicles.

Pumice clasts make up <5% of the thin section and generally are 1.5 to 3.5 mm long. Most pumice lapilli have long-tube structure with tubular vesicles generally closed and compacted. No phenocrysts occur in the pumice fragments. Clay partially replaces glass in the largest pumice fragment. Some of the smaller pumice clasts are of the open honeycomb type and have slightly to moderately flattened vesicles. Alteration of glass to clay is less pervasive in these smaller pumice clasts.

Phenocrysts are generally rare and make up an estimated 1% of the thin section. All phenocrysts are generally broken and very small (<0.2 mm). The principal phenocryst phases are plagioclase (with albite twinning and zoning), sanidine (up to 0.25 mm long), biotite (0.35 mm in maximum dimension), and hornblende. The plagioclase and sanidine are subequal in abundance; biotite and hornblende are present in trace amounts. Sphene and zircon are accessory minerals.

Only two lithic fragments are present in this section. Both have an altered reddish-brown groundmass and contain phenocrysts of sanidine. The lithics are 1 to 3 mm across and the phenocrysts 0.1 to 0.2 mm across. The phenocrysts make up 5 to 10% of the lithics. Because of their altered nature,

the groundmass of the lithics is difficult to identify. These lithics are tentatively identified as porphyritic lavas.

B. Unnamed Bedded Tuff Between the Yucca Mountain and Pah Canyon Members of the Paintbrush Tuff

1. G2-358 (109.1 m) Nonwelded, pumice-rich, vitric ash-flow tuff

The groundmass is a mixture of glass shards and pumice fragments. The glass may be undergoing incipient divitrification and/or alteration to clay, but most appears fresh. The glass shards in this section are much smaller on the average than those described for the Yucca Mountain ash flows. Most are <0.1 mm in length and few features such as Y-shaped junctions or partial vesicle walls remain intact. Glass in the larger shards is unaltered. Shards are randomly oriented and nonwelded.

Pumice lapilli of all sizes are a striking feature of the section. They make up ~60% of the rock and range in size from 0.05 mm to 1 cm. Glass in the pumice is unaltered. The pumice fragments display a wide variety of fabrics ranging from open honeycombs to dense vitrophyres. The vitrophyric pumices are isotropic and have little internal structure. Long-tube pumices are also common and show similar gradations from tubular pumice with open vesicles to vitrophyric pumice with faint silky traces of collapsed tubes still preserved. No devitrification or infilling of tubes by secondary material has taken place in the honeycomb pumice; hence, their permeability is still high.

There is a notable change in the abundance, size, and diversity of phenocrysts in this section compared to the Yucca Mountain Member. Phenocrysts made up ~5 to 6% of the section. The most abundant phenocryst phase is sanidine (~5% of section), which ranges in size from 0.1 to 0.8 mm in diameter, but with most crystals falling in the 0.3- to 0.6-mm size range. Most of the smaller sanidine crystals are subhedral to anhedral and some are broken. The larger grains tend to be subhedral to euhedral. Plagioclase and biotite are minor phenocryst phases, together making up <1% of the section. Plagioclase usually occurs in small (<0.2-mm) subhedral grains in which twinning (albite and carlsbad) and zoning are often present. Biotite occurs in subhedral laths 0.1 to 0.3 mm long. Some biotite grains are baked(?) or decomposed to reddish-brown alteration products, but most are still fresh. Accessory phases include

titanomagnetite, sphene, apatite, zircon, and hornblende. The sphene and hornblende are up to 0.3 and 0.2 mm in diameter, respectively. No quartz phenocrysts were identified. Phenocrysts in the pumice fragments are similar to those in the groundmass. Sanidine is by far the most abundant phenocryst, occurring in crystals that are 1 to 2 mm in diameter (very much larger than phenocrysts of the groundmass). Biotite also occurs in larger crystals than those of the groundmass (up to 1 mm long) and is subordinate to the sanidine in abundance. Plagioclase was not positively identified as a phenocryst in any of the pumice lapilli. Accessory phases in the pumice include sphene, zircon, hornblende, and titanomagnetite.

Lithics make up ~1% of the section. They are reddish-brown in color and range in diameter from 0.5 to 2.7 mm. They appear to be fragments of devitrified welded tuff; in some relict pumice lapilli are discernible, and in others devitrified axiolitic glass shards are preserved. Some of these lithics appear to be fragments of ash-flow tuff that have undergone devitrification. Spherulites and granophyric textures are common in these lithics. Sanidine is a common phenocryst in one of the lithic clasts.

2. G2-395 (120.4 m) Nonwelded, pumice rich, vitric ash flow

The groundmass is a mixture of glassy materials made up of finely pulverized ash, glass shards, and small fragments of pumice fragments. There is a small amount of clay replacing glass in the groundmass, but most of the glass is unaltered. Identifiable glass shards are very small (<0.05 mm across) and merge into the groundmass.

Pumice clasts make up 50 to 60% of the thin section. The clasts are matrix supported and range from <0.3 mm to 0.5 cm in diameter. As in section G2-358, the pumice displays all gradations from honeycomb, long-tube, and vitrophyric pumice. The glass in the pumice is fresh and unaltered.

Phenocrysts make up 7 to 8% of the thin section. Sanidine makes up ~6% of the rock and occurs in small (0.5-mm), broken grains as well as large (>2-mm) subhedral-euhedral crystals. Plagioclase and biotite are minor phenocryst phases, occurring as subhedral to euhedral grains generally <0.3 mm across. Opaques, sphene, and hornblende are present in trace amounts. The hornblende is euhedral and ~0.3 mm along the c axis.

Lithics make up 2 to 3% of the section. There are several varieties: (1) axiolitic, iron-stained ash-flow tuff, (2) granophyric ash-flow tuff, and (3) fragments of rhyolitic flows with trachytic groundmass and phenocrysts of sanidine, biotite, and quartz. Some of the ash-flow lithics contain large percentages of clay.

C. Pah Canyon Member of the Paintbrush Tuff

1. G2-501 (152.7 m) Nonwelded, vitric ash-flow tuff

The groundmass is light brown under plane light and made up of glass shards in a matrix of ash and clay. A considerable amount of clay is believed present in the groundmass because of the tan color of the slide under plane light and faint birefringence under crossed-nicols. Opal may also be present in the groundmass. Most shards are still glassy, but their margins are slightly embayed and replaced by clay. Delicate features like Y-shaped junctions and unbroken vesicles are common. There is no preferred orientation to the shards or flattening around phenocrysts or pumice fragments. Minor amounts of opal are tentatively identified in open vesicles. Most shards are <0.4 mm in the longest dimension.

Long-tube and honeycomb pumice lapilli make up ~40% of the sample. Glass in the pumice is still fresh and the lapilli are highly vesicular. Pumice clasts are generally <1 cm long. Phenocrysts in pumice are similar in size, proportion, and composition to those found in the groundmass (plagioclase, biotite, sanidine, and augite).

Phenocrysts make up 3 to 4% of the thin section. The most common are plagioclase feldspars (3% of section), followed by subequal amounts of biotite and sanidine (~0.5% each), and minor amounts of augite (<0.5%). Accessory phases include zircon, apatite, titanomagnetite, sphene, and perrierite. Plagioclase phenocrysts are generally large (up to 2.5 mm in diameter), subhedral, moderately to strongly zoned, and sometimes glomeroporphyritic. Biotite, apatite, opaques, sanidine, and small plagioclase crystals are poikilitically enclosed or intergrown along adjacent crystal boundaries with the large plagioclase phenocrysts. Zoning and twinning often observed in these large plagioclase phenocrysts have complex patterns indicating a prolonged and multistage history of cooling in these crystals. Biotite occurs

in subeuhedral laths up to 1 mm long. Most sanidine phenocrysts are subhedral and relatively small, rarely exceeding 0.3 mm in maximum dimension.

Lithic fragments make up <1% of the section. Most are small (<1 mm), light-brown (under plane light) fragments of ash-flow tuff in which the glass is largely replaced by clay. In some cases they are thoroughly devitrified to a granophyric texture. Some massive, altered lithics might be lavas, but this identification is tentative. Only one phenocryst (biotite) is identifiable in a lithic clast.

2. G2-547 (166.7 m) Nonwelded, vitric ash-flow tuff

Alteration of glass to clay appears to be pervasive throughout the groundmass. Well-defined glass shards are suspended in a matrix of fine-grained clay. Most shards are in the 0.1- to 0.3-mm size range. Well-formed Y-shaped junctions and complete vesicles are relatively rare. Though largely glassy, the centers of shards are consistently colored light-brown and the outer rims are white and clear under plane light. Shards are isotropic under crossed-nicols.

Pumice makes up 25 to 30% of the thin section and includes a variety of textures (open honeycomb, open long tube, closed long tube, and dense glass with perlitic fractures). The phenocrysts in the pumice are similar in type, size, and abundance to those in the groundmass. Much of the glass in the pumice framework has altered to clay, and clay fills some vesicles. Pumice lapilli are matrix-supported and range in size from 0.5 mm to 1 cm in diameter.

Phenocrysts make up ~2 to 4% of the thin section. Sanidine and plagioclase are the two principal phenocryst phases and occur in ~60:40 proportions. Sanidine crystals occur both singly and as complex intergrowths with plagioclase. Sanidine frequently mantles strongly zoned plagioclase crystals. Some plagioclase crystals occur in glomeroporphyritic clots containing up to six individual crystals. Several periods of growth can be seen in some plagioclase grains. Biotite, augite, quartz, and titanomagnetite are minor phenocryst phases and together make up ~1% of the rock. Sphene, zircon, apatite, and perrierite are accessory phases. Biotite is occasionally poikilitically enclosed by the feldspars. Sizes of phenocrysts are as follows: sanidine

(0.1 to 1.8 mm), plagioclase (0.3 to 3.0 mm), biotite (0.1 to 0.6 mm), and augite (0.3 mm). All phenocryst phases are subhedral to euhedral.

Lithics make up <1% of the section and include pyroclastic material as well as pieces of lava flows. Pyroclastic lithics include ash-flow material that is both granophyric and spherulitic. Other types of ash-flow lithics are only slightly welded, and the glass has been replaced by clay minerals. The lava lithics are rare and consist of an aphanitic glassy matrix with scattered felty microlites of sanidine and plagioclase.

3. G2-548 (167.0 m) Moderately welded, partially devitrified, partially zeolitized ash-flow tuff

The groundmass is made up of clay, alkali feldspar, cristobalite, and zeolites. Partially open vugs in the groundmass are rimmed by terminated crystals of heulandite. Relict shards are composed of axiolitic cristobalite and sanidine; no glass remains. Central portions of shards are often stained red by iron oxide and contain clay. Shard structure is almost completely obliterated throughout most of the groundmass. This rock appears to have first undergone devitrification and later low-temperature diagenesis during which clays and zeolites replaced the remaining glass.

Pumice clasts make up ~25 to 35% of the section and generally are 1.5 to 9 mm long. All glass in the pumice is replaced by spherulites of alkali feldspar and cristobalite. In some cases smectite appears to be intergrown with the spherulitic blades. Spherulitic pumices often contain open voids and therefore retain a significant degree of porosity. Phenocrysts in the pumice match those in the groundmass. Many of the pumice clasts have axiolitic outer edges.

Phenocrysts make up 2 to 3% of the thin section. The principal phenocrysts are sanidine and plagioclase with the sanidine being perhaps slightly more abundant than plagioclase. Quartz, biotite, opaques, and augite are minor phenocryst phases and together make up ~0.5% of the section. Sphene, perrierite, and zircon are accessory minerals. Apatite needles are common in the larger feldspar and biotite phenocrysts. Plagioclase is moderately zoned in most cases and often occurs in glomeroporphyritic clots containing up to four or five grains. Sanidine occurs both as freestanding phenocrysts and as mantles around zoned plagioclase. Many of the phenocrysts in this thin

section are broken, particularly sanidines. When not broken, plagioclase, sanidine, and biotite are subhedral to euhedral. Augite phenocrysts are more common than in previous sections. Typical phenocryst sizes are: sanidine (0.3 to 1.2 mm), plagioclase (0.15 to 1.2 mm), biotite (0.1 to 1.8 mm), quartz (0.15 to 0.6 mm), and augite (0.15 to 1.2 mm).

Lithic fragments make up ~1% of the section. Most lithics are tuffs having long-tube pumice with pervasive axiolitic structure overprinted by spherulitic growths. Lithics made up of tuff with granophyric pumice are also common. Plagioclase, sanidine, and biotite are common phenocrysts in the first type of lithic; quartz is the only phenocryst observed in the granophyric lithic. One lava lithic with a felty, trachytic groundmass and phenocrysts of opaques, biotite, and plagioclase is also present.

A major fracture runs the length of the thin section. It is perpendicular to welding and therefore is vertical. It is largely open, but in places it is partially filled with quartz and alkali feldspar. Zeolites are the last minerals deposited in the central area of the fracture. They occur as blocky euhedral crystals of heulandite that completely fill the fracture in places. Some opal(?) is also present in these fractures.

4. G2-561 (171.0 m) Partly welded, partially devitrified, partially zeolitized ash-flow tuff

The groundmass is thoroughly recrystallized to smectite and zeolite. In plane light the groundmass is medium brown in color. Small vugs in the groundmass are lined by an axiolitic rim of felty, low-birefringent devitrification phases. A few rectangular, blocky crystals of heulandite (with lower relief) occupy the central portions of these vugs inside the axiolitic rims. These vugs often have open centers. All glass has been replaced by clay and zeolites or has undergone partial devitrification. Zeolites have pseudomorphed shard forms or the glass has dissolved, leaving holes. Incomplete devitrification preceded the clay and zeolite-forming events.

This particular thin section is cut so that a large pumice occupies approximately one-third of the section. Spherulites are common in the pumice and are indicative of devitrification. The pumice appears to have been the long-tube variety and much of the original glass now appears to have crystallized to smectite. The pumice clasts have a discontinuous outer rim of

clay and zeolites and a more continuous inner rim of alkali feldspar and tridymite.

The principal phenocrysts are sanidine and plagioclase in proportions of ~60:40. Opaques, biotite, augite, sphene, and zircon are present in trace amounts. Phenocrysts make up ~3 to 5% of the section in the nonpumice parts of the section. In the large pumice, clast phenocrysts make up only ~2% of the rock but are comparable in mineralogy, relative abundance, and size to phenocrysts in groundmass areas. Compositional zoning is strong in plagioclase and slight in sanidine. Phenocryst sizes vary as follows: sanidine (0.3 to 1.5 mm), plagioclase (0.3 to 2.0 mm), biotite (0.15 to 1.2 mm), and augite (0.3 to 0.6 mm). One sphene grain is 0.3 mm long. Plagioclase crystals are occasionally glomeroporphyritic with up to five crystals clotted together. Mantling of plagioclase by sanidine is more common in this thin section than in G2-547. Biotite is occasionally enclosed in plagioclase.

Lithic clasts are rare in this thin section and are made up of devitrified granophyric tuffs. Many are stained so severely by reddish-brown iron oxide that the clasts appear opaque.

5. G2-627 (191.1 m) Moderately welded, partially devitrified, partially zeolitized ash-flow tuff

The groundmass is made up of a mixture of zeolites and clays as well as cristobalite and sanidine (from devitrification). No glass has survived. In plane light the groundmass is light brown in color. Relict shards are common throughout the groundmass, but the glass has crystallized to crystobalite-sanidine. Clay and zeolites (heulandite) replace shard forms in some parts of the groundmass. It appears that this rock has a history similar to thin sections G2-548 and G2-561, in which a moderately welded ash-flow cooling unit has undergone devitrification and later low-temperature diagenesis.

Pumice clasts make up ~30% of the thin section. All pumice clasts are severely affected by vapor phase alteration. Spherulites of sanidine and tridymite overprint the pumice fabric. Some clay also appears to be intergrown in the spherulites. Some pumice clasts have axiolitic rims. Phenocryst phases are basically unaltered except for biotite, which is slightly baked to a reddish-brown color. One pumice fragment contains glomeroporphyritic clots of plagioclase and biotite in which the plagioclase is mantled or partially

mantled by sanidine. There are still open voids in the pumice clasts. These voids commonly contain heulandite.

Sanidine and plagioclase are the principal phenocrysts (~4%) in the rock. They are subequal in abundance and generally subhedral when not broken. Quartz and biotite make up ~1 to 2% of the section. Accessory phases include opaques, sphene, perrierite, and apatite. The plagioclase crystals are often strongly zoned and occasionally mantled by a rim of sanidine. Average sizes for the major phenocrysts are as follows: sanidine (0.15 to 1.8 mm), plagioclase (0.3 to 2.0 mm), quartz (0.15 to 1.0 mm), and biotite (0.15 to 0.60 mm).

Lithics make up <1% of the section. They are generally made up of small (<1 mm) clasts of granophyric tuff with quartz, plagioclase, and sanidine phenocrysts.

6. G2-675 (205.7 m) Moderately welded, thoroughly zeolitized ash-flow tuff

All glass in this section has been altered to zeolite (heulandite) and clays. Remnant shard forms are present but are usually indistinct. Heulandite has roughly pseudomorphed the shard forms. It also lines small, open vugs throughout the groundmass.

Pumice lapilli make up ~35 to 40% of the section. All glass in them is replaced by zeolites and clay. The mineralogy of the phenocrysts is similar to that of the groundmass. Crude long-tube structure is pseudomorphed by heulandite. Relatively few voids are present in these pumice clasts. In general the pumices have a darker, more reddish-brown color under plane light than does the groundmass. A higher proportion of clay:zeolite is tentatively proposed to account for the difference in coloration. Tiny fractures in the pumice are filled with zeolites.

Phenocrysts make up 1 to 2% of the section. Sanidine is the most abundant phenocryst phase (~1%), followed by plagioclase (~0.5%), quartz (0.25%), and biotite (0.25%). Sphene, perrierite, and opaques are accessory phases. Typical grain sizes for the major phenocrysts are: sanidine (0.3 to 1.2 mm), plagioclase (0.1 to 1.5 mm), quartz (0.3 to 0.6 mm), and biotite (0.1 to 0.9 mm). Both plagioclase and sanidine form glomeroporphyritic clots. One biotite crystal occurs in a glomeroporphyritic clot of plagioclase crystals.

Freestanding and glomeroporphyritic plagioclase is occasionally rimmed by sanidine.

Lithics make up <1% of the rock. The only identifiable lithics are small (<1 mm), devitrified ash-flow tuffs with granophyric textures.

7. G2-723 (220.4 m) Nonwelded, calcite cemented, vitric ash-flow tuff

The groundmass is made up of glass shards and fine ash. Calcite has infiltrated parts of the groundmass and filled porous areas of the matrix. All glass in shards appears to be essentially fresh despite the obvious introduction of $CaCO_3$-bearing fluids into the rock. Many delicate shard features such as Y-shaped junctions and partial vesicles are common throughout the thin section.

Pumice lapilli make up ~50 to 60% of the thin section. The pumice is matrix-supported, and textural types include honeycomb, long tube, and vitrophyric. All open vesicles in the pumices have acted as pathways for groundwater movement and $CaCO_3$ deposition. The $CaCO_3$ has crystallized as an optically continuous network in these open spaces. Glass in the pumice is largely unaltered and shows only minor dissolution along pumice walls. The presence of pumice types that are gradational between honeycomb and vitrophyric combined with the influx of $CaCO_3$-depositing groundwater demonstrates the variable permeability of these different pumice types. Whereas the honeycomb pumice is extremely permeable (calcite totally fills all vesicles), long-tube pumice allows water to be transmitted relatively poorly, and only portions of vesicles contain calcite. The vitrophyric pumice is nearly impermeable and, except along fractures, contains no calcite. Based on the distribution of the $CaCO_3$, the permeability of the groundmass was much lower than that of the honeycomb pumice but greater than that of most long-tube pumices.

Phenocrysts make up 1 to 2% of the section. Sanidine and plagioclase are the dominant phenocryst phases and occur roughly in 60:40 proportions. Both feldspars occur either as freestanding phenocrysts or glomeroporphyritic clots. Plagioclase is often mantled by sanidine. In several crystals the two feldspars are complexly intergrown. Plagioclase crystals are often, though not always, strongly zoned. Quartz, biotite, and augite are minor phenocryst phases, making up <0.5% of the section. One quartz crystal is doubly

terminated. Biotite laths are generally small (<0.15 mm) and often baked to a dull reddish brown. Augite crystals are rare and small (usually <0.3 mm). Accessory phases include sphene, opaques, and perrierite. The phenocrysts range in size as follows: sanidine (0.1 to 1.0 mm), plagioclase (0.3 to 3.0 mm), biotite (0.1 to 0.6 mm), quartz (0.15 to 0.4 mm), and augite (0.2 to 0.3 mm).

Lithics make up <1% of the section and consist of highly altered tuffaceous(?) rocks from older events. Some are medium brown under plane light and are largely altered to clay. Others are granophyric tuffs that are thoroughly devitrified.

8. G2-743 (226.5 m) Bedded, possibly reworked, calcite-cemented vitric tuff

The groundmass is largely composed of glass shards, fine vitric ash, and some clay. Permeable areas within the groundmass are irregularly filled with $CaCO_3$. Glass shards are visible in parts of the groundmass and are relatively rare. Where present, they are well preserved and the glass is essentially unaltered.

Pumice makes up 50 to 60% of the section. Honeycomb, long-tube, and vitrophyric varieties are all present. Calcite fills vesicles in the pumice in over half of the thin section but does not extend as an optically continuous network as it did in G2-723. The glass in the framework of the pumice is fresh and unaltered. Phenocrysts in the pumice are similar to those of the groundmass. Portions of the thin section are characterized by matrix-supported pumice, but in parts it is clast-supported (that is, little matrix between points of contact). Rounding of pumices indicates possible reworking of this bedded unit.

Phenocrysts make up ~1% of the section and consist mainly of sanidine and plagioclase in about a 60-to-40 ratio. No glomeroporphyritic clots were seen in this section. Only a few plagioclase grains are mantled by sanidine and few plagioclase are strongly zoned. The presence of quartz is suspected, but it has not been positively identified. Biotite is a minor phenocryst. Opaques and perrierite are accessory phases. Most crystals are poorly formed (that is, either broken or subhedral to anhedral) compared to other thin sections examined for the Pah Canyon Member. Phenocrysts range in size as

follows: sanidine (0.3 to 1.8 mm), plagioclase (0.3 to 2.0 mm), quartz(?) (0.4 to 1.2 mm), and biotite (0.3 to 0.8 mm).

Lithics are rare in this section. Those present are similar to the clay-rich tuffs described in thin section G2-723.

D. Pumiceous Tuff Between the Pah Canyon and Topopah Spring Members of the Paintbrush Tuff

G2-762 (232.3 m) Nonwelded, zeolitized, pumice-rich tuff

This unit is a pumice swarm made almost entirely of pumice, with no shards and very little matrix. The pumice is up to 5 mm in diameter, undeformed, and has abundant open void space. Tan to lemon-yellow zeolite (heulandite) and clays pseudomorph the pumice framework. Open voids are lined with opal and chalcedony. Clays lining tube walls are slightly birefringent (in the yellows). Brown clays and oxides fill some cavities in open voids. Heulandite grows perpendicular to the pumice fabric. Phenocrysts are scarce (<2%) and consist mostly of feldspars. Albite and carlsbad twins are common in plagioclase phenocrysts. Biotite, oxide, and clinopyroxene occur in trace amounts. Lithics consist of older tuffs; some have outer rims of chalcedony. Two veins are present in the section. One is open, and the other is filled primarily with calcite but has minor opal along the outer walls.

E. Topopah Spring Member of the Paintbrush Tuff

1. G2-770 (234.7 m) Densely welded, divitrified to vitrophyric, crystal-rich ash-flow tuff

The groundmass is devitrified to cristobalite and sanidine but commonly has a high content of dark-brown clay that occurs as sprays or small spherulites. Shards are of two predominant types: (1) clear and still vitric and (2) tan, furry-looking shards that are devitrified to cristobalite and sanidine. Axiolitic and incipient granophyric shards are also present in lesser amounts. All shards are typically rimmed by dark-brown clays.

Pumices are large, occurring as lapilli up to 7 mm in diameter. They are vitric with perlitic cracks partially filled with yellow clay. They are clear

under plane light and dusky red in crossed-nicols. The red coloration is caused by minute rutile crystals disseminated throughout the lapilli. The fabric of pumice lapilli is intact; some minor cristobalite and sanidine occurs in scattered patches.

Phenocrysts make up 20% or more of the rock. They consist of feldspar, quartz, biotite, pyroxenes, and opaque oxides. The feldspars are euhedral to anhedral, are slightly zoned and embayed, and commonly have carlsbad and albite twins. The quartz is subhedral to anhedral and commonly strained. Biotite is common throughout the section and often occurs in large laths. Both orthopyroxene and clinopyroxene may be present; they are twinned and sometimes zoned.

Two types of older tuff lithics are present. One type is dominated by plagioclase phenocrysts and the other by plagioclase and hornblende phenocrysts.

2. G2-822 (250.5 m) Densely welded, devitrified, vapor phase altered, ash-flow tuff

The groundmass is dark reddish-brown and consists of fine-grained devitrification products and clay. Vapor phase alteration commonly occurs as tridymite pockets throughout the matrix. Veins of tridymite also partially or wholly fill fractures in the groundmass. Shards are replaced by fine-grained granular to axiolitic growths of sanidine and cristobalite. Shard forms are extremely flattened because of dense welding.

Pumice lapilli are typically devitrified, and in some cases the original textures are obliterated. Cristobalite and sanidine are intergrown perpendicular to lapilli walls. The interior of the lapilli are filled by incomplete spherulites and fine-grained granular patches. Tridymite pockets, clays, and oxides are dispersed throughout the pumice clasts.

Phenocrysts consist predominantly of feldspar, quartz, and minor amounts of biotite, clinopyroxene, and opaque oxides. The abundance and proportion of phenocrysts is similar to those in thin section G2-770. The biotite in this section is severely blackened and the clinopyroxene is altered to serpentine. Lithics consist of devitrified ash-flow tuffs.

3. G2-855 (260.6 m) Densely welded, devitrified, vapor phase altered, ash-flow tuff

The groundmass is dark reddish-brown and consists of fine-grained devitrification products and clay. Vapor phase alteration products commonly occur as tridymite pockets throughout the matrix. Shards are replaced by fine-grained granular to axiolitic growths of sanidine and cristobalite. Shard forms are extremely flattened because of the dense welding.

Pumice lapilli are clear and tan under plane light and gray under crossed-nicols. Most primary pumice textures have been destroyed by devitrification and vapor phase alteration. Sanidine intergrowths are perpendicular to the outer wall. The remainder of the pumice is fine-grained, granular, devitrified, and vapor phase altered, with central areas filled by tridymite. Fairly high clay contents occur in central portions of the pumice near tridymite pockets.

Phenocrysts consist predominantly of feldspar and quartz and minor amounts of biotite, clinopyroxene, and opaque oxides. The abundance and proportion of phenocrysts are similar to those in thin section G2-770. Lithics consist of devitrified ash-flow tuffs.

This sample has many fractures, all of which have had wall rock alteration by vapor phase alteration to granular quartz and sanidine. Most fractures are partly filled with tridymite. Some fractures have had clays infilling after tridymite but almost all are partly open. One vein is completely filled by calcite.

4. G2-898 (273.7 m) Densely welded, devitrified, vapor phase altered ash flow

The groundmass is dark reddish-brown and consists of fine-grained devitrification products and clay. Tridymite occurs as pockets throughout the matrix. Shards are replaced by fine-grained granular to axiolitic growths of sanidine and cristobalite. Shard forms are extremely flattened as a result of the dense welding.

Pumice lapilli are characterized by fibrous intergrowths of cristobalite and sanidine that grow perpendicular to outer walls. The interiors of the

lapilli are filled by mottled, indistinct spherulites and pockets of tridymite.

Phenocrysts consist predominantly of feldspar, quartz, and minor amounts of biotite, clinopyroxene, and opaque oxides. The abundance and proportion of phenocrysts are similar to those of thin section G2-770. Lithics consist of devitrified ash-flow tuffs.

There are three prominent veins in this sample. They are affected by vapor phase alteration that resulted in partial filling of the fractures by tridymite and then minor clays.

5. G2-921 (280.7 m) Densely welded(?), devitrified, vapor phase altered, ash-flow tuff

The degree of welding is difficult to determine because intense vapor phase alteration obliterates most primary textures within the thin section. Most of section is dominated by lithophysae and large, dirty, brown spherulites. Lithophysae, composed of three to six bands of intergrown cristobalite and sanidine, typically contain crystals up to 15 µm wide and 50 µm long. Lithophysal bands are sometimes rimmed by coarsely crystalline devitrification phases up to 4 mm in diameter. Brown spherulites are composed of the same mineral phases and are very finely intergrown. Often the centers of spherulites show granophyric crystallization or have nucleated on phenocrysts. Other vapor phase structures include (1) plumose growth, (2) very fine-grained, microcrystalline cristobalite and sanidine, and (3) granophyric crystallization. Very fine needles of rutile are disseminated throughout the section. Relict pumice that is still discernible is largely overprinted by numerous small (5-to 25-µm) spherulites and contains areas of coarse interstitial quartz and sanidine. Plagioclase, the dominant phenocryst phase, commonly exhibits albite and carlsbad twinning and oscillatory zoning. Sanidine is less common, but ubiquituous throughout the section. Both feldspars are commonly shattered. Quartz, biotite, and oxides occur in trace amounts. The quartz is commonly strained and shattered. Biotite is relatively rare and usually severely blackened.

6. G2-951 (289.9 m) Moderately to densely welded, devitrified, vapor phase altered, ash-flow tuff

The groundmass is primarily made up of dirty-brown, irregular spherulites that grew across shard boundaries. Clays and oxides are disseminated throughout the groundmass. Parts of the matrix are composed of fine-grained to granophyric patches of devitrified products. Pockets of tridymite are common. Shards have crystallized to sheaves of intergrown cristobalite and sanidine subparallel to the long dimension of the shards. Axiolitic shards are also common. The central regions of both shard types commonly have incipient granophyric crystallization.

Pumice lapilli are light tan under plane light. Most original textures are now obliterated. Lapilli boundaries are indistinct because of the masking effect of vapor phase crystallization. Some spherulites are present; most are fine grained. Some pumice clasts have patches of granophyric crystallization and pockets of tridymite with some sanidine laths. Pumice in a lithic fragment shows the following sequence of crystallization: (1) axiolitic outer border, (2) random spherulites, and (3) central granophyric regions.

Phenocrysts are similar to those in G2-921 except that they are more abundant and show very little shattering. Veins are mostly open or only partially filled. The principal vein-filling materials are chalcedony, oxides, and clays.

7. G2-984 (299.9 m) Densely welded, devitrified, vapor phase altered, ash-flow tuff

The groundmass is made up of fine-grained quartz and sanidine with high concentrations of brown clays. Vapor phase regions are light tan and composed of microcrystalline quartz, sanidine, and interspersed pockets of tridymite. Lithophysae and plumose structures are common. These vapor phase pockets are lined by quartz, chalcedony, and sanidine. Sanidine laths rarely occur in pockets with tridymite. Some tridymite has reverted to quartz. Crystallization of shards has resulted in (1) subparallel sheaves of cristobalite and sanidine and (2) axiolitic shards that have transformed to incipient granophyric textures.

Pumice outlines are generally discernible although the glass is replaced by 25- to 35-μm spherulites and rare pockets of tridymite. These spherulite textures do not crosscut lapilli boundaries. Fine-grained rutile needles are dispersed throughout the pumice. Pumice tubes are outlined by brown clays.

The principal phenocryst phases are feldspars and quartz. Biotite and oxides are present in trace amounts.

One major fracture in the section is filled by calcite only. This fracture appears to be part of a fault as evidenced by shearing and mylonitization of the wall rock.

8. G2-1032 (314.6 m) Densely welded, devitrified, vapor phase altered ash flow

The groundmass is a mixture of dark-brown, assymetric spherulites, fine-grained quartz and sanidine, and dark-brown clay. Vapor phase crystallization dominates a large portion of the sample. Very large lithophysae occupy major portions of the sample. Interstitial regions are filled by brown assymetric spherulites. Pockets of tridymite are interspersed throughout the groundmass, of which ~40% have transformed to chalcedony. Shards are up to 2 mm in length, but more commonly 200 μm in length. Typically the shards show a two-stage growth with the outer border region coarsely axiolitic and the central portions spherulitic or granophyric. A small per cent of shards have crystallized in parallel sheaves; these occur primarily near heavy vapor phase alteration zones.

There are three primary crystallization zones in the pumice. The outer border is composed of fine-grained intergrowths of cristobalite and sanidine that grow perpendicular to the outer edge of the lapilli. The bulk of the pumice is composed of dirty, interlocking spherulites containing abundant disseminated oxide and clay. The innermost void regions are characterized by vapor phase or granophyric crystallization. None of the crystallization processes extend past the outer margin of these lapilli, though much of the original textures has been obliterated.

Phenocryst compositions and abundances are similar to those in G2-984. Fractures in the section are mostly open. One is filled by quartz; another is partially filled with clay.

9. G2-1072 (326.7 m) Densely welded, devitrified, vapor phase altered ash flow

The groundmass is made up of very fine-grained quartz and sanidine. High contents of brown clay mask many of the textures. Large lithophysae and many spherulites are present throughout the slide. Many pockets of tridymite (reverted to chalcedony or quartz) are dispersed throughout the thin section. Four types of devitrified shard morphologies occur: (1) axiolitic with central vapor phase pockets, (2) granophyric textures made up of five or six interstitial locking crystals, (3) very fine-grained, equant crystals that encroach on the groundmass, and (4) fine-grained crystals that have recrystallized as sprays or sheaves cross-cutting shard boundaries.

Pumice lapilli are highly degraded. Some still have spherulitic outer border regions and an inner region made up of minor spherulites (interstitial) but dominated by granophyric and vapor phase crystallization. One pumice is consumed by a lithophysae that nucleated in the pumice and then cross-cut the clast boundaries. Other pumices have crystallized into fibrous sheaves of cristobalite and sanidine that barely encroach on the groundmass. These lapilli also contain pockets of vapor phase sanidine and quartz crystals projecting into void areas with late-stage quartz filling the central void.

Phenocrysts are similar to those in G2-984. One lithic of devitrified granophyric tuff is present in the section. Fractures are common in this thin section. All are open and none have any filling phases.

10. G2-1133 (345.3 m) Densely welded, devitrified, vapor phase altered ash flow

The groundmass is largely made up of dirty-brown, assymetric spherulites that transgress shard and pumice boundaries. Some parts of the matrix contain fine-grained equant quartz and sanidine aggregates with high brown clay contents. Lithophysae, spherulites, and very fine-grained material are once again present. About half of the tridymite pockets are intact; the rest are converted to quartz. Some dirty-brown spherulites are intact in vapor phase regions, otherwise all original textures are gone. Also, some regions have extremely coarse-grained, interlocking quartz and sanidine grains. They appear to be extreme cases of granophyric crystallization and, in some cases,

may be the edges of lithophysal cavities. Shard textures are similar to those in G2-1072. In addition, dirty-brown spherulites transgress all shard boundaries in some parts of the slide (an indication of higher temperature?). In these areas, spherulites may cover up to 6 mm^2 and encompass hundreds of compressed shards.

Pumice lapilli are reddish-brown to clear under plane light. In some portions of the slide original textural features near lapilli borders are intact. These border textures are composed of indistinct spherulites and/or axiolitic textures. Some borders are encroached by dirty-brown groundmass spherulites. The central parts of the lapilli consist of large granophyric aggregates; large, clear, indistinct spherulites; and pockets of vapor phase tridymite.

Phenocryst abundances and proportions are similar to those in G2-1072, except that quartz is more abundant. There is one completely healed fracture. It appears to be filled by a silicate phase, probably deposited during vapor phase or granophyric crystallization.

11. G2-1178 (359.1 m) Densely welded, devitrified, vapor phase altered ash flow

The crystallized groundmass, shards, and pumice lapilli in this section are similar mineralogically and texturally to those described in G2-1133. However, one pumice lapilli has the following morphology, which is very different. The outer border comprises large, dirty-brown spherulites that nucleated on the boundaries and grew inward. Other spherulites compose much of the inner region. The remainder of interstitial regions have coarse, granophyric crystals, vapor phase tridymite pockets, and one small lithophysae. Most of the vapor phase crystallization in this slide is a combination of interspersed fine-grained devitrification products, very large indistinct lithophysae, tridymite pockets that are partly reverted to quartz, and dirty-brown to clear assymetric spherulites. These four textures dominate most of the vapor phase regions. Three large lithophysal cavities occur in the vapor phase region. They are partly open and the phases growing into (but not filling) the voids are alkali feldspars and tridymite that has retrograded to quartz. All crystals are mottled and contain disseminated clays and oxides. These vug-lining crystals are separated from the groundmass by zones

of granophyric (mosaic) crystallization with abundant tridymite pockets. The phenocrysts in this section are similar to those in G2-1133. There is one identifiable lithic fragment of devitrified granophyric tuff. It is coated by an opal shell that is partly transformed to chalcedony.

12. G2-1234 (376.1 m) Densely welded, devitrified, vapor phase altered ash flow

This slide is very similar to G2-1133. There are some minor differences however. For example, shards have the following textures: (1) axiolites with vapor phase centers, (2) granophyric, (3) cross-cut by dirty-brown spherulites, with no authigenic recrystallization, and (4) sheaves of quartz and sanidine oriented parallel to shard length. All types of shards are outlined by dark clays and/or oxides.

Two pumice lapilli are made up of dirty-brown (clay-rich) spherulites with central vapor phase pocket. The rest of the lapilli have the following general textural features: (1) outer border of axiolitic quartz and sanidine growth, (2) an inner growth of clear to mottled spherulites that are typically small, and (3) interstitial central regions comprising vapor phase pockets and/or granophyric crystallization. The ratio of spherulites to interstitial crystallization varies greatly, ranging from all spherulites to nearly all granophyric crystals and interspersed vapor phase pockets.

Fractures are narrow and partially healed by devitrification and vapor phase processes, but for the most part they are open.

13. G2-1281 (390.4 m) Densely welded, devitrified, vapor phase altered ash flow

Approximately 75% of this thin section is a single lithic fragment. It is a densely welded granophyric tuff. Four other lithic fragments with granophyric texture are also present in the section. All lithics have clay-rich sprays of sanidine and cristobalite growing on their boundaries.

In the nonlithic portions of the thin section, all devitrification textures are masked by pervasive spherulitization. Spherulites can range up to 3 mm and most are assymetric. Also present are select lithophysae and pristine tridymite pockets. The clay and disseminated oxide content is

relatively high in this section. Because of fairly indistinct boundaries on spherulites, it is possible that incipient granophyric crystallization was in process. Tridymite pockets are also very common throughout the ash flow. Many of the pockets are partially to totally converted to chalcedony. Unreacted tridymite pockets have partial to complete stringers of opal to chalcedony around borders.

The principal phenocrysts are plagioclase and sanidine. The feldspars are characterized by albite and carlsbad twinning and oscillatory and sector zoning. Rutile is an accessory phase. No quartz or biotite was seen in this section.

One large branching fracture has a two-stage sequence of infilling. First quartz and then vapor phase tridymite was deposited. The fracture is not sealed, however, containing only ~80% fill.

14. G2-1331 (405.7) Moderately welded, devitrified, vapor phase altered ash flow

The groundmass has a high clay content that masks many textures. However, spherulitic sheaves and fine-grained aggregates of quartz and sanidines are conspicuous throughout the matrix. Three large lithophysal cavities are present in the section. The rest of the intense vapor phase regions are characterized by spherulites, lithophysae, and fine-grained interstitial material (very similar to G2-1178). All shards are crystallized and have coarse, axiolitic outer boundaries and vapor phase centers. Some shards have undergone granophyric crystallization only, although combinations of all textural types exist. All shards are clear under plane light; many are bordered by dark clays. Many shards have indistinct borders that may indicate incipient authigenic recrystallization.

Pumice clasts are up to 2 mm in diameter. The outer margins, which are often indistinct, comprise axiolite sprays up to 100 μm thick. Perpendicular to walls, these axiolite sprays comprise quartz and sanidine and may have a high clay content. The inner regions of the lapilli have some fine-grained granular components and indistinct spherulites. However, the bulk of the lapilli have two-stage vapor pockets. Initial crystals lining pockets comprise feldspar or tridymite to quartz. The rest of the void is then completely filled by granophyric (large mosaic) crystals.

The principal phenocrysts are plagioclase and sanidine. Quartz, biotite, and opaques are minor phenocryst phases. The quartz is subhedral and occurs as small (<5-mm) crystals. Biotite laths are unoriented and burned.

Five lithics are present; all devitrified and most are granophyric. One has an extremely high clay content. Another is very large (~20% of section).

Many fractures are present in this section. All are healed by mosaic quartz. There is also some interstitial clay present in the vein material.

15. G2-1382 (421.2 m) Moderate to densely welded, devitrified, vapor phase altered ash flow

This rock has undergone intense vapor phase alteration, as evidenced by numerous lithophysal cavities. The groundmass is characterized by asymmetric to symmetric spherulites, sprays and sheaves of intergrown fibrous cristobalite and sanidine, and very fine-grained interstitial aggregates. The clay content of this matrix material is very high. All original shard textures are masked by pervasive growth of devitrification products in the groundmass.

Most pumices are replaced by small interlocking spherulites; the remainder have spherulites along borders and in parts of the central region. The rest of the central region is characterized by vapor phase or granophyric crystallization.

The phenocryst mineralogy is similar to that of G2-1331. This thin section is intensely sheared and has at least two generations of fractures. The older set is healed by quartz in a mosaic fabric and some tridymite. However, some wide portions of these fractures are still open. A small percentage of the older set are filled by clays. The younger set of fractures is essentially open. None of the fractures are completely sealed, and most have only a thin veneer of fill (quartz), if anything at all.

16. G2-1420 (432.8 m) Moderately to densely welded, devitrified, vapor phase altered ash flow

Vapor phase crystallization is moderate in this section. No lithophysal cavities are present. Otherwise it is similar to G2-1178. Many tridymite pockets have rims of opal to chalcedony. Three types of crystallized shards predominate the groundmass: (1) axiolitic with central regions filled by

granophyric crystallization, (2) sheaves subparallel to the long dimension of the shard, typically clay rich, and (3) granophyric crystallization of shards. None of these forms show authigenic recrystallization.

The outer portions of pumice lapilli have one of the following or all three textures: (1) small-scale spherulites (up to 2 μm in diameter), (2) fine-grained granophyric texture, and (3) dark-brown sheaves or sprays. The central portions of lapilli typically exhibit two-stage crystallization; first vapor phase crystals partly to totally infill lapilli centers and then granophyric crystals fill the remainder of the lapilli.

Phenocrysts are similar to those in G2-1131. There are at least 15 subangular to round lithics in this section; all are densely welded, devitrified tuffs. There are a large number of fractures in this section; most are completely open. The remaining fractures are predominantly sealed by a combination of mosaic quartz (75%) and tridymite (25%). Tridymite is the last phase to precipitate.

17. G2-1461 (445.3 m) Densely welded, devitrified, vapor phase altered ash flow

This thin section is very similar to G2-1420, except that axiolitic shards are a minor component of the matrix and granophyric shards predominate. Also, of the fractures present, ~30% are completely open, 10% are partly to totally filled by clays and tridymite, and 60% are mostly to totally filled by mosaic quartz and tridymite.

18. G2-1536 (468.2 m) Densely welded, devitrified, vapor phase altered ash flow

Four lithophysal cavities are present in this section. They have the same general sequence of crystallization as G2-1178. One large region of vapor phase activity covers approximately half of the section. This vapor phase activity is characterized by intermediate to large, dirty-brown spherulites. Other parts of this vapor phase region are composed of spherulites, lithophysae, and patches of granophyric crystallization. Tridymite pockets are abundant throughout the section. Most have a thin skin of opal to chalcedony and some tridymite has reverted to quartz.

The outer regions of pumice lapilli are characterized by axiolitic textures, small spherulites, or fine-grained devitrified products. Inner regions of lapilli are a mixture of spherulites, granophyric crystallization, and vapor phase crystallization.

Phenocrysts are similar to those in G2-1131. Three large allanite grains occur in the groundmass. Lithic clasts are densely welded devitrified tuffs. Approximately 85% of the fractures present are sealed with mosaic quartz, tridymite, and minor clays. The rest have some lining of vapor phase crystals (tridymite and sanidine).

19. G2-1585 (483.1 m) Densely welded, devitrified, vapor phase altered ash flow

The groundmass is very clay rich. In general it is similar to G2-1420; however, there are some microcrystalline patches of quartz and sanidine. Shards exhibit three main types of crystallization textures: (1) distinct, pink-tan, axiolitic borders with vapor phase and granophyric centers; (2) borders of sheaves or sprays with or without vapor phase centers; and (3) very fine-grained granophyric textures fill the remaining open areas.

Some pumice lapilli have axiolitic borders and interiors of clear spherulitic and granophyric textures. However, a new morphology has appeared. Large, murky-brown spherulites have nucleated on lapilli borders and have grown inwards towards the centers. The interiors of these lapilli are dominated by the same type of murky-brown spherulites. Granophyric and/or vapor phase crystals fill interstitial regions between spherulites (up to 30% of the lapilli).

Phenocrysts consist predominantly of plagioclase and sanidine. Quartz (small grains), biotite (heavily burned and oriented parallel to fabric), basaltic hornblende (six grains), and opaque oxides are minor phenocryst phases. The content of the lithic fragments in this section is very high (~40%). These lithics are similar to the densely welded, devitrified tuffs described higher in the core. Most fractures are parallel to subparallel to the fabric and healed. Once again the principal vein materials are quartz, tridymite, and minor clays. There are open voids in the tridymite-rich regions where growth of crystals is incomplete. There are also open voids in some pumice.

20. G2-1634 (498.0 m) Zeolitized vitrophyre

The groundmass is made up entirely of clear, fine-grained clinoptilolite. Most shard forms are dark tan (the result of clays) with clear borders. These shards are pseudomorphed by fine-grained clinoptilolite with voids in the centers. Some centers are completely filled by larger clinoptilolite crystals. Pumice lapilli are slightly lighter in color than shards, but are also replaced by clinoptilolite. All perlitic cracks (especially small ones) are filled by clays. The larger cracks are also filled with clinoptilolite (after clay). Most outer margins of these cracks are lined by opal. In many of the concentric perlitic rings, the center is a void that is rimmed by and partially filled by clinoptilolite and numerous opal balls.

The principal phenocrysts are plagioclase and sanidine. Quartz, biotite, clinopyroxene, and opaque oxides are minor phenocryst phases. Fractures are very common and often connect perlitic cracks. The common vein-fill sequence is opal to clays to clinoptilolite. A small proportion of the fractures is completely filled by iron-titanium oxides.

21. G2-1664 (507.2 m) Vitrophyre

Glass in this vitrophyre is tan to white and unaltered. Numerous fine cracks are filled with clays and clinoptilolite(?). These cracks may be precursors to perlitic fractures. The pumice lapilli have a dark color and dark-brown borders. These lapilli are starting to alter to clays and possibly minor clinoptilolite.

The phenocrysts in this section are similar to those in G2-1634. Numerous small lithic clasts are present. They are all devitrified tuffs. Many small fractures are present; all are filled with clays and possibly very fine-grained clinoptilolite(?).

22. G2-1691 (515.4 m) Nonwelded, zeolitized ash flow

The groundmass is a tan, very fine-grained aggregate of clay and clinoptilolite. Shard forms are clear and totally undeformed. Shards are characterized by a very thin rim of yellow, birefringent clay surrounding massive crystalline clinoptilolite (10 to 30 μm). Terminated clinoptilolite

crystals grow into central voids in the shards. Infrequently, the terminated clinoptilolite fills the voids.

Pumice lapilli are nonwelded and all primary structures remain intact though replaced by clinoptilolite. Clays coat vesicle walls and clinoptilolite fills them. The lapilli, which are only slightly darker than the matrix, make up only a small percentage of the thin section. Most open vesicles are also filled with clinoptilolite.

The phenocrysts are similar to those in G2-1634. Two allanite grains are also present. Many lithic clasts occur in this section. They consist of devitrified ash flows and one altered dacitic(?) fragment. Fractures are not readily discernible; any present are wholly sealed by clinoptilolite and minor clays.

F. Bedded Tuff Between the Topopah Spring Member of Paintbrush Tuff and Tuff Of Calico Hills

1. G2-1745 (531.9 m) Nonwelded, zeolitized, bedded tuff

The groundmass is an aggregate of clinoptilolite, mordenite, and clay. Under plane light its color varies from light tan to dark brown with increasing clay content. Scattered throughout the groundmass and pumice are bright orangish-red iron oxides(?) or a peculiar clay. Their distribution is random and irregular.

Pumice clasts are the major constituents of the section, but their area is difficult to estimate because of the thorough zeolitization of the rock. Most pumice lapilli are subrounded to rounded, indicating probable reworking. The lapilli are generally clast supported, but the differences between discrete pumice clasts and matrix are often indistinct and boundaries between the two are difficult to distinguish. Long-tube and honeycomb types are both present. Vesicle walls are crudely pseudomorphed by clinoptilolite. Terminated clinoptilolite extends into open void areas, particularly in the honeycomb pumice. In places, tube walls and vesicles are outlined by a thin coat of clay. In exceptional cases, clay is an important component of the altered pumice.

Phenocrysts make up ~1 to 2% of the thin section. Quartz, plagioclase, and sanidine are the principal phenocrysts and are present in subequal

amounts. Biotite is an accessory phenocryst, being present in trace amounts only. Opaques and zircon are less common accessory phases. Quartz is generally subhedral and occasionally shows double terminations. It generally ranges in size between 0.15 and 1.0 mm along the c-axis. Well-formed subhedral-euhedral sanidine phenocrysts range in size from 0.2 to 0.6 mm along the major axis. Plagioclase crystals vary generally from 0.3 to 1.2 mm in size and are generally subhedral or broken. Biotite generally ranges between 0.2 and 0.4 mm along the c-axis.

Lithics make up ~5% of the thin section and consist of 2 types: (1) moderately to densely welded granophyric tuff, and (2) granophyric "lava"(?) in which no ash-flow features are evident. Both types are light tan to brick red colored in hand specimen.

Fractures are generally very small, though they extend across the diameter of the slide. The fractures do not appear to contain zeolites. Clay and the red iron hydroxides(?) described above partially fill some of the fractures; however, they are not completely healed.

2. G2-1752 (534.0 m) Nonwelded, zeolitized, bedded tuff

This thin section is apparently made up of one large, long-tube pumice lapillus. The USGS lithologic logs indicate that swarms of large lapilli occur at the bottom of this bedded sequence. The principal phenocrysts are subequal amounts of sanidine and quartz, lesser biotite, and trace plagioclase. Phenocrysts make up ~1% of the clast. Most of the feldspar and quartz phenocrysts are between 0.3 and 1.5 mm in the maximum dimension. Biotites are highly variable in size with a few large grains oriented parallel to the long-tube structures and reaching 2.0 mm in length along the c-axis. Small biotites between 0.3 and 0.4 mm in length are also present. No lithic clasts are incorporated into this pumice. The long-tube structure is pseudomorphed primarily by zeolites, although thin clay linings occasionally coat tubes and vesicles. Coarse clinoptilolite fills voids between the tube walls.

G. Tuff of Calico Hills

1. G2-1798 (548.0 m) Nonwelded, zeolitized, bedded tuff

The vitric material in the groundmass is completely replaced by clinoptilolite, mordenite, and a minor amount of smectite. The bulk of the groundmass is made up of clinoptilolite. Groundmass vugs are rimmed by terminate clinoptilolite crystals that grew inward toward the vug's open interior. Sheaves of subparallel opal occupy the central portions of some vugs. From these relationships, it is inferred that opal was deposited late in these rocks. Glass shards are totally replaced by clinoptilolite; no primary glass remains. Shard forms are rare if present at all.

Pumice clasts make up 60 to 70% of the section. All glass is thoroughly replaced by clinoptilolite and mordenite(?). Vesicles in pumice are often rimmed by a thin layer of smectite and filled with clinoptilolite. The glassy areas between vesicles are primarily altered to clinoptilolite. Late-forming (vesicle- and vug-filling) zeolite appears to be primarily clinoptilolite. However, areas of pure mordenite appear to be present at least in local areas of the pumice. Because of their extremely small size, resolution of individual mordenite crystals is just beyond the capability of the microscope at 1500X; however, its identification, though tentative, is based on the appearance of faint bundles of fibrous, extremely accicular crystals. X-ray diffraction (XRD) data confirms its presence in the sample. Phenocryst compositions and proportions in pumice are similar to those in the groundmass.

The predominant phenocryst phase is quartz, followed by minor sanidine, and trace plagioclase, biotite, zircon, and opaques. Phenocrysts make up 1 to 2% of the thin section with the following approximate proportions: 65:25:5:5 for quartz, sanidine, plagioclase, and biotite, respectively. Most quartz is partially resorbed and/or broken. Rare euhedral crystals have occasional double terminations. Sanidine crystals, when not broken, are generally subhedral and display albite twinning. Plagioclase and biotite grains are relatively rare and generally small. Ranges of common crystal sizes are as follows: quartz (0.3 to 1.2 mm), sanidine (0.3 to 1.5 mm), plagioclase (0.15 to 0.4 mm), and biotite (0.15 to 0.6 mm). The plagioclase is poorly zoned.

Lithics make up ~7 to 10% of the section. They are primarily made up of vapor phase altered tuff with feldspar and biotite phenocrysts. Most are

granophyric; some have spherulites. There are a few fragments of what appears to be metamorphosed sandstone with extremely fine iron oxide disseminated throughout. In the hand specimen these particular lithics are brick red. There is one tuff lithic containing highly perthitic feldspar.

2. G2-1848 (563.3 m) Nonwelded, zeolitized, pumice-rich tuff

The groundmass has a pervasive light-tan color in plane light (as opposed to the almost clear groundmass in G2-1798). Clinoptilolite appears to be the major constituent of the groundmass, with lesser amounts of mordenite(?). Again, mordenite identification is difficult because of the extremely fine-grained nature of the crystals. The XRD data shows negligible clay at this interval, though this particular thin section appears to contain up to 5% clay. The clay is light yellowish-brown and is common in some long-tube pumice. Some of the coloration in the groundmass observed in this slide might be caused by opal disseminated among the zeolites. Small fractures are filled with mordenite(?). Glass shards are totally altered to zeolite and no relict forms remain.

Pumice lapilli types include both honeycomb and long-tube varieties. All pumice clasts are thoroughly zeolitized. Thin clay rims are present around some vesicles and along tubes. Zeolites (both clinoptilolite and mordenite?) replace all glass in the pumice and partially fill the vesicles. There are open vesicular areas in the pumice. Phenocrysts in the pumice are similar to those in the groundmass. Pumice makes up ~60% of the section.

Phenocrysts make up ~2% of the sample. Subequal amounts of quartz, plagioclase, and sanidine are the principal phenocrysts. Biotite and opaques are present in trace amounts. Sizes of the principal phenocrysts are as follows: quartz (0.3 to 0.8 mm), plagioclase (0.25 to 3.0 mm), sanidine (0.3 to 1.5 mm), and biotite (0.15 to 0.4 mm). Textures of the phenocryst are similar to those described for G2-1798, except that some plagioclase grains show surface sericitization. Thus far, the Calico Hills has a much smaller variety and content of accessory mineral phases than does the overlying Paintbrush Tuff.

Lithics make up ~1% of the thin section. All are devitrified ash-flow tuffs that have granophyric textures. Phenocrysts include quartz, plagioclase, and sanidine but no biotite. The plagioclase is strongly zoned.

Small areas of extremely flattened shard forms can be seen in some granophyric tuffs, showing that at least some are moderately to densely welded ash-flow tuffs. Finely disseminated iron oxide gives the lithics a brick-red color in hand specimens.

3. G2-1899 (578.8 m) Nonwelded, zeolitized, ash-flow tuff

The groundmass is light tan under plane light and nearly isotropic under crossed-nicols. Vugs within the groundmass are lined by thin rinds of terminated clinoptilolite crystals. Mordenite occasionally fills groundmass voids, but appears to be more commonly intermixed with the clinoptilolite in the groundmass. Clays are relatively minor (<2%) constituents of the groundmass. Three types of clays are present: (1) golden-yellow clay masses in pumice and the groundmass, (2) light-yellow clay rims around vesicles in pumice, and (3) dark-brown clay filling small veins in the groundmass. Mordenite(?) and quartz seal small fractures in the groundmass. Dissolution of glass and deposition of clinoptilolite and mordenite(?) have resulted in the destruction of most shard forms. The few identifiable shards are crudely pseudomorphed by clinoptilolite.

Pumice lapilli make up 40 to 50% of the section. Honeycomb and long-tube varieties are both present. All glass is pseudomorphed by massive clinoptilolite and mordenite, and vesicles are partially infilled by projecting crystals of clinoptilolite. Thin rinds of light-yellow clay line some vesicle walls. Some vugs are partially open in the honeycomb pumice clasts.

Phenocrysts make up 1 to 2% of the section and consist predominantly of quartz, sanidine, and plagioclase in roughly 45:40:15 proportions. Biotite is present as very small crystals and only in trace amounts. Opaques and allanite(?) are accessory phases, but they are relatively rare. Phenocryst sizes range as follows: quartz (0.1 to 0.9 mm), sanidine (0.2 to 0.5 mm), plagioclase (0.2 to 1 mm), and biotite (0.15 to 0.3 mm).

Two types of lithics are present in this section. The most abundant are devitrified ash-flow tuffs with granophyric texture. A less common type of lithic(?) is nonwelded, zeolitized ash-flow tuff. These zeolitic tuff lithics contain significant amounts of clay and have well-defined boundaries with the practically clay-free Calico Hills host rock. Their identification as lithics is tentative. Quartz, sanidine, and plagioclase are common phenocrysts in

both types of lithics. The granophyric ash-flow lithics frequently contain disseminated iron oxide and are brick red in color in hand specimens. Partial welding of shards still can be recognized in some of these lithics. Some lithics are made up entirely of large, broken "brown-hair" spherulites.

4. G2-1952 (595.0 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is light tan with plane light and nearly isotropic under crossed-nicols. All glass is replaced with mordenite and clinoptilolite. Clays are rare and are similar to those in section G2-1899. Tiny fractures in the groundmass are healed by mordenite(?) and/or sheaves of quartz. Glass shards are completely altered to clinoptilolite and/or mordenite. Few shard forms are discernible.

Pumice lapilli make up ~60% of the section. Long-tube and honeycomb types are both present. All glass is replaced by massive zeolites and vesicles are partially filled by terminated crystals of clinoptilolite. Some pumice borders have thin rims of axiolitic clay. The original structures of some pumice lapilli are nearly obliterated. Open vugs are common in central parts of vesicles in the honeycomb pumice.

Phenocrysts make up 1 to 2% of the section. Quartz, sanidine, and plagioclase are the principal phenocrysts and occur in proportions of ~45:35:20. Biotite is present in trace amounts and as small crystals. Accessory minerals include opaques and allanite(?). Most of the quartz is anhedral and resorbed. Plagioclase generally occurs as small crystals. Sanidine is generally subanhedral. Crystal sizes are comparable to those in sections G2-1848 and G2-1899.

Lithics are similar to those described in the previous section. Moderate to dense welding and devitrification are pervasive in most lithics. No spherulites were seen in any lithics. Nearly all have granophyric texture under crossed-nicols, but flattened shards are identifiable with plane light.

5. G2-2001 (609.9 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is light tan in plane light and nearly isotropic under crossed-nicols, reflecting the total replacement of all glass by mordenite and clinoptilolite and the absence of clay. Crude shard forms can be identified

in parts of the thin section, but most have been destroyed by the authigenic growth of zeolites. Vugs in the groundmass are lined by mordenite and clinoptilolite and some have partially open centers. These vugs impart a permeability to the rocks, but the zeolitization is so extensive that it closes many of these potential water pathways.

Pumice lapilli make up ~30% of the section. Most are an open honeycomb type; long-tube varieties are less abundant. Zeolites have replaced all the glass in the pumice. Pore space or vesicles are partially to totally filled with mordenite and clinoptilolite.

Phenocrysts make up 1% or less of the section. Most are extremely small (<0.3 mm) and generally broken. Phenocryst proportions are very similar to section G2-1952 with the principal phases being quartz, sanidine, and plagioclase. Biotite is a common minor phase. Accessory phases include zircon and blocky brown crystals of allanite.

Lithics are relatively rare (<5%) in this thin section. They are of three types: (1) clay-rich zeolitized tuff with phenocrysts of quartz and sanidine, (2) granophyric tuff with no phenocrysts, and (3) medium-grained cumulate-like lithics of diorite(?) with euhedral, strongly zoned plagioclase and lesser subhedral biotite and accessory allanite(?).

6. G2-2078 (633.4 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is light tan under plane light and nearly isotropic under crossed-nicols. Zeolites have replaced all vitric materials. Voids in the groundmass appear to be principally filled with clinoptilolite. Minor amounts of dark-brown clay are intermixed with the zeolites locally within the groundmass. Interestingly, secondary biotite occurs with clinoptilolite in some groundmass vugs. Glass shards are totally replaced by clinoptilolite and mordenite. Shard forms are often well preserved with fine axiolitic zeolites occurring on the outer margin of the shard boundary and coarser zeolites (both clinoptilolite and mordenite) infilling the shard interior. There are open holes in the central portions of some relict shards. Shard forms are much better preserved and larger (up to 0.5 mm in cross section) than in previous thin sections.

Pumice lapilli make up 30 to 50% of the section. They are matrix-supported long-tube and honeycomb pumice types in which all glass has been

zeolitized. Fine clay rinds frequently delineate pumice vesicle walls in the long-tube types. Coarse clinoptilolite and fine, wispy mordenite occupy the vesicles. Compressed long-tube pumice is made up of mordenite and clinoptilolite, with clinoptilolite prominent in partially open vesicles.

Phenocryst sizes and abundances change significantly in this thin section compared to previous Calico Hills samples described in the upper part of the drill core. Phenocrysts are significantly larger and more abundant in this section. They make up 7% of the thin section and are composed primarily of plagioclase, quartz, sanidine, and biotite in proportions of ~47:22:29:3. Titanomagnetite and zircon are accessory phases. The sanidine is occasionally glomeroporphyritic.

Lithics make up 7% of the section and are principally devitrified, ash-flow tuff with granophyric texture. In some cases shards are still apparent under plane light. Spherulites are also common.

7. G2-2158 (657.8 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is primarily clinoptilolite and mordenite. Trace amounts of dark-brown clays are concentrated in small local areas. All glass shards are replaced by clinoptilolite, mordenite, and trace amounts of clay. A few relict shard forms are crudely pseudomorphed by clinoptilolite; the best preserved have rims of massive clinoptilolite and projecting euhedral terminated crystals of clinoptilolite extending perpendicular from the outer rim into open vugs in the centers of shards. Some shards are totally dissolved away and the remaining void is only slightly infilled by clinoptilolite, leaving an open vug in the groundmass. Most of the open vugs in the groundmass probably originated in this way. Mordenite does not appear to pseudomorph glass shards well, and though it probably replaces some shards, it tends to destroy their outlines in the process. Mordenite-rich samples such as this one (mordenite abundance from XRD) tend to have few identifiable relict shards.

Pumice lapilli are thoroughly zeolitized. Pumice types include open honeycomb and long-tube varieties. Clay and opal(?) often define vesicle walls in the honeycomb and long-tube pumices. Vesicles themselves are generally rimmed and filled by projecting euhedral crystals of clinoptilolite. The glassy framework between vesicles is replaced by clinoptilolite and mordenite.

In some cases, the pumice structure is totally destroyed and clinoptilolite appears to grow in radiating patterns around central clay and opal(?) balls.

Again there seems to be a major shift in phenocryst mineralogy in this thin section compared to samples from higher in the drill core. Quartz is the most abundant phenocryst, followed by subequal amounts of sanidine and plagioclase. Proportions of these phases are approximately 40:30:30. The sizes and overall abundance of phenocrysts (~7 to 9%) are similar to the previous section. Biotite is present in trace amounts. Accessory phases include opaques and zircon.

Lithics make up 15 to 20% of this sample. The most common lithics are moderately welded granophyric tuff (shard structure apparent under plane light). This type of lithic is relatively phenocryst rich with the main phases being plagioclase, sanidine, and quartz in ~50:30:20 proportions with trace biotite, opaques, and pyroxene. A second type of lithic is partially devitrified and partially zeolitized tuff(?) with phenocrysts of sanidine, quartz, and plagioclase in approximately 40:40:20 proportions. Some of the large sanidine phenocrysts in these lithics have dissolved cores filled by quartz and/or zeolites. Both lithic types are iron stained and brick-red color in hand specimen.

8. G2-2248 (685.2 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is light tan under plane light and isotropic under crossed-nicols. It is totally replaced by clinoptilolite and mordenite. Dark-brown clay is concentrated in a few small areas in the groundmass, but it is a relatively minor constituent. There are scattered groundmass vugs that contain coarse, terminated clinoptilolite crystals. For the most part, all shard forms have been obliterated during the zeolitization process.

Pumice clasts make up ~20% of the section. All are thoroughly zeolitized. Long-tube types are most common, although open honeycomb types are also present. Phenocrysts are generally rare in the pumice. When present they are similar to those of the groundmass.

Phenocrysts make up 7 to 10% of the section with quartz, sanidine, and plagioclase the dominant phases in ~40:20:20 proportions. Biotite and opaques occur in trace amounts. Phenocryst sizes are comparable to the previous two sections described. Few euhedral crystals (except biotite) are present. The

feldspar are often broken and subhedral, whereas the quartz is anhedral to subhedral and occasionally is partially resorbed. Some plagioclase grains are strongly zoned.

Lithics make up ~5% of the section. All are moderately welded ash-flow tuffs with granophyric texture and phenocrysts of quartz, sanidine, and plagioclase.

9. G2-2353 (717.2 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is light tan under plane light and slightly birefringent to nearly isotropic under crossed-nicols. All vitric material is thoroughly zeolitized. Vugs in the groundmass are lined by clinoptilolite, but many centers are still open. Euhedral crystals of secondary alkali feldspars [adularia(?)] with microprobe compositions of Or_{99-100} are intergrown with clinoptilolite in these vugs. This sample represents the highest occurrence of authigenic feldspar in the drill core. The XRD data suggests that these secondary feldspars are important constituents of the rock, and textural relations indicate contemporaneous growth with clinoptilolite. Dark-brown clay is a minor constituent of the groundmass and is concentrated only in a few areas. All shard forms have been destroyed by zeolitization.

Pumice clasts make up 25% of the section. They consist of both long-tube and honeycomb types. All glass has been replaced by clinoptilolite and mordenite. Phenocryst compositions and proportions are similar to those found in the groundmass.

Phenocrysts make up 8% of this section. Quartz, sanidine, plagioclase, and biotite are the principal phases and occur roughly in 38:23:38:2 proportions. Crystal sizes are somewhat larger than in previous sections. This is especially true for biotite. The feldspars are subhedral to euhedral. Quartz shows a fair amount of resorption. These phenocrysts are not nearly as broken as in G2-2248. Titanomagnetite is an accessory phase.

Lithics make up 3% of the section. Most lithics are moderately to densely welded, granophyric tuff with plagioclase and sanidine phenocrysts. However, one lithic is a slightly metamorphosed sandstone(?) in which grain boundaries are seriated and fused, and there is a slight, but detectable foliation. Dark reddish-brown clay occurs in some of the intergranular areas of this sandstone lithic.

10. G2-2430 (740.7 m) Nonwelded, zeolitized tuff

The groundmass is light tan under plane light and nearly isotropic under crossed-nicols. Clinoptilolite and mordenite are the dominant groundmass phases. Clay is a minor constituent in the groundmass, occurring more commonly in pumice as fine linings to vesicle structures. Open vugs in the groundmass are lined and partially filled by coarse clinoptilolite and authigenic alkali feldspar (OR_{100}). The authigenic feldspar is intergrown with, and therefore contemporaneous with, the clinoptilolite. From the XRD data, it appears that submicroscopic crystals of alkali feldspar and cristobalite must be significant components of the groundmass. Some of the abundant alkali feldspar identified in the XRD data (20 to 40% of the rock) can be attributed to phenocrysts (~3%) and crystallized lithic fragments (~5%). The remaining 12 to 32% of the alkali feldspar must consist of fine microlites of primary feldspar crystallized from the rapidly cooling magma and authigenic feldspar that crystallized contemporaneously with clinoptilolite. All shard forms in the groundmass have been destroyed during the zeolitization process.

Pumice clasts make up ~65 to 75% of the thin section. All are thoroughly zeolitized and the borders of some blend imperceptibly into the groundmass. Both long-tube and honeycomb pumice types are common, though most original structures are barely discernible. Phenocrysts in the pumice are similar to those described below for the groundmass. It appears in some cases that glass in the pumice was dissolved and transported away, leaving a void area. Zeolites then filled these void areas to varying degrees. The amount of porosity represented by the remaining open voids is unevaluated at this time.

Phenocrysts make up ~10 to 12% of the section with plagioclase, sanidine, quartz, and biotite being the principal phases in roughly 40:30:25:5 proportions. Biotite occasionally forms very large crystals (up to 1.5 mm across), some of which are baked. Biotite is occasionally poikilitically enclosed in the feldspars. Plagioclase is often moderately zoned and sometimes mantled by a rim of sanidine. Quartz is partially resorbed in some cases. Allanite(?) and zircon are accessory phases along with ubiquitous titanomagnetite. Crystal sizes are comparable to previous thin sections.

Lithic clasts make up ~5 to 7% of the section. They are usually moderately to densely welded, granophyric ash-flow tuffs with phenocrysts of plagioclase, quartz, sanidine, and biotite.

11. G2-2528 (770.5 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is medium tan to light brown under plane light and evidently contains a considerable amount of clay mixed with the zeolites. Open vugs are relatively infrequent in the groundmass, but those that exist contain predominantly clinoptilolite and lesser mordenite. However, more mordenite occurs as an important constituent, partially filling open vugs in this thin section, than all previous Calico Hills samples described. All shard forms were destroyed during growth of zeolites. No shard forms survived this period of authigenic crystallization.

Pumice lapilli make up 50 to 55% of the section and consist of thoroughly zeolitized long-tube and honeycomb pumice types. The long-tube pumice is more common than the honeycomb type. Breakdown of glass in these pumices has resulted in the crystallization of zeolites and minor amounts of clay. Phenocrysts in the pumice are similar to those in the groundmass. Unlike section G2-2430, these pumices are thoroughly crystallized and have relatively little open pore space remaining.

This sample is phenocryst rich when compared with previous samples. Phenocrysts make up 11% of the section; if the area occupied by lithics is discounted, the phenocrysts make up 15% of the section. The principal phenocrysts are plagioclase, quartz, sanidine, and biotite in proportions of roughly 40:30:25:5. Plagioclase crystals are generally anhedral to subhedral, are partially resorbed, and generally appear out of equilibrium. Many plagioclase are moderately to strongly zoned and mantled by a uniform rim of albite. Quartz forms subhedral crystals, a few of which are embayed. Sanidine is generally subhedral and often poikilitically encloses biotite grains. Many biotite laths are crinkled or slightly bent. Titanomagnetite and zircon are accessory phases.

Lithics make up 13% of the thin section. They consist principally of granophyric ash-flow tuff and some possible lavas. Phenocrysts include plagioclase, sanidine, quartz, and minor biotite in the granophyric tuffs. Spherulites are common in some of these lithics. Some densely welded shards are apparent in plane light. These lithics are brick red in hand specimen.

12. G2-2667 (812.9 m) Nonwelded, zeolitized, crystal-rich ash-flow tuff

The groundmass is light tan under plane light and nearly isotropic under crossed-nicols. A mixture of mordenite, opal(?), authigenic alkali feldspar(?), and clay has replaced all glass. The presence of opal is suspected but cannot be confirmed optically. A few groundmass vugs are filled with authigenic feldspar (OR_{100}) and mordenite. Small, relatively unimportant fractures cut the groundmass. These are filled by mordenite, clay, or opal. All glass shards have been replaced by mordenite and/or opal(?). Mordenite crudely pseudomorphs some shard forms, but in general the shard structure is no longer discernible.

Pumice lapilli are abundant in the thin section, but their area is difficult to estimate because they are so thoroughly zeolitized that they blend into the groundmass. Both long-tube and honeycomb types are present. Delicate rinds of clay line relict vesicle walls. A mixture of mordenite, opal, authigenic feldspar, and clay has replaced all glass in the pumice. Little pore area remains open.

Phenocrysts make up 21% of the section. Plagioclase, quartz, sanidine, and biotite are the principal phenocrysts, occurring in 51:25:18:7 proportions. Again the plagioclase shows considerable evidence of disequilibrium and is occasionally mantled by albite. Resorption textures are common in quartz crystals. Biotite abundance and size are similar to G2-2528. Titanomagnetite, apatite, and zircon are accessory phases.

Lithics make up ~5% of the section. They consist of moderately to densely welded, granophyric ash-flow tuffs similar to those described in many of the preceding thin sections. In addition to the phenocrysts described in previous thin sections, these lithics also contain freestanding anorthoclase and anorthoclase mantling plagioclase. These lithics are brick red in hand specimen.

H. Prow Pass Member of the Crater Flat Tuff

1. G2-2744 (836.4 m) Densely welded, devitrified tuff

The groundmass is devitrified and contains occasional plumose structures that are probably made up of quartz and feldspar. The groundmass is generally

clear, but it has many slightly diffuse brown spots ~0.002 mm in size. Shards are small (≤0.03 mm) and totally flattened with rounded ends. They are deformed around all phenocrysts. They have undergone axiolitic devitrification to quartz and feldspar. Many of the details of original shard structure are destroyed, but flow and compaction are apparent.

Pumices have flattening ratios of 1:5. Devitrification in pumices is characterized by plumose sprays and sheaves. Radiating masses of devitrification tend not to be spherical because many centers of crystallization interfere with each other. Axiolitic textures are common along the outer edges. Some spherulites are also present. Pumice phenocrysts are similar to those in the groundmass.

Phenocrysts make up 7 to 10% of the rock. Phenocrysts include plagioclase, quartz, and probable sanidine. Phenocrysts of biotite and other ferromagnesium minerals are now altered to secondary minerals. Quartz is broken, resorbed, and severely embayed. Plagioclase (0.3 to 1.0 mm) is zoned and resorbed along cleavages, fractures, and around edges. Sanidine usually has at least one euhedral face; other faces are fractured and/or resorbed but not embayed. Most phenocrysts have a dusty look from dust-like, disseminated opaque inclusions. Rectangular pseudomorphs of gray-brown alteration replace orthopyroxene. These pseudomorphs are sometimes associated with opaques. The biotite is replaced with golden-brown alteration products. Zircon is an accessory phase.

A large vein 0.3 to 0.5 mm in width runs diagonally across section with bleached zones on both sides. The vein is primarily filled with MnO and finely crystalline silica.

2. G2-2820 (859.5 m) Partly to moderately welded, devitrified ash-flow tuff

The groundmass is fine-grained (~0.01 mm) and devitrified; it probably consists primarily of quartz and feldspar. There are patches of coarser devitrification with grain sizes up to 0.05 mm. Individual shards are mostly unidentifiable because of either devitrification or welding; there is some alignment and deformation of shards around phenocrysts where they are distinguishable. Elongate particles of coarser devitrification may or may not

have been shards. Tiny, almost axiolitic elongate patches (two sets of parallel hair-like needles) probably were.

Angular patches of incomplete spherulites may have once been pumice lapilli. Spherulitic growth is confined to these patches, and they are surrounded by a fine-grained, devitrified groundmass.

Phenocrysts make up 15 to 20% of the total rock. They consist primarily of resorbed, embayed fragments of quartz and feldspar 0.4 to 1.4 mm in size. Plagioclase has a lacy look from being resorbed internally and somewhat preferentially along cleavages. Some quartz is severely embayed. Sparse biotite (0.4 to 0.7 mm) is somewhat oxidized and is red-brown to opaque. A few possible pseudomorphs after orthopyroxene are present.

Lithic fragments consist of rounded volcanics mostly 0.5 to 1.0 mm in size. One fragment (0.4 mm) consists of coarser grained quartz and feldspar with phenocrysts of plagioclase and quartz.

3. G2-2869 (874.5 m) Partly welded, devitrified ash-flow tuff

The groundmass is made up of finely devitrified quartz and feldspar $\leq$0.01 mm in size. Some dendritic and elongate patches showing coarser devitrification are also composed of quartz and feldspar. Shards are nearly indiscernible. Light streaks in the groundmass, which may have been shards, appear deformed around larger phenocrysts.

Pumices are replaced with coarse quartz and feldspar devitrification products. There is some growth of these minerals perpendicular to edges of lapilli. Elongate fragments with original structure are still visible. There is variable flattening of these pumices, and not all are aligned.

Phenocrysts make up 4 to 7% of the total rock. The phenocrysts are similar to those described in sample G2-2820. Altered biotite is embayed, resorbed, and now almost totally opaque. Some baked biotite (0.2 to 0.3 mm) with gold-black pleochroism still remains.

A 0.1- to 0.3-mm-wide fracture at one end of the section is lined with opaque minerals. No offset is seen along the fracture, but it is rimmed and braided with opaques and filled with granular 0.01- to 0.03-mm quartz and 0.06- to 0.10-mm feldspar fragments.

4. G2-2887 (880.0 m) Moderately welded, devitrified ash-flow tuff

The groundmass is made up of fine-grained ($\leq$0.05 mm) devitrification products composed of quartz and feldspar. It is very light tan in plane light and fairly clear. Darker mottling associated with coarser grained devitrification may be the result of exclusion of opaque dust during devitrified crystal growth. There is strong flattening, alignment, and deformation of shards around phenocrysts. These shards are small ($\sim$0.02 mm), lighter streaks of coarser devitrification in the very fine-grained devitrified groundmass. Some axiolitic textures are present.

Pumice lapilli contain well-formed spherulites up to 0.5 mm in diameter. These spherulites occur both individually and as intergrowths. Granular devitrification products fill in between spherulites.

Phenocrysts make up 5 to 7% of the rock. They are similar to those described for G2-2820. Again the biotite is strongly altered and nearly totally oxidized to a cherry-red color.

Lithics are relatively rare in this thin section. There are two small volcanic fragments and one siltstone.

5. G2-2950 (899.2 m) Moderately to densely welded, devitrified ash-flow tuff

The groundmass is heterogeneous and looks much like two co-existing melts that were mixed. One melt was light colored and the other dark. The darker material contains somewhat lighter colored shards and occurs as irregular patches in the lighter matrix. Together, they give the sample a marble-cake appearance. The groundmass is finely devitrified ($\leq$0.005 mm) and has a very low birefringence. Shards are strongly deformed around phenocrysts and lithic fragments. They are axiolitic under crossed-nicols, and an appearance of flowage comes from alignment of the shards.

Pumice lapilli have flattening ratios of 3:1 to 5:1. Radiaxial sprays of spherulites are common in the pumice, but do not cross pumice boundaries.

Phenocrysts make up 7 to 10% of the rock. Phenocrysts consist mostly of resorbed and embayed quartz, plagioclase, and sanidine. More quartz and sanidine occur than in the upper part of the Prow Pass Member. There are

sparse rectangular pseudomorphs after orthopyroxene and more opaques than in previous samples.

Lithics consist of one very large red argillite and two small clasts that may be baked argillite. All lithics are very fine grained.

6. G2-2970 (905.3 m) Moderately welded, devitrified ash-flow tuff

The groundmass is nearly dark brown because of numerous disseminated opaque inclusions. Shards are generally 0.05 mm in size, are moderately welded, and have undergone axiolitic devitrification to quartz and feldspar.

Pumice lapilli show flattening and compaction around phenocrysts. Most have a little coarser devitrification texture than the groundmass. "Brown-hair" spherulites occur in some lapilli. Larger lapilli have plumose spherulites or ordinary spherulites visible only under crossed-nicols, giving them a felted look. Smaller lapilli have granular quartz and feldspar devitrification products. Sheaves of felted quartz and feldspar are present in some lapilli.

Phenocrysts make up ~10% of the rock. Embayed, resorbed quartz and feldspar similar to those in the upper Prow Pass are common in the section. Quartz and sanidine appear to be less abundant than in previous sections.

The sample is cut by a major, red, hematite(?)-stained vein, 0.7 to 0.9 mm wide. This vein is filled with fragments of country rock and very fine-grained (~0.005 mm) quartz. Several other fractures ~0.03 mm wide cut through the section. The vein-filling materials, if any, appear to be clay.

7. G2-3037 (925.7 m) Nonwelded to slightly welded, devitrified ash-flow tuff

The groundmass is made up of randomly distributed, tiny (0.02-mm), radi-axial, spherulite-like growths. Clusters of needles (6 to 10 per cluster) in these spherulitic growths are associated with gray opaque dust, giving them a birds' nest appearance. These spherulites are embedded in a matrix that is riddled with filament-like streaks of clay. Shards are small (~0.1 mm) and sparse. Under 40X power, shard forms are barely visible in plane or polarized light. All shards are devitrified to quartz and feldspar.

Phenocrysts make up 10 to 15% of the rock and consist mostly of quartz, plagioclase, and sanidine. Quartz is usually severely embayed. Plagioclase phenocrysts are rounded but not as lacy as in other Prow Pass samples higher in the drill core. Biotite is resorbed and altered to orange-red-brown materials. One irregularly shaped pseudomorph possibly after pyroxene was noted.

Lithics are abundant in this section, making up at least 10% of the rock. They consist mostly of argillite with quartz grains up to 0.15 mm in diameter.

8. G2-3067 (934.8 m) Nonwelded, zeolitized ash-flow tuff

The groundmass is slightly dusty looking. Undeformed shards ~0.14 mm in diameter are clearly visible in the dusty-looking matrix. Some shards still have delicate points and hooks. No crystals are visible within shards in either plane light or under crossed-nicols.

Pumice lapilli are undeformed, numerous, and large. Some long-tube pumice are present. Though individual crystals cannot be distinguished, some pumices are thought to have slight devitrification textures under crossed-nicols. Large pumice lapilli have undergone devitrification crystallization in which crystals parallel to original tubular vesiculation impart a brushed appearance to the pumice. The major phenocrysts in pumice lapilli are similar to those in the groundmass.

There are more plagioclase phenocrysts present than in G2-3037. They are the largest of the phenocrysts present and are more nearly euhedral. Rounded, resorbed, and embayed quartz is common. No biotite phenocrysts are present. A few pseudomorphs of pyroxene(?) or hornblende(?) are present.

9. G2-3192 (972.9 m) Slightly welded, slightly devitrified, zeolitized ash-flow tuff

The groundmass consists of fine, granular devitrification products, small shards, and phenocryst fragments. The shards are 0.06 to 0.4 mm in diameter and have rinds of axiolitic crystallization and centers of larger terminated crystals (clinoptilolite). Tiny hemispherulites (0.02 to 0.04 mm diameter) filling centers of some shards appear to be mordenite. Some shards also have green-yellowish material with yellow birefringence partly filling central vugs.

No pumice textures are discernible in this slide. Yellow-brown, clay-rich patches probably were pumice clasts that were totally replaced during authigenic crystallization.

Phenocrysts make up ~5% of the rock. They consist of fragments of quartz and feldspar. Quartz is severely embayed. Feldspars are rounded and resorbed. About 20% of the phenocrysts are plagioclase; the rest are quartz and/or sanidine.

Lithics make up ~1 to 2% of the rock.

10. G2-3250 (990.6 m) Nonwelded, zeolitized bedded tuff

The groundmass contains abundant streaks of filament-like clay alteration products. The parts of the groundmass that do not have streaks of clay are opaque in plane light and highly reflective in reflected light. About 40% of the groundmass consists of opaque "dust"; the rest is very light tan in plane light. Shards are generally 0.15 to 0.40 mm in length. Most shards still retain points, some even retain delicate hooks. Faint axiolitic structures are visible under high power; low-birefringent, coarser crystals occur in shard centers, and opaque to low-birefringent materials occur on shard edges. Shards are outlined by white to pale-yellow birefringent clay. Most of the alteration appears to be confined to the groundmass and not to the shards. Shards are clear to light tan and nearly inseparable from the groundmass in plane light. Microprobe data show all shards have altered to analcime and/or clinoptilolite and mordenite.

Pumice clasts range in size from 0.8 to 4.0 mm in diameter. They are not flattened but are well altered to filament-like clay. Vesicle space is filled with brownish clays.

Phenocrysts consist of quartz, sanidine, and plagioclase. Most are angular fragments of crystals and range in size from 0.1 to 0.5 mm. Very sparse, euhedral biotite flakes up to 0.4 mm are undeformed but may have broken or etched ends. One large, slightly rounded feldspar is 1.5 mm in length. All phenocrysts are unaltered.

I. Bullfrog Member of the Crater Flat Tuff

1. G2-3308 (1008.3 m) Nonwelded, devitrified, vapor phase altered, crystal-rich ash-flow tuff

The groundmass is thoroughly devitrified, consisting of sanidine and cristobalite ranging from 0.02 to 0.03 mm in diameter. These grains are considerably coarser than devitrification products of shards. Sprays of fine feldspar fill voids in groundmass. Shards are distinguishable only in plane light. They have axiolitic devitrification with an opaque central axis. Average shard lengths range from 0.2 to 0.3 mm. The axial core of shards sometimes contains clear, higher relief material. Vesicles in shards contain prismatic authigenic(?) feldspar crystals. Some shard vesicles are filled with silica as well.

Pumice lapilli are 1 to 5 mm in length, flattened, and devitrified. Devitrification minerals are finer grained than those of the groundmass. Vesicles are filled with coarse feldspar devitrification products similar to those of the groundmass. The largest pumice has brownish clay alteration as well as tiny crystals growing into voids.

The principal phenocrysts are plagioclase, sanidine, quartz, and biotite. Plagioclase phenocrysts are 0.8 to 2.0 mm in diameter, often zoned, and mostly resorbed around edges and in patches in centers of grains. Plagioclase also occurs as a microphenocryst. Sanidine occurs as rounded grains 0.8 to 2.0 mm across. At least one angular, resorbed quartz fragment, ~0.9 mm in length, was noted. Biotite flakes are golden red-brown to nearly black-brown and ~0.5 to 0.7 mm long. Biotite also occurs as microphenocrysts 0.2 mm long.

2. G2-3366 (1026.0 m) Nonwelded to slightly welded, devitrified, ash-flow tuff

The groundmass is devitrified to very low birefringent grains of sanidine and cristobalite ~0.03 mm in size. The groundmass is light tan in plane light. Many irregular voids contain tiny crystals growing into them, but fewer than in G2-3307. Tiny (~0.03-mm), doubly terminated, prismatic, clear crystals occur adjacent to opaque crystals and patches. Shards are up to 0.2 mm in length, are characterized by axiolitic devitrification, have beige

rims, and contain clear center fillings. Shards are subaligned, but not all have the same orientations.

Pumice lapilli are difficult to distinguish from lithic fragments. Two types of pumice occur: (1) wavy patches of coarser devitrification products and clays that look like completely collapsed pumice, and (2) others that look the same but have not been flattened.

The principal phenocryst phases are quartz, plagioclase, sanidine, and biotite. Most phenocryst fragments are resorbed on one or more sides, sometimes until there is hardly anything left of the crystal. Quartz is ~1 mm long and is severely embayed. Plagioclase phenocrysts range up to 0.9 mm in length. Some clots of plagioclase are larger, but the individual grains are small. Sanidine is up to 1.5 mm length. Biotite laths are 0.3 to 0.9 mm long, and straw or red-brown to almost opaque in color.

3. G2-3416 (1041.2 m) Partly welded(?), devitrified ash-flow tuff

The groundmass is tan and contains 10 to 15% opaque particles ~0.01 mm in diameter. It is coarsely devitrifed (0.02 to 0.06 mm) to feldspar and silica. Some finer grained, plumose devitrification phases, possibly consisting of feldspar, also occur in the groundmass. Because of coarse devitrification, shards are sometimes difficult to identify. In general, they are 0.2 to 0.4 mm long and have somewhat rounded edges. Axiolitic feldspar and silica are common in the shards. There is some minor alignment of shards, but little if any draping around phenocrysts.

Pumice lapilli are large, undeformed, subangular to subrounded, finely crystalline fragments. There is some brown alteration within these pumices, consisting of iron oxides and silica.

Phenocrysts are rounded, severely resorbed, and embayed. Feldspars 0.5 to 1.0 mm long are full of tiny opaque alteration products preferentially oriented along cleavages. Quartz phenocrysts are <1 mm long and rounded. Biotite crystals are up to 0.4 mm in length, rounded on the ends, and golden brown to nearly black. The biotite appears to be only slightly altered or oxidized.

4. G2-3492 (1064.4 m) Nonwelded, devitrified, zeolitized ash-flow tuff

The groundmass is light beige in plane light. Under crossed-nicols it appears to be made up of finely crystalline, very low birefringent materials. Small vugs in the groundmass are filled by crystals of authigenic feldspar. Shards are 0.1 to 0.5 mm long, clear, and sometimes have beige rims. Delicate shard features are generally well preserved. Shards are generally replaced by zeolites. Fibrous mordenite grows in from the edges of shards, looking like rutilated quartz. The rims of shards, which are finely accicular and grow perpendicular to the edge, are probably mordenite. There is no alignment of shards.

Pumice lapilli are undeformed, darker tan than the groundmass, and contain brown streaks in plane light. Every tubular vesicle is lined with yellow birefringent clay. Pumice contains phenocrysts of feldspar (plagioclase and probably sanidine), embayed quartz, and biotite fragments.

Phenocrysts make up 10% of the rock. Plagioclase (0.2 to 0.9 mm), quartz (0.3 to 1.0 mm), and sanidine (~0.5 mm) are the principal phenocrysts. Biotite (~0.5 mm) is present in trace amounts. All phenocrysts are rounded and severely embayed.

5. G2-3541 (1079.3 m) Nonwelded, devitrified, partially zeolitized, crystal-rich ash-flow tuff

The groundmass is mostly tan with flecks of opaque minerals. It has a rather chaotic appearance because opaques appear as streaks and swirls in plane light. Yellow-white birefringent clays look the same under crossed-nicols. The groundmass is devitrified throughout, but only the clays show up under crossed-nicols. Shards are up to 0.5 mm in length and generally clear in plane light except for a few needles. The rims of the shards are clearer than the centers. The shards are replaced by zeolites (analcime). There is no apparent lineation to the shards.

Phenocrysts make up 20 to 25% of the rock. Most are angular and broken. Some show evidence of resorption. Quartz and sanidine are the most common phenocryst phases. Plagioclase and biotite are relatively minor phenocrysts phases.

J. Tram Member of the Crater Flat Tuff

1. G2-3671 (1118.9 m) Nonwelded, slightly reworked bedded tuff

In general, this is an extremely immature, calcite-cemented, epiclastic rock. Most of the very delicate shards (relict) are well preserved in a very diverse, lithic-rich matrix. This sample is crossed by irregular fractures <10 to 150 µm wide and filled with calcite cement. About 55 to 60% of the rock consists of material <200 µm across, which is termed here as matrix. This matrix consists of mostly relict shards in a microcrystalline cement. The shards are beautifully preserved as relicts outlined by chains of 0.5- to 2.0-µm hematite grains. No glass is preserved. Supported within this matrix are coarser (>200-µm) shards and small pumice clasts. The secondary mineralogy of these coarser pyroclasts is variable, consisting of (1) inward-growing, finely crystalline, equant, low-birefringent phases around open vugs, (2) replacement phases with very low birefringence, and (3) pumice pyroclasts (equant to slightly elongate) replaced entirely by anhedral phases of very low birefringence. Elongate vesicles within the pumices are filled with finely crystalline (<1- to 2-µm) colorless phases with low birefringence. Some of the vesicles in the long-tube pumice are replaced by colorless, highly elongate, platy or fibrous phases with intermediate birefringence. This phase is plastically deformed when compressed between adjacent grains. Pumice pyroclasts have only rare phenocrysts and are rimmed by microcrystalline hematite. Delicate relict bubble-wall projections are preserved in some of the pumice lapilli. Some vesicles in coarser pumice pyroclasts are filled with carbonate cement.

The most common phenocrysts are plagioclase, sanidine, quartz, and biotite. Opaque oxides occur in trace amounts. Plagioclase has complex oscillatory zoning and occurs as anhedral to subhedral grains 1 to 2 mm long. Some thoroughly comminuted anhedral fragments of plagioclase are in the 300- to 400-µm size range. Sanidine occurs as unzoned equant, subhedral crystals 1 to 1.5 mm in diameter. Quartz is found as equant, subhedral grains in the 0.5-mm-diam range. Some elongate, broken fragments are up to 2 mm long. Biotite occurs as subhedral, ragged-ended grains 0.5 to 0.75 mm in diameter.

The section is dominated by a 15- x 9-mm andesite(?) fragment. Oscillatory-zoned plagioclase (150 to 1500 µm) and opaque phenocrysts occur in

an aphanitic matrix of fine plagioclase laths. The matrix plagioclase is mostly tabular, but includes some extensions and hollow forms (quench textures). Some alteration of the andesite to clays(?) and hematite has occurred.

2. G2-3772 (1149.7 m) Nonwelded, devitrified, lithic- and crystal-rich ash-flow tuff

About 50% of the rock consists of very delicate, thin-walled relict shards 100 to 500 µm long and 10 to 150 µm wide. The relict texture is visible because of clusters of 1-µm hematite grains along former pyroclast boundaries. The pyroclasts have been replaced by finely crystalline (3- to 10-µm long), colorless, low-birefringent phases and a slightly higher birefringent flaky phase. These replacement phases are sometimes finer along pyroclast rims and coarser in cores. Some cores of shards have open void spaces. These cores are rarely filled with layered, botryoidal silica(?) phases. Space between the shards and pumice is filled with very finely crystalline (<2-µm), colorless phases and finely crystalline hematite grains. There are some coarser hematite phases (up to 40 µm) scattered throughout the groundmass, but they are a relatively minor component of the rock.

Phenocrysts make up ~20% of the rock. The principal phenocrysts are quartz, plagioclase, and biotite. Quartz is usually subhedral to anhedral and 200 to 400 µm in diameter. Plagioclase occurs as slightly elongate, subhedral phenocrysts 450 to 600 µm long. Biotite occurs in euhedral laths up to 300 µm long.

Lithic fragments make up ~30% of the rock. These lithics consist of older andesitic to rhyolitic tuffs. These lithics are 1 to 4 mm long and slightly elongate. They are dominated by pale-brown, finely crystalline secondary phases. Very faint relict textures can be barely identified. Ferromagnesium phenocrysts are replaced by hematite; plagioclase phenocrysts are altered to carbonate and clay. Quartz phenocrysts are unaltered. A less common type of lithic are lavas with trachytic texture. Plagioclase phenocrysts in these lava lithics are altered to calcite and clay.

3. G2-3875 (1181.1 m) Partly welded, devitrified, crystal-rich tuff

Relict shards and pumices are difficult to distinguish because they merge into the matrix. The "rims" of hematite described in previous Tram samples are absent here. These hematite rims seem typical of only nonwelded tuffs in this sequence. Shards and pumice lapilli are replaced by rims of pale-brown, low-birefringent material <2 μm across and cores of low-birefringent anhedral phases (alkali feldspar or silica) up to 15 μm across. The areas between pyroclasts are made up of finely crystalline (<5-μm) phases, including platy clays and pale-brown, low-birefringent phases. Pumices are ragged and poorly preserved. They are generally 2 to 4 mm long and slightly elongate. These pumice lapilli are replaced by pale-brown, low-relief smectites with some traces of alkali feldspar or SiO_2. The cores of several pumice lapilli are replaced by calcite.

Phenocrysts make up ~20% of the rock. The most common phenocrysts are plagioclase, quartz, oxides, and sanidine. Most phenocrysts are subhedral or broken and 200 to 1000 μm in length. Plagioclase phenocrysts are either unzoned or have oscillatory zoning. The oxides are mostly replaced by hematite.

Lithic fragments make up ~15% of the rock. They consist mainly of older tuffs that are similar to those described for G2-3792. In addition to the older tuffs, there are also broken spherulites and thoroughly altered lavas. The lavas have a trachytic texture, but nearly all mineral phases are replaced by carbonate and low-birefringent microcrystalline phases, heavily stained by hematite.

4. G2-3933 (1198.8 m) Partly welded, devitrified, crystal-rich, bedded(?) tuff

Relict textures are difficult to see in this unit because of extreme alteration. Faint patterns of what appear to be oriented, slightly deformed pumice pyroclasts are dominant and make up most of the sample. These 1- to 4-mm-long pyroclasts are wispy, "ghosts" of the original pumice lapilli. The pumice has been replaced by low-birefringent, granular alkali feldspar and SiO_2 (8 to 24 μm) interspersed with a higher birefringent low-relief brown clay. Relict elongate vesicles in pumices are marked in some cases by

parallel lines of medium-brown, finely crystalline phases. The matrix between relict pumices is composed of low-birefringent, colorless, finely crystalline secondary minerals. Some matrix pore space is filled with calcite (~5% of the rock). There may be some epidote in the groundmass.

The phenocrysts in this sample are similar modally and in size to those described in G2-3875, with only minor differences. Biotite, for example, is more common than in the upper part of the Tram. Plagioclase phenocrysts are commonly strained and show undulatory extinction. Also, most phenocrysts are shattered and broken. Sulphide and hematite are accessory phases. Lithic fragments make up ~5% of the rock. They consist of well-formed plumose, light-tan spherulites, and older crystallized tuffs.

5. G2-4005 (1220.7 m) Nonwelded, devitrified, crystal-rich, ash-flow tuff

This rock consists of shards and pumice pyroclasts (both are relicts) in very fine-grained, brown or orangish-brown matrix material. The relict shards are replaced by colorless, low-birefringent, fibrous phases (1 to 3 μm) along outer edges and 12- to 20-μm granular phases in cores. Both shards and pumices are outlined by a matrix containing small (<1-μm) hematite grains. Low-relief (in reflected light), reddish-brown, low- to medium-birefringent clays occur in the matrix. Some void spaces in the matrix are filled with carbonate and low-birefringent, coarsely crystalline phases. Delicate, wispy pumices up to 3.5 mm long are identifiable in the matrix. These pumices are replaced by pale-brown, low-relief smectites. Some pumices are aphyric and others have glomeroporphyritic clots of plagioclase, biotite, and magnetite. Biotite (up to several mm in diameter) is prominent as a phenocryst in the pumice pyroclasts. Plagioclase phenocrysts are subhedral or euhedral and are zoned.

Phenocrysts make up ~40% of the rock. The most common phenocrysts are plagioclase with oscillatory zoning. Less common are quartz, amphibole(?), biotite, and oxides. Nearly all phenocrysts are subhedral or anhedral, having been broken or shattered. The amphibole and biotite phenocrysts are extremely altered.

Lithic fragments make up 7 to 10% of the rock. They consist of older tuffs with hematite-stained spherulites and pale-brown lavas with faint

relict-flow banding and phenocrysts of amphibole, plagioclase, and biotite (all altered or replaced by secondary minerals).

K. Rhyodacite Lava Between the Tram Member of the Crater Flat Tuff and Lithic Ridge Tuff

1. G2-4090 (1246.6 m) Ash flow at the top of hornblende-biotite rhyodacite lava flow

The groundmass is greatly recrystallized to granular quartz and feldspar intergrowths bounded by brown clay-rich zones. Fine-grained (<0.1-mm) carbonate growths cut across textures of the clay-quartz-feldspar mixture in the matrix. Shard relicts show slight deformation and draping around phenocrysts. These shards have undergone complete granular recrystallization to quartz and feldspar. Pumice lapilli are characterized by collapsed vesicles. At one end of the thin section the lapilli are almost totally replaced by blue clay. Pumices at the other end of the thin section retain a granular texture with minor amounts of clay.

Plagioclase phenocrysts make up 20 to 25% of the thin section. Some plagioclase grains are up to 3 mm in length, but most are <0.5 mm. Strongly zoned andesine is the commonest type of plagioclase, but many grains are heavily altered to carbonate and clay replacements. Multistage plagioclase growth is suggested by biotite-rich cores mantled by biotite-free rims. Quartz phenocrysts ($\leq$0.5 mm) make up 1% of the thin section and typically are slightly strained and rounded. Biotite ($\leq$1.0 mm) comprises 1% of the rock and is characterized by brown-red to straw-yellow pleochroism. Amphibole ($\sim$0.3 mm) occurs in trace amounts and is heavily altered, possibly to chlorite, serpentine, and clay. Zircon and oxides are accessory phases.

Lithic fragments include porphyritic dacite with phenocrysts of hornblende and plagioclase. Hornblende is completely replaced by opaque minerals. The groundmass of these lithics is feldspathic with trachytic flow orientation. These lithics are not accidental inclusions.

Veins cutting the rock are characterized by botryoidal crystobalite walls, and centers of granular quartz. There is some clay near the vein walls.

2. G2-4124 (1257.0 m) Altered, vitrophyric, hornblende-biotite rhyodacite lava flow

The matrix forms ~55% of the sample; much has been altered to isotropic pale-brown analcime. Relict perlitic cracks are filled by birefringent clay. Rare patches of matrix have recrystallized to albite(?), rare calcite, and brown clay (final infilling).

Phenocrysts consist of plagioclase, amphibole, and biotite. Plagioclase grains (25%) have strong to moderate oscillatory zoning and many have been broken in areas of concentrated brecciation. The cores of these crystals are labradorite. The maximum size of plagioclase crystals is ~3 mm. Amphiboles (10%) are largely altered or disaggregated and have olive-green to pale yellow-green pleochroism. Amphibole crystals are up to 1 mm long and subhedral. Biotite (5%) occurs as well-preserved phenocrysts. Crystals are commonly subhedral and up to 1 mm across. Accessory phases include abundant titanomagnetite and apatite and rare zircon.

L. Bedded Tuff Between the Tram Member of the Crater Flat Tuff and the Lithic Ridge Tuff

G2-4167 (1270.1 m) Devitrified, crystal-rich, bedded tuff

The groundmass is a patchy yellow-brown color and consists of numerous clays in "grid" pattern similar to the nonwelded ash flow in sample G2-4005. Calcite is very abundant, although most is concentrated in large grains (1 mm), replacing pumice fragments as well as plagioclase and amphibole(?) phenocrysts. Shards have been replaced by granular silica and feldspar intergrowths. There is little apparent deformation, but relict shards are difficult to identify. Pumices are also recrystallized to granular quartz and feldspar intergrowths and to clay. Some pumices contain apple-green spheroids of very finely intergrown quartz-feldspar-clay.

Plagioclase phenocrysts make up 25 to 30% of the rock. They are up to 3 mm in length but average ~0.7 mm. Oscillatory zoning is common. Many plagioclase phenocrysts are almost completely replaced by calcite and clay. Biotite phenocrysts make up 1% of the rock. They are generally up to 0.5 mm long, red-brown to straw-yellow, and contain inclusions of zircon and possibly

apatite. Trace quartz is present in the rock as very small (~0.2-mm), unstrained grains. Amphibole(?) may be present in this sample, but it is highly altered and replaced by calcite. Accessory minerals include magnetite (largely altered to hematite), zircon, and apatite.

Lithic fragments consist of biotite-dacite clasts (0.8 cm) with relict flow-deformation in the groundmass. There are also smaller lithics with a very fine-grained, feldspathic (trachytic) texture.

M. Lithic Ridge Tuff

1. G2-4199 (1279.9) Densely welded, crystal-rich tuff

The groundmass is dark brown and consists of granular quartz, feldspar, and scattered clays. Calcite is abundant as patchy microcrystalline zones ~1 mm in diameter, developed across pumice and groundmass areas. Shards are replaced by blocky quartz and feldspar that have undulatory extinction and might have been strained after replacement. Pumices are severely flattened and are characterized by abundant dark clay. Some pumices enclose "euhedral" calcite, replacing plagioclase.

Plagioclase phenocrysts make up 20% of the rock and are up to 1 mm in length but average ~0.05 mm. Oscillatory zoning and biotite-plagioclase intergrowths are common. Some plagioclase grains are partially to totally replaced by calcite. Biotite makes up <1% of the rock and is up to 0.7 mm in length. The biotite is dark red-brown to straw-yellow and contains apatite inclusions. Quartz occurs in trace amounts as small (<0.2-mm), unstrained grains.

Lithic fragments consist of recrystallized shard-rich vitrophyres and a biotite-bearing volcanic breccia with vesicles filled by quartz and feldspar. Accessories include magnetite-hematite and apatite.

2. G2-4209 (1282.9 m) Nonwelded, devitrified lithic-rich tuff

The groundmass is pale tan to dark brown and contains quartz-feldspar intergrowths and abundant fine-grained clay and calcite. Dark patches of nonbirefringent blue clay are abundant but small (<0.3 mm). Some shards have been replaced by granular quartz-feldspar intergrowths; other shards are

totally replaced by calcite. Pumices are well preserved though somewhat flattened and totally replaced by calcite.

Quartz phenocrysts make up ~5% of the rock. They are slightly strained or unstrained and as much as 0.5 mm across. Plagioclase phenocrysts make up about 8% of the rock and generally have slight normal zoning from oligoclase cores. These plagioclase grains are up to 2 mm in size and are replaced by clay but not calcite. Sanidine makes up 4% of the rock and is up to 1 mm in size. Biotite makes up 2% of the rock and is typically deep yellow to very dark brown-black and heavily oxidized. Accessory phases include sparse zircon and oxidized magnetite (<0.2 mm).

A diverse assortment of lithic fragments comprise ~60% of the thin section and are 1 to 2 cm in size. Biotite-hornblende-plagioclase dacite lithics make up ~40% of the thin section. Biotite is rimmed by heavy oxidation, and amphiboles are completely oxidized or replaced by calcite. The plagioclase is generally oligoclase or andesine. Vugs are lined with euhedral authigenic quartz and albite crystals and are filled by calcite. Microgranular silicic volcanic lithic fragments (devitrified) with biotite phenocrysts make up ~2% of the rock. Welded silicic tuff lithics (~5% of the rock) are characterized by abundant shard structures with granular or radiotaxial replacement and by quartz, sanidine, and plagioclase phenocrysts. Very feldspathic silicic volcanic lithics (~90% plagioclase) with biotite phenocrysts (completely replaced) make up ~2% of the thin section. Several aphyric lithics (~5% of the rock) represent welded tuff replaced by quartz, feldspar, clay, and carbonate. Lithics consisting of large, coalesced spherulites up to 3 mm across make up ~4% of the thin section.

3. G2-4267 (1361.5 m) Slightly welded, devitrified ash-flow tuff

The groundmass is very pale yellow and shard rich. It is very distinct from sample G2-4209. Clays are abundant in flattened pumices and along fractures but are otherwise relatively rare. Shards are largely replaced by granular quartz and feldspar intergrowths and by calcite. Shards exhibit only very slight deformation. Typical relict pumices are only slightly flattened and are totally replaced by calcite, except for rare albite crystals. Rarer pumices(?) are more strongly flattened and replaced by clay.

Lithic fragments make up ~3% of the thin section. The most common types are: (1) glassy siliceous vitrophyre with granular shard replacement and spherulitic zones (~0.5 cm), (2) biotite-magnetite dacitic(?) lava, and (3) heavily altered feldspathic sandstone (~0.5 cm) containing abundant clay.

The principal phenocrysts are quartz, plagioclase, sanidine and biotite. The quartz (up to 1 mm) makes up 4% of the rock and is slightly strained. Plagioclase (up to 2 mm) makes up 7% of the rock, exhibits slight oscillatory or normal zoning, and is partially replaced by clay. Sanidine (up to 2 mm) makes up 4% of the rock. Biotite comprises about 1% of the rock and is up to 1 mm in size. Accessories include apatite, zircon, magnetite, and ilmenite(?).

4. G2-4329 (1319.5 m) Slightly welded, devitrified ash-flow tuff

The groundmass contains abundant, slightly deformed relict shards in a dark-brown matrix with abundant clay. Blue clays (poorly birefringent and dark) replace some pumices. Shards are abundant and dominantly replaced by granular quartz and feldspar intergrowths; otherwise they are totally replaced by calcite, and/or albite. Pumices are sparse and small (<1 to 2 mm) and replaced by granular quartz-feldspar intergrowths. Calcite is relatively rare, in contrast to Lithic Ridge samples from higher levels.

The principal phenocrysts are quartz, plagioclase, sanidine, and biotite. Quartz cystals are unstrained, are <1 mm in size, and make up ~2% of the rock. Plagioclase (7%) is generally slightly zoned and extensively altered to birefringent clay. Sanidine (4%) occurs in crystals up to 1.2 mm in size. Biotite (<1%) occurs as yellow-brown to dark black-brown crystals <0.7 mm in size. Accessory phases include magnetite (oxidized) and one very small zircon.

Lithic fragments consist of (1) highly altered quartzite (5% of thin section), (2) oxide-rich altered glass of unknown primary composition (~4% of thin section), (3) badly altered biotite-hornblende dacite(?) (2%), and (4) spherulitic and altered-spherulitic silicic volcanic fragments containing badly altered biotite and plagioclase and crossed by a fracture that is lined with authigenic albite crystals.

5. G2-4467 (1361.5 m) Slightly welded, devitrified ash-flow tuff

The groundmass is very pale brown, with large (0.5-cm) patches of blue clay and one small patch of green (chlorite) alteration. Calcite is scattered as patches within the groundmass; it replaces some pumices and fills fractures. Calcite is apparently more abundant in thin sections containing blue clay. Relict shards are replaced by granular quartz and feldspar. Most pumice lapilli are slightly flattened and altered to poorly birefingent, dark-blue clay. Blue clays occur along with albite and some fine-grained chlorite. Relict textures are very poorly preserved. The thin section contains a large (0.7-cm) vesicle(?) lined by clay. This "vesicle" may represent a complete pumice loss.

The principal phenocrysts are plagioclase, sanidine, quartz, and biotite. Plagioclases (4%) are up to 1 mm in length, have subdued oscillatory zoning, and are heavily altered to clay ± calcite. Sanidine phenocrysts (3%) occur as unzoned, unaltered, euhedral tabular crystals up to 1 mm across. Quartz (3%) is usually very slightly strained and broken. Biotite phenocrysts (<1%) are up to 0.3 mm in diameter. Accessory phases include zircon (rare) and magnetite.

Lithic fragments consist of the following types: (1) biotite-hornblende dacite(?) containing relict pseudomorphs of ferromagnesian minerals characterized by opaque rims and albite, opaque, and chalcedony interiors (3% of thin section); (2) feldspathic volcanic fragments (<1% of thin section); (3) brown spherulite fragments 1 to 2 mm in size (<1% of thin section); and (4) mottled yellow clay replacement of a feldspathic volcanic rock (<1% of thin section).

6. G2-4570 (1392.9 m) Slightly welded, devitrified ash-flow tuff

The groundmass of this sample is pale brown and contains abundant relict shard forms. Minor calcite is typically associated with alteration of plagioclase phenocrysts. Shards have recrystallized to granular quartz and feldspar. Pumices are a relatively minor constituent of the sample. They are flattened, deformed, and largely replaced by birefringent clay.

Phenocrysts consist of sanidine, plagioclase, quartz, and biotite. Sanidine (6%) occurs in unaltered crystals up to 2 mm in diameter. Plagioclase crystals (4%) are poorly zoned albite-oligoclase up to 1.5 mm long.

They are badly altered to clay and calcite. Quartz (1%) occurs as small, broken grains <0.5 mm across. Biotite (<1%) occurs as dark-brown to pale-yellow laths <1 mm in length.

Lithic fragments consist of the following: (1) a large fragment (1.5 cm in diameter) of feldspathic volcanic rock with calcite/clay alteration and no evidence of ferromagnesian minerals (voids in this clast are filled by zoned silica phases); (2) spherulites with some poorly zoned plagioclase grains that have fan-like growths up to 1.5 mm in diameter (~3% of thin section); (3) plagioclase-biotite dacite(?); and (4) badly altered hornblende(?)-biotite dacite (<2% of thin section).

7. G2-4788 (1459.4 m) Slightly welded, devitrified ash-flow tuff

The groundmass is similar to that of the previous samples. Shards are slightly deformed or undeformed and are replaced by granular intergrowths of quartz and feldspar. Pumices are only slightly deformed and almost entirely replaced by clay. Clays continue laterally from pumices into seams and fractures. Pumice lapilli are much more abundant than in G2-4570 but less flattened.

Phenocrysts consist of sanidine, quartz, plagioclase, and biotite. Sanidine (4%) usually occurs as unaltered, euhedral to subhedral, tabular grains <1 mm in diameter. Quartz (2%) occurs as moderately strained, broken grains <0.5 mm across. Plagioclase (2%) is typically poorly zoned, extensively replaced by calcite, and <1 mm in diameter. Biotite (<1%) occurs as altered grains <0.2 mm long.

Lithic fragments consist of the following types: (1) feldspathic volcanic rock with well-preserved plagioclase (1% of thin section); (2) granoblastic, recrystallized feldspathic volcanic rock containing sanidine, plagioclase, and quartz (2% of thin section); and (3) badly altered biotite-dacite (2% of thin section).

N. Bedded Tuff at the Base of the Lithic Ridge Tuff

G2-4805 (1464.6 m) Nonwelded, devitrified, pumice-rich bedded tuff

This sample is dominated by recrystallized pumice and by clay interfacings between pumices. Very few shard structures are evident. The pumice fragments are only slightly deformed but are sometimes draped around plagioclase and biotite grains. Pumice fragments range in size from ~1 mm to 1 cm; pumice replacements are dominantly albite, quartz, and alkali feldspar. Birefringent clays are concentrated in seams between pumice fragments. Some pumices contain voids lined by euhedral authigenic albite.

Phenocrysts consist of plagioclase, sanidine, quartz, and biotite. Plagioclase (9%) is very poorly zoned and generally very poorly preserved. Many grains contain voids filled by calcite. Sanidine (3%) occurs as rather small (<0.3-mm), altered grains. These grains frequently contain voids, though less commonly than in plagioclases. Quartz (3%) occurs as rounded and embayed grains. Biotite is rare and occurs as small, heavily altered crystals <0.2 mm in size. Accessory phases include titanomagnetite, zircon, and apatite.

The only lithics occurring in this sample are spherulites; they make up <2% of the rock.

O. Rhyolite Lavas

1. G2-4838 (1474.6 m) Slightly welded, devitrified ash-flow tuff

The matrix is heavily recrystallized to feldspars and quartz. No shard forms are evident. Pumices are spindled and only very slightly draped. They are typically replaced by granular feldspar and quartz intergrowths as well as by calcite. Clays are also common within pumice, though they are concentrated around the margins of pumice remnants.

Phenocrysts consist of plagioclase, sanidine, quartz, and biotite. The plagioclase (8%) consists of altered grains with voids (plucked?) and calcite replacement in cores. Individual plagioclase grains range up to 2 mm but average ~1 mm. Glomeroporphyritic clots of plagioclase are up to 0.5 cm in diameter. Sanidine grains (<1%) are altered and small (<0.5 mm). Quartz

(<1%) occurs as rounded or frayed grains <0.5 mm across. Biotite (<1%) occurs as frayed grains up to 2 mm across with interlayered oxides. Accessory phases include titanomagnetite (oxidized), zircon, and apatite.

Lithic fragments are very rare, making up ~1% of the rock. They consist entirely of broken spherulites.

2. G2-4924 (1500.8 m) Top of recrystallized dacite lava flow

The matrix is very faintly banded and heavily recrystallized. Granular intergrowth of quartz, plagioclase, and sanidine are the principal matrix components. Birefringent brown clays are evenly distributed throughout the groundmass. Calcite is localized along fractures.

The principal phenocrysts consist of plagioclase and biotite. The plagioclase (5%) is moderately zoned oligoclase. Calcite alteration is common in plagioclase cores. Except for fractures, all calcite within the thin section occurs as an alteration of plagioclase. Individual plagioclase grains are up to 0.5 cm in length; there are some glomeroporphyritic clots of plagioclase or of plagioclase and biotite. Biotite makes up 3% of the thin section and commonly contains apatite inclusions. Some biotites are distended along cleavage by quartz-feldspar intergrowths. The largest biotite grains are ~1 mm in length; the average grain size is 0.5 mm. Accessories include titanomagnetites with zircon inclusions, apatite, and freestanding zircon.

3. G2-5017 (1529.2 m) Flow-banded interior of dacite lava flow

The matrix is coarsely recrystallized to sanidine and quartz. Quartz patches are up to 0.2 mm across, and sanidine <0.02 mm. Fairly dark to pale-dark flow-banding is common. Late-stage, pale albite flow-bands parallel to principal flow-banding have well-defined plumose terminations. Spherulites of quartz, albite, and sanidine are up to 0.5 cm in diameter in the matrix.

The principal phenocrysts are plagioclase and biotite. Plagioclase (5%) consists of unzoned to very slightly zoned oligoclase. Some plagioclase grains have faint sanidine rims. Calcite alteration of cores is common. Individual plagioclase grains are up to 0.5 cm across but are commonly 1 mm in size. Biotite makes up <1% of the rock. Individual grains are up to 2 mm long and are poorly preserved. Some biotite grains are expanded along

cleavage or embayed by groundmass recrystallization. Greenish coloration and low birefringence of biotite suggests abundant alteration to chlorite. Inclusions of apatite and zircon are common within biotite. Accessory titanomagnetites (<0.3 mm) also contain zircon and apatite inclusions.

4. G2-5144 (1567.9 m) Lower brecciated lava flow, below spherulitic zone

The groundmass consists of dark-brown masses of poorly birefringent clay and fine-grained quartz and feldspar. It is seamed by fractures (autoclastic?) that are filled with granular quartz. Some fractures are filled or lined with albite. No calcite occurs in these fractures, although it is abundant in the groundmass. Spherulites are rare (<1%) in the groundmass and up to 3 mm across. These spherulites consist of quartz-feldspar radial growths that apparently postdate the autoclastic fracturing.

The principal phenocrysts are biotite, amphibole, and plagioclase. Euhedral biotite crystals (3%) 1 mm in length are relatively well preserved and commonly contain apatite inclusions. Amphibole phenocrysts (rare) consist of relicts completely replaced by clays and quartz and outlined by black opaque zones. These amphibole relicts are ~0.6 mm across. Plagioclase is notably rare in this thin section (<1%), compared to higher portions of this flow. All plagioclase grains are completely altered to calcite and albite. Accessories include titanomagnetite, zircon, and apatite.

P. Quartz Latite Lavas

1. G2-5206 (1586.8 m) Autoclastic top of crystal-rich lava flow

The groundmass contains ragged intergrowths of birefringent brown clay with fine-grained feldspars and quartz. Sparse fractures are filled with quartz and may be lined by albite. Autoclastic brecciation is very slight if present at all.

The principal phenocrysts consist of plagioclase, biotite, amphibole, and pyroxene. Plagioclase is very abundant (30%) and extremely altered to red-brown birefringent clay. Alteration to calcite is absent. A few unaltered patches show original polysynthetic twinning. Plagioclase grains are up to 0.5 cm in length but average ~2 mm. Biotite (4%) occurs in

moderately well-preserved crystals up to 1 mm long and averaging ~0.3 mm. Amphibole phenocrysts (1%) are totally replaced by quartz and opaques. Relicts of these grains are up to 1 mm long, though many are <0.3 mm (possibly two populations). Pyroxene pseudomorphs (<1%) have octagonal outlines and apatite inclusions; they are completely replaced by granular quartz. Accessories include titanomagnetite, apatite, zircon, and rare sphene (one grain).

2. G2-5305 (1617.0 m) Interior of lava flow

The groundmass is dark brown and has very low birefringence. It consists of clays intergrown with feldspar and quartz. Most fractures cutting the groundmass are irregular and dominantly clay filled. A large vein, however, is filled by granular quartz and calcite or clay. Calcite fillings are concentrated near the centerline of this major vein, whereas clay fillings concentrate in sparry growth centers of the groundmass.

Phenocrysts include plagioclase, amphibole, biotite, and pyroxene(?). The plagioclase (7%) is poorly preserved, slightly zoned oligoclase, with some sanidine rims. There is thorough replacement of cores (and some complete crystals) by clay and calcite. Some plagioclase occurs with biotite as glomeroporphyritic clots. Plagioclase phenocrysts are up to 2 mm in length and average 1 mm. All amphibole phenocrysts (3%) are completely replaced by quartz, opaques, and dark low-reflectivity rims; relict grains are up to 2 mm long. Biotite (<1%) is extensively replaced by opaque minerals. Pyroxene(?) relicts make up <1% of the rock. They now consist of tabular quartz pseudomorphs. Accessories include titanomagnetites, apatite, and zircon.

3. G2-5379 (1639.5 m) Interior of middle rhyodacite lava flow

The matrix consists of intergrown clays, quartz, and feldspars. Yellow-brown clays predominate at the walls of fractures and voids that have been filled by granular quartz. The last mineral precipitated in voids is calcite.

Phenocrysts include plagioclase, amphibole, biotite, and pyroxene(?). Plagioclase (7%) is extensively altered to clay and/or calcite. Grains average ~0.7 mm in size though some are up to 1 cm. Glomeroporphyritic clots are common. Amphiboles (3%) are totally replaced by quartz, fine-grained

oxides, and an opaque phase of low reflectance. Crystal relicts average ~0.5 mm in size. Biotite grains (1%) are altered and up to 2 mm long. Pyroxenes (<1%) are replaced by octagonal quartz pseudomorphs. Accessory phases include titanomagnetite, zircon, and apatite.

4. G2-5493 (1674.3 m) Silicified interior of rhyodacite lava

The matrix consists of very pale yellow-brown intergrowths of feldspars and quartz. Clay is not as abundant as in sample G2-5379. Fractures with widths up to 0.5 mm are (1) filled with quartz, (2) lined with quartz and have a second-stage calcite filling, or (3) lined with quartz and have a second-stage clay filling.

Phenocryst phases include plagioclase, biotite, amphibole, and pyroxene(?). Plagioclase (10%) is altered and cores are replaced by calcite and clay. Zoning is very poorly preserved if present at all. There is some evidence for two-stage growth. Grains are up to 3 mm long; some are in glomeroporphyritic clots with biotite and magnetite. Biotite (3%) consists of well-preserved grains up to 2 mm long. Amphiboles (1 to 2%) are ~0.5 mm in diameter and totally replaced by quartz and oxides. Some amphibole relicts have biotite inclusions. Probable pyroxenes (<1%) are pseudomorphed by quartz. Accessories include zircon, apatite, and titanomagnetite.

5. G2-5596 (1705.7 m) Pumice-rich, basal zone of middle rhyodacite lava flow

The matrix consists of coarse (0.1-mm) granophyric quartz intergrown with feldspar and interstitial clay. Pumice fragments are unflattened, up to 0.5 cm in diameter, and make up more than 70% of the thin-section area. Pumice replacements are one of two types: (1) vesicle walls altered to clay and vesicles infilled by quartz and feldspar with no crystals larger than 0.01 mm, and (2) total pumice replacement by two or three calcite crystals with vesicle walls preserved by clay.

Phenocryst phases are plagioclase and biotite. Plagioclase phenocrysts (8%) are badly altered and have abundant calcite in their cores. Some crystals are as large as 0.5 cm. There is no apparent zoning. Biotite grains (1%) are also very badly altered. The original pleochroism has been washed

out, probably because of alteration to chlorite. Alteration of biotite results in lensoid inclusions of sphene. Accessories include apatite, zircon, and titanomagnetites.

Q. Ash-Flow Tuff

1. G2-5638 (1718.5 m) Lithic-rich lahar or reworked, devitrified, lithic-rich tuff

This is a reworked sample and probably contains a mixture of pyroclastic and lava-type volcanic rocks. Crystals are rounded and broken; lithic fragments are varied and rounded. This type of assemblage might be indicative of a lahar. The matrix is pale yellow-brown and has a low birefringence. It contains polygonal intergrowths of authigenic quartz and feldspar surrounded by clays. The clays are clear and colorless, with first-order birefringence colors. Some might be chlorite. Pumices are sparse (1 to 2%), deformed, and completely replaced by quartz, feldspar, and clays.

The "phenocrysts" are broken grains that may include many accidental crystals. Plagioclase crystals (4 to 5%) are very badly altered; some are completely replaced by calcite. Quartz (<1%) occurs as angular or rounded grains $\leq$0.5 mm in diameter. Amphiboles (<1%) are typically <0.2 mm across and broken. Some grains are not too badly altered; others are completely replaced by calcite. Biotite (<1%) is generally altered to chlorite ± clay. Accessories include titanomagnetite and zircon. Some titanomagnetite crystals have well-preserved cores and oxidized rims.

Lithic fragments make up >50% of the rock. They are very diverse and show more variety than in the Lithic Ridge Tuff. Included are: (1) pyroclasts with relict vapor phase crystallization, (2) trachytic-textured volcanic feldspathic rocks, (3) a diktytaxitic plagioclase-porphyritic volcanic rock, (4) a plagioclase vitrophyre with quartz and analcime(?) lined vesicles, and (5) a porphyritic dacite.

2. G2-5657 (1724.3 m) Densely welded, devitrified ash-flow tuff

All matrix and shard materials are completely recrystallized to extremely fine-grained quartz, feldspar, and clay(?). Vugs in the groundmass are lined

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by euhedral authigenic albite. Pumices are up to 3 cm across and make up ~15% of the thin section. They consist of euhedral phenocrysts of plagioclase and subrounded titanomagnetite in a dark, yellow-brown clay-rich matrix. All pumices are completely collapsed.

Phenocrysts consist of plagioclase, sanidine, biotite, and quartz. The plagioclase (~5%) is altered to albite and calcite. Polysynthetic twinning is preserved. Most grains are ≤2 mm in diameter. Sanidine (~3%) is replaced by albite(?). Biotite (~1 to 2%) is replaced entirely by colorless, coarse, highly birefringent clay. Quartz (<1%) occurs as small grains <0.3 mm in diameter. Accessories include apatite and titanomagnetite. Apatite grains are very coarse (0.4 mm long) and occur in glomeroporphyritic clots of opaque-plagioclase-biotite. Large, anhedral apatite masses also occur in one corner of the thin section.

Lithic fragments consist of the following: (1) plagioclase-porphyritic volcanic rocks with patchy, intergrown feldspar recrystallization of the groundmass (~2% of thin section); (2) plagioclase-porphyritic, uncollapsed pumices with very fine-grained vug fillings (<1% of thin section); (3) feldspathic, coarse-plagioclase, vesicular porphyritic lava with vesicles filled with yellow-brown clays and chlorite (~2% of thin section); and (4) fragmented spherulites (<<1%).

R. Dacite Lavas

1. G2-5696 (1736.1 m) Upper part of plagioclase-rich dacite lava flow

The groundmass is very dark brown and consists of a mixture of clay, feldspar, carbonate, and quartz. Many vugs are lined by quartz and filled with multiple (two-stage) chlorite growths. A composite, breccia-filled vein cuts part of the thin section.

Phenocrysts consist of plagioclase, hornblende, and pyroxene. The plagioclase (25%) occurs in grains typically ~0.5 mm in diameter but up to 2 mm. All plagioclase is completely altered to albite (unzoned) and calcite. Relict hornblende grains (3%) are generally <0.3 mm across, though one grain is ~0.5 mm. All hornblende is completely replaced by chlorite and quartz. Relict pyroxene grains (1%) are generally <0.2 mm long, though one grain is 1.5 mm long. As with hornblende, the pyroxene is replaced by chlorite and quartz,

although more quartz is evident. Accessories include titanomagnetite and zircon(?).

2. G2-5820 (1773.9 m) Middle of plagioclase-rich, dacite lava flow

The groundmass is made up of pale yellow-brown, very fine-grained, quartz-feldspar-clay intergrowths. There are some free patches of calcite, although most occurs as a replacement of pyroxene and amphibole. There is a major vein cutting through the thin section. It consists of fine-grained (0.05-mm) polygonal quartz filling, coarse calcite patches ($\leq$2.0 mm), and interstitial polygonal chlorite (0.05 mm). One wall of the vein is heavily hematite-stained.

Plagioclase (30%) is the dominant phenocryst phase. It is only slightly altered to sericite. Strong normal zonation of labradorite to andesine is well preserved. Most plagioclase crystals are <1.0 mm in length. Relict amphibole grains (<1%) are replaced by calcite. Relict pyroxene (<1%) is replaced by calcite ± quartz. Titanomagnetite is an accessory phase.

S. Baked Conglomerate and Reworked Tuff

1. G2-5885 (1793.7 m) Baked volcanic conglomerate

The matrix makes up ~80% of the rock. It consists of pale-yellow, silty(?) material recrystallized to coarse, patchy feldspar and fine-grained clay. Freestanding crystals in the matrix include plagioclase and quartz. The plagioclase (12%) is rounded and completely replaced by calcite. Plagioclase grains range from 1 mm to 0.01 mm in size. Quartz (1%) is angular and 0.01 to 0.4 mm in size. Clasts are matrix supported and consist of: (1) devitrified tuff(?) with quartz-filled voids (~2%), (2) rare small pumice (1 mm), (3) plagioclase-porphyritic lava(?) (<<1%), and (4) feldspathic lava with trachytic texture (<<1%).

2. G2-5895 (1796.8 m) Reworked devitrified ash-flow(?) tuff

Shards are very poorly preserved. Those that are evident have been replaced by calcite (and rarely by quartz and albite). Pumices are abundant

(~10%) and small (≤1.0 mm) and have abundant clay fillings. Most are unflattened or only slightly elongate. Rounding of pumice may indicate some reworking. Lithic fragments are rare (<1%) and consist of heavily carbonate-altered lava(?) and "brown hair" spherulites.

The principal phenocrysts are quartz, feldspar, and biotite. The quartz (3%) is subangular to rounded and embayed. One grain is 1.3 mm; others are <0.2 mm. Feldspars (<2%) are totally replaced by calcite. Rare feldspar grains contain relict polysynthetic twinning. Some grains may be relict sanidine(?). Relict biotite grains are rare (<1%) and consist of magnetite inclusions and clay. Accessories include zircon and titanomagnetite.

3. G2-5926 (1806.2 m) Devitrified ash-flow tuff

Shards are reasonably well preserved. There is some replacement by calcite and quartz/feldspar; other shards have undergone total dissolution, and the remaining void space is lined with sparse authigenic albite. Pumices are small (≤2 mm) and rare (<4%). They are slightly flattened and entirely replaced by clay. Lithic fragments are rare (<2%) and consist of felsic volcanic fragments with trachytic texture. They have a yellowish matrix, sodic plagioclase phenocrysts, and radial and fan spherulites.

The principal phenocrysts include plagioclase, sanidine, and quartz. The plagioclase (4%) has some calcite and clay alteration but is relatively well preserved. There is some moderate to normal zoning in some grains. Compositionally the plagioclase is dominantly albite, although there is some oligoclase. Most individual grains are ~0.5 mm in diameter, though some are up to 1.0 mm. Sanidine phenocrysts (1%) have about the same size range as plagioclase. Quartz (1%) occurs as angular, unstrained grains. Accessories include zircon and titanomagnetite.

T. Unnamed Ash Flows

1. G2-5951 (1813.9 m) Devitrified, vapor phase altered ash-flow tuff

There has been total dissolution of some shards; a few albite crystals line the remaining voids. Other shards have been replaced by calcite or albite ± quartz. There are abundant spherulites with radial and plumose

structure. Pumices are up to 1 cm long, greatly flattened, and replaced by clay, calcite, albite, and quartz. Apparently calcite and albite replacements do not occur together. Lithics are rare (<1%) and consist of spherulite and trachytic lavas.

Phenocrysts consist of plagioclase, quartz, sanidine, amphibole(?), and biotite. The plagioclase (8%) is characterized by calcite replacement of crystal cores or of complete crystals. The total replacement of plagioclase by calcite is most effective where the original plagioclase grain occurs along a fracture. Some polysynthetic twinning is preserved, but there is no apparent zonation. Quartz (1%) occurs as angular to embayed grains 0.5 to 1.0 mm in diameter. Sanidine (1 to 2%) is microperthitic and less altered to calcite than plagioclase. Relict amphibole(?) occurs in trace amounts and consists of opaque outlines of amphibole end-sections replaced by quartz. Biotite(?) also occurs in trace amounts and is replaced by a coarse, colorless clay. Accessories include abundant zircon and titanomagnetite.

2. G2-5992 (1826.4 m) Devitrified ash-flow tuff

Shards have been totally dissolved and later infilled by authigenic minerals. Some have albite linings and calcite cores. Others are infilled by quartz and albite. Pumices are highly flattened (~10:1) and replaced dominantly by very coarse-grained clay. Lithics (~1%) include spherulite fragments 0.5 to 1.0 mm in diameter and rare clasts of felty-textured volcanic rock with a very dark matrix.

Phenocrysts include plagioclase, sanidine, quartz, and amphibole(?). Plagioclase (7%) is generally replaced by calcite. Crystals are relatively unzoned and average about 0.5 mm in diameter. Some grains occur in glomeroporphyritic clots. Sanidine occurs in rare grains (1%) with clay alteration. The average size of sanidine phenocrysts is ~0.5 mm. Quartz (2%) occurs as irregular and embayed crystals 0.5 to 1.0 mm in diameter. Amphibole(?) occurs as relicts with opaque crystal outlines and quartz or calcite cores. Accessories include abundant euhedral zircon and titanomagnetite.

III. THIN SECTION DESCRIPTIONS FOR DRILL HOLE UE25b-1H, FROM 2400 FT TO T.D.

A. Bullfrog Member of the Crater Flat Tuff

1. UE25b-1H-2402 (732.1 m) Partly to moderately welded, devitrified, vapor phase altered, crystal-rich ash-flow tuff

The groundmass is finely devitrified to equigranular silica and feldspar. In plane light it is light tan and clear except for small (<0.01-mm) opaque phases. Spherulitic sprays and sheaves of crystals indicate probable vapor phase crystallization.

Relict shards are 0.05 to 0.02 mm in diameter, are unaligned, and still retain much of their original morphology. They are clear in plane light and sometimes have an opaque axis. Recrystallization may have concentrated opaque dust at the centers of these shards. Quartz and feldspar in shard interiors appear to be coarser than along shard rims.

Relict pumice clasts are identifiable by brown clay(?) alteration along what are probably collapsed vesicles. The framework of pumice lapilli is devitrified to granular silica and feldspar. There are some radiating crystals of feldspar and silica within the pumice. Most pumices appear flattened or stretched out.

Phenocrysts make up ~20% of the rock. The principal phenocryst phases consist of rounded, embayed quartz ($\leq$0.8 mm), plagioclase (0.15 to 0.8 mm), probable sanidine (0.4 mm), and darkened, altered biotite (0.15 to 0.5 mm). There are rectangular and prismatic crystal forms pseudomorphed by alteration products. These pseudomorphs may represent altered pyroxene or amphibole.

2. UE25b-1H-2525 (769.6 m) Coarsely devitrified tuff

The whole rock is extremely altered, and original structures such as shards and pumices are no longer identifiable. Therefore, the degree of welding cannot be estimated in thin section. The groundmass is fine-grained and has a very low birefringence. Devitrified feldspar and silica have grain sizes of 0.02 mm in the groundmass and up to 0.5 mm in what might have been pumice lapilli. Phenocrysts are extremely resorbed and embayed, even biotite. Plagioclase phenocrysts are altered and have overgrowths of sanidine(?). Some

freestanding sanidine phenocrysts are not significantly altered but still are embayed and have overgrowths. Many plagioclase crystals are totally replaced by gray-yellow birefringent material. Quartz crystals are deeply embayed and full of holes.

3. UE25b-1H-2596 (791.3 m) Partly welded, devitrified, vapor phase altered ash-flow tuff

This rock is very similar in appearance to UE25b-1H-2525, except that the phenocrysts are more intact. The groundmass is totally devitrified to <0.01 to 0.2 mm grains of feldspar and silica. Most mineral grains are granular but have indistinct margins. Coarser devitrified crystals are clear in plane light; finer-grained material is light tan.

Relict shards consist of flat streaks of coarser devitrification products. The original size of shards appears to have been 0.5 to 0.6 mm. In plane light, fine sprays of needles up to 0.02 mm long can be seen growing towards the centers of the shard from the edges.

Phenocrysts consist mostly of quartz and feldspar. Most phenocrysts are rounded, resorbed, and somewhat embayed around the edges. Plagioclase phenocrysts are severely altered and contain many holes. Biotite crystals are slightly bent and have wavy extinction. The color of biotite grains ranges from gold-red brown to almost black.

4. UE25b-1H-2737 (834.2 m) Partly welded, devitrified, vapor phase altered ash-flow tuff

The groundmass is light tan and has a texture of tiny (0.05-mm), clear, mica-like patches. Larger devitrification products consist of feldspar or silica.

Relict shards are sharp and distinct. These shards are reddish-brown against the pale-tan groundmass. Most are 0.1 to 0.7 mm in size and totally replaced by very fine-grained devitrification products. Some shards are realigned and flattened, giving a false impression of flowage. Some are draped around pumice and phenocrysts. The pumices themselves are flattened but not totally collapsed. Some pumices are undeformed. Evidence about the degree of welding seems conflicting in different parts of the thin section,

but it seems that the welding is greater than in the previous two samples. The degree of alteration, however, doesn't seem as severe as in previous thin sections.

Phenocrysts make up ~5% of the rock. Feldspars, quartz, and biotite are the dominant phenocryst phases. As in previous samples, most are rounded, resorbed, and embayed.

5. UE25b-1H-2832 (863.2 m) Slightly welded, devitrified, and zeolitized ash-flow tuff

The groundmass consists of a mixture of fine-grained devitrification(?) products and zeolites.

Relict shards are generally ~0.1 mm in size. Some shards have axiolitic texture with opaque dust concentrated at their centers. Glass in some shards has dissolved away, and clinoptilolite has crystallized in the resulting voids. In general, shards are not flattened and have random orientations.

Probable relict pumice lapilli consist of fine-grained devitrification products with abundant clays.

Phenocrysts make up 7 to 10% of the rock and consist of plagioclase, sandine, quartz, and biotite. About 50% of the rock is phenocryst-free, possible pumice. The other 50% contains 7 to 10% phenocrysts. The feldspar phenocrysts are mostly large (1 to 1.5 mm), nearly euhedral, and variously twinned. Some plagioclase phenocrysts are replaced by calcite. Quartz phenocrysts ($\leq$0.1 mm) are sometimes resorbed and embayed. Biotite occurs in kinked grains 0.4 to 0.8 mm long.

6. UE25b-1H-2855 (870.2 m) Zeolitized, crystal-rich bedded tuff

The groundmass is completely altered to golden-yellow clays and zeolites. Except for the clays it is clear in plane light and nearly isotropic under crossed-nicols. Alteration of the rock is so complete that neither shards nor pumices can be distinguished from the groundmass.

Phenocrysts make up 20 to 25% of the rock. Most consist of highly fractured and fragmented quartz and feldspar 0.4 to 0.7 mm in diameter. Some phenocryst fragments are strongly rounded and embayed. There are only a few bent biotite phenocrysts.

B. Tram Member of the Crater Flat Tuff

1. UE25b-1H-2953 (900.1 m) Partly welded, devitrified ash-flow tuff

Relict shards are more or less oriented and slightly deformed, especially around phenocrysts. They have been replaced by fibrous spherulitic bundles of colorless mineral phases. The matrix between shards is filled with low-birefringent, colorless to pale-brown, equant, anhedral phases 5 to 12 µm in diameter. Hematite grains <1 to 10 mm in diameter are scattered throughout this matrix.

Pumice pyroclasts are 1 to 5 mm long and 0.5 to 2 mm wide. The larger pyroclasts are poorly preserved and difficult to identify. Vesicles are elongate and tubular. Smaller pumice pyroclasts are outlined by trains of hematite grains <1 µm in diameter. All glass in the pumices has been replaced by spherulitic bundles made up of individual crystals 2 to 4 µm wide and 30 to 50 µm long. Granular iron(?) oxide phases are scattered throughout the spherulite bundles. Relict vesicles in the pumices are filled with equant, anhedral, low-birefringent phases and scattered grains of hematite (<2 µm). Some vesicles in less deformed pumice pyroclasts have open voids in their centers, rimmed with 60- to 90-µm colorless phases (zeolite?).

Phenocrysts make up ~15% of the rock. The principal phenocrysts are quartz, sanidine, plagioclase, and biotite. The quartz (1 to 3 mm) is equant and subhedral and shows some resorption. Sanidine occurs in crystals up to 3 mm long crossed by multiple fractures with traces of alteration along some fracture surfaces. Plagioclase phenocrysts are zoned, about the same size as sanidines, and may show considerable alteration. Biotite occurs as oxidized crystals 300 µm to 1.5 mm long.

Lithic fragments make up ~5% of the rock and consist of highly altered, hematite-stained older tuffs.

2. UE25b-1H-3050 (929.6 m) Moderately to densely welded, slightly zeolitized, devitrified, crystal-rich ash-flow tuff

This rock is very similar to UE25b-1H-2953, except that it is more welded. Relict shards are consistently deformed and oriented by compaction and welding. The main body of each shard is generally 30 to 300 µm long and

replaced by colorless, low-birefringent phases up to 700 μm long. The matrix supporting the shards is replaced by low-birefringent granular phases similar to those described in UE25b-1H-2953.

Pumice pyroclasts have been replaced by pale-brown fibrous bundles similar to those described in the previous sample. Voids in the pumices are filled with carbonate and low-birefringent, colorless phases in patches up to 140 μm across. Some of the pumices have plagioclase phenocrysts replaced by phyllosilicates and carbonate.

Phenocrysts make up ~20% of the thin section. They are similar to those described in UE25b-1H-2953.

Lithic fragments make up 5% of the rock and consist of highly oxidized older tuffs.

3. UE25b-1H-3095 (943.4 m) Well bedded, moderately to densely welded, crystal-rich tuff

Bedding in this rock is defined by variations in phenocryst content from bed to bed. Individual beds are 1 to 3 mm thick and exhibit grading to some degree. Lithic fragments are concentrated in phenocryst-rich beds. This could be a surge deposit associated with a pyroclastic flow.

The rock consists mostly of relict shards and rare relict pumice pyroclasts. Well-preserved shards range from 60 μm long and 15 μm wide to 600 μm long and 60 μm wide. Vesicles are highly elongate to equant. Most shards are tabular with flared ends. They are replaced by pale-brown to colorless spherulitic bundles with fibrous phases usually <1 μm wide. The matrix between shards consists of low-birefringent, colorless, granular, anhedral phases 3 to 50 μm across and scattered hematite grains 1 to 20 μm in diameter.

Phenocrysts make up ~20 to 25% of the rock. Most are subhedral and exhibit no fracturing. Quartz occurs as equant to slightly elongate phenocrysts 300 μm to 1 mm in diameter. Sanidine (40 to 800 μm) occurs as subhedral phenocrysts. Plagioclase phenocrysts (~1 mm diameter) have some zoned cores but are generally replaced by clays(?) and carbonate. Biotite occurs as 400- to 1000-μm phenocrysts oriented parallel to welded shards.

Lithic fragments make up 5 to 10% of the rock. They consist of highly oxidized, hematite-rich altered tuffs.

4. UE25b-1H-3098 (944.3 m) Moderately to densely welded, devitrified tuff

This sample is nearly identical to UE25b-1H-3050 except for a slightly smaller percentage of phenocrysts and the presence of pervasive fractures. The main fracture is 60 µm-8 mm wide and is filled with optically continuous phases up to 5 mm in diameter. This irregular, branching fracture runs the length of the thin section. Fracture surfaces are coated with an irregular mass of opaque phases, mixed with hematite or goethite(?) in a zone 24 to 150 µm wide. The center of the vein is filled with carbonate. At a distance of 1 to several millimeters out, there are small (0.5- to 1-mm-long, 60-µm-wide) fractures that are parallel to the main fracture. In places, there are several en echelon fractures filled with carbonate. Several relict pumices near these fractures are partly replaced by carbonate. All fractures cut across the fabric of the rock, and there appears to be little control of direction or shape by original texture.

5. UE25b-1H-3163 (964.1 m) Moderately to densely welded, devitrified tuff

This rock is similar to UE25b-1H-3050, except that it contains more pumice (~40%). Relict shards are devitrified to pale-brown to deep orange-brown phases with low-birefringence and fibrous habit. The shards are supported by a matrix of hematite and 10- to 50-µm, irregular, low-birefringent, colorless phases. The pumice pyroclasts are compacted, ragged relicts generally 2 to 4 mm long. They are deformed when in contact with phenocrysts. These pumices are replaced by pale-brown spherulitic phases <1 µm wide. Phenocrysts in the pumice include quartz, sanidine, plagioclase, and biotite.

Phenocrysts make up 15 to 20% of the rock. They are similar in composition and proportion to UE25b-1H-2953. The plagioclase phenocrysts have zoned cores. In some plagioclase cores, rims are criss-crossed with thin irregular fractures that are altered to clays(?) and carbonate.

A large fracture runs the full length of the thin section, cutting across all phases and the fabric developed in the rock. It is, on the average, 1.25 mm wide. There is ~1.25-mm lateral offset of a lithic fragment by this

fracture. Zonation of minerals lining the fracture is assymetric. Opaque, botryoidal phases are better developed and thicker on one wall of the fracture than the other. Calcite crystals (0.5 to 2 mm) fill the fracture.

6. UE25b-1H-3185 (970.8 m) Moderately to densely welded, devitrified tuff

Relict shards are very difficult to identify in this sample. They are in the 100- to 200-µm size range and are replaced by pale-brown to colorless, very finely crystalline sheaves of very low-birefringent minerals. Pumices occur as compacted, elongate clasts, up to 6 mm long. They are draped around the edges of phenocrysts. Relict textures are outlined by finely crystalline hematite phases. All pumices have been recrystallized, and vesicles are filled with coarse secondary phases including some smectite. Terminated crystals project into some of the open vesicles. Pumice frameworks are replaced by light-tan to colorless granular phases 40 µm to 1 mm in diameter.

Phenocrysts make up 10 to 15% of the rock. Plagioclase (0.7 to 1.2 mm) occurs as subhedral crystals and, in contrast to the Upper Tram, is fairly fresh and unaltered. Some of the plagioclase phenocrysts form glomeroporphyritic clots. Sanidine is less common than plagioclase and occurs in large (>1.2 mm), subhedral crystals, some of which are resorbed. Quartz occurs in large (2- to 3-mm), resorbed, subhedral crystals. Biotite occurs as oxidized, tattered flakes up to 2 mm long. Allanite is an accessory phase occurring in subhedral to euhedral crystals frequently associated with oxides.

Lithic fragments make up <5% of the rock. They consist of 1- to 3-mm, highly altered, almost unrecognizable tuffs and lavas.

Fractures form a trellis-like pattern in the thin section. The main fracture is oriented normal to the welded fabric, with branches extending a few millimeters parallel to the fabric. The fractures are filled with a mosaic of sparry calcite, with calcite crystals 0.5 to 1.5 mm long. Some appear to have pseudomorphed an earlier blocky phase growing out from fracture surfaces. The fracture tips are filled with a barbed, colorless, low-birefringent secondary mineral. Banding is developed in the fractures because of changes in the size of the secondary minerals.

7. UE25b-1H-3196 (974.1 m) Moderately to densely welded, devitrified, vapor phase altered crystal-rich tuff

Relict shards are extremely difficult to identify and appear to be replaced by pale-brown, fibrous phases. These shards are supported by a pale brown, finely crystalline (<4-μm) matrix that contains some carbonate. Large spherulites occur in the matrix on one edge of the thin section. Relict pyroclasts are not very clear, but can be identified. Trains of sub-μm hematite outline the pumice pyroclasts. All pumices are compacted and welded and stretched around phenocrysts and lithic fragments. They have been replaced by two phases: (1) pale-brown, very low-birefringent, equigranular phases <4 μm and (2) colorless, fairly low-birefringent phases up to 150 μm long and 30 μm wide (filling former vesicles?). Both phases have fairly high relief in reflected light, but the first phase has a little more texture. Some pumices have a medium-brown smectite(?) rim and a core of colorless, equigranular phases about 25 to 150 μm in diameter. Some of these cores are surrounded by 0.5-mm-diam spherulites.

Phenocrysts make up ~25% of the rock. Quartz is subhedral and up to 1.5 mm in diameter. Plagioclase (<0.6 mm) occurs as subhedral crystals with oscillatory zoned crystals that are partly replaced by calcite. Sanidine occurs as irregular chips and laths up to 1 mm long. Biotite forms oxidized laths up to 1 mm long. Allanite is an accessory phase, occurring as subhedral to euhedral twinned crystals 400 μm long.

Lithic fragments make up ~5% of the rock and consist of mostly subrounded, equant to elongate lava clasts. They are severely altered; plagioclase phenocrysts are replaced by calcite and the groundmass by clays(?). These lithics are possibly andesites.

8. UE25b-1H-3225 (983.0 m) Moderately to densely welded, devitrified tuff

About three quarters of this thin section consists of a subrounded lithic fragment of andesite; it is similar to those described in the previous sample. The lithic is contained within a welded tuff. Pumice and shard relicts in the tuff are compacted and wrapped neatly around the end of the lithic fragment.

Pore space within the tuff is filled with coarsely crystalline (150-µm anhedral, colorless phases (authigenic alkali feldspar or silica?).

9. UE25b-1H-3267 (995.8 m) Moderately to densely welded, devitrifie tuff

In general, this rock is very similar to UE25b-1H-3196. Relict pumice and shards consist of equigranular, colorless, low-birefringent phases (5 t 15 µm) and medium-brown, fibrous smectite(?). The medium-brown smectites mak up ~35% of the matrix materials. Phenocrysts and lithic fragments are simila to those described in UE25b-1H-3196.

10. UE25b-1H-3326 (1013.8 m) Moderately welded, devitrified tuff

This rock is similar to UE25b-1H-3196, only with less relict pumice and more shards. Relict pumice makes up ~30% of the matrix. Relict shards(?) are replaced by pale-brown, medium-birefringent, 10- to 20-µm smectites(?). The matrix between shards consists of colorless, very low-birefringent phases in 5- to 10-µm size range. A slightly coarser version of these phases can be found in lenticular patches in cores of relict pumices.

Lithic fragments consist of older, metamorphosed tuffs and badly altered andesite lava fragments. Some matrix in the older tuffs has been replaced by 50- to 150-µm-diam spherulitic bundles of colorless, low-birefringent phases.

This rock has the same phenocryst assemblage as UE25b-1H-3196. Calcite fills irregular, branching veins in the rock (<5% by volume). These veins range in width from 10 to 300 µm.

11. UE25b-1H-3393 (1034.2 m) Nonwelded, devitrified, and zeolitized tuff

Relict shards are well preserved and consist of long, curved forms with 2 to 4 cusps. The matrix consists of broken phenocrysts and finely crystalline (3- to 20-µm) phases, including: (1) colorless, low-birefringent phases (high relief in reflected light), (2) medium-brown, low-birefringent, low-relief smectite(?), (3) sub-µm hematite, (4) anhedral pale-green chlorite(?), and (5) large (4- x 2-mm), irregular patches of sparry calcite. Pumice pyroclasts are highly inflated; vesicularity probably makes up 85% of these

pumices. Pumice clasts are 2 to 4 mm wide, with vesicles up to 2 mm in diameter and vesicle walls of ~10 to 50 µm thick. They are similar in appearance to pumices from some peralkaline tephras. This must have been a low-viscosity magma or one with a high gas content. Glass has been replaced by coarse phases with very low birefringence and high relief (analcime?).

Phenocrysts make up ~10% of the rock. Sanidine occurs as 0.5- to 1.5-mm, equant, resorbed phenocrysts. Plagioclase with oscillatory zoning occurs in the 0.5- to 1-mm size range. Many are altered, with a network of veins across the phenocrysts. Quartz occurs as broken, subhedral forms up to 1 mm across. Biotite forms ragged, oxidized crystals up to 1.5 mm long. Allanite is a rare accessory phase occurring as subhedral grains up to 400 µm long.

Lithic fragments (>4 mm) consist of older welded tuff, replaced by carbonate (calcite) and medium-brown smectites. Aphantic lava fragments are probably andesites.

12. UE25b-1H-3469 (1057.4 m) Nonwelded, zeolitized tuff

This rock is very similar in appearance to UE25b-1H-3393, except that relict pumices and shards have smaller vesicles, and large lithic fragments of lava or hypabyssal magma are common. The lithics consist mostly of 300- to 400-µm plagioclase. Mafic(?) phases have been replaced by calcite and brown smectites(?). Some lithic fragments contain well-developed sheaves of what appears to be chlorite.

13. UE25b-1H-3506 (1068.6 m) Nonwelded, zeolitized tuff

This sample is nearly identical to UE25b-1H-3393 and 3469. Phenocrysts make up ~20% of the rock, matrix 50%, and lithics ~30%. The thin section is dominated by a large lithic fragment that may have been a glassy lava(?). No relict pyroclasts are visible. Phenocrysts of oxidized biotite, plagioclase, oxides, and sanidine occur in a matrix of granophyric colorless phases with low birefringence and 10 to 600 µm in size.

14. UE25b-1H-3571A (1088.4 m) Thin section across fracture fill

This fracture consists mostly of sparry calcite with crystals up to 4 mm long. Some fractures in the calcite are filled with colorless, low-birefringent, fibrous phases up to 150 μm in diameter. Angular bits of broken volcaniclastic sediment occur in the middle of the fracture fill. Irregular chains of chlorite (4 to 5 mm long, 60 to 300 μm wide) cross the calcite. The chlorite is associated with fine-grained hematite(?). It appears that the rock was brecciated before being engulfed by the calcite-chlorite bearing solutions.

15. UE25b-1H-3571B (1088.4 m) Reworked, bedded tuff

This sample appears to be an extremely immature tuffaceous sandstone consisting of 7- to 250-μm size sand grains in a low-relief, pale-brown matrix of silt to medium grain sand. The population of sand grains includes: (1) subrounded to subangular quartz, (2) altered tuffs replaced mainly by low-birefringent equigranular phases; some with small spherulites, (3) subangular to angular sanidine, (4) aphanitic lavas (altered) with replacement of groundmass by smectites, (5) spherulite fragments, (6) angular to subangular allanite grains, (7) subangular plagioclase grains, and (8) subrounded to subangular opaques.

16. UE25b-1H-3660 (1115.6 m) Nonwelded, zeolitized tuff

This sample is very similar to UE25b-1H-3393. Phenocrysts make up ~7% of the rock, matrix 68%, and lithics 25%. Pyrite is disseminated throughout the matrix. Fractures are characterized by brecciated clasts of tuff surrounded by calcite and colorless, equigranular phases (analcime?). Both sides of the major fracture have a 0.5-mm-thick layer of sparry calcite. Calcite extends out 1 to 2 mm into the matrix from the fracture walls. The upper walls of the fracture contain well-developed, 0.5-mm-long analcime crystals. Plumose growths of calcite grew inward in the central cavity. There may have been some movement or shear along this fracture before it was filled by secondary minerals.

17. UE25b-1H-3767 (1148.2 m) Nonwelded, zeolitized, lithic-rich tuff

This sample too is very similar to UE25b-1H-3393. One main difference is that this sample contains 3 to 5% subhedral to euhedral pyrite (1 to 30 μm) scattered through the matrix. Also, there are several 1- to 3-mm-long lenticular zones where a lithic fragment(?) has been replaced by medium-brown, fibrous, low-relief smectites. Phenocrysts make up 7 to 10% of the rock, lithic fragments 20 to 25%, and matrix 65 to 73%.

18. UE25b-1H-3835 (1168.9 m) Nonwelded, zeolitized, lithic-rich tuff

Again, this sample is similar to UE25b-1H-3393. One major difference is that this sample contains significantly more brown, fibrous smectite in lenticular zones in the matrix. Also, sparry calcite cement occurs in small clusters throughout the matrix. Irregular, microcrystalline patches of chlorite are still common throughout the matrix. Lithics consist of older, altered, welded, and nonwelded tuffs as well as highly altered and oxidized andesitic lavas. Phenocrysts make up 10 to 15% of the rock, lithic fragments 40%, and matrix 45 to 50%.

C. Unassigned Bedded Tuff Between the Tram Member, Crater Flat Tuff, and Lithic Ridge Tuff

UE25b-1H-3956 (1205.8 m) Moderately welded, devitrified crystal-rich tuff

The matrix is a mixture of (1) colorless, equigranular phases 3 to 10 μm in diameter, (2) pale-brown, micaceous, medium-birefringent phases, and (3) disseminated calcite. Only faint outlines of shards are preserved; they are outlined by the pale-brown phases. The relict pumice pyroclasts have been compacted and are deformed when in contact with a phenocryst or lithic fragment. The pumice pyroclasts have been replaced by a colorless to pale-brown, micaceous phase with medium to high birefringence. Each phase is ~1 μm wide and 10 to 30 μm long. All are oriented parallel to the relict grain of the pumice.

Phenocrysts make up ~20% of the rock. Plagioclase phenocrysts are 150 µm to 4 mm long and occur as angular, subhedral crystals. About 25% exhibit oscillatory zoning, and some are partly replaced by calcite. Sanidine occurs as anhedral grains 600 to 800 µm long. Some are partly pseudomorphed by calcite. Biotite occurs as rare, strongly pleochroic, oxidized grains 600 to 700 µm long (occasionally up to 2 mm) present in glomeroporphyritic clots.

Lithic fragments make up ~2% of the rock and consist of subrounded orange-brown or light-brown older tuffs.

D. Lithic Ridge Tuff

UE25b-1H-3988 (1215.5 m) Moderately welded, devitrified crystal-rich tuff

The matrix consists of pale-brown, equigranular phases (3 to 30 µm long) in irregular to equigranular patches, separated by medium-brown, low-relief (in reflected light), fibrous smectites(?). The smectites are in zones 3 to 10 µm wide. Scattered throughout are 30- to 100-µm-long patches of a colorless, medium-birefringent micaceous phase. There are also occasional 200- to 300-µm patches of colorless phases cored with pale-green, equigranular chlorite(?). Only rarely are relict shards visible; they are preserved by zeolite(?) phases or outlined by smectite. The fabric is mostly preserved by relict, compacted pumice pyroclasts that make up 20% of the matrix. These pumices have been replaced by a dark-brown, fibrous smectite(?). The pyroclasts are 3 to 4 mm long and 300 to 500 µm wide.

Phenocrysts make up ~20% of the thin section. They consist mostly of subhedral, oscillatory zoned plagioclase 200 µm to 3.1 mm long and lesser amounts of 200- to 500-µm-long, subhedral sanidine. Biotite occurs in trace amounts as 0.5- to 1.5-mm oxidized crystals. Some of the longer biotite crystals are compressed and deformed with the larger pumice pyroclasts.

Lithic fragments make up ~5% of the rock. Most consist of older tuffs replaced mainly by finely crystalline equigranular phases 90 to 200 µm long. There are also traces of oxidized, porphyritic lava lithics with plagioclase phenocrysts in a trachytic groundmass.

Fractures in the rock are 10 to 20 µm wide and both parallel and normal to the fabric. These fractures are filled with calcite. In a few places

opaques partially line fracture walls, but in general calcite is the dominant fracture fill.

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APPENDIX A

FELDSPAR MICROPROBE DATA

1. FELDSPAR MICROPROBE DATA FOR USW-G2

Yucca Mountain Member of the Paintbrush Tuff

Microprobe analyses of feldspars in USW-G2-304

	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C	FE03A	FE03B	FE03B	FE03C	FE02A	FE02B	FE02C	FE03A	FE03B	FE03C	FE04A	FE04B	FE04C	FE05A	FE05B	FE05C
	PLAGIOCLASE PHENOCRYSTS																					
SiO_2	67.32	66.71	65.62	52.66	53.82	52.63	56.66	57.23	57.05	56.56	56.38	57.09	59.18	58.48	58.46	56.96	62.67	62.25	63.41	62.24	63.43	62.86
Al_2O_3	18.99	19.81	20.52	28.27	28.30	28.14	26.57	26.16	24.74	25.90	26.43	25.94	25.25	24.88	25.46	26.02	23.18	22.58	22.20	22.26	22.37	22.40
FeO	0.01	0.00	0.29	0.56	0.52	0.56	0.62	0.44	0.50	0.50	0.25	0.19	0.12	0.38	0.52	0.57	0.31	0.31	0.29	0.32	0.23	0.29
MgO	0.00	0.00	0.00	0.04	0.07	0.00	0.06	0.03	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.10	0.32	0.17	0.56	0.42	0.23	0.27	0.38	0.53	0.40	0.10	0.00	0.10	0.00	0.25	0.10	0.23	0.00	0.15	0.03	0.00	0.08
CaO	0.40	1.16	2.41	11.83	11.50	11.30	9.72	9.06	7.80	9.16	9.34	8.71	7.60	7.26	7.06	8.08	4.71	4.43	3.98	4.36	4.05	4.06
Na_2O	11.34	10.68	9.86	4.48	4.41	4.56	5.46	6.03	6.36	5.76	5.96	6.11	7.02	7.01	6.64	6.16	8.33	8.41	8.77	8.80	8.66	8.75
K_2O	1.02	1.34	1.68	0.41	0.50	0.30	0.63	0.73	0.92	0.76	0.29	0.34	0.52	0.77	0.68	0.56	1.00	1.08	1.46	1.00	1.18	1.12
SUM	99.21	100.13	100.54	98.94	99.66	98.27	98.96	100.12	98.02	99.20	98.75	98.43	99.80	98.81	99.07	98.27	100.45	99.09	100.26	99.13	99.96	99.59
	Cation formula based on 8(O)																					
Si	2.987	2.946	2.900	2.427	2.453	2.441	2.541	2.581	2.637	2.576	2.566	2.596	2.651	2.661	2.632	2.567	2.778	2.792	2.815	2.796	2.816	2.807
Al	0.992	1.030	1.068	1.536	1.519	1.532	1.429	1.380	1.329	1.383	1.417	1.391	1.333	1.329	1.360	1.406	1.210	1.193	1.161	1.178	1.169	1.176
Fe	0.000	0.002	0.010	0.020	0.019	0.020	0.019	0.016	0.019	0.019	0.009	0.006	0.004	0.013	0.018	0.021	0.010	0.010	0.010	0.012	0.008	0.010
Mg	0.000	0.000	0.000	0.004	0.004	0.005	0.002	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.005	0.002	0.009	0.006	0.004	0.004	0.006	0.009	0.006	0.001	0.000	0.001	0.000	0.004	0.001	0.003	0.000	0.001	0.000	0.000	0.001
Ca	0.018	0.054	0.114	0.584	0.560	0.563	0.476	0.437	0.381	0.446	0.456	0.423	0.369	0.353	0.337	0.436	0.224	0.211	0.188	0.208	0.191	0.194
Na	0.975	0.915	0.844	0.400	0.389	0.408	0.482	0.526	0.562	0.508	0.523	0.534	0.616	0.616	0.579	0.548	0.715	0.730	0.754	0.766	0.745	0.757
K	0.057	0.076	0.093	0.024	0.028	0.023	0.036	0.041	0.053	0.042	0.016	0.019	0.029	0.043	0.038	0.031	0.056	0.062	0.082	0.062	0.066	0.063
SUM	5.030	5.027	5.032	5.004	4.984	4.998	4.982	5.000	4.993	4.983	4.986	4.975	4.996	5.006	4.988	5.010	4.996	4.999	5.012	5.021	4.998	5.009
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																					
Or	5.4	7.2	8.8	2.4	2.9	2.3	3.6	4.1	5.3	4.2	1.6	1.9	2.9	4.2	3.8	3.1	5.6	6.2	8.0	6.0	6.6	6.2
Ab	92.9	87.6	80.3	38.7	38.8	41.0	48.5	52.4	56.4	51.0	52.6	54.9	60.6	60.9	58.2	54.0	71.9	72.8	73.6	73.9	74.4	74.7
An	1.7	5.2	10.8	57.9	57.3	56.6	47.8	43.5	38.3	44.8	45.8	43.2	36.5	34.9	37.9	43.0	22.5	21.0	18.4	20.2	19.1	19.1

Microprobe analyses of feldspars in USW-G2-304 (cont)

	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C	FE03A	FE03B	FE03C	FE04A	FE04B	FE04C	FE06A	FE06B	FE03A	FE03B	FE03C	FE04A	FE05A	FE06A	FE07A	FE08A	FE09A
	SANIDINE PHENOCRYSTS																	VAPOR PHASE SANIDINE					
SiO_2	64.58	64.51	64.90	66.09	66.11	66.07	66.08	65.59	66.33	66.26	65.82	66.16	65.64	65.31	66.51	65.74	65.11	68.35	68.48	68.92	68.96	69.54	67.66
Al_2O_3	19.02	19.44	18.91	18.76	18.64	18.71	18.98	18.56	18.79	18.72	18.64	18.77	18.98	18.86	18.64	18.53	19.06	17.11	17.07	17.24	16.28	16.57	17.41
FeO	0.22	0.20	0.15	0.26	0.22	0.26	0.22	0.22	0.16	0.16	0.25	0.17	0.20	0.27	0.20	0.17	0.14	0.32	0.38	0.47	0.34	0.40	0.43
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	1.14	1.62	1.04	0.20	0.38	0.08	0.06	0.71	0.50	0.73	0.66	0.73	0.61	0.35	1.04	1.14	1.06	0.00	0.12	0.08	0.10	0.07	0.00
CaO	0.36	0.34	0.34	0.20	0.34	0.32	0.46	0.49	0.56	0.57	0.63	0.50	0.48	0.48	0.40	0.54	0.60	0.04	0.04	0.04	0.04	0.17	0.08
Na_2O	6.06	7.21	6.34	6.18	5.72	5.61	6.31	5.83	6.03	5.52	5.00	5.76	6.55	6.33	6.52	6.24	5.91	6.11	5.04	6.06	6.06	6.73	6.31
K_2O	7.30	6.06	7.12	7.76	8.75	8.61	7.58	8.05	7.80	8.17	7.81	8.25	6.82	7.31	6.96	7.51	7.04	7.63	7.54	6.53	6.77	6.33	7.33
SUM	98.86	99.56	98.90	99.54	100.20	99.67	100.57	99.66	100.25	100.21	99.68	100.45	99.48	99.02	100.31	99.96	99.64	99.57	99.47	99.90	98.63	99.09	99.22
	Cation formula based on 8(O)																						
Si	2.957	2.930	2.946	2.988	2.985	2.989	2.970	2.981	2.986	2.989	2.983	2.982	2.971	2.970	2.992	2.982	2.961	3.046	3.077	3.071	3.110	3.097	3.053
Al	1.026	1.042	1.010	0.999	0.991	0.997	1.006	0.994	0.996	0.996	0.995	0.997	1.012	1.010	0.987	0.990	1.021	0.905	0.903	0.905	0.866	0.869	0.925
Fe	0.009	0.006	0.005	0.009	0.008	0.009	0.008	0.008	0.005	0.005	0.009	0.005	0.006	0.009	0.006	0.005	0.005	0.012	0.013	0.017	0.012	0.014	0.016
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.020	0.029	0.017	0.002	0.006	0.001	0.010	0.012	0.008	0.012	0.010	0.012	0.010	0.005	0.017	0.020	0.019	0.000	0.001	0.000	0.001	0.000	0.000
Ca	0.017	0.016	0.016	0.013	0.016	0.014	0.021	0.022	0.026	0.026	0.029	0.023	0.022	0.022	0.018	0.025	0.028	0.001	0.001	0.001	0.004	0.008	0.002
Na	0.537	0.636	0.562	0.541	0.500	0.491	0.550	0.513	0.526	0.482	0.509	0.502	0.575	0.558	0.567	0.548	0.521	0.531	0.507	0.575	0.528	0.501	0.550
K	0.426	0.352	0.414	0.447	0.503	0.496	0.434	0.465	0.448	0.470	0.451	0.473	0.393	0.423	0.398	0.434	0.443	0.436	0.431	0.378	0.389	0.359	0.421
SUM	4.996	5.023	5.001	5.000	5.010	4.997	5.007	4.998	4.996	4.980	4.997	4.998	4.993	5.001	4.987	5.006	5.000	4.953	4.933	4.939	4.909	4.928	4.967
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																						
Or	43.5	35.1	41.7	44.7	49.4	49.6	43.2	46.5	44.8	48.1	45.6	47.4	39.7	42.2	40.5	43.1	44.7	45.0	45.9	39.1	42.4	37.9	43.3
Ab	54.8	63.3	56.7	54.0	49.1	49.1	54.7	51.3	52.6	49.3	51.5	50.3	58.1	55.6	57.7	54.4	52.5	54.9	54.0	60.8	57.3	61.5	56.5
An	1.7	1.6	1.6	1.3	1.6	1.4	2.1	2.2	2.6	2.7	2.9	2.3	2.2	2.2	1.8	2.5	2.8	0.1	0.1	0.1	0.4	0.6	0.2

Microprobe analyses of feldspars in USW-G2-331

	FE03A	FE03B	FE03C	FE05A	FE05B	FE05C	FE06A	FE06B	FE06C	FE08A	FE08B	FE08C	FE07A	FE07B	FE07C	FE09A	FE09B	FE09C	FE10A	FE10B	FE10C	FE11A	FE11B	FE11C
	PLAGIOCLASE PHENOCRYSTS												SANIDINE PHENOCRYSTS											
SiO_2	60.93	61.42	62.06	60.67	59.09	58.29	64.29	64.00	64.12	56.10	57.99	59.02	62.53	62.52	62.74	64.39	64.66	64.39	64.38	64.08	64.26	64.09	65.44	64.95
Al_2O_3	22.40	22.45	22.50	23.04	24.64	24.80	21.27	21.06	21.34	26.16	25.00	25.37	19.53	19.29	19.51	18.82	18.74	19.09	18.77	18.92	19.41	18.71	18.47	18.92
FeO	0.29	0.36	0.22	0.18	0.15	0.32	0.29	0.29	0.30	0.08	0.04	0.08	0.22	0.12	0.24	0.22	0.19	0.16	0.20	0.26	0.27	0.22	0.31	0.18
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.46	0.30	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.55	2.73	2.93	1.47	0.91	1.75	1.11	1.04	1.75	0.48	0.54	0.66
CaO	4.18	3.90	4.41	6.00	7.23	7.42	2.88	3.66	3.10	8.06	7.79	7.59	0.64	0.53	0.49	0.60	0.46	0.52	0.40	0.40	0.49	0.56	0.31	0.50
Na_2O	8.41	8.48	8.26	7.90	7.45	7.19	8.06	8.75	8.87	6.39	6.91	7.27	5.07	5.74	4.96	5.64	5.21	5.10	5.16	5.22	5.03	5.77	5.45	5.82
K_2O	1.51	1.28	1.21	0.68	0.50	0.31	1.80	0.77	1.55	0.34	0.42	0.46	7.57	6.67	7.80	8.04	8.46	8.54	8.37	8.46	8.52	7.96	8.01	8.16
SUM	98.25	98.39	99.07	99.38	99.05	98.32	99.38	98.93	99.32	97.05	99.02	99.79	98.49	97.97	99.06	99.29	98.80	99.08	98.69	98.58	99.93	98.65	99.41	99.27
	Cation formula based on 8(O)																							
Si	2.775	2.785	2.791	2.720	2.648	2.652	2.868	2.874	2.860	2.574	2.619	2.644	2.911	2.919	2.914	2.957	2.978	2.949	2.966	2.955	2.938	2.972	2.984	2.964
Al	1.202	1.199	1.191	1.299	1.310	1.330	1.118	1.106	1.122	1.414	1.377	1.340	1.071	1.060	1.067	1.019	1.014	1.029	1.019	1.027	1.045	1.009	0.992	1.016
Fe	0.010	0.013	0.008	0.006	0.005	0.012	0.010	0.010	0.010	0.000	0.001	0.002	0.008	0.004	0.008	0.008	0.006	0.005	0.006	0.009	0.009	0.008	0.010	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.008	0.006	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.049	0.053	0.025	0.016	0.031	0.019	0.018	0.031	0.008	0.009	0.010
Ca	0.203	0.193	0.212	0.298	0.349	0.360	0.137	0.175	0.147	0.436	0.376	0.364	0.031	0.026	0.023	0.028	0.021	0.024	0.019	0.019	0.022	0.027	0.015	0.024
Na	0.742	0.745	0.719	0.693	0.642	0.634	0.766	0.755	0.764	0.560	0.604	0.631	0.458	0.519	0.447	0.501	0.463	0.459	0.461	0.465	0.445	0.512	0.481	0.514
K	0.086	0.073	0.040	0.038	0.027	0.017	0.102	0.043	0.087	0.019	0.023	0.026	0.449	0.396	0.462	0.470	0.495	0.499	0.490	0.497	0.496	0.463	0.512	0.474
SUM	5.027	5.014	4.995	5.005	5.010	5.006	5.001	4.964	4.993	5.009	5.001	5.007	4.984	4.984	4.965	5.010	4.991	5.004	4.984	4.994	4.993	5.008	5.006	5.011
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																							
Or	8.3	7.2	4.0	3.7	2.6	1.7	10.1	4.4	8.7	1.9	2.3	2.5	47.9	42.1	49.6	47.0	50.6	50.8	50.5	50.7	51.5	46.2	50.8	46.8
Ab	72.0	73.7	72.0	68.0	63.5	62.7	76.2	77.6	76.6	55.6	60.2	61.8	48.8	55.2	48.0	50.2	47.3	46.7	47.5	47.4	46.2	51.1	47.7	50.8
An	19.7	19.1	21.2	28.3	33.9	35.6	13.6	18.0	14.7	42.6	37.5	35.7	3.3	2.8	2.5	2.8	2.1	2.4	2.0	1.9	2.3	2.7	1.5	2.4

Microprobe analyses of feldspars in USW-G2-331 (cont)

	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C	FE04A	FE04B	FE04C
	SANIDINE PHENOCRYSTS (cont)								
SiO_2	66.11	66.91	66.64	66.54	66.71	66.84	62.13	61.77	61.95
Al_2O_3	18.28	18.42	18.40	18.42	18.54	18.57	19.44	19.48	19.48
FeO	0.21	0.17	0.20	0.29	0.25	0.22	0.15	0.21	0.18
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	3.63	3.60	3.18
CaO	0.16	0.16	0.18	0.12	0.11	0.19	0.43	0.41	0.40
Na_2O	7.72	6.34	6.76	5.57	6.23	7.41	4.24	4.25	4.21
K_2O	5.57	7.84	7.29	8.82	8.81	6.39	8.69	8.67	8.90
SUM	98.06	99.84	99.47	99.78	99.86	99.61	99.14	99.04	98.77
	Cation formula based on 8(O)								
Si	3.006	3.010	3.004	3.007	3.002	3.001	2.904	2.899	2.903
Al	0.979	0.975	0.977	0.979	0.982	0.981	1.070	1.077	1.075
Fe	0.008	0.005	0.006	0.010	0.009	0.008	0.005	0.008	1.007
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.064	0.069	0.058
Ca	0.006	0.006	0.008	0.005	0.004	0.008	0.021	0.019	0.019
Na	0.680	0.552	0.590	0.488	0.542	0.644	0.384	0.385	0.382
K	0.323	0.450	0.419	0.507	0.459	0.365	0.517	0.519	0.532
SUM	5.001	4.998	5.004	4.997	5.000	5.007	4.983	4.991	4.991
	Mol.% potassium felspar (Or), albite (Ab), and anorthite (An)								
Or	32.0	44.6	41.2	50.7	45.7	36.9	56.1	56.2	57.0
Ab	67.4	54.8	58.0	48.8	53.9	63.3	41.6	41.7	40.9
An	0.6	0.6	0.8	0.5	0.4	0.8	2.3	2.1	2.0

Microprobe analyses of feldspars in USW-G2-338

	FE04A	FE04B	FE04C	FE05A	FE05B	FE05C	FE06A	FE06B	FE06C
	PLAGIOCLASE PHENOCRYSTS								
SiO_2	59.14	57.57	58.23	61.19	61.24	60.63	66.82	65.84	66.35
Al_2O_3	24.64	24.86	24.95	23.76	23.68	23.96	19.68	19.49	19.35
FeO	0.21	0.22	0.21	0.14	0.11	0.11	0.21	0.14	0.26
MgO	0.00	0.02	0.03	0.00	0.00	0.00	0.01	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	7.77	7.85	7.95	6.30	5.98	6.33	1.66	1.41	1.21
Na_2O	7.22	6.84	6.94	8.03	7.37	7.63	8.41	8.11	8.23
K_2O	0.66	0.62	0.66	0.77	1.37	0.68	3.69	4.20	4.68
SUM	99.68	98.00	99.01	100.20	99.77	99.35	99.56	99.26	100.13
	Cation formula based on 8(O)								
Si	2.660	2.636	2.640	2.726	2.737	2.719	2.941	2.952	2.955
Al	1.307	1.340	1.333	1.247	1.247	1.266	1.036	1.029	1.015
Fe	0.008	0.008	0.008	0.005	0.004	0.004	0.008	0.005	0.009
Mg	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.374	0.384	0.386	0.300	0.286	0.304	0.079	0.067	0.057
Na	0.629	0.605	0.609	0.693	0.639	0.663	0.729	0.704	0.711
K	0.037	0.036	0.037	0.043	0.077	0.038	0.209	0.239	0.265
SUM	5.014	5.010	5.014	5.014	4.989	4.994	5.004	4.986	5.013
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	3.6	3.5	3.6	4.2	7.7	3.8	20.6	23.7	25.7
Ab	60.5	59.0	59.8	66.9	63.8	66.0	71.7	69.7	68.8
An	36.0	37.5	37.4	29.0	28.5	30.2	7.8	6.6	5.5

Microprobe analyses of feldspars in USW-G2-338 (cont)

	FE03A	FE03B	FE03C	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C	FE03A	FE03B	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C
	SANIDINE PHENOCRYSTS						FELDSPAR PHENOCRYSTS IN LITHICS										
SiO_2	64.59	65.13	65.16	67.79	66.76	67.36	61.83	63.62	63.89	61.96	62.26	63.67	64.08	65.25	64.48	64.46	64.26
Al_2O_3	18.76	18.41	18.43	18.36	18.40	18.21	22.2	18.59	20.32	22.98	22.36	20.49	18.79	18.89	18.78	18.47	18.67
FeO	0.15	0.13	0.13	0.18	0.19	0.20	0.29	0.19	0.34	0.26	0.27	0.18	0.18	0.12	0.19	0.21	0.20
MgO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.00	0.02
BaO	1.03	0.66	0.66	0.20	0.00	0.23	0.27	2.38	1.29	0.61	0.10	0.00	1.15	2.00	1.38	1.07	1.06
CaO	0.46	0.29	0.34	0.10	0.18	0.18	4.14	0.33	2.07	4.70	4.38	3.18	0.43	0.34	0.37	0.36	0.37
Na_2O	4.79	4.61	4.90	6.06	6.32	6.43	8.48	4.64	6.66	8.21	8.25	7.76	4.68	4.64	4.63	4.46	4.74
K_2O	8.94	9.50	9.30	7.64	7.92	7.46	1.37	9.20	4.86	1.19	1.25	3.12	8.94	9.40	9.48	9.20	8.92
SUM	98.90	98.97	98.16	101.22	98.78	100.08	98.68	99.21	99.74	99.98	98.91	98.45	98.30	100.83	99.58	98.56	98.43
	Cation formula based on 8(O)																
Si	2.970	2.987	2.984	3.013	3.005	3.021	2.793	2.954	2.898	2.770	2.801	2.877	2.968	2.966	2.960	2.975	2.968
Al	1.016	0.995	0.994	0.961	0.976	0.961	1.184	1.016	1.083	1.210	1.185	1.093	1.014	1.012	1.016	1.006	1.017
Fe	0.006	0.004	0.004	0.006	0.006	0.006	0.010	0.006	0.012	0.009	0.009	0.006	0.006	0.004	0.006	0.008	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.017	0.011	0.011	0.002	0.000	0.004	0.004	0.042	0.022	0.010	0.001	0.000	0.020	0.036	0.024	0.019	0.018
Ca	0.021	0.013	0.016	0.004	0.008	0.008	0.200	0.015	0.099	0.224	0.209	0.154	0.020	0.016	0.017	0.018	0.018
Na	0.426	0.409	0.434	0.530	0.551	0.558	0.744	0.417	0.602	0.710	0.719	0.640	0.415	0.408	0.411	0.399	0.424
K	0.523	0.555	0.542	0.433	0.454	0.427	0.078	0.543	0.279	0.067	0.071	0.179	0.521	0.544	0.555	0.548	0.526
SUM	4.984	4.981	4.991	5.013	5.000	4.985	5.014	5.000	4.992	5.002	4.995	4.994	4.976	4.991	4.998	4.973	4.981
	Mol.% potassium felspar (Or), albite (Ab), and anorthite (An)																
Or	53.9	56.8	54.6	42.0	44.8	43.0	7.6	55.7	28.5	6.7	7.1	17.7	54.5	56.2	56.5	56.4	54.2
Ab	43.9	41.9	43.7	57.2	54.4	56.2	72.8	42.8	61.4	70.9	72.0	63.1	41.4	42.1	41.8	41.7	43.9
An	2.2	1.3	1.6	0.8	0.8	0.8	19.6	1.5	0.1	22.4	20.9	19.2	2.1	1.7	1.7	1.9	1.9

Unnamed Bedded Tuff Between the Yucca Mountain and Pah Canyon Members of the Paintbrush Tuff

Microprobe analyses of feldspars in USW-G2-358

	FL01B	FL02A	FL02B	FL03A	FE03B	FL04A	FE04B	FL05A	FL05B	FL05L	FL06A	FL06B	FL07B	FL08A	FL08B
							SANIDINE PHENOCRYSTS								
SiO_2	65.06	66.59	65.91	66.30	66.71	66.40	66.95	67.16	66.42	67.09	66.27	67.01	66.02	66.96	67.00
Al_2O_3	18.51	18.41	18.29	18.53	18.45	18.50	18.50	18.50	18.41	18.67	18.36	18.44	18.20	18.36	18.21
FeO	0.24	0.18	0.17	0.14	0.20	0.11	0.25	0.26	0.24	0.18	0.19	0.17	0.23	0.24	0.13
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.20	0.20	0.19	0.21	0.18	0.19	0.17	0.22	0.23	0.26	0.20	0.22	0.20	0.25	0.16
Na_2O	6.64	6.38	5.82	6.43	6.18	6.41	6.23	6.52	6.30	6.77	6.39	6.64	6.34	6.36	6.13
K_2O	7.31	7.55	7.99	7.22	7.52	7.44	7.38	6.91	7.01	6.63	7.14	6.98	7.26	7.00	7.30
SUM	98.96	99.34	98.38	98.84	99.27	99.04	99.43	99.60	98.78	99.59	98.56	99.46	98.25	99.22	98.94
							Cation formula based on 8(O)								
Si	2.989	3.004	3.010	3.003	3.012	3.003	3.013	3.013	3.011	3.007	3.009	3.015	3.010	3.016	3.025
Al	0.992	0.979	0.983	0.989	0.980	0.986	0.981	0.978	0.982	0.985	0.982	0.977	0.978	0.974	0.968
Fe	0.008	0.006	0.005	0.005	0.006	0.004	0.009	0.009	0.008	0.006	0.006	0.005	0.008	0.008	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.009	0.009	0.000	0.009	0.000	0.000	0.000	0.010	0.010	0.012	0.009	0.010	0.009	0.012	0.006
Na	0.585	0.563	0.515	0.563	0.541	0.561	0.544	0.566	0.560	0.588	0.562	0.578	0.560	0.554	0.535
K	0.423	0.434	0.465	0.416	0.432	0.428	0.419	0.395	0.404	0.378	0.413	0.408	0.421	0.406	0.420
SUM	5.013	4.990	4.985	4.986	4.979	4.990	4.974	4.971	4.975	4.977	4.981	4.984	4.986	4.980	4.958
							Mol.% Potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	41.6	43.6	47.1	42.1	44.0	42.9	43.2	40.7	41.5	38.7	42.0	40.5	42.5	41.0	43.7
Ab	57.5	55.7	52.1	57.0	55.1	56.3	56.0	58.3	57.5	60.1	57.1	58.5	56.6	57.0	55.7
An	0.9	0.9	0.8	0.9	0.8	0.8	0.8	1.0	1.0	1.2	0.9	1.0	0.9	1.2	0.6

Microprobe analyses of feldspars in USW-G2-395

	FE0[illegible]A	FE0[illegible]C	FE01A	FE01B	FE02A	FE02B	FE02C	FE03A	FE04A	FE04B	FE05A	FE05B	FE07A	FE07B
	SANIDINE PHENOCRYSTS													
SiO_2	62.63	62.05	66.00	66.65	65.86	65.73	66.04	65.40	66.97	67.30	66.03	65.71	66.31	66.13
Al_2O_3	19.14	22.62	18.50	18.81	18.09	18.11	18.29	18.05	18.43	18.51	18.17	18.25	18.33	18.38
FeO	0.26	0.28	0.16	0.23	0.25	0.19	0.20	0.15	0.18	0.21	0.15	0.18	0.20	0.18
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	2.43	0.12	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.02	0.00
CaO	0.38	4.35	0.15	0.17	0.26	0.27	0.27	0.28	0.13	0.20	0.22	0.22	0.13	0.26
Na_2O	4.92	7.09	6.36	6.33	6.63	6.71	6.46	6.20	6.54	6.27	6.41	6.49	6.06	6.08
K_2O	7.71	1.07	7.57	7.24	6.82	6.94	7.04	7.91	7.36	7.36	7.05	7.16	7.71	6.80
Sum	98.15	98.59	99.33	98.64	97.93	97.97	98.20	97.90	99.66	99.86	98.05	98.04	98.06	98.43
	Cation formula based on 8(O)													
Si	2.927	2.794	3.006	3.024	3.010	3.006	3.000	3.003	3.011	3.016	3.014	3.002	3.011	3.006
Al	1.053	1.200	0.994	0.962	0.973	0.976	0.977	0.977	0.977	0.977	0.976	0.981	0.980	0.984
Fe	0.009	0.013	0.006	0.008	0.009	0.006	0.006	0.006	0.006	0.008	0.006	0.008	0.006	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.043	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.034	0.208	0.006	0.008	0.012	0.012	0.012	0.009	0.006	0.009	0.010	0.010	0.006	0.012
Na	0.445	0.660	0.566	0.566	0.586	0.594	0.569	0.551	0.570	0.544	0.566	0.574	0.531	0.540
K	0.459	0.061	0.436	0.418	0.396	0.404	0.408	0.462	0.421	0.420	0.418	0.417	0.449	0.393
Sum	4.962	4.967	4.983	4.986	4.987	4.988	4.981	5.007	4.993	4.973	4.981	4.993	4.983	4.987
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)													
Or	48.9	6.4	43.7	42.6	39.8	40.0	41.3	45.2	42.1	43.2	41.6	41.7	45.6	39.6
Ab	47.4	71.9	56.7	56.6	58.8	58.6	57.5	53.9	57.1	55.9	57.4	57.3	53.9	59.2
An	3.6	21.7	0.6	0.8	1.2	1.2	1.2	0.9	0.8	0.9	1.0	1.0	0.5	1.2

	FE[illegible]A	FE[illegible]A	FE[illegible]B	FE[illegible]C	FE14A	FE14B	FE12A
	FELDSPAR PHENOCRYSTS IN LITHICS						
SiO_2	65.61	65.39	64.38	64.59	65.22	64.73	64.46
Al_2O_3	18.61	20.05	20.62	20.29	20.40	20.32	20.59
FeO	0.26	0.12	0.10	0.08	0.11	0.11	0.12
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.12	0.00
CaO	0.00	2.02	1.93	2.12	2.18	2.20	2.24
Na_2O	6.45	9.43	9.55	9.46	9.70	9.97	9.40
K_2O	6.60	1.12	1.25	1.35	1.45	1.50	1.30
Sum	98.35	98.13	97.82	98.14	98.65	97.96	98.10
	Cation formula based on 8(O)						
Si	2.987	2.932	2.904	2.900	2.915	2.917	2.900
Al	0.996	1.069	1.096	1.075	1.078	1.079	1.090
Fe	0.009	0.004	0.002	0.002	0.004	0.004	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Ca	0.000	0.096	0.092	0.111	0.104	0.105	0.106
Na	0.567	0.818	0.833	0.826	0.796	0.782	0.819
K	0.382	0.063	0.071	0.076	0.081	0.085	0.074
Sum	4.981	4.972	4.999	4.999	4.977	4.973	4.994
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	38.7	6.4	7.1	7.5	8.3	8.7	7.4
Ab	57.4	83.7	83.6	81.5	81.1	80.5	82.8
An	3.9	9.8	9.2	11.0	10.6	10.8	10.6

Pah Canyon Member of the Paintbrush Tuff

Microprobe analyses of feldspars in USW-G2-501

	FE04A	FE04B	FE05A	FE06A	FE06B	FE01A	FE01B	FE02B	FE03A	FE03B
	PLAGIOCLASE PHENOCRYSTS					SANIDINE PHENOCRYSTS				
SiO_2	63.21	62.52	63.75	61.74	63.21	63.92	64.56	64.33	64.06	64.96
Al_2O_3	21.34	21.49	21.31	20.95	22.17	18.28	18.61	18.78	18.66	18.49
FeO	0.29	0.00	0.24	0.31	0.22	0.13	0.22	0.15	0.08	0.13
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.48	0.12	0.00	0.00	1.76	0.96	0.94	2.28	0.83
CaO	3.32	3.55	3.35	2.05	3.71	0.39	0.36	0.23	0.43	0.34
Na_2O	8.28	8.37	8.55	8.29	8.33	4.09	4.90	4.53	4.95	5.00
K_2O	1.62	1.54	1.46	1.91	1.25	8.42	8.91	9.23	8.58	8.98
SUM	98.09	97.99	98.78	98.05	98.89	97.93	98.59	98.79	100.00	98.75
	Cation formula based on 8(O)									
Si	2.855	2.836	2.861	2.879	2.831	2.977	2.973	2.978	2.968	2.984
Al	1.136	1.149	1.127	1.115	1.169	1.003	1.010	1.017	1.006	1.000
Fe	0.010	0.000	0.008	0.010	0.008	0.004	0.008	0.005	0.002	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.008	0.001	0.000	0.000	0.030	0.016	0.016	0.040	0.015
Ca	0.160	0.171	0.161	0.136	0.177	0.019	0.018	0.012	0.020	0.016
Na	0.725	0.736	0.743	0.725	0.723	0.498	0.437	0.403	0.439	0.444
K	0.093	0.089	0.083	0.110	0.071	0.500	0.523	0.563	0.496	0.519
SUM	4.979	4.991	4.983	4.975	4.979	4.979	4.989	4.977	4.979	4.995
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)									
Or	9.5	8.9	8.4	11.3	7.3	52.1	53.5	56.7	51.9	53.0
Ab	74.1	73.9	75.3	74.7	74.5	45.9	44.7	42.1	46.0	45.4
An	16.4	17.2	16.3	14.0	18.2	2.0	1.8	1.3	2.1	1.6

Microprobe analyses of feldspars in USW-G2-547

	FE01A	FE01B	FE06A	FE06B	FE06C	FE06C	FE03A	FE04A	FE04B	FE04C	FE05A	FE05B	FE05C	FE02A	FE02B	FE02C	FE07A	FE07B	FE07C	FE09A	FE09B
	PLAGIOCLASE PHENOCRYSTS						SANIDINE PHENOCRYSTS														
SiO_2	61.93	62.70	63.02	56.75	56.84	56.59	64.15	64.14	63.46	62.58	63.67	60.79	56.56	63.93	63.15	63.02	63.84	64.19	63.25	63.29	62.59
Al_2O_3	22.30	22.30	22.09	27.50	26.64	24.69	19.60	19.00	18.94	22.09	18.96	23.11	26.66	18.93	18.96	19.28	19.10	18.99	18.73	19.14	19.14
FeO	0.03	0.12	0.03	0.00	0.05	0.06	0.05	0.00	0.04	0.10	0.00	0.17	0.15	0.00	0.05	0.04	0.00	0.03	0.00	0.00	0.03
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.03	0.00	0.00	0.00	0.00	1.41	1.21	1.47	0.00	1.57	0.36	0.00	1.31	2.30	2.36	1.39	1.44	1.23	2.13	2.62
CaO	4.18	4.12	3.56	9.76	8.67	6.92	0.50	0.34	0.47	3.66	0.46	4.50	7.00	0.39	0.46	0.56	0.42	0.42	1.25	0.49	0.45
Na_2O	8.45	8.39	8.97	5.64	6.30	7.29	5.00	5.12	4.99	8.73	4.91	8.12	6.99	5.63	4.86	5.48	4.96	5.17	5.12	4.90	4.60
K_2O	1.25	1.26	1.37	0.34	0.30	0.62	8.39	8.37	8.32	1.43	8.05	1.10	0.64	7.34	8.32	7.61	8.52	8.26	8.36	8.06	8.21
Sum	98.15	98.91	99.06	97.99	98.90	98.17	98.71	98.32	97.87	98.57	97.85	98.32	99.01	98.06	98.30	98.50	98.30	98.62	98.00	98.20	97.93
	Cation formula based on 8(O)																				
Si	2.802	2.813	2.824	2.514	2.575	2.666	2.966	2.961	2.952	2.818	2.956	2.760	2.679	2.966	2.943	2.928	2.962	2.966	2.942	2.945	2.932
Al	1.188	1.176	1.166	1.487	1.422	1.323	1.032	1.034	1.037	1.172	1.037	1.236	1.318	1.031	1.041	1.055	1.041	1.031	1.026	1.048	1.057
Fe	0.000	0.004	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.002	0.000	0.006	0.006	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.024	0.021	0.026	0.000	0.027	0.006	0.000	0.023	0.042	0.042	0.024	0.025	0.021	0.036	0.046
Ca	0.202	0.197	0.171	0.479	0.420	0.336	0.024	0.016	0.023	0.176	0.021	0.222	0.337	0.019	0.021	0.026	0.020	0.020	0.061	0.023	0.022
Na	0.741	0.729	0.778	0.502	0.561	0.642	0.446	0.450	0.449	0.761	0.441	0.714	0.610	0.505	0.430	0.493	0.442	0.461	0.461	0.441	0.417
K	0.071	0.071	0.077	0.019	0.021	0.036	0.492	0.492	0.492	0.041	0.477	0.064	0.036	0.466	0.494	0.450	0.502	0.465	0.494	0.476	0.489
Sum	5.004	4.991	5.017	5.001	5.000	5.003	4.981	4.986	4.986	5.009	4.960	5.009	4.977	4.996	4.986	5.002	4.987	4.984	5.012	4.978	4.973
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																				
Or	7.0	7.1	7.5	1.9	2.1	3.5	51.1	50.9	51.0	4.0	50.0	6.6	3.7	46.5	51.0	46.4	52.1	50.2	48.6	50.7	52.7
Ab	73.1	73.1	75.8	50.2	56.0	63.4	46.4	47.4	46.6	74.0	47.0	71.1	62.1	51.5	46.0	50.9	45.9	47.7	45.4	46.8	44.9
An	19.9	19.8	16.7	47.9	41.9	33.2	2.5	1.7	2.4	17.2	2.2	22.1	34.3	1.9	2.2	2.7	2.1	2.1	6.0	2.4	2.4

Microprobe analyses of feldspars in USW-G2-548

	FE03A	FE03B	FE05A	FE05B	FE05C	FE07A	FE07B	FE08A	FE08B	FE02D	FE01A	FE01B	FE04A	FE04B	FE06A	FE06B	FE06C	FE02A	FE02B	FE02C
	PLAGIOCLASE PHENOCRYSTS									PLAGIOCLASE PHENOCRYST WITH SANIDINE RIM					SANIDINE PHENOCRYSTS					
SiO_2	63.68	65.21	66.93	66.03	50.20	58.04	62.66	66.15	58.31	63.90	63.53	63.87	63.56	66.45	65.66	65.16	64.34	64.61	64.14	62.78
Al_2O_3	21.78	22.09	21.70	22.22	24.30	24.30	22.40	22.49	26.94	22.65	19.16	18.86	18.96	19.18	19.18	22.65	22.02	19.03	19.34	22.27
FeO	0.28	0.28	0.25	0.21	0.18	0.16	0.23	0.17	0.27	0.29	0.18	0.20	0.22	0.22	0.28	0.25	0.29	0.15	0.22	0.32
MgO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
BaO	0.29	0.00	0.50	0.07	0.00	0.00	0.00	0.00	0.07	0.20	1.66	1.02	1.20	1.66	1.94	0.50	0.04	1.56	2.51	0.37
CaO	3.66	3.77	2.96	3.75	6.30	5.81	3.67	4.24	8.46	4.29	0.41	0.38	0.42	0.39	0.34	3.90	3.63	0.46	0.50	3.00
Na_2O	8.48	8.40	8.52	8.77	7.69	7.79	8.66	8.63	6.34	8.09	4.79	4.96	5.02	4.96	4.67	8.29	8.37	5.00	4.88	8.56
K_2O	1.56	1.66	1.91	1.20	0.66	0.72	1.34	1.15	0.39	1.26	9.16	9.01	8.89	8.78	9.32	1.41	1.46	8.88	8.52	1.43
Sum	99.80	101.43	101.80	101.31	98.46	97.73	98.97	101.64	101.28	100.46	98.87	98.42	98.80	100.73	101.54	101.93	100.16	99.91	100.59	99.61
	Cation formula based on 8(O)																			
Si	2.839	2.860	2.875	2.844	2.604	2.646	2.811	2.835	22.584	2.818	2.938	2.954	2.948	2.964	2.963	2.839	2.848	2.957	2.938	2.810
Al	1.143	1.138	1.114	1.146	1.303	1.312	1.183	1.153	1.407	1.175	1.043	1.027	1.029	1.020	1.019	1.152	1.148	1.025	1.040	1.174
Fe	0.010	0.010	0.008	0.007	0.006	0.006	0.008	0.006	0.009	0.010	0.006	0.006	0.008	0.008	0.006	0.009	0.010	0.005	0.008	0.012
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.004	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.030	0.018	0.021	0.029	0.033	0.007	0.000	0.026	.044	0.005
Ca	0.174	0.175	0.138	0.174	0.306	0.284	0.176	0.196	0.420	0.201	0.019	0.018	0.020	0.019	0.016	0.184	0.171	0.021	0.024	0.181
Na	0.732	0.712	0.720	0.743	0.676	0.668	0.753	0.728	0.543	0.690	0.429	0.443	0.448	0.433	0.408	0.691	0.717	0.443	0.431	0.742
K	0.087	0.091	0.106	0.065	0.039	0.042	0.076	0.063	0.021	0.069	0.540	0.530	0.522	0.506	0.536	0.078	0.062	0.518	0.496	0.081
Sum	4.991	4.976	4.971	4.980	5.013	5.016	5.007	4.980	4.985	4.967	5.011	5.000	5.003	4.983	4.966	4.960	4.976	5.001	4.989	5.006
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																			
Or	8.8	9.3	11.0	6.6	3.8	4.1	7.6	6.4	2.1	7.2	54.7	53.5	52.7	52.8	55.8	8.2	8.5	52.7	52.2	8.1
Ab	73.7	72.8	74.7	75.7	66.2	67.9	74.9	73.8	55.2	71.9	43.4	44.7	45.3	45.2	42.5	72.5	73.9	45.1	45.3	73.9
An	17.5	17.9	14.3	17.7	30.0	28.0	17.6	19.9	42.7	20.9	1.9	1.8	2.0	2.0	1.7	19.3	17.6	2.1	2.5	18.0

Microprobe analyses of feldspars in USW-G2-561

	FE02A	FE02B	FE03A	FE03B	FE03C	FE07A	FE07B	FE07C	FE08A	FE08B	FE08A	FE08B	FE08C	FE01A	FE01B	FE04A	FE04B	FE05A	FE05B
	PLAGIOCLASE PHENOCRYSTS													SANIDINE PHENOCRYSTS					
SiO_2	65.46	56.73	65.70	65.24	63.60	65.20	60.15	62.20	64.93	64.04	64.75	62.50	61.39	65.09	66.20	63.72	66.22	65.06	66.50
Al_2O_3	21.45	26.19	21.31	21.58	22.16	21.43	25.58	23.50	21.68	21.77	18.08	23.09	24.23	18.29	18.07	19.25	18.62	18.75	18.04
FeO	0.25	0.21	0.19	0.29	0.19	0.22	0.06	0.00	0.15	0.15	0.15	0.12	0.14	0.08	0.07	0.10	0.00	0.06	0.16
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.10	0.00	0.00	0.79	0.77	2.61	2.05	1.43	1.17
CaO	3.19	9.02	3.25	3.52	4.49	3.67	7.41	5.16	3.54	3.02	0.59	6.05	6.09	0.20	0.20	0.62	0.31	0.40	0.43
Na_2O	8.93	6.29	8.77	8.70	8.33	8.70	6.04	8.20	8.00	8.57	5.34	7.74	7.36	4.39	4.46	5.05	4.78	5.00	5.04
K_2O	1.36	0.36	1.52	1.51	1.24	1.56	0.53	0.90	1.61	1.41	7.64	0.70	0.64	9.61	9.55	8.08	8.72	8.27	8.69
SUM	100.67	100.06	100.79	100.85	100.09	100.04	100.57	100.01	100.57	99.79	99.08	101.00	100.46	99.39	99.08	99.04	101.03	100.08	100.96
	Cation formula based on 8(O)																		
Si	2.876	2.608	2.883	2.867	2.821	2.866	2.664	2.763	2.861	2.896	2.961	2.750	2.721	3.007	3.015	2.932	2.990	2.983	2.989
Al	1.110	1.371	1.102	1.117	1.150	1.110	1.335	1.230	1.125	1.100	1.017	1.230	1.266	0.983	0.960	1.043	0.989	1.000	0.997
Fe	0.009	0.008	0.006	0.010	0.006	0.007	0.001	0.000	0.005	0.005	0.005	0.003	0.005	0.002	0.002	0.002	0.002	0.001	0.005
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.037	0.000	0.000	0.013	0.013	0.046	0.036	0.025	0.020
Ca	0.149	0.429	0.152	0.166	0.213	0.171	0.361	0.245	0.167	0.101	0.028	0.295	0.317	0.012	0.009	0.029	0.014	0.022	0.020
Na	0.760	0.541	0.745	0.740	0.716	0.741	0.586	0.706	0.734	0.738	0.474	0.660	0.632	0.389	0.404	0.451	0.417	0.438	0.438
K	0.075	0.020	0.085	0.083	0.069	0.086	0.030	0.051	0.090	0.079	0.445	0.039	0.035	0.559	0.554	0.470	0.502	0.477	0.497
SUM	4.979	4.978	4.974	4.982	4.986	4.985	4.969	4.995	4.982	4.989	4.973	4.974	4.976	4.966	4.968	4.991	4.958	4.954	4.968
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																		
Or	7.6	2.0	8.7	8.4	6.9	8.6	3.1	5.1	9.1	7.9	7.0	4.0	3.6	56.2	57.3	49.7	53.8	50.9	52.0
Ab	77.2	54.6	75.9	74.9	71.7	74.2	60.6	70.4	74.1	73.9	50.1	67.1	64.2	40.5	41.8	47.3	44.7	46.7	45.9
An	15.1	43.3	15.5	16.7	21.3	17.1	36.3	24.5	16.9	18.1	3.0	29.0	32.2	1.2	0.9	3.0	1.5	2.3	2.1

Microprobe analyses of feldspars in USW-G2-627

	FE09A	FE09B	FE09C	FE09A	FE09B	FE02A	FE02B	FE02C	FE02A	FE02B	FE02C	FE04A	FE04B	FE05A	FE05B	FE05C	FE06A	FE06B	FE06C	FE06D	FE03A	FE03B	FE07A	FE07B
	PLAGIOCLASE PHENOCRYSTS																PLAGIOCLASE PHENOCRYST WITH SANIDINE RIM				SANIDINE PHENOCRYSTS			
SiO_2	64.37	63.07	59.19	62.59	62.95	60.10	59.66	56.64	63.48	64.13	64.23	61.27	58.63	64.24	58.62	56.09	64.16	64.46	63.19	63.10	63.21	64.00	62.67	62.50
Al_2O_3	21.59	22.57	24.10	22.75	21.96	24.21	24.55	26.41	21.42	21.50	22.10	22.59	24.22	21.57	25.40	26.17	18.78	18.56	22.37	22.41	18.04	18.69	18.93	19.09
FeO	0.25	0.26	0.29	0.20	0.29	0.16	0.01	0.09	0.18	0.16	0.21	0.16	0.09	0.17	0.02	0.02	0.12	0.14	0.27	0.24	0.19	0.13	0.15	0.15
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.50	0.00	0.09	0.14	0.09	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	1.56	1.51	0.25	0.27	1.99	1.63	2.27	2.63
CaO	3.43	4.37	6.16	4.71	3.95	6.39	6.93	8.76	3.43	3.23	3.53	4.40	6.16	3.34	7.80	8.71	0.45	0.25	4.03	3.77	0.43	0.30	0.51	0.50
Na_2O	8.38	8.14	7.32	7.77	8.02	7.45	7.21	6.26	8.08	8.29	8.22	8.19	7.93	8.00	6.00	6.69	5.16	4.08	8.19	8.02	4.05	4.53	4.00	4.98
K_2O	1.09	1.14	0.72	1.05	1.30	0.66	0.50	0.36	1.71	1.75	1.28	1.12	0.64	1.52	0.52	0.27	8.66	9.53	1.31	1.46	8.09	9.31	8.74	8.56
SUM	100.06	99.56	97.87	99.23	98.66	99.05	98.95	98.48	98.71	99.34	99.61	97.84	97.88	99.54	97.80	97.95	99.04	99.11	99.66	99.30	98.63	98.62	98.33	99.02
	Cation formula based on 8(O)																							
Si	2.953	2.809	2.698	2.797	2.830	2.706	2.688	2.579	2.852	2.862	2.847	2.703	2.604	2.862	2.643	2.570	2.959	2.973	2.814	2.822	2.943	2.962	2.932	2.927
Al	1.127	1.184	1.295	1.197	1.164	1.203	1.304	1.416	1.134	1.130	1.154	1.209	1.302	1.130	1.367	1.414	1.021	1.006	1.174	1.180	1.033	1.019	1.043	1.047
Fe	0.009	0.009	0.010	0.006	0.010	0.005	0.000	0.001	0.006	0.005	0.007	0.005	0.002	0.005	0.000	0.000	0.004	0.005	0.009	0.008	0.006	0.004	0.005	0.005
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.007	0.000	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.027	0.004	0.004	0.035	0.028	0.041	0.047
Ca	0.162	0.208	0.299	0.224	0.190	0.307	0.333	0.426	0.165	0.153	0.167	0.217	0.301	0.158	0.379	0.428	0.021	0.012	0.192	0.179	0.020	0.018	0.024	0.024
Na	0.719	0.702	0.646	0.673	0.698	0.649	0.629	0.552	0.730	0.716	0.706	0.721	0.700	0.701	0.529	0.590	0.461	0.399	0.707	0.694	0.437	0.406	0.442	0.446
K	0.106	0.064	0.041	0.059	0.070	0.037	0.033	0.020	0.097	0.099	0.071	0.064	0.036	0.084	0.029	0.015	0.509	0.560	0.074	0.083	0.527	0.548	0.520	0.508
SUM	4.984	4.975	4.991	4.959	4.970	4.980	4.987	4.993	4.992	4.969	4.953	5.000	5.025	4.980	4.948	5.021	5.007	4.999	4.975	4.969	5.000	4.989	5.015	5.013
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																							
Or	10.7	6.6	4.2	6.2	8.1	3.7	3.3	2.0	9.7	10.2	7.5	6.4	3.5	8.5	3.1	1.4	51.4	57.7	7.6	8.7	53.6	56.4	52.7	51.8
Ab	72.8	72.1	65.5	70.3	72.3	65.4	63.2	55.3	73.8	74.0	74.8	72.0	67.5	75.4	56.5	57.3	46.5	41.1	72.7	72.6	44.4	41.8	44.8	45.7
An	16.4	21.4	30.3	23.6	19.7	30.9	33.5	42.7	16.5	15.8	17.7	21.7	29.0	16.1	40.4	41.3	2.1	1.2	19.7	18.7	2.0	1.9	2.4	2.4

Microprobe analyses of feldspars in USW-G2-723

	FE02A	FE02B	FE02C	FE05A	FE05B	FE05C	FE06A	FE06B	FE06C	FE07A	FE07B	FE08A	FE08B	FE08C
	PLAGIOCLASE PHENOCRYSTS													
SiO_2	64.09	64.47	63.11	64.61	57.30	56.87	65.25	63.57	64.05	64.90	62.78	63.91	50.67	58.52
Al_2O_3	21.02	21.41	22.50	21.47	26.68	26.95	21.33	21.04	21.82	21.37	22.79	21.57	26.42	24.51
FeO	0.35	0.23	0.33	0.30	0.36	0.36	0.22	0.26	0.33	0.37	0.30	0.29	0.32	0.49
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.39	0.27	0.63	0.06	0.09	0.09	0.11	0.32	0.24	0.11	0.06	0.17	0.19	0.24
CaO	3.00	3.64	4.30	3.31	9.32	9.18	3.29	3.76	3.01	3.29	4.50	3.10	7.17	7.25
Na_2O	9.10	8.81	8.60	9.30	6.29	6.23	9.14	8.98	8.90	9.20	8.59	9.40	7.61	7.49
K_2O	2.06	1.77	1.37	1.56	0.35	0.32	1.62	1.39	1.30	1.61	1.11	1.75	0.67	0.62
SUM	100.02	100.63	101.02	100.65	100.39	100.01	100.96	100.16	100.62	100.86	100.23	100.29	100.04	99.15
	Cation formula based on 8(O)													
Si	2.870	2.854	2.792	2.856	2.568	2.558	2.871	2.820	2.833	2.842	2.788	2.842	2.674	2.655
Al	1.096	1.117	1.177	1.118	1.408	1.426	1.105	1.195	1.137	1.110	1.192	1.130	1.291	1.310
Fe	0.011	0.007	0.011	0.010	0.013	0.013	0.007	0.009	0.011	0.013	0.010	0.010	0.012	0.019
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.006	0.003	0.010	0.000	0.001	0.001	0.001	0.005	0.003	0.001	0.000	0.002	0.002	0.004
Ca	0.141	0.172	0.204	0.156	0.447	0.442	0.153	0.180	0.140	0.155	0.217	0.151	0.363	0.352
Na	0.780	0.756	0.737	0.799	0.545	0.543	0.778	0.770	0.770	0.795	0.739	0.810	0.660	0.659
K	0.115	0.099	0.076	0.006	0.020	0.017	0.090	0.078	0.076	0.089	0.063	0.099	0.038	0.034
SUM	5.020	5.008	5.012	5.025	5.001	5.003	5.006	5.019	5.011	5.015	5.009	5.005	5.021	5.033
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)													
Or	11.1	9.6	7.5	0.3	2.0	1.7	8.8	7.6	7.4	8.6	6.2	9.3	3.7	3.3
Ab	75.3	73.6	72.3	76.0	53.9	54.2	76.2	75.0	75.0	76.3	72.5	76.4	63.4	63.1
An	13.6	16.7	20.2	14.9	44.2	44.1	15.0	17.4	17.5	15.1	21.3	14.2	32.9	33.7

	FE01A	FE01B	FE03A	FE03B	FE04A	FE04B
	SANIDINE PHENOCRYSTS					
SiO_2	65.60	65.18	64.51	64.06	65.39	63.01
Al_2O_3	18.04	19.02	18.96	18.97	18.62	19.41
FeO	0.27	0.22	0.24	0.23	0.23	0.33
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	1.51	2.02	2.09	2.39	1.02	3.16
CaO	0.35	0.50	0.63	0.52	0.46	0.66
Na_2O	4.02	5.00	5.14	5.15	5.15	4.91
K_2O	9.56	8.70	8.30	8.59	9.06	8.42
SUM	100.03	100.93	100.03	100.92	99.96	100.15
	Cation formula based on 8(O)					
Si	2.977	2.957	2.954	2.952	2.980	2.912
Al	0.996	1.017	1.022	1.018	1.000	1.056
Fe	0.009	0.008	0.008	0.008	0.008	0.012
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.026	0.034	0.036	0.041	0.017	0.057
Ca	0.016	0.024	0.029	0.024	0.021	0.031
Na	0.423	0.446	0.456	0.454	0.455	0.439
K	0.563	0.503	0.493	0.498	0.527	0.496
SUM	5.001	4.995	4.994	5.001	5.008	5.010
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	55.7	51.7	49.9	51.0	52.5	51.3
Ab	42.6	45.8	47.1	46.5	45.4	45.4
An	1.6	2.5	3.0	2.5	2.1	3.2

Pumiceous Tuff Between the Pah Canyon and Topopah Spring Members of the Paintbrush Tuff

Microprobe analyses of feldspars in USW-G2-762

	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C	FE03A	FE03B	FE03C	FE04A	FE04B	FE04C	FE05A	FE05B	FE05C	FE06A	FE06B	FE06C	FE07A	FE07B	FE07C
	PLAGIOCLASE AND ANORTHOCLASE PHENOCRYSTS																				
SiO_2	58.83	64.25	65.27	64.58	65.07	64.74	65.54	64.95	65.02	68.59	69.36	68.91	66.57	69.71	68.36	57.77	64.74	64.16	68.50	68.58	67.80
Al_2O_3	25.21	21.68	21.66	21.96	21.60	21.59	20.70	21.31	21.46	18.82	18.70	18.80	20.08	18.72	18.82	26.06	21.48	21.33	19.16	18.63	19.04
FeO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.07	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.25
CaO	7.58	2.94	2.63	3.70	2.54	2.73	2.87	2.49	2.68	0.30	0.23	0.46	2.91	0.30	0.44	6.65	2.49	2.18	0.50	0.46	0.64
Na_2O	7.17	9.07	9.20	9.28	9.07	8.91	9.02	8.72	8.97	10.21	10.52	10.70	9.34	10.55	10.36	6.35	9.02	9.25	9.41	9.06	9.44
K_2O	0.49	0.84	1.03	0.81	0.89	1.03	1.52	1.27	0.90	2.51	1.75	1.30	1.13	1.70	1.50	0.30	1.03	1.12	3.27	2.61	2.50
SUM	99.42	100.11	100.80	100.39	100.24	100.03	98.69	98.80	100.23	100.50	100.50	100.57	100.06	101.07	100.68	98.16	98.81	98.10	100.86	100.64	98.93
	Cation formula based on 8(O)																				
Si	2.647	2.841	2.864	2.846	2.866	2.862	2.904	2.876	2.869	3.011	3.022	3.009	2.911	3.027	3.023	2.606	2.866	2.864	3.000	3.009	2.988
Al	1.336	1.141	1.119	1.140	1.121	1.126	1.081	1.112	1.116	0.973	0.960	0.973	1.036	0.967	0.965	1.384	1.120	1.121	0.988	0.973	0.990
Fe	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003
Ca	0.364	0.136	0.130	0.174	0.167	0.126	0.135	0.165	0.173	0.013	0.010	0.020	0.136	0.013	0.020	0.317	0.165	0.152	0.023	0.021	0.030
Na	0.625	0.777	0.782	0.792	0.774	0.763	0.775	0.748	0.766	0.868	0.869	0.912	0.792	0.888	0.875	0.554	0.773	0.800	0.790	0.838	0.807
K	0.027	0.046	0.057	0.045	0.049	0.057	0.085	0.071	0.066	0.140	0.097	0.077	0.062	0.093	0.087	0.017	0.057	0.063	0.181	0.145	0.146
SUM	5.003	4.942	4.982	4.997	4.976	4.982	4.980	4.971	4.982	5.004	4.979	4.992	4.976	4.979	4.972	4.979	4.984	5.000	4.990	4.989	4.974
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																				
Or	2.7	6.0	5.6	4.5	4.9	5.7	8.5	7.2	5.6	13.7	9.7	7.6	6.3	9.4	8.9	1.7	5.7	6.2	18.1	14.4	14.0
Ab	61.5	77.0	77.5	78.3	78.2	76.6	77.9	76.0	77.0	86.0	88.3	90.4	80.0	89.3	89.1	56.1	77.7	78.8	79.6	83.5	82.2
An	36.0	16.4	16.8	17.2	16.9	17.7	13.6	16.8	17.4	1.3	1.8	2.0	13.7	1.3	2.0	42.2	16.6	15.0	2.3	2.1	3.1

Topopah Spring Member of the Paintbrush Tuff

Microprobe analyses of feldspars in USW-G2-770

	FE01A	FE01B	FE01C	FE12B	FE13A	FE13B	FE13C	FE14A	FE14B	FE14C	FE16A	FE16B	FE16C	FE10A	FE10B	FE10C	FE11A	FE11B	FE11C	FE12C	FE15A	FE15B	FE15C
	PLAGIOCLASE PHENOCRYSTS																SANIDINE PHENOCRYSTS						
SiO_2	59.44	61.04	62.04	65.16	56.05	55.57	56.32	59.73	63.39	63.52	61.29	62.69	62.13	61.57	61.40	61.56	67.27	67.33	67.11	67.76	65.63	66.20	66.65
Al_2O_3	24.23	23.79	22.86	21.03	27.23	26.07	27.50	25.05	22.74	22.06	23.61	22.84	22.71	23.61	23.26	23.60	18.76	18.88	18.80	18.84	18.57	18.66	18.76
FeO	0.17	0.13	0.13	0.05	0.10	0.16	0.12	0.00	0.08	0.14	0.05	0.12	0.16	0.12	0.00	0.03	0.02	0.00	0.01	0.03	0.00	0.01	0.00
MgO	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.45	0.30	0.00	0.13	0.00	0.05	0.07	0.20	0.07	0.37	0.15	0.20	0.35	0.50	0.27	0.03	0.13	0.00	0.30	0.15	0.32	0.75
CaO	6.61	6.09	5.20	3.52	9.91	9.74	8.95	7.35	5.08	4.30	6.02	5.26	5.27	5.64	5.70	5.66	0.58	0.54	0.64	0.73	0.63	0.70	0.62
Na_2O	6.82	6.90	7.55	8.39	5.34	5.48	5.55	6.76	7.45	8.01	7.34	7.18	7.62	7.34	7.20	7.23	5.16	5.32	6.00	6.13	4.77	5.07	6.10
K_2O	1.14	1.29	1.64	1.73	0.50	0.49	0.49	0.88	1.04	1.03	1.44	1.71	1.55	1.41	1.46	1.45	8.03	8.73	7.79	7.30	9.77	8.94	7.03
SUM	99.22	99.85	99.83	100.72	99.34	98.61	100.18	99.92	100.63	99.80	100.28	100.02	99.73	100.29	99.79	100.14	100.75	101.00	100.43	101.24	99.62	100.14	100.21
	Cation formula based on 8(O)																						
Si	2.609	2.731	2.776	2.861	2.579	2.541	2.531	2.671	2.803	2.828	2.735	2.798	2.780	2.745	2.752	2.746	3.003	2.999	2.996	3.001	2.904	2.909	2.991
Al	1.292	1.254	1.205	1.129	1.453	1.447	1.456	1.320	1.185	1.157	1.241	1.197	1.197	1.240	1.229	1.240	0.986	0.990	0.989	0.982	0.994	0.991	0.992
Fe	0.005	0.004	0.004	0.001	0.002	0.005	0.004	0.000	0.002	0.005	0.001	0.004	0.006	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.010	0.008	0.005	0.000	0.001	0.000	0.000	0.000	0.002	0.000	0.005	0.002	0.002	0.005	0.008	0.005	0.000	0.001	0.000	0.005	0.002	0.005	0.012
Ca	0.320	0.292	0.249	0.165	0.481	0.476	0.432	0.352	0.236	0.205	0.287	0.250	0.252	0.268	0.277	0.270	0.027	0.024	0.030	0.034	0.030	0.033	0.029
Na	0.597	0.597	0.654	0.713	0.468	0.485	0.484	0.586	0.638	0.691	0.635	0.619	0.660	0.634	0.629	0.624	0.446	0.458	0.519	0.526	0.420	0.442	0.537
K	0.065	0.073	0.093	0.096	0.028	0.028	0.027	0.050	0.075	0.091	0.081	0.096	0.086	0.080	0.083	0.082	0.903	0.495	0.442	0.412	0.546	0.513	0.401
SUM	4.902	4.963	4.988	4.966	4.974	4.984	4.987	4.979	4.964	4.977	4.988	4.959	4.985	4.980	4.981	4.974	4.968	4.969	4.977	4.964	5.000	4.977	4.967
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																						
Or	6.6	7.6	9.3	9.9	2.9	2.8	2.7	5.1	9.8	9.2	8.1	9.9	8.8	8.1	8.4	8.4	51.5	50.7	44.6	42.4	55.7	51.9	41.5
Ab	60.8	62.1	66.7	73.2	47.9	49.8	48.7	59.3	65.8	70.8	63.3	64.1	66.8	64.6	63.6	63.9	45.7	46.9	52.4	54.1	41.3	44.7	55.5
An	32.6	30.4	25.0	16.9	49.2	48.1	48.5	35.7	24.4	20.0	28.6	25.9	25.2	27.3	28.0	27.7	2.8	2.5	3.0	3.5	3.0	3.3	3.0

Microprobe analyses of feldspars in USW-G2-770 (cont)

	FE17A	FE17B	FE17C	FE19A	FE19B	FE19C
	SANIDINE PHENOCRYSTS (cont)					
SiO_2	65.45	66.52	66.05	66.18	66.79	66.25
Al_2O_3	18.70	18.60	19.03	18.46	18.61	18.62
FeO	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.03	0.03	0.37	0.05	0.38	0.20
CaO	0.63	0.56	0.67	0.50	0.57	0.63
Na_2O	5.83	5.28	5.64	4.86	5.29	5.83
K_2O	8.09	8.51	7.78	9.25	9.47	8.22
SUM	98.81	99.02	100.52	99.50	101.13	100.03
	Cation formula based on 8(O)					
Si	2.982	2.996	2.991	2.997	2.994	2.985
Al	1.004	0.998	1.003	0.996	0.982	1.000
Fe	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.006	0.000	0.006	0.002
Ca	0.029	0.026	0.031	0.020	0.020	0.029
Na	0.515	0.461	0.490	0.426	0.459	0.509
K	0.469	0.487	0.444	0.534	0.541	0.472
SUM	5.003	4.970	4.969	4.979	5.000	4.998
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	46.3	50.0	46.0	54.1	52.7	46.7
Ab	50.8	47.3	50.8	43.1	44.7	50.4
An	2.9	2.7	3.2	2.8	2.5	2.9

Microprobe analyses of feldspars in USW-G2-898

	FE20A	FE20B	FE20C	FE24A	FE24B	FE24C	FE25A	FE25B	FE25C	FE27A	FE27B	FE27C	FE29A	FE29B	FE29C
	PLAGIOCLASE PHENOCRYSTS												PLAGIOCLASE PHENOCRYSTS WITH SANIDINE RIM		
SiO_2	64.17	63.98	64.43	59.59	58.94	64.45	62.86	62.39	62.07	63.18	61.89	61.68	64.85	[illegible]	67.79
Al_2O_3	21.71	22.18	21.34	24.77	25.66	21.96	22.51	22.70	22.80	22.92	23.23	23.34	21.12	21.15	18.65
FeO	0.03	0.08	0.00	0.00	0.00	0.13	0.06	0.10	0.14	0.04	0.13	0.14	0.03	0.06	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.13	0.00	0.10	0.00	0.07	0.00	0.48	0.15	0.13	0.00	0.30	0.03	0.00	0.17	0.07
CaO	4.02	4.27	3.51	7.26	8.07	4.19	4.84	5.07	5.05	5.18	5.60	5.76	3.36	3.16	0.75
Na_2O	7.94	8.02	8.12	6.93	6.81	8.41	7.70	7.45	7.73	7.74	7.66	7.71	8.33	8.17	6.46
K_2O	2.02	1.77	1.97	0.83	0.68	1.02	1.63	1.45	1.24	1.14	0.93	0.84	1.62	2.18	7.56
SUM	100.07	100.34	99.58	99.45	100.27	100.25	100.17	99.38	99.22	100.29	99.79	99.83	99.38	99.94	100.94
	Cation formula based on 8(O)														
Si	2.849	2.831	2.869	2.677	2.634	2.843	2.801	2.792	2.781	2.792	2.763	2.757	2.886	2.883	3.009
Al	1.136	1.156	1.119	1.310	1.361	1.142	1.182	1.196	1.205	1.193	1.222	1.225	1.107	1.106	0.976
Fe	0.000	0.002	0.000	0.000	0.000	0.003	0.001	0.002	0.005	0.001	0.004	0.005	0.000	0.001	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.002	0.001	0.000	0.005	0.000	0.000	0.002	0.000
Ca	0.190	0.201	0.167	0.349	0.386	0.198	0.230	0.243	0.242	0.245	0.267	0.274	0.159	0.149	0.035
Na	0.683	0.687	0.700	0.602	0.590	0.718	0.664	0.646	0.672	0.663	0.663	0.666	0.718	0.701	0.520
K	0.113	0.100	0.111	0.047	0.038	0.057	0.091	0.083	0.069	0.063	0.052	0.047	0.091	0.122	0.427
SUM	4.973	4.927	4.969	4.986	5.000	4.962	4.979	4.966	4.976	4.960	4.976	4.977	4.962	4.965	4.968
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)														
Or	11.5	10.1	11.3	4.7	3.7	5.9	9.2	8.5	7.0	6.5	5.3	4.8	9.4	12.6	43.5
Ab	69.3	69.5	71.6	60.3	58.2	73.8	67.4	66.5	68.4	68.3	67.5	67.5	74.2	72.1	53.0
An	19.3	20.3	17.1	35.0	38.1	20.3	23.4	25.0	24.6	25.2	27.2	27.8	16.4	15.3	3.6

	FE21A	FE21B	FE21C	FE22A	FE22B	FE22C	FE23A	FE23B	FE23C
	SANIDINE PHENOCRYSTS								
SiO_2	66.70	66.82	66.36	66.52	66.43	67.25	66.33	67.45	66.25
Al_2O_3	18.50	18.37	18.94	18.41	18.57	18.61	19.03	18.57	18.68
FeO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.56	0.00	0.00	0.00	0.38	0.07	0.75
CaO	0.59	0.61	0.97	0.38	0.42	0.63	1.02	0.47	0.70
Na_2O	5.13	4.12	6.25	5.25	5.16	5.33	5.68	4.65	5.16
K_2O	9.37	9.66	6.78	9.09	8.92	8.77	7.86	9.63	8.43
SUM	100.34	99.86	99.98	99.75	99.59	100.66	100.52	100.92	100.38
	Cation formula based on 8(O)								
Si	2.999	3.016	2.981	3.004	3.002	3.005	2.975	3.014	2.984
Al	0.980	0.976	1.002	0.979	0.989	0.979	1.005	0.978	1.001
Fe	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.009	0.000	0.000	0.000	0.005	0.000	0.012
Ca	0.027	0.029	0.046	0.017	0.020	0.030	0.048	0.022	0.033
Na	0.446	0.360	0.544	0.450	0.451	0.461	0.511	0.402	0.451
K	0.537	0.567	0.368	0.523	0.513	0.500	0.449	0.548	0.483
SUM	4.990	4.949	4.973	4.984	4.976	4.977	4.996	4.965	4.969
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	53.2	59.3	39.7	52.4	52.1	50.5	44.5	56.4	49.9
Ab	44.2	37.7	55.6	45.9	45.8	46.5	50.7	41.4	44.6
An	2.7	3.0	4.7	1.7	2.0	3.0	4.8	2.3	3.4

Microprobe analyses of feldspars in USW-G2-898 (cont)

	FE26A	FE26B	FE26C	FE26A	FE26B	FE26C
	SANIDINE PHENOCRYSTS (cont)					
SiO_2	65.98	66.57	66.07	65.67	66.00	66.48
Al_2O_3	18.59	18.79	19.16	19.15	18.88	18.88
FeO	0.00	0.00	0.00	0.00	0.01	0.01
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.42	0.37	0.73	0.00	0.07	0.45
CaO	0.00	0.00	0.00	0.00	0.96	0.95
Na_2O	5.63	6.11	6.03	5.00	6.39	6.43
K_2O	8.03	7.22	7.16	8.32	6.70	6.63
SUM	99.36	100.09	100.30	99.46	99.91	99.96
	Cation formula based on 8(O)					
Si	2.990	2.990	2.967	2.971	2.991	2.984
Al	0.993	0.994	1.014	1.021	0.996	0.998
Fe	0.000	0.000	0.002	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.006	0.005	0.012	0.000	0.000	0.000
Ca	0.032	0.042	0.042	0.032	0.044	0.044
Na	0.499	0.531	0.520	0.490	0.554	0.560
K	0.464	0.413	0.410	0.479	0.382	0.379
SUM	4.981	4.978	4.976	4.996	4.968	4.977
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	46.9	41.9	42.0	47.9	39.0	38.6
Ab	49.9	53.9	53.7	49.0	56.5	57.0
An	3.2	4.3	4.3	3.2	4.5	4.5

Microprobe analyses of feldspars in USW-G2-984

	FE02A	FE02B	FE02C	FE03A	FE03B	FE03C	FE06A	FE06B	FE06C
	PLAGIOCLASE PHENOCRYSTS								
SiO_2	65.74	66.03	65.98	64.68	65.58	64.43	61.08	63.80	64.73
Al_2O_3	20.23	20.13	20.21	21.18	21.27	21.36	23.55	21.45	21.20
FeO	0.10	0.12	0.14	0.11	0.07	0.08	0.10	0.10	0.15
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	2.13	2.23	2.17	3.19	2.98	3.04	5.41	3.61	3.42
Na_2O	9.02	8.97	8.68	8.71	8.80	9.01	7.86	9.01	8.04
K_2O	2.02	1.84	2.32	1.24	1.37	1.24	0.75	1.20	1.01
SUM	99.32	99.31	99.54	99.11	99.99	99.09	98.75	99.18	99.40
	Cation formula based on 8(O)								
Si	2.926	2.934	2.931	2.882	2.891	2.866	2.708	2.852	2.875
Al	1.061	1.054	1.057	1.111	1.106	1.120	1.299	1.129	1.111
Fe	0.004	0.004	0.005	0.004	0.002	0.000	0.002	0.002	0.005
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.101	0.105	0.103	0.151	0.140	0.143	0.260	0.171	0.162
Na	0.777	0.772	0.747	0.751	0.752	0.776	0.685	0.780	0.761
K	0.113	0.103	0.130	0.070	0.076	0.070	0.042	0.068	0.056
SUM	4.983	4.972	4.971	4.970	4.960	4.995	4.986	5.002	4.973
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	11.4	10.5	13.3	7.2	7.9	6.9	4.3	6.7	5.7
Ab	78.4	78.8	76.2	77.3	77.7	76.9	69.4	76.5	77.7
An	10.2	10.7	10.5	15.5	14.5	16.2	26.3	16.8	16.5

Microprobe analyses of feldspars in USW-G2-984 (cont)

	FE05A	FE05B	FE05C	FE01A	FE01B	FE01C	FE04A	FE04B	FE04C	FE07A	FE07B	FE07C	FE08A	FE08B	FE08C	FE99A	FE99B
	PLAGIOCLASE PHENOCRYST WITH SANIDINE RIM			SANIDINE PHENOCRYSTS												VOLCAN PHASE SANIDINE IN GROUNDMASS	
SiO_2	64.63	65.87	66.44	67.06	67.41	66.05	66.92	66.90	65.57	66.55	66.90	66.40	66.02	66.71	66.70	66.75	69.10
Al_2O_3	21.56	18.35	18.37	18.56	18.46	18.57	18.02	18.01	18.07	18.35	18.21	18.38	18.25	18.36	18.29	17.72	17.26
FeO	0.08	0.07	0.16	0.12	0.10	0.13	0.10	0.16	0.10	0.10	0.14	0.17	0.12	0.12	0.21	0.06	0.06
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.15	0.00	0.00	0.12	0.02	0.32	0.00	0.00	0.02	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
CaO	3.37	0.39	0.35	0.30	0.26	0.30	0.37	0.40	0.33	0.36	0.35	0.40	0.27	0.27	0.45	0.13	0.00
Na_2O	9.11	5.10	5.22	5.09	5.04	5.30	5.02	4.91	4.60	5.22	5.50	5.05	4.96	5.00	5.57	4.66	4.44
K_2O	1.16	8.99	8.73	8.38	8.43	8.49	9.19	9.27	9.91	8.89	8.76	9.01	9.24	9.23	8.04	9.04	9.62
SUM	99.99	98.06	99.26	100.63	100.41	99.24	100.02	100.04	98.73	99.59	99.94	99.43	98.96	99.70	99.46	100.67	100.63
	Cation formula based on 8(O)																
Si	2.862	3.002	3.011	3.012	3.015	2.999	3.013	3.016	3.006	3.009	3.017	3.009	3.010	3.011	3.004	3.053	3.083
Al	1.125	0.985	0.980	0.976	0.972	0.992	0.978	0.977	0.975	0.978	0.966	0.981	0.980	0.976	0.976	0.933	0.906
Fe	0.000	0.002	0.005	0.004	0.004	0.004	0.002	0.005	0.005	0.005	0.005	0.005	0.004	0.004	0.008	0.001	0.001
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.000	0.000	0.001	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.160	0.019	0.016	0.013	0.012	0.013	0.017	0.017	0.016	0.017	0.016	0.019	0.012	0.012	0.021	0.005	0.002
Na	0.782	0.457	0.458	0.493	0.489	0.473	0.437	0.428	0.416	0.456	0.480	0.442	0.437	0.444	0.499	0.404	0.383
K	0.065	0.521	0.504	0.477	0.480	0.491	0.527	0.533	0.570	0.512	0.502	0.520	0.536	0.531	0.499	0.562	0.546
SUM	4.995	4.987	4.974	4.975	4.974	4.977	4.974	4.973	4.997	4.979	4.986	4.976	4.979	4.978	4.997	4.958	4.922
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																
Or	6.5	52.3	51.5	48.5	48.9	50.3	53.7	54.5	57.2	52.0	50.3	53.0	54.4	53.8	49.5	57.9	58.6
Ab	77.7	45.8	46.8	50.2	49.8	48.4	44.5	43.8	41.2	46.3	49.1	45.1	44.4	45.0	40.5	41.6	41.1
An	15.9	1.9	1.6	1.3	1.2	1.3	1.7	1.7	1.6	1.7	1.6	1.9	1.2	1.2	2.1	0.5	0.2

Microprobe analyses of feldspars in USW-G2-1133

	FE10A	FE10B	FE10C	FE11C	FE12A	FE12B	FE13A	FE13B	FE13C	FE14A	FE14B	FE14C	FE15A	FE15B	FE15C
	PLAGIOCLASE PHENOCRYSTS									SANIDINE PHENOCRYSTS					
SiO_2	65.53	65.02	64.76	64.48	65.03	64.77	63.97	63.85	64.51	65.73	65.61	66.26	65.95	66.29	65.96
Al_2O_3	21.63	21.98	21.56	21.01	22.00	22.30	22.42	21.75	22.02	18.64	18.29	18.68	18.38	18.62	18.31
FeO	0.12	0.14	0.14	0.14	0.13	0.11	0.00	0.14	0.13	0.11	0.06	0.12	0.07	0.13	0.09
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.02	0.06	0.00	0.02	0.00	0.00	0.06	0.00
CaO	3.10	3.59	3.49	3.45	3.73	3.86	3.57	3.41	3.23	0.13	0.19	0.27	0.34	0.34	0.32
Na_2O	8.81	9.06	9.16	8.84	9.16	8.89	9.17	9.09	9.14	4.50	4.32	4.68	5.09	5.40	5.23
K_2O	1.30	1.14	1.20	1.09	1.21	1.06	1.11	1.14	1.25	10.63	10.74	9.94	9.29	9.81	9.30
SUM	100.48	100.93	100.30	99.82	101.32	101.00	100.24	99.41	100.35	99.74	99.23	99.96	99.12	99.93	99.31
	Cation formula based on 8(O)														
Si	2.878	2.851	2.867	2.856	2.847	2.835	2.828	2.846	2.847	2.991	3.002	2.988	3.003	2.994	3.001
Al	1.119	1.136	1.121	1.138	1.134	1.154	1.167	1.142	1.146	0.990	0.986	0.996	0.986	0.980	0.981
Fe	0.003	0.005	0.006	0.006	0.003	0.003	0.000	0.006	0.003	0.004	0.001	0.004	0.002	0.004	0.002
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.146	0.168	0.164	0.162	0.174	0.180	0.168	0.162	0.151	0.006	0.008	0.012	0.016	0.016	0.015
Na	0.750	0.769	0.763	0.759	0.777	0.754	0.785	0.785	0.781	0.386	0.382	0.418	0.449	0.439	0.460
K	0.072	0.063	0.071	0.061	0.066	0.058	0.062	0.064	0.070	0.617	0.627	0.573	0.538	0.518	0.543
SUM	4.967	4.982	5.001	4.981	5.002	4.986	5.010	5.003	4.999	5.012	5.006	4.982	4.994	5.001	5.004
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)														
Or	7.4	6.3	7.0	6.2	6.5	5.8	6.1	6.3	7.0	60.6	61.7	57.6	53.6	51.1	53.3
Ab	77.5	76.9	76.9	77.3	76.4	76.0	77.3	77.6	77.9	38.9	37.6	41.2	44.8	47.3	45.2
An	15.1	16.8	16.1	16.5	17.1	18.1	16.6	16.0	15.1	0.5	0.8	1.2	1.6	1.6	1.5

Microprobe analyses of feldspars in USW-G2-1281

	FE27A	FE27B	FE27C	FE28A	FE28B	FE28C	FE21A	FE21B	FE21C	FE22A	FE22B	FE22C	FE23A	FE23B	FE23C	FE24A	FE24B	FE24C	FE25A	FE25B	FE25C	FE26A	FE26B	FE26C
	PLAGIOCLASE PHENOCRYSTS												SANIDINE PHENOCRYSTS											
SiO_2	64.97	64.57	64.87	58.86	64.21	65.16	57.42	58.05	66.70	65.99	65.79	64.38	66.37	66.43	66.17	67.01	66.30	66.24	66.14	66.75	65.89	67.02	66.99	66.68
Al_2O_3	22.11	21.62	21.68	25.64	22.29	21.37	26.36	26.12	21.80	21.32	21.60	21.88	18.34	18.43	18.43	18.03	18.68	18.64	18.23	18.36	18.61	18.72	18.54	18.57
FeO	0.09	0.13	0.19	0.11	0.00	0.11	0.14	0.22	0.21	0.17	0.14	0.11	0.18	0.17	0.12	0.16	0.16	0.17	0.14	0.14	0.14	0.14	0.19	0.21
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.20	0.29	0.12	0.00	0.00	0.27	0.00	0.00	0.02
CaO	2.93	3.14	3.46	7.16	3.94	3.18	7.83	7.17	2.78	2.75	2.88	2.67	0.41	0.38	0.42	0.36	0.37	0.38	0.36	0.38	0.37	0.46	0.35	0.44
Na_2O	8.85	8.93	8.71	7.24	8.88	9.02	6.68	6.86	8.09	9.21	9.52	9.23	5.63	5.81	5.81	5.96	5.22	5.11	5.38	5.49	6.97	5.60	5.59	5.66
K_2O	1.27	1.33	1.19	0.50	0.97	1.14	0.48	0.42	1.16	1.26	1.21	1.19	9.00	8.77	8.80	8.34	9.32	9.43	9.68	9.23	9.63	8.58	8.52	8.33
SUM	100.22	99.72	100.10	98.52	100.36	100.03	98.92	98.84	101.57	100.73	101.23	99.36	99.86	98.98	99.28	100.05	100.34	100.10	99.96	100.36	99.89	100.58	100.18	99.94
	Cation formula based on 8(O)																							
Si	2.862	2.864	2.863	2.643	2.833	2.877	2.599	2.622	2.881	2.893	2.873	2.861	3.003	2.999	3.000	2.995	2.990	2.993	2.998	3.003	2.989	3.000	3.008	3.002
Al	1.148	1.130	1.127	1.356	1.159	1.111	1.406	1.380	1.113	1.101	1.116	1.141	0.977	0.980	0.984	0.951	0.983	0.992	0.974	0.973	0.994	0.988	0.980	0.986
Fe	0.002	0.003	0.006	0.004	0.000	0.003	0.006	0.008	0.007	0.006	0.006	0.004	0.002	0.006	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.008
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.004	0.001	0.000	0.000	0.004	0.000	0.000	0.000
Ca	0.137/	0.148	0.162	0.342	0.185	0.150	0.379	0.346	0.128	0.128	0.134	0.126	0.019	0.017	0.020	0.017	0.017	0.017	0.017	0.017	0.017	0.021	0.016	0.021
Na	0.755	0.768	0.744	0.629	0.759	0.772	0.585	0.600	0.746	0.782	0.806	0.794	0.494	0.507	0.511	0.516	0.457	0.447	0.472	0.478	0.437	0.486	0.486	0.494
K	0.071	0.074	0.066	0.027	0.054	0.063	0.026	0.023	0.064	0.069	0.066	0.066	0.519	0.500	0.467	0.475	0.536	0.543	0.559	0.529	0.566	0.490	0.487	0.478
SUM	4.975	4.987	4.968	5.001	4.990	4.978	5.000	4.989	4.960	4.979	5.000	4.982	5.014	5.013	4.987	5.000	5.001	4.990	5.025	5.005	5.001	4.990	4.983	4.989
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																							
Or	7.4	7.5	6.8	2.7	5.4	6.4	2.6	2.4	6.8	7.0	6.6	6.7	50.3	49.8	46.8	47.2	53.5	53.9	53.3	51.7	56.0	49.1	49.2	48.1
Ab	78.4	77.6	76.5	63.8	76.1	78.4	59.1	61.9	79.5	79.9	80.1	80.5	47.9	49.3	51.2	51.1	45.2	44.4	45.8	46.7	43.3	48.7	49.1	49.7
An	14.2	14.9	16.7	34.3	18.5	15.2	38.3	35.7	13.6	13.1	13.3	12.8	1.8	1.7	2.0	1.7	1.7	1.7	1.6	1.7	1.7	2.1	1.6	2.1

Microprobe analyses of feldspars in USW-G2-1420

	FE30A	FE30B	FE30C	FE31A	FE31B	FE31C	FE32A	FE32B	FE32C	FE33A	FE33B	FE33C
	PLAGIOCLASE PHENOCRYSTS											
SiO_2	64.42	64.10	64.63	64.17	64.99	64.05	64.64	64.60	65.14	64.60	65.41	65.11
Al_2O_3	22.30	21.94	21.39	21.98	22.09	22.14	22.03	21.93	22.12	21.67	21.86	22.05
FeO	0.15	0.13	0.17	0.20	0.13	0.10	0.20	0.20	0.22	0.14	0.16	0.16
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
CaO	3.54	3.75	3.05	3.66	3.57	3.66	3.61	3.31	3.15	3.10	2.84	3.73
Na_2O	9.04	9.21	9.46	8.96	9.10	9.11	8.94	9.05	9.08	9.04	8.70	8.98
K_2O	1.13	1.14	0.96	1.13	1.14	0.90	1.22	1.12	1.09	1.24	1.22	0.73
SUM	100.59	100.30	99.66	100.09	101.02	100.05	100.64	100.41	100.83	99.87	100.18	100.77
	Cation formula based on 8(O)											
Si	2.835	2.836	2.867	2.840	2.847	2.833	2.844	2.853	2.856	2.860	2.877	2.853
Al	1.156	1.143	1.118	1.146	1.140	1.153	1.143	1.139	1.142	1.130	1.133	1.130
Fe	0.005	0.003	0.005	0.006	0.003	0.006	0.006	0.006	0.007	0.005	0.005	0.005
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Ca	0.167	0.176	0.144	0.172	0.167	0.172	0.169	0.155	0.148	0.146	0.133	0.175
Na	0.771	0.789	0.813	0.768	0.772	0.780	0.762	0.772	0.771	0.776	0.741	0.762
K	0.063	0.063	0.053	0.062	0.063	0.050	0.067	0.062	0.060	0.069	0.067	0.040
SUM	4.998	5.011	5.000	4.994	4.992	4.995	4.991	4.989	4.985	4.991	4.956	4.972
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)											
Or	6.3	6.1	5.2	6.2	6.3	5.0	6.7	6.3	6.1	6.9	7.1	4.1
Ab	77.0	76.8	80.5	76.6	77.0	77.8	76.4	78.1	78.0	78.0	78.7	78.0
An	16.7	17.1	14.3	17.2	16.7	17.2	16.9	15.7	15.1	15.1	14.1	17.9

	FE34A	FE34B	FE34C	FE35A	FE35B	FE35C	FE36A	FE36B	FE36C
	SANIDINE PHENOCRYSTS								
SiO_2	66.26	66.61	65.58	66.14	66.06	66.33	66.37	65.70	66.56
Al_2O_3	18.06	18.39	18.45	18.02	18.71	18.52	18.54	18.55	18.49
FeO	0.21	0.10	0.07	0.03	0.09	0.07	0.06	0.06	0.11
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.09	0.07	0.00	0.00	0.00	0.05	0.00
CaO	0.23	0.25	0.30	0.22	0.23	0.18	0.20	0.21	0.19
Na_2O	5.04	4.83	4.79	4.01	4.46	4.34	4.55	4.56	4.61
K_2O	9.57	10.11	9.92	10.38	10.59	10.65	10.61	10.67	10.77
SUM	100.18	100.29	99.22	99.69	100.14	100.10	100.37	99.32	100.73
	Cation formula based on 8(O)								
Si	2.989	3.007	2.992	3.006	2.992	3.003	2.999	2.984	3.001
Al	1.002	0.978	0.992	0.985	0.998	0.989	0.986	1.000	0.982
Fe	0.008	0.002	0.002	0.000	0.002	0.002	0.001	0.001	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.010	0.012	0.015	0.010	0.010	0.008	0.009	0.009	0.008
Na	0.440	0.422	0.423	0.388	0.391	0.381	0.399	0.404	0.402
K	0.549	0.582	0.577	0.601	0.611	0.614	0.611	0.623	0.619
SUM	4.999	5.002	5.001	4.990	5.004	4.990	5.006	5.022	5.016
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	55.0	57.3	56.8	60.2	60.4	61.2	60.0	60.1	60.2
Ab	44.0	41.5	41.7	38.8	38.6	38.0	39.2	39.0	39.1
An	1.0	1.2	1.5	1.0	1.0	0.8	0.9	0.9	0.8

Microprobe analyses of feldspars in USW-G2-1585

	FE01A	FE01C	FE02A	FE02B	FE02C	FE03A	FE04A	FE04B	FE04C
	PLAGIOCLASE PHENOCRYSTS								
SiO_2	65.49	65.68	57.70	62.48	65.77	65.74	62.44	64.32	65.23
Al_2O_3	22.11	22.11	26.23	23.35	22.08	21.13	23.30	22.03	21.61
FeO	0.13	0.20	0.29	0.11	0.10	0.20	0.06	0.14	0.19
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	3.14	3.06	8.09	4.49	3.10	2.67	4.91	4.11	3.07
Na_2O	8.92	9.19	6.45	8.55	8.91	9.02	8.48	8.73	8.94
K_2O	1.23	1.08	0.38	0.77	1.38	1.62	0.82	0.99	1.01
SUM	101.05	101.43	99.21	99.76	101.26	100.38	100.01	101.15	100.06
	Cation formula based on 8(O)								
Si	2.862	2.862	2.605	2.776	2.868	2.895	2.772	2.817	2.875
Al	1.139	1.136	1.393	1.222	1.130	1.096	1.219	1.178	1.123
Fe	0.003	0.010	0.010	0.004	0.002	0.006	0.001	0.005	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.146	0.142	0.390	0.213	0.145	0.125	0.233	0.191	0.145
Na	0.755	0.776	0.562	0.736	0.753	0.770	0.729	0.740	0.763
K	0.068	0.059	0.021	0.043	0.075	0.090	0.045	0.055	0.055
SUM	4.974	4.983	4.981	4.994	4.973	4.982	5.000	4.987	4.946
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	7.0	6.0	2.2	4.3	7.7	9.1	4.5	5.6	5.7
Ab	77.9	79.4	57.8	74.2	77.4	78.2	72.4	75.1	79.2
An	15.1	14.5	40.1	21.5	14.9	12.7	23.1	19.4	15.1

	FE05A	FE05B	FE05C	FE06A	FE06B	FE06C	FE07A	FE07B	FE07C
	SANIDINE PHENOCRYSTS								
SiO_2	66.36	66.96	66.36	65.98	66.09	66.18	65.17	65.29	65.75
Al_2O_3	18.04	18.70	18.57	18.29	18.20	18.43	18.44	18.41	18.30
FeO	0.00	0.15	0.13	0.09	0.06	0.15	0.00	0.08	0.13
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.05	0.00	0.02	0.00	0.59	0.60	1.09
CaO	0.27	0.30	0.24	0.20	0.23	0.23	0.12	0.14	0.20
Na_2O	5.56	5.21	5.03	4.50	4.36	4.58	4.00	4.06	3.91
K_2O	9.07	9.00	9.04	10.66	10.51	10.75	11.25	10.87	11.16
SUM	100.19	100.33	99.80	99.63	99.50	100.33	99.73	99.38	100.66
	Cation formula based on 8(O)								
Si	2.990	3.005	3.001	3.004	3.010	2.997	2.987	2.993	2.993
Al	0.999	0.989	0.989	0.977	0.977	0.983	0.995	0.996	0.981
Fe	0.002	0.005	0.004	0.002	0.001	0.005	0.002	0.002	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.009	0.019
Ca	0.012	0.013	0.010	0.009	0.010	0.010	0.005	0.005	0.009
Na	0.495	0.453	0.440	0.397	0.383	0.401	0.355	0.361	0.344
K	0.521	0.515	0.544	0.619	0.611	0.621	0.656	0.636	0.647
SUM	5.009	4.979	4.989	5.009	4.992	5.018	5.011	5.002	5.000
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	51.2	52.5	54.7	60.4	60.9	60.2	64.6	63.5	64.7
Ab	47.6	46.2	44.3	38.7	38.1	38.9	34.9	36.0	34.4
An	1.2	1.3	1.0	0.9	1.0	1.0	0.5	0.5	0.9

Microprobe analyses of feldspars in USW-G2-1664

	FE11A	FE12A	FE12B	FE12C	FE13A	FE13B	FE13C	FE14A	FE14B	FE14C	FE15A	FE15B	FE15C	FE16A	FE16B	FE16C
	PLAGIOCLASE PHENOCRYSTS										SANIDINE PHENOCRYSTS					
SiO_2	64.98	64.86	66.72	64.63	53.90	64.68	65.01	57.38	59.46	65.11	65.88	66.71	65.37	66.26	66.02	66.45
Al_2O_3	22.32	22.18	21.72	21.60	28.55	22.13	22.70	25.56	24.80	21.52	18.28	18.47	18.44	18.29	18.37	18.46
FeO	0.09	0.08	0.10	0.10	0.08	0.14	0.14	0.17	0.09	0.31	0.06	0.08	0.08	0.16	0.06	0.11
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.06	0.00	0.12
CaO	3.78	3.63	3.52	3.66	1.13	3.42	3.36	8.02	7.27	3.04	0.16	0.18	0.18	0.22	0.17	0.20
Na_2O	8.66	8.91	9.07	9.11	5.11	8.88	8.98	7.18	7.25	9.13	3.71	4.28	4.29	4.15	3.93	4.63
K_2O	1.17	1.25	1.28	1.20	0.22	1.30	1.30	0.46	0.49	1.31	11.46	10.82	10.86	11.07	11.41	10.28
SUM	100.91	100.82	101.50	100.48	99.04	100.54	100.99	98.78	99.37	100.50	99.55	99.55	99.22	100.20	99.96	100.45
	Cation formula based on 8(O)															
Si	2.846	2.846	2.867	2.852	2.458	2.849	2.848	2.608	2.672	2.868	3.007	2.997	2.994	3.007	3.003	2.998
Al	1.151	1.147	1.116	1.126	1.533	1.147	1.146	1.369	1.313	1.117	0.983	0.993	0.994	0.977	0.985	0.981
Fe	0.000	0.000	0.006	0.006	0.002	0.006	0.006	0.006	0.002	0.010	0.001	0.002	0.002	0.006	0.001	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Ca	0.176	0.170	0.164	0.172	0.543	0.160	0.157	0.391	0.349	0.143	0.006	0.008	0.008	0.010	0.008	0.009
Na	0.736	0.757	0.767	0.780	0.451	0.757	0.762	0.632	0.631	0.779	0.327	0.377	0.380	0.365	0.346	0.422
K	0.064	0.069	0.070	0.067	0.012	0.072	0.072	0.026	0.027	0.073	0.667	0.629	0.634	0.640	0.662	0.581
SUM	4.972	4.990	4.990	5.003	5.000	4.991	4.989	5.031	4.996	4.992	4.991	5.006	5.013	5.004	5.004	5.006
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)															
Or	6.6	6.9	7.0	6.6	1.2	7.3	7.3	2.6	2.7	7.3	66.7	62.8	62.8	63.1	66.2	57.8
Ab	76.4	76.0	76.6	76.5	44.8	76.5	76.9	60.2	62.7	78.3	32.7	37.2	37.2	36.8	34.1	41.3
An	16.1	17.1	16.4	16.9	54.0	16.2	15.8	37.3	34.7	14.4	0.6	0.0	0.0	1.0	0.0	0.9

Microprobe analyses of feldspars in USW-G2-1691

	FE20A	FE20B	FE20C	FE21A	FE21B	FE21C	FE25A	FE25B	FE25C	FE27A	FE27B	FE27C	FE22A	FE22B	FE22C	FE23A	FE23B	FE23C	FE24A	FE24B	FE24C	FE26A	FE26B	FE26C
	PLAGIOCLASE PHENOCRYSTS												SANIDINE PHENOCRYSTS											
SiO_2	63.39	63.12	63.70	64.12	63.86	63.46	64.70	64.44	65.10	64.38	63.19	63.04	65.08	65.29	64.83	66.24	66.09	66.86	65.87	65.44	66.66	65.13	65.06	65.45
Al_2O_3	21.63	22.00	21.46	21.42	21.16	21.89	21.90	22.22	21.73	22.16	22.43	22.30	18.07	18.22	18.29	18.13	18.24	18.37	18.41	18.39	18.49	18.31	18.59	18.34
FeO	0.15	0.00	0.17	0.17	0.17	0.11	0.17	0.14	0.16	0.17	0.08	0.19	0.09	0.11	0.05	0.06	0.11	0.07	0.07	0.13	0.12	0.14	0.11	0.11
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.02	0.15	0.12	0.02	0.24	0.07
CaO	3.58	3.54	3.25	2.89	2.86	3.40	3.43	3.67	3.14	3.40	3.95	3.90	0.25	0.26	0.19	0.20	0.17	0.15	0.22	0.20	0.20	0.20	0.20	0.21
Na_2O	8.96	9.24	9.25	9.38	8.74	9.07	8.88	8.93	8.98	8.59	8.64	8.30	4.01	3.94	4.11	3.78	3.64	4.03	4.30	4.25	4.30	3.99	3.76	4.41
K_2O	1.28	1.26	1.26	1.41	1.86	1.13	1.16	1.20	1.34	1.30	1.17	1.22	10.89	11.21	10.88	11.44	11.62	11.16	10.65	10.55	10.45	11.16	11.26	10.34
SUM	98.97	99.15	99.09	99.39	98.64	98.87	100.25	100.61	100.52	100.40	99.45	99.07	98.39	99.04	98.39	98.96	99.86	99.66	99.74	99.10	100.34	98.96	99.25	98.95
	Cation formula based on 8(O)																							
Si	2.842	2.824	2.851	2.860	2.871	2.836	2.864	2.838	2.866	2.839	2.815	2.819	3.005	2.990	2.994	3.001	3.010	3.001	3.004	2.998	3.009	2.993	2.986	3.000
Al	1.142	1.159	1.130	1.125	1.121	1.152	1.137	1.153	1.126	1.152	1.170	1.179	0.983	0.986	0.996	0.982	0.978	0.986	0.985	0.992	0.982	0.994	1.004	0.990
Fe	0.005	0.000	0.006	0.006	0.006	0.004	0.006	0.005	0.006	0.006	0.002	0.006	0.002	0.004	0.001	0.001	0.004	0.002	0.002	0.004	0.004	0.005	20.004	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.004	0.000
Ca	0.171	0.169	0.156	0.137	0.137	0.162	0.162	0.172	0.147	0.162	0.188	0.189	0.011	0.011	0.008	0.009	0.008	0.006	0.010	0.009	0.009	0.009	0.009	0.009
Na	0.777	0.801	0.802	0.810	0.761	0.785	0.759	0.762	0.765	0.733	0.745	0.719	0.357	0.350	0.367	0.336	0.321	0.355	0.378	0.376	0.376	0.354	0.334	0.391
K	0.072	0.071	0.071	0.080	0.105	0.064	0.064	0.067	0.075	0.072	0.065	0.069	0.641	0.656	0.641	0.671	0.675	0.648	0.616	0.616	0.601	0.654	0.658	0.604
SUM	5.009	5.024	5.014	5.016	5.000	5.003	4.981	4.997	4.984	4.964	4.994	4.982	5.000	5.004	5.006	5.001	4.986	5.000	4.997	4.997	4.982	5.007	5.000	4.997
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																							
Or	7.1	6.8	6.9	7.8	10.5	6.3	6.5	6.7	7.6	7.3	6.5	7.1	63.5	64.5	63.1	66.8	67.2	64.2	61.4	61.5	61.0	64.3	65.7	60.2
Ab	76.2	76.9	78.0	78.9	75.9	77.6	77.1	76.1	77.5	74.3	74.6	73.6	35.4	34.4	36.1	33.1	32.0	35.2	37.6	37.6	38.1	34.8	33.4	38.9
An	16.8	16.2	15.1	13.3	13.7	16.0	16.4	17.2	14.9	18.4	18.8	19.3	1.1	1.1	0.8	0.9	0.8	0.6	1.0	0.9	0.9	0.9	0.9	0.9

Bedded Tuff Between the Topopah Spring Member of Paintbrush Tuff and Tuff of Calico Hills

Microprobe analyses of feldspars in USW-G2-1745

	FE02A	FE04A	FE04B	FE05A	FE05B	FE01A	FE01B	FE03A	FE03B	FE06A	FE06B
	PLAGIOCLASE PHENOCRYSTS					SANIDINE PHENOCRYSTS					
SiO_2	64.11	63.70	64.94	63.47	63.78	65.70	65.47	65.51	65.07	65.61	65.11
Al_2O_3	22.07	22.73	22.25	22.71	21.97	18.21	18.38	18.39	18.42	18.16	18.17
FeO	0.03	0.13	0.00	0.10	0.00	0.05	0.06	0.07	0.10	0.05	0.01
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.09	0.03	0.09	0.24	0.19	0.34	0.16	0.27	0.45	0.24	0.21
CaO	3.41	4.35	4.03	4.56	4.26	0.13	0.14	0.16	0.16	0.10	0.13
Na_2O	8.81	8.50	8.38	8.88	8.93	3.54	3.50	3.56	3.41	3.36	3.41
K_2O	1.09	1.04	1.22	1.04	1.11	11.12	11.76	11.65	11.37	11.73	11.63
SUM	99.62	100.48	100.99	100.98	100.25	99.13	99.48	99.66	99.06	99.34	98.68
	Cation formula based on 8(O)										
Si	2.846	2.810	2.844	2.798	2.829	3.010	2.998	2.997	3.003	3.009	3.005
Al	1.154	1.182	1.147	1.180	1.147	0.982	0.992	0.991	0.990	0.981	0.987
Fe	0.000	0.003	0.002	0.002	0.000	0.001	0.001	0.002	0.002	0.001	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.000	0.001	0.003	0.002	0.005	0.002	0.004	0.008	0.004	0.002
Ca	0.161	0.204	0.188	0.214	0.202	0.005	0.006	0.006	0.006	0.000	0.005
Na	0.760	0.776	0.710	0.758	0.768	0.313	0.310	0.314	0.301	0.297	0.305
K	0.061	0.058	0.066	0.058	0.062	0.649	0.687	0.679	0.661	0.685	0.684
SUM	4.988	4.993	4.960	5.014	5.010	4.967	4.996	4.995	4.973	4.984	4.988
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)										
Or	6.2	5.9	6.8	5.6	6.0	7.1	68.5	68.0	68.3	69.2	68.0
Ab	77.3	73.5	73.7	73.6	74.4	32.4	30.9	31.4	31.1	30.0	30.7
An	16.4	20.6	19.5	20.8	19.6	0.5	0.6	0.6	0.6	0.8	0.5

Microprobe analyses of feldspars in USW-G2-1752

	FE01A	FE01B	FE02A	FE02B	FE03A	FE03B	FE03C	FE04A	FE04B	FE05A	FE05B	FE06A	FE06B
	PLAGIOCLASE PHENOCRYSTS							SANIDINE PHENOCRYSTS					
SiO_2	64.77	65.23	63.07	64.17	65.07	63.87	65.11	66.34	66.72	68.21	64.96	65.84	66.32
Al_2O_3	22.00	21.66	22.03	21.84	21.84	21.98	21.50	18.07	18.06	18.07	18.18	18.16	18.14
FeO	0.03	0.14	0.03	0.13	0.10	0.03	0.07	0.12	0.07	0.05	0.12	0.06	0.10
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.11	0.08	0.10	0.25	0.09	0.03	0.14	0.09	0.11	0.03	0.14	0.03	0.21
CaO	4.15	3.86	4.47	3.80	3.77	3.98	3.82	0.17	0.16	0.16	0.18	0.15	0.12
Na_2O	8.66	8.32	8.71	8.74	8.91	8.85	8.84	3.40	3.54	3.36	3.57	3.23	3.56
K_2O	1.17	1.56	1.15	1.28	1.17	1.14	1.20	12.14	11.77	11.67	11.70	11.90	11.58
SUM	100.86	100.87	100.42	100.30	100.86	99.83	100.78	100.26	100.40	101.38	100.88	99.40	100.10
	Cation formula based on 8(O)												
Si	2.844	2.863	2.825	2.840	2.856	2.834	2.862	3.015	3.020	3.042	3.019	3.011	3.017
Al	1.138	1.121	1.148	1.130	1.120	1.149	1.113	0.967	0.962	0.950	0.966	0.978	0.972
Fe	0.000	0.006	0.000	0.003	0.002	0.000	0.002	0.004	0.002	0.001	0.004	0.001	0.002
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.001	0.002	0.006	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.002
Ca	0.194	0.182	0.211	0.184	0.176	0.188	0.179	0.008	0.006	0.006	0.008	0.006	0.006
Na	0.737	0.708	0.746	0.749	0.758	0.760	0.750	0.298	0.308	0.288	0.312	0.286	0.312
K	0.064	0.086	0.063	0.071	0.064	0.063	0.067	0.704	0.678	0.661	0.672	0.693	0.671
SUM	4.978	4.966	4.997	4.991	4.986	4.996	4.977	4.996	4.989	4.941	4.981	4.977	4.982
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)												
Or	6.4	8.8	6.2	7.1	6.4	6.2	6.7	69.7	68.3	68.8	67.7	70.4	67.9
Ab	74.1	72.5	73.1	74.6	76.0	75.2	75.3	29.5	31.1	30.5	31.5	29.0	31.6
An	19.5	18.6	20.7	18.3	17.6	18.6	18.0	0.8	0.6	0.6	0.8	0.6	0.5

Microprobe analyses of feldspars in USW-G2-2158

	FE01A	FE01B	FE03A	FE03B	FE05A	FE05B	FE06A	FE06B	FE07A	FE07B	FE10A	FE10B	FE12A	FE12B
	PLAGIOCLASE PHENOCRYSTS													
SiO_2	63.93	63.23	63.02	63.96	62.72	61.02	63.11	62.79	61.33	62.03	63.09	65.13	65.20	62.71
Al_2O_3	22.46	22.01	22.60	22.24	23.23	23.00	22.96	22.92	24.05	22.34	21.71	22.23	21.80	22.17
FeO	0.12	0.00	0.02	0.13	0.03	0.00	0.03	0.05	0.07	0.07	0.09	0.10	0.00	0.02
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	4.26	4.73	4.77	3.09	4.07	5.21	4.24	4.93	5.09	4.30	4.30	3.90	3.49	3.63
Na_2O	8.44	8.51	8.30	8.93	8.10	7.05	8.57	8.49	7.30	8.03	8.25	8.76	8.66	8.69
K_2O	1.09	1.07	0.94	1.11	0.99	0.86	1.03	0.91	0.69	1.06	1.07	1.16	1.32	1.24
SUM	100.30	100.47	99.82	100.20	100.10	99.24	99.96	100.10	99.43	98.73	99.46	101.30	100.50	98.46
	Cation formula based on 8(O)													
Si	2.822	2.797	2.802	2.828	2.780	2.765	2.800	2.797	2.739	2.816	2.843	2.845	2.846	2.822
Al	1.148	1.184	1.197	1.158	1.214	1.233	1.200	1.190	1.266	1.188	1.139	1.145	1.120	1.176
Fe	0.003	0.002	0.000	0.003	0.000	0.002	0.000	0.001	0.002	0.002	0.002	0.002	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.201	0.223	0.227	0.104	0.230	0.249	0.200	0.234	0.200	0.209	0.200	0.182	0.164	0.174
Na	0.721	0.729	0.765	0.703	0.688	0.736	0.729	0.678	0.697	0.711	0.742	0.730	0.746	0.750
K	0.061	0.060	0.052	0.062	0.054	0.048	0.057	0.051	0.038	0.060	0.060	0.064	0.073	0.070
SUM	4.976	5.000	4.989	5.001	4.982	4.978	4.993	5.000	4.963	4.984	4.984	4.979	4.969	5.000
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)													
Or	6.2	5.9	5.2	6.1	5.5	4.9	5.7	5.0	4.0	6.2	6.1	6.5	7.5	7.0
Ab	73.3	72.0	72.1	75.7	71.2	69.6	74.1	71.9	66.7	72.2	72.6	75.1	75.7	75.6
An	20.4	22.0	22.7	18.2	23.3	25.5	20.1	23.1	29.3	21.6	21.2	18.4	16.8	17.4

	FE02A	FE02B	FE04A	FE04B	FE08A	FE08B	FE09A	FE09B
	SANIDINE PHENOCRYSTS							
SiO_2	65.60	65.46	66.56	65.70	66.15	66.30	65.56	65.82
Al_2O_3	18.31	18.29	17.92	17.91	17.92	17.89	18.38	18.00
FeO	0.00	0.00	0.11	0.04	0.03	0.05	0.09	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.04	0.12	0.00	0.00	0.14	0.00	0.00	0.04
CaO	0.17	0.18	0.14	0.16	0.14	0.20	0.16	0.13
Na_2O	3.04	3.00	3.39	3.50	3.10	3.06	3.24	3.37
K_2O	11.77	11.95	11.71	11.79	11.75	11.74	11.91	12.01
SUM	99.44	99.44	99.89	99.15	99.34	99.32	99.29	99.37
	Cation formula based on 8(O)							
Si	3.002	3.002	3.026	3.013	3.026	3.029	3.005	3.016
Al	0.987	0.987	0.959	0.969	0.965	0.963	0.989	0.972
Fe	0.002	0.000	0.004	0.001	0.000	0.001	0.002	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000
Ca	0.008	0.008	0.005	0.006	0.005	0.009	0.006	0.005
Na	0.305	0.301	0.297	0.311	0.280	0.271	0.288	0.298
K	0.686	0.690	0.679	0.689	0.685	0.684	0.695	0.702
SUM	4.991	4.990	4.972	4.990	4.963	4.958	4.986	4.993
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)							
Or	68.7	69.3	69.2	68.5	70.6	71.0	70.3	69.9
Ab	30.5	29.9	30.3	30.9	28.9	28.1	29.1	29.7
An	0.8	0.8	0.5	0.6	0.5	0.9	0.6	0.5

	FE11A	FE11B	FE13A	FE13B
	SANIDINE PHENOCRYSTS (cont)			
SiO_2	66.00	65.26	66.05	65.60
Al_2O_3	17.87	18.36	17.98	18.43
FeO	0.09	0.00	0.01	0.00
MgO	0.00	0.00	0.00	0.00
BaO	0.12	0.06	0.00	0.09
CaO	0.20	0.18	0.19	0.18
Na_2O	3.23	3.30	3.52	3.26
K_2O	11.95	11.82	11.69	11.68
SUM	99.47	98.96	99.50	99.24
	Cation formula based on 8(O)			
Si	3.021	3.001	3.016	3.006
Al	0.963	0.995	0.968	0.995
Fe	0.002	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000
Ba	0.001	0.000	0.000	0.001
Ca	0.009	0.008	0.008	0.008
Na	0.286	0.292	0.311	0.290
K	0.697	0.692	0.681	0.681
SUM	4.979	4.989	4.986	4.978
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)			
Or	70.3	69.8	68.1	69.7
Ab	28.8	29.4	31.1	29.5
An	0.9	0.8	0.8	0.8

Microprobe analyses of feldspars in USW-G2-2325

	FE01A	FE01B	FE02A	FE02B	FE04A	FE04B	FE05A	FE05B	FE09A	FE09B	FE10A	FE10B
	PLAGIOCLASE PHENOCRYSTS											
SiO_2	61.96	61.47	61.82	60.80	61.61	61.60	61.57	57.86	62.38	63.08	62.01	63.27
Al_2O_3	22.56	23.30	22.75	23.46	22.81	22.82	22.75	25.03	22.52	21.33	22.46	22.12
FeO	0.18	0.22	0.13	0.06	0.13	0.14	0.13	0.12	0.14	0.11	0.13	0.10
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	4.86	5.43	5.23	5.92	4.86	4.88	4.95	7.61	4.77	3.56	4.56	3.84
Na_2O	8.08	7.91	8.07	7.60	8.39	8.29	8.14	7.04	8.34	8.54	8.54	8.64
K_2O	1.08	0.87	0.99	0.77	0.97	0.94	0.95	0.50	0.95	1.37	1.02	1.17
SUM	98.73	99.21	98.98	99.64	98.84	98.68	98.50	98.16	99.13	98.73	98.79	99.15
	Cation formula based on 8(O)											
Si	2.788	2.756	2.777	2.743	2.774	2.775	2.778	2.639	2.796	2.841	2.791	2.829
Al	1.196	1.231	1.203	1.247	1.210	1.211	1.210	1.345	1.188	1.126	1.191	1.165
Fe	0.006	0.008	0.004	0.002	0.004	0.005	0.004	0.004	0.005	0.004	0.004	0.002
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.233	0.260	0.250	0.296	0.233	0.236	0.238	0.372	0.229	0.169	0.219	0.184
Na	0.706	0.688	0.702	0.665	0.731	0.725	0.711	0.621	0.725	0.742	0.745	0.749
K	0.062	0.048	0.057	0.043	0.055	0.053	0.054	0.028	0.054	0.078	0.058	0.066
SUM	4.992	4.991	4.993	4.995	5.009	5.004	4.996	5.007	4.996	4.981	5.008	4.994
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)											
Or	6.2	4.8	5.6	4.3	5.4	5.2	5.4	2.7	5.4	7.9	5.7	6.5
Ab	70.5	69.1	68.6	66.9	71.7	71.6	70.9	60.8	71.9	75.0	72.9	75.1
An	23.3	26.1	24.8	28.8	22.9	23.2	23.7	36.4	22.7	17.1	21.4	18.4

	FE03A	FE03B	FE06A	FE06B	FE07A	FE07B	FE08A	FE08B	FE11A	FE11B
	SANIDINE PHENOCRYSTS									
SiO_2	65.34	65.43	65.13	65.21	65.23	64.89	64.39	64.35	66.70	66.61
Al_2O_3	18.05	18.04	17.87	18.18	18.28	18.13	18.13	18.15	18.51	18.17
FeO	0.04	0.06	0.00	0.24	0.08	0.06	0.03	0.01	0.11	0.07
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.09	0.24	0.21	0.09	0.00	0.16
CaO	0.16	0.13	0.16	0.14	0.14	0.13	0.13	0.16	0.16	0.18
Na_2O	3.31	3.14	3.30	3.32	3.38	3.26	3.36	3.33	3.36	3.21
K_2O	11.92	11.98	11.77	11.82	11.61	11.65	11.56	11.83	11.17	11.43
SUM	98.86	98.82	98.46	99.02	98.84	98.46	97.91	98.00	100.09	99.69
	Cation formula based on 8(O)									
Si	3.040	3.043	3.030	3.001	3.002	3.002	2.999	2.993	3.015	3.024
Al	0.970	0.970	0.973	0.986	0.987	0.988	0.995	0.995	0.985	0.971
Fe	0.001	0.001	0.002	0.000	0.002	0.001	0.000	0.000	0.004	0.002
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.001	0.004	0.002	0.001	0.000	0.002
Ca	0.006	0.006	0.008	0.006	0.006	0.006	0.005	0.006	0.005	0.000
Na	0.298	0.279	0.304	0.296	0.301	0.292	0.303	0.300	0.293	0.281
K	0.700	0.703	0.693	0.693	0.680	0.687	0.686	0.701	0.643	0.662
SUM	4.998	4.980	4.999	4.992	4.980	4.982	4.994	4.997	4.948	4.952
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)									
Or	70.0	71.2	69.1	69.7	68.9	69.0	69.[illegible]	69.6	68.3	69.6
Ab	29.4	28.3	30.3	29.7	30.5	29.7	30.5	29.8	31.1	29.5
An	0.6	0.5	0.6	0.6	0.6	0.5	0.5	0.6	0.5	0.8

	FE12A	FE13A	FE13B	FE14A	FE15A
	AUTHIGENIC ALKALI FELDSPAR IN GROUNDMASS				
SiO_2	67.09	68.18	68.66	68.80	68.06
Al_2O_3	16.47	16.43	16.59	16.39	17.03
FeO	0.03	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00
CaO	0.02	0.00	0.02	0.00	0.01
Na_2O	0.03	0.04	0.10	0.05	0.01
K_2O	15.40	15.26	15.13	15.20	14.75
SUM	99.02	99.89	100.50	100.44	99.86
	Cation formula based on 8(O)				
Si	3.106	3.109	3.112	3.121	3.090
Al	0.887	0.883	0.886	0.875	0.910
Fe	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000
Ca	0.000	0.000	0.000	0.000	0.000
Na	0.001	0.002	0.014	0.004	0.000
K	0.903	0.849	0.874	0.878	0.856
SUM	4.896	4.885	4.886	4.878	4.868
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)				
Or	99.9	99.8	98.4	99.5	100.0
Ab	0.1	0.2	1.6	0.5	0.0
An	0.0	0.0	0.0	0.0	0.0

Microprobe analyses of feldspars in USW-G2-2430

	FE01A	FE01B	FE02A	FE02B	FE03A	FE03B	FE07A	FE07B	FE08B	FE08C	FE10A	FE10B
	PLAGIOCLASE PHENOCRYSTS											
SiO_2	63.36	64.23	62.98	62.60	62.91	60.96	58.56	57.07	63.51	58.39	63.12	61.91
Al_2O_3	22.75	22.41	23.10	24.00	23.75	24.56	26.09	27.09	22.93	26.62	23.59	23.55
FeO	0.15	0.14	0.10	0.03	0.13	0.19	0.10	0.13	0.14	0.31	0.11	0.13
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
BaO	0.00	0.00	0.00	0.04	0.02	0.07	0.30	0.22	0.22	0.20	0.15	0.02
CaO	4.50	3.98	5.11	5.43	5.38	6.57	8.66	9.24	4.01	8.76	5.10	5.47
Na_2O	7.02	8.34	7.96	8.03	7.78	7.38	6.36	5.95	8.00	6.30	8.30	7.96
K_2O	1.00	1.14	0.98	0.78	0.92	0.69	0.45	0.41	1.42	0.51	0.89	0.88
SUM	99.09	100.26	100.32	100.94	100.91	100.45	100.64	100.13	101.06	101.13	101.35	99.94
	Cation formula based on 8(O)											
Si	2.812	2.833	2.787	2.755	2.767	2.707	2.613	2.562	2.797	2.595	2.769	2.756
Al	1.189	1.166	1.205	1.245	1.231	1.285	1.371	1.433	1.190	1.394	1.219	1.235
Fe	0.005	0.005	0.006	0.000	0.003	0.006	0.006	0.004	0.005	0.010	0.003	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.002	0.002	0.002	0.001	0.000
Ca	0.213	0.188	0.241	0.255	0.253	0.311	0.414	0.444	0.276	0.416	0.243	0.260
Na	0.673	0.712	0.682	0.684	0.662	0.634	0.550	0.518	0.682	0.542	0.705	0.687
K	0.061	0.063	0.054	0.042	0.051	0.038	0.024	0.023	0.079	0.028	0.049	0.049
SUM	4.954	4.966	4.975	4.981	4.969	4.981	4.983	4.985	4.982	4.989	4.989	4.991
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)											
Or	6.4	6.5	5.6	4.3	5.3	3.9	2.4	2.3	8.0	2.8	4.9	4.9
Ab	71.1	73.9	69.8	69.7	68.5	64.5	55.7	52.6	69.1	55.0	70.7	69.8
An	22.5	19.5	24.7	26.0	26.2	31.6	41.9	45.1	22.9	42.2	24.4	25.1

	FE04A	FE04B	FE05A	FE05B	FE06A	FE06B	FE09A	FE09B	FE11A
	SANIDINE PHENOCRYSTS								AUTHIGENIC ALKALI FELDSPAR IN GROUNDMASS
SiO_2	66.06	66.00	66.02	66.64	65.70	66.14	65.51	65.01	67.80
Al_2O_3	18.35	17.63	18.56	18.32	18.56	18.34	18.26	18.56	16.76
FeO	0.10	0.13	0.07	0.05	0.04	0.09	0.04	0.07	0.03
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.12	0.07	1.02	0.22	1.02	0.92	0.43	0.96	0.00
CaO	0.16	0.13	0.19	0.17	0.20	0.22	0.17	0.24	0.00
Na_2O	3.16	2.47	3.12	3.07	3.14	3.11	3.06	3.14	0.03
K_2O	11.84	12.75	11.72	12.23	11.64	11.88	11.95	11.95	15.50
SUM	100.43	100.36	100.82	100.77	100.41	100.79	99.50	100.41	100.13
	Cation formula based on 8(O)								
Si	3.010	3.040	2.996	3.013	2.993	3.005	3.004	2.999	3.095
Al	0.979	0.959	0.992	0.975	0.996	0.981	0.986	0.994	0.901
Fe	0.002	0.004	0.002	0.001	0.001	0.002	0.001	0.002	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.000	0.017	0.002	0.017	0.016	0.006	0.009	0.000
Ca	0.006	0.005	0.008	0.008	0.009	0.010	0.008	0.010	0.000
Na	0.274	0.217	0.274	0.268	0.276	0.273	0.271	0.276	0.001
K	0.683	0.739	0.670	0.705	0.676	0.688	0.698	0.692	0.901
SUM	4.965	4.958	4.971	4.973	4.971	4.979	4.970	4.979	4.099
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	70.8	76.9	70.6	71.9	70.3	70.9	71.4	70.8	99.9
Ab	28.6	22.6	28.5	27.3	28.7	28.1	27.7	28.2	0.1
An	0.6	0.5	0.8	0.8	0.9	1.0	0.8	1.0	0.0

Microprobe analyses of feldspars in USW-G2-2667

	FE03A	FE03B	FE04A	FE04B	FE05A	FE05B	FE08A	FE08B	FE09A	FE09B
	PLAGIOCLASE PHENOCRYSTS									
SiO_2	62.64	63.73	62.71	59.19	62.15	58.87	63.08	58.88	63.61	63.75
Al_2O_3	23.70	22.91	23.83	25.46	23.62	25.86	23.36	26.09	22.25	22.98
FeO	0.18	0.17	0.15	0.14	0.20	0.12	0.12	0.15	0.08	0.19
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.09	0.09	0.20	0.00	0.22	0.04	0.20	0.00	0.00	0.02
CaO	5.52	4.45	5.53	7.99	5.23	7.88	4.92	8.34	3.89	5.08
Na_2O	7.76	8.20	8.17	6.66	8.09	6.52	8.16	6.43	8.19	8.39
K_2O	0.80	1.07	0.88	0.50	0.75	0.41	0.93	0.35	1.03	0.80
SUM	100.76	100.69	101.49	100.02	100.27	99.71	100.77	100.29	98.99	101.34
	Cation formula based on 8(O)									
Si	2.761	2.808	2.753	2.646	2.759	2.637	2.782	2.625	2.837	2.792
Al	1.232	1.189	1.232	1.340	1.235	1.364	1.213	1.371	1.168	1.187
Fe	0.006	0.005	0.005	0.005	0.006	0.004	0.003	0.005	0.000	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.001	0.002	0.000	0.002	0.000	0.002	0.000	0.000	0.000
Ca	0.260	0.209	0.259	0.381	0.249	0.377	0.231	0.397	0.186	0.238
Na	0.662	0.699	0.694	0.577	0.695	0.566	0.697	0.554	0.708	0.712
K	0.044	0.059	0.049	0.027	0.042	0.022	0.051	0.020	0.057	0.049
SUM	4.966	4.971	4.995	4.978	4.988	4.970	4.981	4.972	4.957	4.985
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)									
Or	4.6	6.1	4.9	2.7	4.3	2.3	5.2	2.1	6.0	4.9
Ab	68.5	72.3	69.3	56.6	70.5	58.7	71.2	57.1	74.4	71.3
An	26.9	21.6	25.8	38.7	25.3	39.1	23.6	40.9	19.6	23.8

	FE01A	FE01B	FE02A	FE02B	FE06A	FE06B	FE07A	FE07B
	SANIDINE PHENOCRYSTS							
SiO_2	65.61	65.93	65.18	64.98	65.58	66.09	65.51	67.24
Al_2O_3	18.71	18.64	18.71	18.52	18.56	19.11	19.42	18.70
FeO	0.06	0.13	0.11	0.07	0.14	0.07	0.07	0.06
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
BaO	1.49	1.59	1.54	1.23	1.07	1.64	1.02	0.25
CaO	0.16	0.16	0.21	0.20	0.17	0.18	0.13	0.15
Na_2O	2.78	2.63	2.93	2.99	3.01	2.88	2.96	2.97
K_2O	11.97	12.07	11.71	11.63	11.65	11.63	12.02	12.39
SUM	100.82	101.33	100.58	99.70	100.29	101.79	100.27	101.04
	Cation formula based on 8(O)							
Si	2.991	2.991	2.979	2.985	2.994	2.981	2.995	3.008
Al	1.004	0.997	1.007	1.002	0.998	1.015	0.993	0.986
Fe	0.001	0.004	0.004	0.002	0.005	0.002	0.002	0.001
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.025	0.028	0.026	0.021	0.019	0.027	0.017	0.004
Ca	0.006	0.006	0.009	0.009	0.008	0.008	0.005	0.006
Na	0.238	0.230	0.259	0.266	0.266	0.251	0.261	0.257
K	0.695	0.697	0.683	0.681	0.678	0.668	0.700	0.706
SUM	4.963	4.957	4.972	4.972	4.969	4.959	4.970	4.969
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)							
Or	74.0	74.7	71.0	71.2	71.2	72.1	72.5	72.9
Ab	25.3	24.7	27.2	27.8	27.9	27.1	27.0	26.5
An	0.6	0.6	0.9	0.9	0.8	0.9	0.5	0.6

Prow Pass Member of the Crater Flat Tuff

Microprobe analyses of feldspars in USW-G2-2744

	FE01A	FE01B	FE02A	FE02B	FE03A	FE03B
	SANIDINE PHENOCRYSTS					
SiO_2	66.71	66.43	66.29	66.87	65.59	66.39
Al_2O	18.54	18.60	18.32	18.59	18.69	18.61
FeO	0.14	0.11	0.06	0.15	0.10	0.16
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.15	0.34	0.12	0.20	0.22	0.00
CaO	0.24	0.24	0.21	0.25	0.23	0.27
Na_2O	5.37	5.41	5.27	5.42	5.32	5.41
K_2O	8.93	8.99	9.20	8.95	8.74	8.80
SUM	100.14	100.10	99.51	100.43	98.91	99.64
	Cation formula based on 8(O)					
Si	3.006	2.998	3.007	3.004	2.982	3.001
Al	0.983	0.989	0.979	0.983	1.004	0.991
Fe	0.005	0.004	0.001	0.006	0.002	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.006	0.001	0.002	0.002	0.000
Ca	0.010	0.010	0.000	0.012	0.010	0.012
Na	0.468	0.473	0.463	0.472	0.470	0.473
K	0.513	0.516	0.531	0.513	0.507	0.506
SUM	4.987	4.996	4.991	4.990	4.988	4.988
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	51.8	51.7	52.9	51.5	51.4	51.1
Ab	47.2	47.3	46.2	47.3	47.6	47.7
An	1.0	1.0	0.9	1.2	1.0	1.2

Microprobe analyses of feldspars in USW-G2-2869

	FE02A	FE02B	FE03A	FE03B	FE04A	FE04B
	SANIDINE PHENOCRYSTS					
SiO_2	66.06	66.41	66.04	66.91	66.16	66.57
Al_2O_3	18.66	18.61	18.64	18.63	18.61	18.66
FeO	0.13	0.17	0.13	0.11	0.14	0.16
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.16	0.04	0.00
CaO	0.23	0.33	0.20	0.24	0.27	0.17
Na_2O	5.23	5.38	5.21	5.50	5.14	5.41
K_2O	9.05	8.96	9.07	9.02	9.28	8.73
SUM	99.40	99.89	100.20	100.66	99.78	99.78
	Cation formula based on 8(O)					
Si	2.994	2.998	3.004	3.002	2.994	3.001
Al	0.996	0.989	0.986	0.984	0.991	0.991
Fe	0.004	0.006	0.004	0.004	0.005	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.002	0.000	0.000
Ca	0.010	0.014	0.009	0.010	0.012	0.008
Na	0.458	0.470	0.454	0.478	0.450	0.472
K	0.522	0.514	0.520	0.516	0.536	0.501
SUM	4.986	4.990	4.979	4.998	4.989	4.979
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	52.7	51.5	52.9	51.4	53.7	51.1
Ab	46.3	47.1	46.2	47.6	45.1	48.1
An	1.0	1.4	0.9	1.0	1.2	0.8

Microprobe analyses of feldspars in USW-G2-2950

	FE01A	FE01B	FE04A	FE04B	FE04C	FE04D	FE02A	FE02B	FE03A	FE03B
	PLAGIOCLASE PHENOCRYSTS						SANIDINE PHENOCRYSTS			
SiO_2	65.82	66.30	65.01	59.63	66.32	62.95	66.31	66.21	65.62	65.74
Al_2O_3	20.51	20.16	20.40	24.39	20.39	22.73	18.29	18.36	18.40	18.42
FeO	0.11	0.17	0.13	0.12	0.10	0.10	0.14	0.05	0.11	0.06
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.07	0.00	0.04	0.07	0.14	0.07	0.39	0.56	0.36
CaO	2.46	2.11	2.32	6.67	2.16	4.55	0.23	0.30	0.28	0.27
Na_2O	9.53	9.46	9.52	7.43	9.50	8.00	5.00	5.30	5.16	5.13
K_2O	1.51	1.93	1.53	0.45	1.57	0.90	9.17	9.11	8.93	9.11
SUM	99.93	100.29	98.94	98.74	100.11	100.18	99.21	99.71	99.15	99.10
	Cation formula based on 8(O)									
Si	2.910	2.931	2.904	2.692	2.928	2.794	3.015	3.003	2.996	3.000
Al	1.067	1.049	1.074	1.297	1.060	1.188	0.979	0.981	0.994	0.991
Fe	0.003	0.005	0.004	0.004	0.002	0.002	0.005	0.001	0.004	0.001
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.001	0.006	0.006	0.009	0.005
Ca	0.116	0.098	0.110	0.322	0.101	0.216	0.010	0.013	0.013	0.012
Na	0.816	0.810	0.824	0.649	0.812	0.757	0.440	0.466	0.456	0.453
K	0.004	0.107	0.086	0.025	0.088	0.051	0.531	0.527	0.520	0.530
SUM	4.996	5.000	5.003	4.989	4.990	5.009	4.979	4.997	4.990	4.991
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)									
Or	0.3	10.5	8.4	2.5	8.8	5.0	54.1	52.4	52.6	53.3
Ab	80.4	79.8	80.8	65.2	81.1	73.9	44.9	46.3	46.1	45.5
An	11.3	9.7	10.8	32.3	10.1	21.1	1.0	1.3	1.3	1.2

Microprobe analyses of feldspars in USW-G2-3192

	FE02A	FE02B	FE01A	FE01B
	PLAGIOCLASE PHENOCRYSTS		SANIDINE PHENOCRYSTS	
SiO_2	55.97	64.05	66.05	65.12
Al_2O_3	16.64	18.63	18.51	18.67
FeO	0.09	0.15	0.08	0.06
MgO	0.00	0.00	0.00	0.00
BaO	0.00	0.06	0.29	0.56
CaO	9.38	2.00	0.26	0.23
Na_2O	6.18	9.06	5.50	5.26
K_2O	0.27	1.63	9.03	9.19
SUM	98.53	98.98	99.75	99.09
	Cation formula based on 8(O)			
Si	2.553	2.901	2.994	2.980
Al	1.433	1.087	0.988	1.007
Fe	0.002	0.005	0.002	0.001
Mg	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.004	0.009
Ca	0.458	0.096	0.012	0.011
Na	0.546	0.837	0.492	0.464
K	0.015	0.092	0.521	0.536
SUM	5.006	5.018	5.004	5.009
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)			
Or	1.5	9.0	51.3	53.0
Ab	53.6	81.7	47.5	45.9
An	44.9	9.4	1.2	1.1

Microprobe analyses of feldspars in USW-G2-3067

	FE03A	FE03B	FE04A	FE05A	FE05B	FE01A	FE01B	FE02A	FE02B
	PLAGIOCLASE PHENOCRYSTS					SANIDINE PHENOCRYSTS			
SiO_2	65.07	65.04	64.62	64.27	64.67	65.46	65.38	65.34	65.62
Al_2O_3	20.83	20.50	20.44	20.88	20.51	18.36	18.09	18.36	18.42
FeO	0.16	0.21	0.15	0.09	0.11	0.13	0.14	0.17	0.10
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.09	0.04
CaO	2.09	1.89	2.35	2.46	2.20	0.29	0.22	0.30	0.27
Na_2O	9.92	9.90	9.36	9.74	9.67	5.35	5.46	5.43	5.31
K_2O	1.04	1.03	1.60	1.52	1.63	9.07	9.04	8.80	9.14
SUM	99.91	100.07	98.55	98.96	98.80	98.96	98.32	98.49	98.91
	Cation formula based on 8(O)								
Si	2.889	2.906	2.901	2.879	2.899	2.993	3.004	2.994	2.997
Al	1.089	1.064	1.082	1.102	1.083	0.988	0.979	0.991	0.990
Fe	0.005	0.007	0.005	0.002	0.004	0.004	0.005	0.005	0.002
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.001	0.000
Ca	0.099	0.089	0.112	0.117	0.105	0.013	0.009	0.015	0.012
Na	0.854	0.856	0.814	0.845	0.839	0.473	0.485	0.481	0.470
K	0.103	0.101	0.091	0.086	0.092	0.520	0.528	0.513	0.532
SUM	5.038	5.030	5.004	5.032	5.021	5.003	5.011	5.000	5.003
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)								
Or	9.8	9.8	8.9	8.2	8.9	52.1	51.7	50.8	52.5
Ab	88.9	81.7	88.0	88.6	81.0	46.6	47.5	47.7	46.4
An	9.4	8.5	11.0	11.2	10.1	1.3	0.9	1.5	1.2

Microprobe analyses of feldspars in USW-G2-3250

	FE01A	FE01B	FE02A	FE02B
	PLAGIOCLASE PHENOCRYSTS			
SiO_2	56.67	61.00	58.01	63.38
Al_2O_3	27.04	23.43	26.14	21.80
FeO	0.20	0.21	0.11	0.10
MgO	0.02	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.11
CaO	8.05	5.14	7.09	3.42
Na_2O	6.16	8.26	7.09	9.02
K_2O	0.34	0.70	0.43	1.16
SUM	98.95	99.54	99.28	99.06
	Cation formula based on 8(O)			
Si	2.546	2.754	2.613	2.836
Al	1.443	1.232	1.388	1.149
Fe	0.008	0.008	0.004	0.006
Mg	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.001
Ca	0.409	0.245	0.361	0.163
Na	0.541	0.712	0.618	0.781
K	0.019	0.039	0.023	0.065
SUM	4.986	4.995	5.007	5.004
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)			
Or	2.0	3.9	2.3	6.4
Ab	55.8	71.5	61.7	77.4
An	42.2	24.6	36.0	16.2

Bullfrog Member of the Crater Flat Tuff

Microprobe analyses of feldspars in USW-G2-3308

	FE01A	FE01B
	PLAGIOCLASE PHENOCRYSTS	
SiO_2	66.96	64.26
Al_2O_3	21.30	21.17
FeO	0.22	0.11
MgO	0.00	0.01
BaO	0.00	0.12
CaO	1.46	3.52
Na_2O	9.29	9.20
K_2O	1.26	1.28
SUM	100.57	99.70
Cation formula based on 8(O)		
Si	2.924	2.861
Al	1.096	1.110
Fe	0.007	0.004
Mg	0.000	0.000
Ba	0.000	0.001
Ca	0.066	0.167
Na	0.785	0.794
K	0.074	0.072
SUM	4.953	5.010
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)		
Or	8.0	7.0
Ab	84.9	76.9
An	7.1	16.2

Microprobe analyses of feldspars in USW-G2-3492

	FE01A	FE01B	FE01C	FE03A	FE03B	FE02A	FE02B
	PLAGIOCLASE PHENOCRYSTS					SANIDINE PHENOCRYSTS	
SiO_2	57.21	60.04	64.96	65.24	64.71	65.18	65.91
Al_2O_3	26.04	24.41	21.87	21.00	21.30	18.44	18.36
FeO	0.37	0.27	0.17	0.10	0.14	0.06	0.13
MgO	0.00	0.02	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.03	0.13	0.06	0.30	0.10
CaO	8.92	6.39	3.06	3.31	3.24	0.21	0.17
Na_2O	5.96	7.60	9.18	9.10	9.21	4.46	4.15
K_2O	0.37	0.59	1.20	1.25	1.26	10.38	10.36
SUM	98.89	99.36	99.67	100.13	99.96	99.16	99.26
Cation formula based on 8(O)							
Si	2.586	2.696	2.883	2.884	2.860	2.987	3.006
Al	1.388	1.291	1.142	1.093	1.112	0.995	0.986
Fe	0.013	0.009	0.006	0.002	0.006	0.001	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.001	0.000	0.006	0.001
Ca	0.432	0.307	0.146	0.156	0.153	0.009	0.008
Na	0.523	0.661	0.789	0.779	0.791	0.395	0.367
K	0.021	0.033	0.066	0.070	0.070	0.606	0.602
SUM	4.976	4.997	4.990	4.985	5.008	5.001	4.975
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)							
Or	2.2	3.3	6.6	7.0	6.9	60.0	61.6
Ab	53.6	66.0	78.9	77.6	78.0	39.1	37.6
An	44.3	30.7	14.5	15.4	15.1	0.9	0.8

Microprobe analyses of feldspars in USW-G2-3541

	FE01A	FE01B	FE02A	FE02B	FE03A	FE03B
	PLAGIOCLASE PHENOCRYSTS		SANIDINE PHENOCRYSTS			
SiO_2	63.81	64.82	66.35	66.71	66.03	66.23
Al_2O_3	22.13	22.32	18.23	18.22	18.52	18.17
FeO	0.13	0.18	0.17	0.18	0.09	0.13
MgO	0.00	0.00	0.00	0.02	0.00	0.00
BaO	0.00	0.00	0.00	0.73	0.06	0.36
CaO	4.51	4.33	0.21	0.17	0.19	0.18
Na_2O	8.81	8.66	3.52	3.18	3.52	3.53
K_2O	1.10	1.01	11.39	11.48	11.46	10.91
SUM	100.50	100.57	99.95	99.77	99.95	99.58
Cation formula based on 8(O)						
Si	2.821	2.823	3.013	3.006	3.003	3.010
Al	1.152	1.150	0.976	0.962	0.993	0.975
Fe	0.003	0.006	0.006	0.002	0.002	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.012	0.000	0.005
Ca	0.212	0.204	0.009	0.008	0.008	0.008
Na	0.756	0.730	0.308	0.280	0.310	0.312
K	0.061	0.066	0.660	0.660	0.666	0.634
SUM	5.004	4.986	4.973	4.966	4.983	4.967
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	5.9	5.5	67.5	68.9	67.7	66.5
Ab	73.6	74.0	31.6	29.3	31.5	32.7
An	20.6	20.5	0.9	0.8	0.8	0.8

Tram Member of the Crater Flat Tuff

Microprobe analyses of feldspars in USW-G2-3671

	FE02A	FE02B	FE03A	FE04A	FE05A	FE06A	FE08A	FE09A	FE10A	FE12A	FE01A	FE01B	FE07A	FE11A	FE14A	FE14B	FE15A	FE13A	FE13B
	PLAGIOCLASE PHENOCRYSTS										SANIDINE PHENOCRYSTS				FELDSPAR PHENOCRYSTS IN LITHICS				
SiO_2	60.15	61.60	59.53	63.78	63.29	59.01	63.22	59.88	59.14	60.79	64.71	65.32	66.00	65.46	56.29	52.04	53.23	53.53	56.05
Al_2O_3	24.96	22.91	25.10	21.92	21.06	24.95	22.45	25.33	25.26	24.56	18.50	18.44	18.59	18.29	27.29	28.71	28.55	28.32	26.56
FeO	0.03	0.00	0.10	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.28	0.31	0.31	0.32
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.25	0.27	0.20	0.00	0.07	0.25	0.04	0.22	0.12	0.32	0.73	0.54	1.04	0.35	0.20	0.02	0.07	0.04	0.07
CaO	6.06	4.93	7.49	4.51	3.79	7.28	4.54	7.40	7.08	6.69	0.21	0.20	0.23	0.18	9.06	11.29	11.00	12.03	9.53
Na_2O	7.06	8.59	6.61	8.67	8.03	7.16	8.72	6.97	6.94	7.00	3.59	3.52	3.56	3.61	5.43	4.27	4.30	4.32	5.60
K_2O	0.57	0.50	0.83	1.00	1.15	0.52	1.04	0.42	0.75	0.65	11.30	11.46	11.26	11.57	0.21	0.29	0.27	0.26	0.31
SUM	100.20	99.32	99.98	99.93	98.22	99.27	100.03	100.30	99.02	100.50	99.23	99.50	100.02	99.50	99.60	97.75	98.61	98.86	98.59
	Cation formula based on 8(O)																		
Si	2.682	2.748	2.664	2.830	2.857	2.677	2.807	2.665	2.652	2.703	2.981	2.994	2.992	3.000	2.540	2.439	2.443	2.450	2.557
Al	1.311	1.211	1.320	1.146	1.120	1.304	1.174	1.328	1.334	1.286	1.004	0.995	0.993	0.987	1.451	1.562	1.543	1.527	1.427
Fe	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.011	0.011	0.011	0.012
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.004	0.004	0.002	0.000	0.000	0.004	0.000	0.002	0.001	0.005	0.012	0.009	0.017	0.005	0.002	0.000	0.000	0.000	0.000
Ca	0.327	0.235	0.358	0.213	0.183	0.350	0.215	0.356	0.364	0.318	0.009	0.009	0.010	0.008	0.475	0.550	0.541	0.589	0.446
Na	0.644	0.746	0.572	0.746	0.772	0.629	0.750	0.601	0.603	0.636	0.320	0.312	0.313	0.320	0.475	0.380	0.382	0.382	0.502
K	0.031	0.051	0.047	0.056	0.066	0.029	0.059	0.023	0.042	0.036	0.660	0.649	0.650	0.676	0.012	0.016	0.015	0.015	0.017
SUM	4.998	5.016	4.974	4.991	4.998	4.998	5.005	4.976	4.996	4.986	4.998	4.992	4.979	4.997	4.969	4.967	4.978	4.975	4.981
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																		
Or	3.1	4.9	4.8	5.6	6.5	2.9	5.8	2.3	4.2	3.6	67.0	67.6	66.6	67.3	1.2	1.7	1.5	1.6	1.7
Ab	64.3	72.3	58.5	73.5	75.6	62.2	73.2	61.3	59.8	64.2	32.1	31.5	32.2	31.9	49.4	39.8	39.1	38.7	51.8
An	32.6	22.8	36.6	21.0	17.9	34.9	21.0	36.3	36.1	32.1	0.9	0.9	1.0	0.8	49.4	58.5	59.4	59.7	47.3

Microprobe analyses of feldspars in USW-G2-3933

	FE04A
	SANIDINE PHENOCRYSTS
SiO_2	64.68
Al_2O_3	18.59
FeO	0.07
MgO	0.00
BaO	0.46
CaO	0.22
Na_2O	3.61
K_2O	11.46
SUM	99.23
Cation formula based on 8(O)	
Si	2.979
Al	1.008
Fe	0.002
Mg	0.000
Ba	0.008
Ca	0.011
Na	0.322
K	0.673
SUM	5.007
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)	
Or	66.9
Ab	32.0
An	1.1

Microprobe analyses of feldspars in USW-G2-4005

	FE01A	FE02A	FE03B
	PLAGIOCLASE PHENOCRYSTS		
SiO_2	55.09	55.54	57.24
Al_2O_3	26.54	27.04	24.87
FeO	0.18	0.18	0.23
MgO	0.00	0.00	0.00
BaO	0.01	0.17	0.12
CaO	8.91	8.83	7.44
Na_2O	6.14	6.01	6.51
K_2O	0.46	0.41	0.94
SUM	98.21	98.29	97.36
Cation formula based on 8(O)			
Si	2.557	2.541	2.637
Al	1.431	1.458	1.350
Fe	0.006	0.006	0.008
Mg	0.000	0.000	0.000
Ba	0.000	0.002	0.001
Ca	0.436	0.432	0.366
Na	0.543	0.533	0.581
K	0.026	0.022	0.054
SUM	5.000	4.997	4.997
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)			
Or	2.6	2.2	5.4
Ab	54.8	54.8	58.0
An	43.6	43.0	36.6

Rhyodacite Lava Between the Tram Member of the Crater Flat Tuff and Lithic Ridge Tuff

Microprobe analyses of feldspars in USW-G2-4090

	FE01A	FE01B	FE01C	FE02A	FE02B	FE02C	FE03A	FE03B	FE03C	FE04A	FE04B	FE04C	FE05A	FE05B	FE05C	FE06A	FE07A	FE07B	FE07C	FE08A	FE09A
	PLAGIOCLASE PHENOCRYSTS																				
SiO_2	55.36	53.41	56.53	56.97	56.34	54.80	55.55	53.36	55.75	58.11	57.36	56.50	55.35	54.54	57.06	56.37	56.01	56.29	56.57	57.17	57.72
Al_2O_3	26.91	28.39	26.25	26.33	26.44	27.52	26.99	28.03	26.75	25.66	25.75	26.68	27.10	27.94	25.84	26.50	26.50	25.71	26.23	26.06	25.82
FeO	0.11	0.15	0.20	0.12	0.03	0.05	0.12	0.07	0.13	0.05	0.08	0.11	0.14	0.14	0.03	0.00	0.00	0.00	0.00	0.15	0.12
MgO	0.03	0.03	0.00	0.04	0.01	0.05	0.01	0.00	0.04	0.02	0.00	0.00	0.02	0.01	0.00	0.01	0.02	0.00	0.00	0.04	0.01
BaO	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	10.01	11.29	9.03	9.27	9.09	10.54	9.57	11.40	9.37	8.02	8.66	9.96	10.52	10.91	8.56	8.90	9.00	8.66	9.21	8.77	8.97
Na_2O	5.51	4.69	5.22	6.10	5.04	5.23	5.74	4.66	5.69	6.14	6.04	5.60	5.02	4.76	6.10	6.04	5.85	6.25	6.07	5.88	6.07
K_2O	0.41	0.30	1.48	0.49	0.44	0.41	0.39	0.30	0.43	0.48	0.52	0.37	0.38	0.32	0.47	0.47	0.35	0.43	0.30	0.39	0.51
SUM	98.38	98.26	98.72	99.34	98.18	98.66	98.39	98.24	98.16	99.27	98.43	98.24	98.54	98.62	98.75	98.29	99.41	99.45	98.38	98.46	99.25
	Cation formula based on 8(O)																				
Si	2.530	2.455	2.580	2.576	2.573	2.502	2.538	2.458	2.552	2.622	2.610	2.541	2.529	2.491	2.623	2.572	2.567	2.625	2.579	2.600	2.605
Al	1.450	1.538	1.412	1.402	1.423	1.401	1.453	1.522	1.402	1.364	1.380	1.439	1.458	1.503	1.370	1.425	1.415	1.363	1.408	1.396	1.374
Fe	0.004	0.005	0.006	0.004	0.000	0.001	0.004	0.018	0.004	0.001	0.002	0.004	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.005	0.004
Mg	0.001	0.001	0.000	0.001	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.490	0.556	0.440	0.448	0.443	0.515	0.468	0.563	0.459	0.425	0.422	0.488	0.515	0.533	0.416	0.434	0.473	0.417	0.449	0.427	0.433
Na	0.487	0.418	0.460	0.535	0.516	0.462	0.508	0.415	0.503	0.537	0.532	0.497	0.443	0.420	0.542	0.534	0.512	0.545	0.536	0.518	0.531
K	0.022	0.017	0.085	0.028	0.025	0.022	0.022	0.018	0.024	0.026	0.029	0.020	0.021	0.019	0.026	0.026	0.020	0.023	0.017	0.022	0.029
SUM	4.985	4.990	4.984	4.994	4.981	4.986	4.993	4.993	4.985	4.975	4.976	4.989	4.971	4.972	4.976	4.991	4.986	4.973	4.989	4.960	4.977
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																				
Or	2.2	1.7	8.6	2.8	2.5	2.2	2.2	1.8	2.4	2.6	3.0	2.0	2.1	2.0	2.6	2.6	2.0	2.3	1.7	2.3	2.9
Ab	49.7	42.2	46.7	52.9	52.4	46.2	50.9	41.7	51.0	54.4	54.1	49.5	45.3	43.2	55.1	53.7	50.9	55.3	53.5	53.6	53.5
An	49.0	56.1	44.7	44.3	45.0	51.6	46.9	56.5	46.6	43.0	42.9	48.6	52.6	54.8	42.2	43.7	47.1	42.3	44.8	44.2	43.6

	FE10A	FE10B	FE10C	FE11A
	PLAGIOCLASE PHENOCRYSTS			
SiO_2	55.84	56.66	54.45	55.84
Al_2O_3	26.83	26.46	27.64	26.82
FeO	0.30	0.27	0.34	0.27
MgO	0.00	0.00	0.00	0.00
BaO	0.18	0.02	0.15	0.00
CaO	9.77	9.14	10.11	9.59
Na_2O	5.40	5.71	5.17	5.58
K_2O	0.46	0.45	0.36	0.40
SUM	98.80	98.73	98.25	98.59
	Cation formula based on 8(O)			
Si	2.546	2.575	2.498	2.547
Al_2O_3	1.441	1.416	1.496	1.441
Fe	0.010	0.009	0.012	0.009
Mg	0.000	0.000	0.000	0.000
Ba	0.002	0.000	0.001	0.000
Ca	0.476	0.444	0.497	0.468
Na	0.476	0.502	0.459	0.492
K	0.025	0.025	0.020	0.026
SUM	4.977	4.972	4.981	4.984
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)			
Or	2.6	2.6	2.0	2.6
Ab	48.7	51.7	47.0	49.9
An	48.7	45.7	50.9	47.5

Lithic Ridge Tuff

Microprobe analyses of feldspars in USW-G2-4199

	FE08A	FE08B	FE08C	FE09A	FE09B	FE09A	FE09C	FE10A	FE10B	FE10D	FE11A	FE12A	FE12B	FE13A	FE14A	FE14B	FE15A	FE15B	FE16A	FE17A	FE17B	FE18B	FE19A
	PLAGIOCLASE PHENOCRYSTS																						
SiO_2	56.31	57.72	56.68	57.55	57.64	58.69	56.23	55.19	57.98	57.60	59.11	58.77	56.26	57.27	58.37	57.93	59.62	55.92	58.54	57.09	56.61	55.80	57.04
Al_2O_3	25.88	25.58	25.88	25.18	24.73	24.31	26.11	26.94	25.44	24.65	24.71	25.49	26.24	25.58	25.61	25.77	24.24	26.21	24.91	26.43	26.46	26.84	25.88
FeO	0.11	0.13	0.20	0.04	0.19	0.20	0.21	0.00	0.08	0.17	0.15	0.30	0.33	0.31	0.31	0.30	0.44	0.33	0.36	0.18	0.29	0.43	0.36
MgO	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.00	0.02	0.01	0.03	0.02	0.00	0.00	0.02	0.01	0.01	0.00	0.02	0.02	0.02
BaO	0.00	0.00	0.00	0.00	0.06	0.23	0.00	0.00	0.00	0.00	0.03	0.06	0.00	0.00	0.00	0.00	0.13	0.23	0.00	0.09	0.00	0.06	0.31
CaO	8.50	7.88	9.21	7.89	7.25	6.98	9.00	9.86	8.25	7.50	7.29	7.71	9.07	7.64	7.89	8.48	6.63	9.19	7.34	9.03	8.82	9.09	8.40
Na_2O	6.26	6.71	6.08	6.64	6.80	7.04	6.07	5.72	6.64	6.79	6.96	6.79	5.61	6.48	6.79	6.30	7.06	6.02	6.82	6.36	6.41	6.06	6.18
K_2O	0.56	0.66	0.50	0.63	0.71	0.80	0.53	0.46	0.63	0.76	0.72	0.71	0.48	0.66	0.60	0.56	0.84	0.52	0.72	0.53	0.54	0.53	0.63
SUM	97.66	98.62	98.57	97.97	97.42	99.27	98.20	98.18	99.36	97.58	98.98	99.89	98.07	98.02	99.71	98.60	99.00	98.49	98.77	99.76	99.18	98.11	98.83
	Cation formula based on 8(O)																						
Si	2.587	2.623	2.584	2.627	2.640	2.684	2.574	2.531	2.621	2.647	2.671	2.637	2.572	2.618	2.626	2.610	2.683	2.560	2.653	2.572	2.568	2.563	2.598
Al	1.401	1.366	1.390	1.356	1.339	1.291	1.409	1.456	1.366	1.336	1.315	1.347	1.414	1.377	1.366	1.369	1.290	1.414	1.330	1.403	1.414	1.410	1.364
Fe	0.004	0.004	0.006	0.001	0.006	0.006	0.008	0.000	0.014	0.006	0.006	0.010	0.012	0.010	0.010	0.010	0.016	0.012	0.013	0.006	0.010	0.016	0.013
Mg	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001
Ba	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.000	0.001	0.000	0.000	0.005
Ca	0.418	0.382	0.449	0.386	0.356	0.336	0.440	0.483	0.399	0.369	0.353	0.370	0.444	0.373	0.380	0.408	0.310	0.450	0.346	0.435	0.428	0.447	0.409
Na	0.557	0.590	0.537	0.588	0.606	0.615	0.538	0.508	0.581	0.604	0.608	0.589	0.496	0.574	0.601	0.568	0.617	0.534	0.598	0.555	0.563	0.539	0.545
K	0.032	0.037	0.028	0.036	0.040	0.045	0.029	0.025	0.036	0.043	0.041	0.038	0.026	0.037	0.036	0.032	0.047	0.029	0.041	0.029	0.030	0.031	0.036
SUM	4.999	5.001	4.994	4.994	4.997	4.988	5.000	5.003	5.006	5.004	4.993	4.993	4.968	4.990	5.002	4.989	4.986	5.003	4.994	5.003	5.014	5.007	4.993
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																						
Or	3.2	3.7	2.8	3.6	4.0	4.5	2.9	2.5	3.5	4.2	4.1	3.9	2.9	3.6	3.6	3.2	4.8	2.9	4.1	2.8	2.9	3.0	3.6
Ab	55.3	58.5	53.0	58.2	60.4	61.7	53.5	50.0	57.2	59.4	60.7	60.0	51.2	58.3	58.6	55.9	62.8	52.7	60.1	54.5	55.1	53.0	55.1
An	41.5	37.9	44.3	38.2	35.6	33.7	43.7	47.5	39.3	36.3	36.2	37.1	46.9	37.9	37.7	40.9	32.5	44.4	35.8	42.7	41.9	44.0	41.3

	FE20A	FE21A	FE21B	FE22A	FE23A	FE25A	FE26A	FE26B	FE27A	FE28A	FE28B
	PLAGIOCLASE PHENOCRYSTS										
SiO_2	59.71	55.16	57.97	57.82	57.66	57.86	55.15	57.29	58.36	53.29	56.90
Al_2O_3	24.60	27.08	25.79	25.74	26.36	24.73	27.36	25.71	25.43	28.48	25.51
FeO	0.35	0.29	0.37	0.29	0.34	0.27	0.25	0.39	0.29	0.07	0.26
MgO	0.00	0.02	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
BaO	0.26	0.31	0.13	0.00	0.13	0.23	0.21	0.00	0.21	0.08	0.00
CaO	6.60	9.57	8.08	8.30	8.29	7.35	8.12	7.84	7.60	11.22	8.11
Na_2O	7.18	5.54	6.60	6.46	6.12	6.02	5.38	6.51	6.59	5.09	6.48
K_2O	0.67	0.44	0.66	0.64	0.57	0.73	0.46	0.64	0.63	0.35	0.50
SUM	99.61	98.51	99.67	99.29	99.52	98.07	99.02	98.44	99.26	98.54	98.12
	Cation formula based on 8(O)										
Si	2.682	2.527	2.611	2.613	2.608	2.646	2.513	2.608	2.636	2.447	2.608
Al	1.302	1.461	1.368	1.372	1.348	1.333	1.470	1.380	1.353	1.542	1.375
Fe	0.013	0.011	0.013	0.010	0.012	0.009	0.009	0.015	0.010	0.002	0.009
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.004	0.006	0.001	0.000	0.001	0.004	0.002	0.000	0.002	0.000	0.004
Ca	0.317	0.469	0.390	0.402	0.398	0.360	0.403	0.382	0.371	0.551	0.397
Na	0.625	0.490	0.576	0.566	0.534	0.604	0.475	0.574	0.576	0.453	0.575
K	0.040	0.025	0.037	0.037	0.032	0.042	0.026	0.036	0.036	0.020	0.033
SUM	4.991	4.991	4.997	4.999	4.977	4.999	4.998	4.996	4.983	5.015	5.001
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)										
Or	4.0	2.5	3.7	3.7	3.3	4.2	2.6	3.6	3.7	2.0	3.3
Ab	63.1	49.8	57.4	56.3	55.3	60.1	47.8	57.9	58.6	44.2	57.2
An	32.0	47.7	38.9	40.0	41.3	35.7	49.6	38.5	37.7	53.8	39.5

Microprobe analyses of feldspars in USW-G2-4467

	FE08A	FE08B	FE08C	FE12A	FE12B	FE12C	FE13A	FE13B	FE15A	FE15B	FE16A	FE16B	FE22A	FE22B	FE23A
	PLAGIOCLASE PHENOCRYSTS														
SiO_2	63.15	63.64	64.34	60.79	58.30	59.91	65.21	64.28	64.05	60.71	61.22	63.90	61.00	62.55	63.13
Al_2O_3	22.38	22.48	21.92	24.17	25.04	23.99	22.04	22.12	21.92	19.05	24.01	21.81	24.00	21.96	22.07
FeO	0.03	0.00	0.04	0.02	0.12	0.00	0.05	0.07	0.04	0.00	0.00	0.03	0.00	0.03	0.01
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	4.31	4.34	3.91	6.26	7.56	6.53	3.49	3.67	3.87	0.01	6.23	3.86	5.79	3.61	4.16
Na_2O	8.61	8.50	8.83	7.80	7.10	7.58	8.96	9.02	9.06	2.41	7.97	9.04	7.95	9.10	8.96
K_2O	0.98	0.96	1.07	0.57	0.44	0.57	1.14	1.13	1.11	0.09	0.61	1.12	0.63	1.02	1.06
SUM	99.45	99.92	100.11	99.63	98.72	98.65	100.90	100.29	100.09	100.26	100.05	99.75	99.52	98.27	99.39
	Cation formula based on 8(O)														
Si	2.814	2.820	2.845	2.717	2.646	2.707	2.856	2.839	2.837	3.000	2.726	2.841	2.729	2.823	2.819
Al	1.175	1.172	1.142	1.273	1.336	1.277	1.137	1.151	1.144	0.988	1.259	1.143	1.264	1.167	1.161
Fe	0.000	0.000	0.001	0.000	0.004	0.002	0.001	0.002	0.002	0.000	0.000	0.000	0.002	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.205	0.205	0.184	0.299	0.367	0.315	0.163	0.173	0.183	0.000	0.296	0.183	0.276	0.173	0.196
Na	0.744	0.729	0.756	0.675	0.630	0.663	0.761	0.772	0.777	1.049	0.687	0.770	0.688	0.795	0.776
K	0.055	0.053	0.060	0.031	0.025	0.032	0.063	0.062	0.062	0.003	0.034	0.063	0.035	0.050	0.060
SUM	4.993	4.979	4.988	4.996	5.008	4.996	4.988	5.001	5.005	5.032	5.002	5.007	4.994	5.017	5.014
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)														
Or	5.5	5.4	6.0	3.1	2.4	3.2	6.4	6.2	6.1	0.3	3.3	6.2	3.5	5.7	5.8
Ab	74.1	73.9	75.6	67.2	61.6	65.6	77.1	76.7	76.8	99.7	67.6	76.0	68.9	77.5	75.0
An	20.4	20.8	18.4	29.8	35.9	31.2	16.5	17.2	17.9	0.0	29.1	17.9	27.6	16.9	19.1

	FE21A	FE07A	FE07B	FE07C	FE08A	FE08B	FE09A	FE09B
	SANIDINE PHENOCRYSTS							
SiO_2	65.11	65.92	64.12	63.91	65.40	65.27	64.50	64.16
Al_2O_3	18.21	18.26	18.07	18.19	18.03	17.66	18.27	17.98
FeO	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.36	0.00	0.00	0.35	0.00	0.00	0.56	0.63
CaO	0.18	0.17	0.16	0.19	0.14	0.16	0.22	0.19
Na_2O	3.06	3.01	3.93	3.91	3.67	3.99	3.96	4.12
K_2O	10.71	11.16	10.90	10.09	11.56	11.01	10.02	10.50
SUM	98.61	99.32	99.26	97.50	98.92	98.08	98.44	97.78
	Cation formula based on 8(O)							
Si	3.002	3.012	3.010	2.988	3.008	3.021	2.987	2.995
Al	0.989	0.981	0.971	1.001	0.976	0.963	0.996	0.989
Fe	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.005	0.000	0.000	0.005	0.000	0.000	0.009	0.011
Ca	0.008	0.008	0.006	0.008	0.006	0.006	0.009	0.008
Na	0.345	0.336	0.357	0.354	0.326	0.357	0.354	0.373
K	0.629	0.650	0.639	0.649	0.677	0.649	0.639	0.670
SUM	4.979	4.988	4.981	5.006	4.995	4.996	4.998	5.005
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)							
Or	64.1	65.6	64.4	64.2	67.1	64.1	63.8	62.2
Ab	35.1	33.8	35.8	35.0	32.3	35.3	35.3	37.0
An	0.8	0.6	0.6	0.8	0.6	0.6	0.9	0.8

	FE11A	FE11B	FE14A	FE17A	FE18A	FE19A	FE20A
	SANIDINE PHENOCRYSTS					DEVITRIFIED(?) SANIDINE	AUTHIGENIC ALBITE
SiO_2	65.18	64.08	65.41	64.00	66.27	60.84	67.56
Al_2O_3	18.38	18.21	18.44	18.25	18.11	17.61	18.04
FeO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.60	0.45	0.75	0.81	0.00	0.00	0.00
CaO	0.18	0.20	0.20	0.18	0.21	0.03	0.11
Na_2O	3.95	4.95	3.82	3.82	4.00	5.50	12.10
K_2O	11.00	10.84	11.01	11.15	11.33	9.70	0.10
SUM	99.38	98.38	99.74	98.95	100.04	99.10	98.81
	Cation formula based on 8(O)						
Si	2.992	2.988	2.993	2.994	3.012	3.037	2.996
Al	0.993	0.994	0.994	0.992	0.970	0.942	0.983
Fe	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.009	0.006	0.013	0.013	0.000	0.000	0.000
Ca	0.008	0.009	0.009	0.008	0.009	0.000	0.005
Na	0.352	0.363	0.338	0.324	0.350	0.404	1.045
K	0.640	0.640	0.642	0.656	0.656	0.532	0.005
SUM	4.999	5.001	4.992	4.991	5.005	4.995	5.034
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	64.1	63.2	64.9	66.4	64.1	52.4	0.5
Ab	35.1	35.9	34.2	32.0	35.0	47.6	99.1
An	0.8	0.9	0.9	0.8	0.9	0.0	0.5

Bedded Tuff at the Base of the Lithic Ridge Tuff

Microprobe analyses of feldspars in USW-G2-4805

	FE06A	FE10A	FE13A	FE18A	FE01A	FE02A
	SANIDINE PHENOCRYSTS					
SiO_2	66.69	66.26	66.16	64.26	64.83	65.03
Al_2O_3	18.40	18.04	18.41	18.57	18.53	18.42
FeO	0.17	0.12	0.08	0.06	0.08	0.14
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.40	1.10	0.68	1.15	1.34	0.75
CaO	0.30	0.13	0.23	0.19	0.17	0.18
Na_2O	5.02	3.70	3.91	3.70	3.84	3.95
K_2O	9.37	11.10	11.03	10.94	10.70	10.85
SUM	99.44	100.54	100.50	98.91	99.68	99.50
	Cation formula based on 8(O)					
Si	2.984	3.016	3.001	2.977	2.981	2.987
Al	0.982	0.967	0.983	1.014	1.004	0.998
Fe	0.005	0.004	0.002	0.001	0.002	0.005
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.006	0.019	0.012	0.020	0.022	0.013
Ca	0.013	0.005	0.010	0.008	0.008	0.008
Na	0.442	0.326	0.343	0.332	0.341	0.360
K	0.544	0.649	0.637	0.646	0.627	0.642
SUM	4.986	4.986	4.988	4.988	4.988	5.005
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	54.5	66.2	64.3	65.5	64.2	64.2
Ab	44.2	33.3	34.6	33.7	34.9	35.8
An	1.3	0.5	1.0	0.8	0.8	0.0

	FE03A	FE04A	FE05A	FE04B	FE05C	FE03A	FE11A	FE11B	FE14A	FE15A	FE16A	FE08A	FE12A	FE12B
	AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS											AUTHIGENIC ALKALI FELDSPAR IN GROUNDMASS		
SiO_2	69.09	67.89	66.48	68.38	68.16	68.96	68.44	68.13	68.55	68.73	68.46	66.56	67.68	66.86
Al_2O_3	18.95	19.66	20.68	18.98	19.43	18.74	19.05	18.83	19.20	19.16	19.36	16.67	16.61	16.50
FeO	0.00	0.00	0.18	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.08	0.13	0.18	0.23	0.20	0.00	0.06	0.00	0.10	0.10	0.10	0.10
CaO	0.00	0.02	1.55	0.00	0.15	0.20	0.04	0.00	0.06	0.32	0.18	0.00	0.00	0.00
Na_2O	12.54	11.77	10.66	12.10	12.34	11.77	12.11	11.98	12.00	12.06	12.27	0.32	0.31	0.17
K_2O	0.02	0.07	0.30	0.02	0.04	0.45	0.06	0.04	0.00	0.06	0.16	15.25	15.38	15.11
SUM	100.62	100.21	98.94	99.62	100.31	100.34	100.90	99.00	99.96	100.33	100.54	97.90	100.09	98.76
	Cation formula based on 8(O)													
Si	3.006	2.970	2.911	3.004	2.980	3.013	3.011	3.006	2.999	2.998	2.986	3.072	3.006	3.006
Al	0.971	1.012	1.063	0.982	1.000	0.964	0.973	0.983	0.989	0.984	0.994	0.949	0.896	0.890
Fe	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.001	0.001	0.002	0.003	0.002	0.000	0.000	0.000	0.001	0.002	0.001	0.001
Ca	0.000	0.037	0.073	0.000	0.006	0.000	0.001	0.000	0.002	0.014	0.007	0.000	0.000	0.000
Na	1.056	0.997	0.918	1.030	1.046	0.988	1.018	1.023	1.024	1.019	1.037	0.029	0.026	0.015
K	0.000	0.002	0.022	0.000	0.001	0.024	0.002	0.001	0.000	0.002	0.007	0.912	0.896	0.893
SUM	5.032	5.019	5.011	5.017	5.036	5.011	5.008	5.013	5.016	5.016	5.032	4.934	4.914	4.903
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)													
Or	0.0	0.2	2.2	0.0	0.1	2.3	0.2	0.1	0.0	0.2	0.7	96.9	97.2	98.3
Ab	100.0	96.2	90.6	100.0	99.3	96.8	99.7	99.9	99.8	99.5	98.7	3.1	2.8	1.7
An	0.0	3.6	7.2	0.0	0.6	0.9	0.1	0.0	0.2	1.4	0.7	0.0	0.0	0.0

Microprobe analyses of feldspars in USW-G2-4838

	FE01A	FE01A	FE02A	FE03A
	SANIDINE PHENOCRYSTS	AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS		
SiO_2	66.00	68.71	68.72	68.63
Al_2O_3	24.02	19.45	19.69	19.08
FeO	0.04	0.03	0.04	0.00
MgO	0.23	0.00	0.00	0.00
BaO	0.16	0.00	0.00	0.00
CaO	10.14	0.36	0.60	0.27
Na_2O	5.33	11.71	11.57	11.63
K_2O	0.55	0.06	0.09	0.02
SUM	99.79	100.34	100.73	99.64
Cation formula based on 8(O)				
Si	2.530	2.993	2.984	3.007
Al	1.431	0.998	1.006	0.984
Fe	0.013	0.000	0.001	0.000
Mg	0.014	0.000	0.000	0.000
Ba	0.002	0.000	0.000	0.000
Ca	0.492	0.015	0.030	0.012
Na	0.460	0.988	0.970	0.987
K	0.032	0.002	0.005	0.000
SUM	4.994	4.998	4.997	4.990
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)				
Or	3.2	0.2	0.5	0.0
Ab	47.2	98.3	96.5	98.9
An	49.6	1.5	3.0	1.1

Rhyolite Lavas

Microprobe analyses of feldspars in USW-G2-5017

	FE01A	FE01C	FE02A	FE02C	FE03A	FE03B	FE03C	FE04A	FE07A	FE07B	FE07C	FE08A	FE08B	FE08C	FE06A	FE06B	FE06A	FE02B
	PLAGIOCLASE PHENOCRYSTS														SANIDINE PHENOCRYSTS		AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS	
SiO_2	58.94	60.81	58.44	59.57	58.18	58.86	61.75	60.42	59.09	59.98	60.69	60.66	61.15	60.82	62.83	61.48	68.82	69.61
Al_2O_3	23.92	23.90	25.10	24.58	24.92	24.21	23.82	23.97	24.31	24.04	24.07	23.75	23.91	23.79	18.84	19.51	19.45	18.96
FeO	0.22	0.16	0.23	0.21	0.20	0.18	0.19	0.18	0.23	0.21	0.20	0.15	0.21	0.26	0.11	0.11	0.01	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.08	0.20	0.23	0.40	0.06	0.15	0.08	0.18	0.13	0.27	0.18	0.27	0.46	0.25	4.47	4.37	0.23	0.06
CaO	6.30	6.39	7.83	6.86	7.19	6.60	6.30	6.51	6.76	6.78	6.52	6.29	6.21	6.02	0.17	0.48	0.23	0.02
Na_2O	7.27	7.41	6.99	7.25	7.11	7.52	7.40	7.44	7.19	7.30	7.41	7.61	7.64	7.41	3.06	4.60	12.03	12.00
K_2O	0.78	0.76	0.60	0.70	0.64	0.74	0.78	0.75	0.70	0.72	0.50	0.76	0.81	0.82	10.45	7.85	0.04	0.02
SUM	97.54	99.64	99.41	99.61	98.29	98.27	100.41	99.66	98.43	99.31	99.66	99.52	100.39	99.36	99.56	98.88	100.83	100.76
	Cation formula based on 8(O)																	
Si	2.669	2.723	2.639	2.680	2.649	2.683	2.739	2.710	2.686	2.702	2.715	2.722	2.726	2.729	2.926	2.882	2.988	3.018
Al	1.291	1.262	1.336	1.303	1.338	1.300	1.244	1.267	1.301	1.275	1.270	1.256	1.256	1.258	1.046	1.081	0.995	0.960
Fe	0.008	0.006	0.008	0.008	0.006	0.006	0.006	0.006	0.008	0.008	0.006	0.006	0.008	0.009	0.004	0.004	0.000	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.001	0.002	0.004	0.006	0.000	0.001	0.001	0.006	0.001	0.004	0.002	0.004	0.008	0.004	0.082	0.080	0.003	0.000
Ca	0.309	0.306	0.377	0.330	0.350	0.321	0.303	0.312	0.328	0.326	0.313	0.301	0.296	0.288	0.008	0.023	0.010	0.000
Na	0.646	0.643	0.611	0.632	0.627	0.663	0.636	0.646	0.633	0.637	0.642	0.662	0.660	0.644	0.279	0.419	1.012	1.015
K	0.044	0.043	0.034	0.040	0.036	0.042	0.042	0.042	0.040	0.041	0.033	0.043	0.046	0.046	0.628	0.471	0.001	0.001
SUM	4.997	4.984	5.009	4.999	5.006	5.016	4.971	4.989	4.996	4.992	4.981	4.994	4.997	4.970	4.966	4.986	5.010	5.002
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																	
Or	4.4	4.3	3.3	4.0	3.6	4.1	4.3	4.2	4.0	4.1	3.3	4.3	4.5	4.7	68.6	51.6	0.1	0.1
Ab	64.6	64.8	59.8	63.1	61.9	64.6	64.8	64.6	63.2	63.4	66.0	66.8	66.0	65.8	30.5	45.9	98.9	99.9
An	31.0	30.8	36.9	32.9	34.6	31.3	30.9	31.2	32.8	32.5	31.7	29.9	29.5	29.4	0.9	2.5	1.0	0.0

Quartz Latite Lavas

Microprobe analyses of feldspars in USW-G2-5493

	FE02A	FE02B	FE02C	FE03A	FE03B	FE03C	FE04A	FE04B	FE05A	FE06A	FE06B	FE06C	FE07A	FE07B	FE07C	FE08A	FE08B	FE09A	FE09B
	PLAGIOCLASE PHENOCRYSTS																		
SiO_2	59.01	57.93	58.63	59.06	57.54	57.70	58.55	59.47	59.36	61.71	60.41	60.57	57.56	58.46	59.72	59.92	60.07	61.32	60.24
Al_2O_3	24.71	25.30	24.49	24.34	25.35	25.44	24.66	23.94	24.16	23.45	24.00	24.02	25.25	24.49	24.02	23.75	24.53	23.59	24.23
FeO	0.26	0.28	0.32	0.37	0.29	0.23	0.21	0.30	0.33	0.28	0.18	0.21	0.34	0.21	0.26	0.18	0.26	0.23	0.28
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.25	0.35	0.15	0.18	0.08	0.18	0.20	0.27	0.25	0.15	0.25	0.13	0.25	0.10	0.25	0.00	0.23	0.42	0.27
CaO	7.36	8.05	6.89	7.02	8.25	8.42	6.98	6.54	6.99	5.06	6.34	6.51	8.10	7.30	6.64	6.55	6.96	6.21	6.89
Na_2O	7.02	6.43	7.09	7.10	6.52	6.46	7.09	7.32	7.05	7.30	7.39	7.48	6.71	6.75	7.22	7.36	7.26	7.36	6.93
K_2O	0.52	0.54	0.66	0.71	0.52	0.39	0.68	0.80	0.77	0.95	0.87	0.66	0.51	0.73	0.75	0.64	0.64	0.86	0.76
SUM	99.95	99.50	98.29	99.38	98.47	98.88	98.44	98.67	98.98	99.78	99.47	99.59	98.78	98.05	98.88	98.33	100.01	100.02	99.52
	Cation formula based on 8(O)																		
Si	2.678	2.621	2.670	2.686	2.620	2.619	2.663	2.699	2.686	2.753	2.713	2.715	2.620	2.660	2.700	2.716	2.686	2.740	2.703
Al	1.304	1.349	1.313	1.298	1.360	1.360	1.321	1.279	1.288	1.232	1.269	1.268	1.354	1.316	1.280	1.268	1.292	1.241	1.281
Fe	0.009	0.010	0.012	0.013	0.010	0.008	0.008	0.010	0.012	0.010	0.006	0.008	0.012	0.008	0.009	0.002	0.009	0.008	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.004	0.005	0.001	0.002	0.000	0.002	0.002	0.004	0.004	0.001	0.004	0.001	0.004	0.001	0.004	0.000	0.004	0.006	0.004
Ca	0.352	0.418	0.335	0.338	0.402	0.409	0.340	0.317	0.338	0.279	0.304	0.312	0.394	0.356	0.321	0.318	0.333	0.296	0.330
Na	0.608	0.563	0.625	0.620	0.574	0.567	0.625	0.643	0.619	0.637	0.643	0.649	0.591	0.597	0.633	0.646	0.628	0.637	0.602
K	0.029	0.030	0.037	0.041	0.029	0.021	0.039	0.045	0.043	0.053	0.040	0.037	0.029	0.042	0.042	0.036	0.037	0.048	0.042
SUM	4.984	4.996	4.994	4.991	4.996	4.988	4.999	4.997	4.991	4.966	4.987	4.990	5.005	4.988	4.988	4.986	4.989	4.976	4.967
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																		
Or	2.9	3.0	3.7	4.1	2.9	2.1	3.9	4.5	4.3	5.5	4.0	3.7	2.9	4.2	4.2	3.6	3.7	4.9	4.3
Ab	61.5	55.7	62.7	62.1	57.1	56.9	62.3	64.0	61.9	65.7	64.6	65.0	58.3	60.0	63.6	64.6	62.9	64.9	61.8
An	35.6	41.3	33.6	33.8	40.0	41.0	33.9	31.5	33.8	28.8	30.6	31.3	38.9	35.8	32.2	31.8	33.4	30.2	33.9

	FE10A	FE10B	FE10C	FE11A	FE11B	FE11C
	PLAGIOCLASE PHENOCRYSTS					
SiO_2	57.81	58.81	58.51	59.70	59.06	59.98
Al_2O_3	25.31	25.02	24.40	24.17	24.13	23.91
FeO	0.26	0.22	0.20	0.13	0.19	0.22
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.25	0.35	0.13	0.33	0.00	0.10
CaO	8.13	7.07	7.10	7.36	6.34	6.46
Na_2O	6.60	6.90	7.20	6.96	7.09	7.56
K_2O	0.52	0.60	0.54	0.66	0.78	0.78
SUM	98.97	99.07	98.20	99.30	97.57	99.05
	Cation formula based on 8(O)					
Si	2.625	2.647	2.667	2.692	2.697	2.708
Al	1.354	1.326	1.311	1.284	1.299	1.271
Fe	0.009	0.008	0.006	0.004	0.006	0.008
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.004	0.005	0.001	0.005	0.000	0.001
Ca	0.394	0.379	0.350	0.354	0.310	0.313
Na	0.587	0.602	0.635	0.609	0.627	0.661
K	0.029	0.038	0.031	0.037	0.044	0.043
SUM	5.002	5.005	5.002	4.985	4.982	5.004
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	2.9	3.7	3.1	3.7	4.5	4.2
Ab	58.1	59.1	62.5	60.9	63.9	65.0
An	39.0	37.2	34.4	35.4	31.6	30.8

Ash-Flow Tuff

Microprobe analyses of feldspars in USW-G2-5657

	FE01A	FE01B	FE02A	FE03A	FE04A	FE05A	FE06A
	AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS						
SiO_2	67.46	66.36	66.84	67.71	66.60	67.86	67.23
Al_2O_3	19.79	19.57	19.25	19.50	19.36	19.48	19.13
FeO	0.00	0.00	0.00	0.00	0.04	0.06	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.37	0.00	0.08	0.20	0.13	0.05	0.13
CaO	0.63	0.71	0.41	0.07	0.55	0.59	0.20
Na_2O	11.86	11.61	11.71	11.84	11.76	11.71	12.27
K_2O	0.04	0.06	0.07	0.04	0.03	0.14	0.03
SUM	100.16	98.30	98.40	100.25	98.53	99.68	99.01
	Cation formula based on 8(O)						
Si	2.961	2.960	2.976	2.966	2.967	2.977	2.979
Al	1.022	1.020	1.010	1.011	1.015	1.006	0.999
Fe	0.000	0.000	0.000	0.000	0.001	0.001	0.000
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.006	0.000	0.001	0.002	0.001	0.000	0.001
Ca	0.028	0.032	0.018	0.040	0.024	0.027	0.009
Na	1.008	1.003	1.010	1.006	1.015	0.996	1.053
K	0.001	0.002	0.004	0.001	0.001	0.007	0.001
SUM	5.026	5.024	5.019	5.025	5.024	5.013	5.042
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	0.1	0.2	0.4	0.1	0.1	0.7	0.1
Ab	97.2	96.7	97.9	96.1	97.6	96.7	99.1
An	2.7	3.1	1.7	3.8	2.3	2.6	0.8

Dacite Lavas

Microprobe analyses of feldspars in USW-G2-5696

	FE01A	FE02A	FE03A	FE04A
	AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS			
SiO_2	66.99	67.36	67.55	67.09
Al_2O_3	20.13	19.50	18.93	19.66
FeO	0.04	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00
BaO	0.20	0.18	0.03	0.03
CaO	0.94	0.63	0.48	0.69
Na_2O	11.48	11.79	11.77	11.62
K_2O	0.02	0.02	0.02	0.01
SUM	99.83	99.48	98.79	99.09
	Cation formula based on 8(O)			
Si	2.946	2.970	2.993	2.973
Al	1.042	1.013	0.988	1.014
Fe	0.001	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000
Ba	0.002	0.002	0.000	0.000
Ca	0.043	0.029	0.022	0.032
Na	0.978	1.007	1.010	0.996
K	0.001	0.000	0.001	0.000
SUM	5.015	5.022	5.015	5.005
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)			
Or	0.1	0.0	0.1	0.0
Ab	95.7	97.2	97.8	96.9
An	4.2	2.8	2.1	3.1

Microprobe analyses of feldspars in USW-G2-5820

	FE01B	FE01C	FE02B	FE02C	FE02D	FE02E	FE02F	FE02G	FE02H	FE02I	FE03A	FE03B	FE03C	FE04A	FE04B	FE04C
	PLAGIOCLASE PHENOCRYSTS															
SiO_2	57.05	57.42	48.81	57.04	58.79	58.32	47.99	51.04	49.03	56.76	58.76	55.00	59.09	56.92	58.45	57.78
Al_2O_3	26.39	26.45	31.83	26.29	25.14	25.54	31.79	30.71	30.99	26.74	24.72	26.93	24.32	26.51	25.45	26.01
FeO	0.75	0.73	0.00	0.59	0.59	0.62	0.00	0.46	0.59	0.50	0.45	0.56	0.52	0.60	0.50	0.65
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.57	0.00	0.00	0.00	0.11	0.03	0.00	0.00	0.00	0.18	0.00	0.26	0.03	0.00	0.21
CaO	9.73	8.87	16.03	9.55	8.16	9.11	16.42	14.39	15.29	10.67	7.79	10.50	7.30	9.03	8.75	9.26
Na_2O	5.51	5.62	2.05	5.36	6.09	5.85	1.96	2.86	2.59	4.97	6.17	5.00	6.46	5.27	5.91	5.91
K_2O	0.75	0.78	0.14	0.70	0.98	0.77	0.12	0.20	0.18	0.54	1.19	0.64	1.29	0.71	0.93	0.89
SUM	100.59	100.54	99.11	99.57	99.82	100.39	98.37	99.75	99.53	99.21	99.30	98.67	100.15	99.93	100.06	100.76
	Cation formula based on 8(O)															
Si	2.575	2.579	2.237	2.578	2.643	2.615	2.232	2.329	2.290	2.535	2.667	2.518	2.686	2.565	2.625	2.591
Al	1.394	1.399	1.732	1.399	1.331	1.350	1.742	1.651	1.679	1.433	1.310	1.452	1.304	1.408	1.347	1.374
Fe	0.027	0.026	0.000	0.021	0.021	0.022	0.000	0.017	0.021	0.019	0.016	0.021	0.018	0.022	0.018	0.023
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.009	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.000	0.000	0.002
Ca	0.467	0.425	0.873	0.461	0.393	0.437	0.818	0.703	0.752	0.519	0.377	0.514	0.354	0.435	0.429	0.445
Na	0.477	0.489	0.183	0.469	0.530	0.507	0.174	0.253	0.229	0.438	0.540	0.443	0.561	0.460	0.514	0.513
K	0.042	0.043	0.006	0.040	0.056	0.043	0.006	0.010	0.009	0.030	0.067	0.036	[illegible]	0.040	0.052	0.050
SUM	4.982	4.973	4.982	4.969	4.974	4.976	4.975	4.963	4.981	4.975	4.979	4.986	4.976	4.971	4.977	4.999
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)															
Or	4.3	4.5	0.6	4.1	5.6	4.4	0.6	1.0	0.9	3.0	6.8	3.6	6.8	4.1	5.3	5.0
Ab	49.4	51.1	18.1	48.4	54.2	51.4	17.4	26.2	23.1	44.4	54.9	44.6	57.1	47.2	52.1	50.9
An	47.4	44.4	81.3	47.5	40.2	44.3	82.0	72.8	76.0	52.6	38.3	51.8	36.0	48.7	42.6	44.1

Microprobe analyses of feldspars in USW-G2-5820 (cont)

	FE05A	FE06A	FE06B	FE06C	FE07A	FE07B	FE07C	FE08A	FE08B	FE09A	FE09B	FE09C	FE10A	FE10B	FE10C	FE11A	FE11B	FE02A
	PLAGIOCLASE PHENOCRYSTS																	AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS
SiO_2	58.25	57.26	58.10	59.51	53.48	53.10	56.02	58.12	59.94	56.79	56.08	59.23	56.77	57.73	57.96	53.04	56.78	69.04
Al_2O_3	25.70	26.18	25.54	25.30	29.79	29.12	26.69	25.98	24.52	26.66	26.52	25.82	26.33	25.84	25.88	28.75	25.93	19.09
FeO	0.58	0.53	0.61	0.47	0.49	0.52	0.52	0.64	0.57	0.52	0.56	0.53	0.52	0.50	0.50	0.56	0.48	0.07
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.18	0.21	0.00	0.32	0.00	0.00	0.00	0.14	0.36	0.18	0.18	0.39	0.00	0.00	0.16	0.14	0.29	0.00
CaO	8.73	9.00	8.01	7.99	12.09	13.15	9.92	9.23	7.43	9.67	10.43	7.78	10.00	9.21	9.26	12.36	9.76	0.36
Na_2O	5.70	5.36	6.06	6.10	4.07	3.84	5.21	5.68	6.51	5.62	5.04	6.21	5.04	5.94	5.60	4.18	5.55	11.55
K_2O	0.91	0.71	0.82	1.07	0.41	0.34	0.64	0.84	1.23	0.66	0.58	1.03	0.59	0.73	0.73	0.43	0.75	0.07
SUM	100.11	100.14	99.98	100.91	100.36	100.10	99.07	100.59	100.63	100.02	99.06	100.28	99.30	100.01	100.18	99.50	99.59	101.70
	Cation formula based on 8(O)																	
Si	2.617	2.578	2.615	2.649	2.427	2.411	2.548	2.602	2.678	2.549	2.545	2.654	2.570	2.597	2.604	2.421	2.575	2.994
Al	1.360	1.388	1.356	1.331	1.540	1.558	1.431	1.366	1.290	1.411	1.418	1.321	1.406	1.370	1.366	1.547	1.386	1.005
Fe	0.021	0.020	0.022	0.017	0.017	0.019	0.019	0.023	0.021	0.018	0.021	0.020	0.019	0.018	0.018	0.020	0.017	0.002
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.002	0.002	0.000	0.005	0.000	0.000	0.000	0.001	0.006	0.002	0.002	0.006	0.000	0.000	0.002	0.001	0.004	0.000
Ca	0.419	0.471	0.424	0.380	0.626	0.640	0.483	0.442	0.355	0.465	0.507	0.373	0.486	0.443	0.445	0.604	0.474	0.016
Na	0.496	0.467	0.520	0.525	0.357	0.338	0.469	0.493	0.563	0.489	0.442	0.539	0.442	0.517	0.494	0.370	0.487	0.950
K	0.051	0.041	0.046	0.040	0.022	0.019	0.037	0.047	0.069	0.037	0.033	0.058	0.033	0.041	0.041	0.024	0.042	0.003
SUM	4.967	4.969	4.989	4.987	4.990	4.983	4.977	4.975	4.982	4.995	4.971	4.972	4.956	4.987	4.972	4.988	4.984	4.980
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)																	
Or	5.3	4.2	4.6	6.2	2.2	1.9	3.8	4.8	7.0	3.7	3.4	6.0	3.4	4.1	4.2	2.4	4.2	0.3
Ab	51.3	47.7	52.9	54.4	35.5	33.9	46.9	50.2	57.0	49.3	45.0	55.6	46.0	51.6	50.4	37.1	48.6	98.1
An	43.4	48.1	42.5	39.4	62.3	64.2	49.3	45.0	36.0	46.9	51.6	38.5	50.5	44.3	45.4	60.5	47.3	1.6

Baked Conglomerate and Reworked Tuff

Microprobe analyses of feldspars in USW-G2-5895

	FE01A	FE02A	FE03A	FE01A
	AUTHIGENIC ALBITE IN GROUNDMASS			AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS
SiO_2	68.86	66.21	68.80	66.66
Al_2O_3	18.91	19.79	18.69	19.56
FeO	0.00	0.00	0.01	0.00
MgO	0.00	0.00	0.00	0.00
BaO	0.13	0.15	0.23	0.03
CaO	0.00	0.46	0.00	0.50
Na_2O	12.17	11.41	11.96	11.30
K_2O	0.00	0.04	0.01	0.04
SUM	100.07	98.06	99.70	98.17
	Cation formula based on 8(O)			
Si	3.000	2.960	3.010	2.970
Al	0.973	1.041	0.966	1.026
Fe	0.000	0.000	0.000	0.000
Mg	0.000	0.000	0.000	0.000
Ba	0.001	0.001	0.003	0.000
Ca	0.000	0.021	0.000	0.023
Na	1.031	0.980	1.017	0.984
K	0.000	0.001	0.000	0.001
SUM	5.013	5.011	5.002	5.006
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)				
Or	0.0	0.1	0.0	0.1
Ab	100.0	97.8	100.0	97.6
An	0.0	2.1	0.0	2.3

Unnamed Ash Flows

Microprobe analyses of feldspars in USW-G2-5992

	FE02A	FE02B	FE03A	FE04A
	AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS			
SiO_2	68.05	68.34	63.51	63.28
Al_2O_3	19.20	18.97	18.01	18.02
FeO	0.01	0.00	0.06	0.00
MgO	0.00	0.00	0.00	0.00
BaO	0.10	0.05	1.05	1.00
CaO	0.14	0.00	0.00	0.00
Na_2O	11.97	11.04	0.42	0.41
K_2O	0.09	0.04	15.55	15.77
SUM	99.56	99.25	98.71	99.28
	Cation formula based on 8(O)			
Si	2.991	3.007	2.993	2.980
Al	0.994	0.984	1.000	0.999
Fe	0.000	0.000	0.001	0.000
Mg	0.000	0.000	0.000	0.000
Ba	0.001	0.000	0.019	0.019
Ca	0.006	0.000	0.002	0.000
Na	1.019	1.010	0.037	0.037
K	0.003	0.001	0.934	0.946
SUM	5.014	5.002	4.985	4.996
Mol % potassium feldspar (Or), albite (Ab) and anorthite (An)				
Or	0.3	0.1	96.0	96.2
Ab	99.1	99.9	3.8	3.8
An	0.6	0.0	0.2	0.0

2. FELDSPAR MICROPROBE DATA FOR UE25b-1H

Bullfrog Member of the Crater Flat Tuff

Microprobe analyses of feldspars in UE25b-1H-2402

	FE01A	FE01B	FE01C	FE02A	FE02B	FE03A	FE03B
	PLAGIOCLASE PHENOCRYSTS					SANIDINE PHENOCRYSTS	
SiO_2	62.34	64.06	64.71	66.46	66.34	65.85	66.32
Al_2O_3	22.23	21.23	21.06	21.31	21.15	17.91	18.47
FeO	0.15	0.22	0.00	0.13	0.19	0.00	0.12
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.00	0.00	0.00	0.21	0.56
CaO	4.20	3.29	3.07	3.04	2.96	0.22	0.21
Na_2O	9.01	9.11	9.44	9.21	9.45	4.11	4.50
K_2O	1.04	1.29	1.37	1.30	1.36	10.50	10.30
Sum	98.83	98.20	99.66	100.49	100.43	98.93	100.63
	Cation formula based on 8(O)						
Si	2.799	2.862	2.873	2.876	2.880	3.020	2.987
Al	1.177	1.117	1.101	1.104	1.080	0.967	0.982
Fe	0.006	0.008	0.002	0.003	0.006	0.002	0.004
Mg	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.000	0.000	0.000	0.002	0.000
Ca	0.201	0.157	0.146	0.143	0.140	0.011	0.009
Na	0.784	0.769	0.812	0.784	0.807	0.364	0.401
K	0.059	0.073	0.077	0.072	0.076	0.613	0.592
Sum	5.026	5.007	5.011	4.986	5.006	4.980	4.986
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)						
Or	6.7	7.2	7.4	7.2	7.3	62.0	59.1
Ab	76.1	77.4	78.5	78.5	78.0	36.8	40.0
An	19.3	15.4	14.1	14.3	13.7	1.1	0.9

Microprobe analyses of feldspars in UE25b-1H-2832

	FE02A	FE02B	FE01A	FE01B	FE03A	FE03B
	PLAGIOCLASE PHENOCRYSTS		SANIDINE PHENOCRYSTS			
SiO_2	64.81	64.22	65.63	66.06	66.14	66.13
Al_2O_3	21.67	21.26	18.46	18.59	18.57	18.48
FeO	0.21	0.17	0.14	0.16	0.13	0.14
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.00	0.00	0.25	0.18	0.63	0.58
CaO	3.30	2.98	0.20	0.26	0.21	0.23
Na_2O	9.28	9.29	3.96	4.06	4.32	4.43
K_2O	1.19	1.00	10.53	10.16	10.28	10.31
Sum	100.48	99.02	99.26	99.48	99.38	99.34
	Cation formula based on 8(O)					
Si	2.867	2.860	2.987	3.002	2.984	2.985
Al	1.125	1.116	0.983	0.996	1.001	0.984
Fe	0.007	0.006	0.006	0.006	0.004	0.006
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.000	0.004	0.006	0.011	0.009
Ca	0.156	0.142	0.009	0.012	0.009	0.011
Na	0.793	0.801	0.361	0.366	0.383	0.383
K	0.066	0.107	0.612	0.588	0.601	0.603
Sum	5.003	5.032	4.972	4.963	4.984	5.004
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	6.5	10.2	63.0	61.5	60.5	58.9
Ab	78.2	76.3	36.1	37.2	38.6	39.0
An	15.3	13.5	0.9	1.3	0.9	1.1

Microprobe analyses of feldspars in UE25b-1H-2855

	FE01A	FE01B	FE02A	FE02B	FE03A	FE03B
	PLAGIOCLASE PHENOCRYSTS				SANIDINE PHENOCRYSTS	
SiO_2	62.31	61.97	59.09	63.45	65.58	66.21
Al_2O_3	23.05	22.94	24.97	21.80	18.22	18.03
FeO	0.14	0.22	0.18	0.17	0.10	0.32
MgO	0.00	0.00	0.00	0.00	0.00	0.00
BaO	0.06	0.12	0.04	0.00	0.21	0.14
CaO	4.86	4.86	7.21	3.46	0.22	0.21
Na_2O	8.56	8.46	7.06	8.94	4.31	4.18
K_2O	0.77	0.82	0.48	1.30	10.48	10.72
Sum	99.76	99.38	99.10	98.21	99.07	99.86
	Cation formula based on 8(O)					
Si	2.775	2.774	2.664	2.838	3.004	3.013
Al	1.210	1.209	1.326	1.148	0.985	0.967
Fe	0.006	0.004	0.006	0.006	0.002	0.012
Mg	0.000	0.000	0.000	0.000	0.000	0.000
Ba	0.000	0.001	0.000	0.001	0.002	0.001
Ca	0.231	0.232	0.348	0.165	0.011	0.009
Na	0.738	0.733	0.615	0.774	0.382	0.369
K	0.043	0.046	0.026	0.073	0.612	0.622
Sum	5.003	5.003	4.987	5.006	4.999	4.993
	Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	4.2	4.5	2.6	7.2	60.9	62.2
Ab	72.9	72.5	62.2	76.5	38.0	36.9
An	22.8	22.9	35.2	16.3	1.1	0.9

Tram Member of the Crater Flat Tuff

Microprobe analyses of feldspars in UE25b-1H-2953

	FE01A
	PLAGIOCLASE PHENOCRYSTS
SiO_2	61.96
Al_2O_3	22.44
FeO	0.13
MgO	0.00
BaO	0.04
CaO	4.27
Na_2O	8.89
K_2O	0.98
SUM	98.71
Cation formula based on 8(O)	
Si	2.790
Al	1.191
Fe	0.004
Mg	0.000
Ba	0.000
Ca	0.205
Na	0.776
K	0.056
SUM	5.021
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)	
Or	5.3
Ab	79.9
An	19.8

Microprobe analyses of feldspars in UE25b-1H-3050

	FE03A	FE04A
	SANIDINE PHENOCRYSTS	
SiO_2	65.38	66.53
Al_2O_3	18.24	18.03
FeO	0.12	0.10
MgO	0.00	0.00
BaO	0.75	0.56
CaO	0.21	0.16
Na_2O	3.60	3.05
K_2O	11.76	10.80
SUM	99.70	100.13
Cation formula based on 8(O)		
Si	2.999	3.021
Al	0.985	0.965
Fe	0.004	0.002
Mg	0.000	0.000
Ba	0.013	0.009
Ca	0.009	0.006
Na	0.327	0.338
K	0.658	0.629
SUM	4.996	4.972
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)		
Or	66.2	64.6
Ab	32.9	34.7
An	0.9	0.6

Microprobe analyses of feldspars in UE25b-1H-3095

	FE04A	FE01A	FE02A	FE03A
	PLAGIOCLASE PHENOCRYSTS	SANIDINE PHENOCRYSTS		
SiO_2	61.72	64.32	65.56	65.04
Al_2O_3	22.89	18.13	18.21	18.24
FeO	0.20	0.07	0.14	0.09
MgO	0.00	0.00	0.00	0.00
BaO	0.08	0.25	0.65	0.33
CaO	4.79	0.16	0.22	0.18
Na_2O	8.82	3.66	3.72	3.76
K_2O	0.90	11.16	11.30	11.45
SUM	98.63	97.77	99.81	99.98
Cation formula based on 8(O)				
Si	2.777	2.997	3.001	3.006
Al	1.213	0.995	0.982	0.980
Fe	0.006	0.002	0.005	0.002
Mg	0.000	0.000	0.000	0.000
Ba	0.001	0.004	0.011	0.005
Ca	0.229	0.007	0.011	0.008
Na	0.700	0.329	0.329	0.332
K	0.051	0.662	0.659	0.664
SUM	4.979	4.996	4.998	5.000
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)				
Or	5.2	66.3	66.0	66.2
Ab	71.4	33.0	32.9	33.0
An	23.4	0.7	1.1	0.8

Microprobe analyses of feldspars in UE25b-1H-3163

	FE06A PLAGIOCLASE PHENOCRYSTS	FE03A SANIDINE PHENOCRYSTS
SiO_2	58.73	65.37
Al_2O_3	24.83	18.36
FeO	0.26	0.06
MgO	0.00	0.00
BaO	0.57	1.00
CaO	6.12	0.23
Na_2O	7.36	3.37
K_2O	0.68	1.02
SUM	98.96	99.46
Cation formula based on 8(O)		
Si	2.700	3.001
Al	1.280	0.982
Fe	0.000	0.001
Mg	0.000	0.000
Ba	0.009	0.017
Ca	0.296	0.011
Na	0.646	0.299
K	0.038	0.644
SUM	4.982	4.961
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)		
Or	3.9	67.5
Ab	66.0	31.3
An	30.1	1.2

Microprobe analyses of feldspars in UE25b-1H-3326

	FE03A PLAGIOCLASE	FE06A PHENOCRYSTS	FE01A SANIDINE PHENOCRYSTS	FE02A FELDSPAR PHENOCRYSTS IN LITHICS	FE04A
SiO_2	58.75	58.30	64.96	66.54	57.90
Al_2O_3	24.88	23.66	18.46	17.42	24.44
FeO	0.24	0.25	0.10	0.20	1.30
MgO	0.00	0.30	0.00	0.00	0.46
BaO	0.52	0.20	0.01	0.34	0.12
CaO	7.79	6.09	0.20	0.13	7.02
Na_2O	6.67	7.52	3.72	3.04	6.01
K_2O	0.50	0.64	11.03	11.79	1.11
SUM	99.50	98.02	99.52	98.70	98.86
Cation formula based on 8(O)					
Si	2.662	2.708	2.984	3.026	2.642
Al	1.323	1.271	0.998	0.947	1.311
Fe	0.008	0.000	0.002	0.006	0.049
Mg	0.000	0.000	0.000	0.000	0.030
Ba	0.008	0.004	0.013	0.006	0.001
Ca	0.376	0.297	0.009	0.006	0.342
Na	0.583	0.644	0.330	0.271	0.530
K	0.027	0.037	0.646	0.684	0.064
SUM	4.980	4.995	4.990	4.963	4.982
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)					
Or	2.7	3.7	65.6	71.5	6.8
Ab	59.1	66.5	33.5	27.9	56.6
An	38.1	29.8	0.9	0.5	36.5

Microprobe analyses of feldspars in UE25b-1H-3185

	FE02A PLAGIOCLASE	FE03A PHENOCRYSTS
SiO_2	62.84	62.40
Al_2O_3	22.27	22.68
FeO	0.19	0.23
MgO	0.00	0.00
BaO	0.27	0.36
CaO	4.43	4.61
Na_2O	8.44	8.56
K_2O	0.92	0.82
SUM	99.49	98.86
Cation formula based on 8(O)		
Si	2.807	2.786
Al	1.171	1.193
Fe	0.006	0.008
Mg	0.000	0.000
Ba	0.004	0.006
Ca	0.211	0.220
Na	0.730	0.740
K	0.052	0.045
SUM	4.986	5.002
Mol.% potassium feldspar (Or), albite (Ab), and anorthite (An)		
Or	5.2	4.5
Ab	73.5	73.6
An	21.2	21.9

APPENDIX B

MAFIC PHENOCRYST MICROPROBE DATA

1. MAFIC PHENOCRYST MICROPROBE DATA FOR USW-G2

Yucca Mountain Member of the Paintbrush Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-331

	#101A	#101B	#102A	#102B	#104A	#104B	#104C
			BIOTITE PHENOCRYSTS				
SiO_2	39.29	38.62	37.32	38.09	37.52	36.98	36.33
TiO_2	3.80	3.92	3.96	3.77	5.61	6.01	5.96
Al_2O_3	13.06	12.87	12.80	12.82	14.14	14.13	13.98
FeO	12.77	13.54	14.13	13.05	9.80	11.54	11.86
MnO	0.57	0.50	0.67	0.50	0.24	0.00	0.05
MgO	15.82	15.64	15.50	15.07	15.46	15.16	15.40
BaO	0.35	0.57	1.22	0.42	2.49	2.61	2.23
CaO	0.12	0.02	0.05	0.09	0.12	0.09	0.04
Na_2O	0.69	0.70	0.67	0.71	0.69	0.63	0.55
K_2O	0.68	0.92	0.80	0.81	0.33	0.62	0.89
SUM	95.14	95.32	95.20	94.53	94.40	95.75	95.33
			Cation formula				
Si	5.814	5.758	5.633	5.825	5.612	5.516	5.461
Ti	0.421	0.437	0.447	0.472	0.628	0.669	0.670
Al	2.275	2.262	2.270	2.259	2.494	2.481	2.474
Fe	1.576	1.684	1.701	1.683	1.225	1.440	1.491
Mn	0.070	0.061	0.084	0.061	0.026	0.000	0.008
Mg	3.487	3.474	3.505	3.362	3.447	3.371	3.449
Ba	0.017	0.030	0.071	0.022	0.145	0.149	0.127
Ca	0.017	0.000	0.004	0.013	0.017	0.013	0.004
Na	0.195	0.201	0.194	0.206	0.197	0.179	0.159
K	1.637	1.693	1.693	1.683	1.590	1.637	1.702
SUM	15.509	15.601	15.692	15.537	15.380	15.454	15.545
			Mg/Mg+Fe				
	0.69	0.67	0.66	0.67	0.74	0.70	0.70

Unnamed Bedded Tuff Between the Yucca Mountain and Pah Canyon Members of the Paintbrush Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-358

	N101A	N101B	AM01A	AM01B	AM02A	AM02B	AM03A	AM03B	AM04A	AM04B	AM06A	AM06B	AM07A	AM07B
	BIOTITE PHENOCRYSTS		AMPHIBOLE PHENOCRYSTS											
SiO_2	36.67	36.72	49.11	49.62	48.98	49.55	48.87	49.00	49.89	49.16	48.11	46.50	48.23	48.42
TiO_2	5.62	5.21	0.79	0.88	0.82	0.87	0.76	0.76	0.69	0.81	0.79	0.96	0.84	0.77
Al_2O_3	13.42	13.19	4.31	4.48	4.33	4.26	4.30	4.36	3.96	4.06	5.22	5.34	4.71	4.46
FeO	13.59	13.48	11.31	11.86	11.56	11.27	11.89	11.79	11.79	11.41	12.16	11.76	11.06	11.34
MnO	0.29	0.31	2.22	2.18	1.97	2.07	2.34	2.20	2.36	2.29	2.28	1.79	1.96	2.06
MgO	14.47	14.36	15.38	14.86	15.32	15.61	15.00	15.13	15.11	14.80	14.63	14.94	15.07	14.86
BaO	2.37	2.34	0.20	0.00	0.03	0.30	0.00	0.06	0.18	0.07	0.10	0.00	0.00	0.16
CaO	0.01	0.02	10.09	10.16	10.43	10.28	10.36	10.46	10.07	10.30	10.30	10.91	10.39	10.02
Na_2O	0.72	0.64	2.32	2.32	2.31	2.30	2.36	2.25	2.18	2.16	2.30	2.36	2.29	2.23
K_2O	0.66	0.56	0.58	0.67	0.64	0.67	0.62	0.63	0.56	0.50	0.73	0.63	0.73	0.64
SUM	94.21	93.84	96.36	97.06	96.38	97.00	96.50	96.78	96.78	96.83	96.77	96.26	96.28	96.00
			Cation formula											
Si	5.484	5.500	7.296	7.316	7.271	7.296	7.267	7.269	7.374	7.338	7.166	7.062	7.229	7.286
Ti	0.578	0.602	0.087	0.096	0.091	0.095	0.082	0.082	0.074	0.087	0.087	0.106	0.092	0.083
Al	2.433	2.304	0.754	0.779	0.758	0.739	0.750	0.760	0.680	0.714	0.912	0.960	0.832	0.791
Fe	1.746	1.738	1.403	1.468	1.434	1.387	1.479	1.460	1.458	1.423	1.510	1.483	1.386	1.426
Mn	0.036	0.036	0.279	0.268	0.243	0.256	0.292	0.274	0.290	0.285	0.284	0.226	0.246	0.260
Mg	3.317	3.300	3.404	3.262	3.380	3.427	3.326	3.337	3.327	3.312	3.244	3.366	3.366	3.334
Ba	0.139	0.140	0.000	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
Ca	0.000	0.000	1.603	1.606	1.656	1.621	1.649	1.666	1.592	1.660	1.666	1.767	1.667	1.612
Na	0.212	0.188	0.667	0.662	0.662	0.663	0.677	0.643	0.624	0.622	0.663	0.688	0.664	0.649
K	1.697	1.684	0.108	0.126	0.122	0.103	0.118	0.117	0.103	0.100	0.136	0.120	0.136	0.124
SUM	15.642	15.593	15.640	15.570	15.627	15.580	15.630	15.606	15.540	15.561	15.664	15.760	15.618	15.576
			Mg/Mg+Fe											
	0.66	0.66	0.71	0.68	0.70	0.71	0.69	0.70	0.70	0.70	0.68	0.69	0.71	0.70

Microprobe analyses of mafic phenocrysts in USW-G2-395

	RI02B	RI03A	RI05A	RI05B	AH01A	AH01B	AH02A	AH02B	AH03A	AH03B	AH04A
	BIOTITE PHENOCRYSTS				AMPHIBOLE PHENOCRYSTS						
SiO_2	36.77	43.85	37.27	37.23	49.14	49.93	49.40	48.76	49.56	49.61	49.73
TiO_2	4.54	2.60	4.61	4.72	0.71	0.71	0.67	0.88	0.58	0.66	0.76
Al_2O_3	12.98	12.27	13.32	13.08	4.39	3.91	4.05	4.61	3.82	4.18	3.93
FeO	14.04	20.87	14.48	14.29	11.70	11.50	11.71	11.64	12.09	12.59	11.63
MnO	0.40	0.50	0.43	0.39	2.13	2.39	2.36	2.20	2.47	2.43	2.52
MgO	14.75	4.60	13.81	14.03	14.72	15.29	15.21	15.15	14.94	14.69	15.00
BaO	1.60	0.10	1.95	1.65	0.30	0.07	0.05	0.05	0.10	0.03	0.05
CaO	0.03	0.20	0.09	0.02	10.40	10.13	10.42	10.23	10.21	10.16	10.23
Na_2O	0.67	0.54	0.64	0.70	2.26	2.12	2.09	2.05	2.11	2.06	2.14
K_2O	8.97	7.08	8.50	9.15	0.61	0.57	0.55	0.63	0.58	0.59	0.56
SUM	94.03	93.64	95.16	96.09	96.35	96.64	96.49	96.69	96.46	96.98	96.61
					Cation formula						
Si	5.600	6.690	5.654	5.594	7.314	7.377	7.328	7.227	7.360	7.348	7.364
Ti	0.510	0.305	0.525	0.534	0.079	0.078	0.074	0.096	0.060	0.069	0.082
Al	2.375	2.206	2.378	2.314	0.769	0.680	0.705	0.805	0.667	0.725	0.682
Fe	1.788	2.663	1.834	1.794	1.455	1.417	1.450	1.439	1.501	1.556	1.438
Mn	0.050	0.072	0.053	0.049	0.266	0.299	0.291	0.274	0.310	0.304	0.312
Mg	3.348	1.044	3.121	3.319	3.264	3.366	3.361	3.346	3.306	3.244	3.312
Ba	0.098	0.005	0.116	0.096	0.017	0.000	0.000	0.000	0.004	0.000	0.000
Ca	0.004	0.045	0.013	0.000	1.656	1.604	1.655	1.640	1.627	1.609	1.621
Na	0.196	0.157	0.187	0.203	0.651	0.607	0.601	0.701	0.606	0.591	0.612
K	1.730	1.533	1.661	1.750	0.113	0.103	0.100	0.110	0.109	0.100	0.103
SUM	15.663	14.725	15.641	15.651	15.583	15.530	15.565	15.645	15.560	15.657	15.533
					Mg/Mg+Fe						
	0.65	0.28	0.63	0.65	0.69	0.70	0.70	0.70	0.69	0.68	0.70

Pah Canyon Member of the Paintbrush Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-501

	N101A	N101B	N102A	N102B	N103A	N103B	N104A	N104B	P101A	P101B	P102A	P102B	P103A	P103B	P104A	P104B
	BIOTITE PHENOCRYSTS								PYROXENE PHENOCRYSTS							
SiO_2	38.15	38.01	36.61	36.37	36.07	38.34	37.63	38.01	52.53	51.72	51.64	51.38	52.02	52.28	52.14	51.78
TiO_2	4.16	4.25	4.99	5.52	3.82	4.03	4.00	4.32	0.21	0.23	0.14	0.18	0.21	0.18	0.18	0.17
Al_2O_3	12.72	12.65	13.66	13.60	12.66	12.76	12.70	12.62	1.28	1.29	0.71	0.85	0.96	0.77	0.94	0.76
FeO	13.68	14.16	14.53	14.64	14.27	13.79	13.98	14.06	8.66	8.87	8.78	8.64	8.38	9.14	8.64	8.56
MnO	0.57	0.65	0.62	0.61	0.56	0.66	0.38	0.54	1.50	1.59	1.27	1.60	1.56	1.66	1.61	1.66
MgO	15.80	15.74	14.02	14.06	15.65	15.42	15.29	15.70	13.23	13.33	13.65	13.54	13.23	13.45	13.29	13.36
BaO	0.55	0.40	3.06	3.11	0.52	0.42	0.80	0.66	0.00	0.18	0.10	0.03	0.15	0.00	0.00	0.10
CaO	0.00	0.02	0.02	0.00	0.00	0.02	0.00	0.00	22.23	22.25	22.02	22.02	21.92	22.46	22.00	22.02
Na_2O	0.63	0.68	0.50	0.57	0.53	0.49	0.55	0.62	0.59	0.61	0.62	0.58	0.61	0.61	0.57	0.46
K_2O	9.40	9.25	8.53	8.48	9.54	9.30	9.25	9.21	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.00
Sum	96.80	96.80	96.57	96.85	96.03	96.27	94.58	96.70	100.17	100.12	98.93	98.31	98.04	100.38	100.26	98.68
	Cation formula															
Si	5.686	5.672	5.466	5.406	5.697	5.736	5.703	5.683	1.968	1.948	1.964	1.963	1.972	1.967	1.968	1.960
Ti	0.463	0.473	0.571	0.633	0.426	0.452	0.454	0.482	0.006	0.006	0.003	0.004	0.006	0.004	0.004	0.004
Al	2.236	2.225	2.444	2.431	2.231	2.249	2.260	2.220	0.063	0.066	0.031	0.038	0.043	0.034	0.041	0.033
Fe	1.706	1.766	1.862	1.871	1.783	1.722	1.770	1.755	0.271	0.278	0.279	0.257	0.266	0.287	0.271	0.270
Mn	0.070	0.070	0.076	0.076	0.071	0.083	0.044	0.066	0.047	0.050	0.040	0.054	0.049	0.052	0.051	0.053
Mg	3.529	3.500	3.202	3.188	3.483	3.438	3.451	3.497	0.738	0.748	0.773	0.770	0.748	0.760	0.744	0.753
Ba	0.030	0.026	0.180	0.183	0.032	0.022	0.044	0.036	0.000	0.002	0.001	0.000	0.002	0.000	0.000	0.001
Ca	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.891	0.897	0.897	0.901	0.890	0.909	0.920	0.925
Na	0.179	0.197	0.149	0.166	0.149	0.140	0.140	0.176	0.043	0.044	0.046	0.043	0.046	0.044	0.041	0.033
K	1.784	1.761	1.664	1.661	1.819	1.703	1.788	1.755	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sum	15.686	15.690	15.621	15.615	15.728	15.626	15.681	15.670	4.016	4.030	4.034	4.030	4.017	4.036	4.030	4.032
	Mg/Mg+Fe															
	0.67	0.66	0.63	0.63	0.66	0.67	0.66	0.67	0.73	0.73	0.73	0.76	0.74	0.72	0.73	0.74

Microprobe analyses of mafic phenocrysts in USW-G2-548

	M101A	M101B	M102A	M102B	M103A	M103B	M104A	M104B	M105A	M105B
	BIOTITE PHENOCRYSTS									
SiO_2	34.53	35.13	36.05	34.63	36.38	33.90	36.01	36.30	35.65	37.30
TiO_2	5.00	5.46	4.99	5.24	4.61	4.52	5.39	4.62	4.84	4.38
Al_2O_3	13.64	13.27	13.30	13.06	12.96	11.89	13.34	13.11	13.09	12.88
FeO	14.84	14.76	14.54	14.91	14.42	19.56	14.91	14.64	14.25	14.84
MnO	0.51	0.61	0.48	0.64	0.08	0.09	0.00	0.00	0.46	0.00
MgO	13.36	13.45	14.16	13.66	14.04	13.19	14.28	14.32	14.48	14.09
BaO	3.40	3.30	2.14	3.41	2.69	1.73	2.34	2.13	2.24	1.15
CaO	0.01	0.02	0.03	0.02	0.09	0.07	0.03	0.07	0.03	0.09
Na_2O	0.80	0.64	0.73	0.70	0.50	0.59	0.75	0.70	0.65	0.60
K_2O	0.29	0.40	0.60	0.31	0.57	0.44	0.63	0.93	0.87	0.56
SUM	95.18	95.16	95.05	95.37	95.13	94.78	95.40	94.82	94.57	93.89
	Cation formula									
Si	5.350	5.434	5.511	5.354	5.577	5.357	5.474	5.561	5.487	5.675
Ti	0.673	0.635	0.570	0.600	0.531	0.534	0.615	0.531	0.560	0.500
Al	2.492	2.415	2.396	2.523	2.338	2.213	2.387	2.364	2.371	2.308
Fe	1.920	1.907	1.850	1.924	1.849	2.583	1.896	1.875	1.833	1.706
Mn	0.063	0.077	0.058	0.082	0.104	0.116	0.000	0.000	0.059	0.000
Mg	3.085	3.100	3.227	3.145	3.207	3.103	3.217	3.268	3.319	3.375
Ba	0.204	0.200	0.126	0.204	0.157	0.106	0.138	0.126	0.131	0.067
Ca	0.000	0.000	0.005	0.000	0.014	0.009	0.004	0.009	0.005	0.013
Na	0.237	0.195	0.215	0.209	0.171	0.176	0.210	0.206	0.190	0.174
K	1.637	1.670	1.674	1.638	1.673	1.698	1.673	1.744	1.738	1.661
SUM	15.661	15.633	15.639	15.686	15.620	15.093	15.622	15.682	15.692	15.560
	Mg/Mg+Fe									
	0.62	0.62	0.63	0.62	0.63	0.55	0.63	0.64	0.64	0.66

	P101A	P101B	P102A	P102B	P103A	P103B	P104A	P104B	P105A	P105B
	PYROXENE PHENOCRYSTS									
SiO_2	52.16	51.29	51.59	51.51	51.41	50.86	50.54	51.20	51.58	51.38
TiO_2	0.20	0.16	0.18	0.21	0.18	0.20	0.18	0.21	0.19	0.16
Al_2O_3	0.86	0.96	0.98	1.06	0.64	0.91	1.04	0.80	0.64	1.00
FeO	8.18	8.50	8.89	8.86	8.11	8.62	8.64	8.39	8.50	8.70
MnO	1.23	1.29	1.73	1.77	1.82	1.45	1.51	1.52	1.41	1.20
MgO	13.52	13.46	12.82	12.84	13.32	13.24	13.04	13.30	13.52	13.50
BaO	0.41	0.15	0.03	0.21	0.03	0.00	0.00	0.23	0.23	0.03
CaO	22.21	22.61	22.03	22.08	22.15	22.34	22.51	22.06	22.51	22.70
Na_2O	0.58	0.51	0.57	0.63	0.56	0.63	0.62	0.68	0.52	0.57
K_2O	0.00	0.01	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00
SUM	99.29	98.94	98.84	99.18	98.26	98.27	98.06	98.40	99.09	99.30
	Cation formula									
Si	1.969	1.953	1.967	1.966	1.966	1.951	1.946	1.959	1.963	1.947
Ti	0.006	0.004	0.004	0.006	0.004	0.005	0.004	0.006	0.004	0.004
Al	0.039	0.042	0.043	0.048	0.028	0.041	0.046	0.036	0.028	0.045
Fe	0.255	0.271	0.283	0.281	0.259	0.276	0.278	0.268	0.270	0.275
Mn	0.039	0.041	0.055	0.054	0.058	0.046	0.049	0.048	0.045	0.038
Mg	0.762	0.763	0.728	0.728	0.760	0.756	0.748	0.758	0.764	0.764
Ba	0.006	0.002	0.000	0.002	0.000	0.000	0.000	0.003	0.003	0.000
Ca	0.899	0.922	0.899	0.900	0.904	0.917	0.928	0.904	0.914	0.924
Na	0.042	0.037	0.041	0.046	0.041	0.046	0.045	0.051	0.038	0.041
K	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SUM	4.016	4.035	4.022	4.024	4.020	4.038	4.044	4.031	4.035	4.041
	Mg/Mg+Fe									
	0.75	0.74	0.72	0.72	0.75	0.73	0.73	0.74	0.74	0.74

Microprobe analyses of mafic phenocrysts in USW-G2-627

	M101A	M101B	M102A	M103A
	BIOTITE PHENOCRYSTS			
SiO_2	36.90	36.81	35.69	36.36
TiO_2	4.36	3.88	5.19	4.67
Al_2O_3	12.62	12.20	13.56	12.94
FeO	16.24	17.67	14.77	14.08
MnO	0.00	0.63	0.48	0.55
MgO	14.29	14.34	14.02	14.29
BaO	0.68	0.77	2.00	1.63
CaO	0.06	0.06	0.00	0.04
Na_2O	0.77	0.72	0.66	0.60
K_2O	8.86	9.11	8.46	8.41
SUM	94.84	95.22	94.80	93.56
	Cation formula			
Si	5.620	5.524	5.466	5.504
Ti	0.496	0.448	0.583	0.537
Al	2.262	2.218	2.446	2.344
Fe	2.066	2.277	1.882	1.884
Mn	0.000	0.082	0.068	0.072
Mg	3.241	3.296	3.200	3.273
Ba	0.039	0.045	0.116	0.094
Ca	0.004	0.006	0.000	0.006
Na	0.224	0.213	0.193	0.176
K	1.722	1.793	1.640	1.640
SUM	15.683	15.900	15.616	15.540
	Mg/Mg+Fe			
	0.61	0.59	0.63	0.65

Microprobe analyses of mafic phenocrysts in USW-G2-675

	M101A	M101B	M102A	M102B	M103A	M103B	P101A	P101B
	BIOTITE PHENOCRYSTS						PYROXENE PHENOCRYSTS	
SiO_2	36.57	36.61	38.18	37.60	36.62	36.98	51.96	51.71
TiO_2	4.44	4.86	4.04	4.19	4.56	4.41	0.16	0.17
Al_2O_3	13.38	13.78	12.77	12.73	13.34	13.21	0.82	0.74
FeO	14.16	14.66	14.04	13.96	14.50	14.30	8.66	9.03
MnO	0.56	0.61	0.52	0.56	0.63	0.61	1.64	1.61
MgO	14.93	14.02	15.24	14.94	15.00	14.52	13.30	13.24
BaO	1.93	2.59	0.46	0.48	1.48	1.58	0.00	0.00
CaO	0.04	0.06	0.02	0.07	0.02	0.01	22.10	22.10
Na_2O	0.76	0.73	0.76	0.74	0.77	0.64	0.69	0.58
K_2O	8.81	8.23	9.08	9.03	9.32	8.38	0.00	0.00
SUM	95.67	95.24	95.07	94.34	96.41	94.73	98.62	98.31
	Cation formula							
Si	5.534	5.468	5.726	5.681	5.513	5.616	1.964	1.963
Ti	0.501	0.566	0.463	0.476	0.512	0.503	0.004	0.004
Al	2.386	2.484	2.253	2.271	2.363	2.362	0.036	0.032
Fe	1.790	1.873	1.760	1.768	1.833	1.814	0.273	0.286
Mn	0.071	0.076	0.064	0.071	0.079	0.076	0.062	0.061
Mg	3.367	3.198	3.406	3.367	3.366	3.286	0.764	0.749
Ba	0.111	0.153	0.027	0.027	0.083	0.094	0.000	0.000
Ca	0.004	0.006	0.000	0.000	0.000	0.000	0.886	0.901
Na	0.222	0.216	0.220	0.217	0.226	0.187	0.050	0.042
K	1.708	1.608	1.721	1.741	1.789	1.623	0.000	0.000
SUM	15.686	15.627	15.633	15.640	15.773	15.570	4.032	4.030
	Mg/Mg+Fe							
	0.65	0.63	0.66	0.66	0.66	0.64	0.73	0.72

Microprobe analyses of mafic phenocrysts in USW-G2-723

	M101A	M101B	M102A	M103A	P101A	P101B
	BIOTITE PHENOCRYSTS				PYROXENE PHENOCRYSTS	
SiO_2	36.92	36.02	38.36	38.21	51.70	52.01
TiO_2	5.07	5.06	4.03	4.07	0.14	0.08
Al_2O_3	13.66	13.83	12.56	12.86	0.91	0.79
FeO	14.80	14.92	14.06	14.14	8.75	8.58
MnO	0.00	0.64	0.46	0.41	1.30	1.23
MgO	13.93	13.93	15.00	14.64	13.24	13.70
BaO	2.79	2.68	0.57	0.96	0.02	0.00
CaO	0.07	0.00	0.13	0.21	21.76	22.53
Na_2O	0.58	0.61	0.54	0.48	0.60	0.60
K_2O	7.77	8.11	7.97	8.00	0.00	0.01
SUM	96.60	96.00	93.67	93.98	98.44	98.52
	Cation formula					
Si	5.500	5.471	5.801	5.782	1.972	1.964
Ti	0.580	0.576	0.457	0.461	0.003	0.002
Al	2.466	2.474	2.237	2.252	0.040	0.034
Fe	1.876	1.896	1.776	1.786	0.278	0.271
Mn	0.000	0.080	0.063	0.060	0.041	0.039
Mg	3.182	3.152	3.362	3.304	0.752	0.771
Ba	0.167	0.166	0.031	0.063	0.000	0.000
Ca	0.008	0.000	0.017	0.034	0.890	0.911
Na	0.171	0.178	0.155	0.142	0.043	0.043
K	1.516	1.560	1.536	1.541	0.000	0.000
SUM	15.495	15.560	15.442	15.430	4.020	4.036
	Mg/Mg+Fe					
	0.63	0.62	0.66	0.66	0.73	0.74

Pumiceous Tuff Between the Pah Canyon and Topopah Spring Members of the Paintbrush Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-762

	M101A	M101B	M101C	M102A	M102B	M102C	M103A	M103B	M103C	P101A	P101B	P101C
				BIOTITE PHENOCRYSTS						PYROXENE PHENOCRYSTS		
SiO_2	36.61	37.64	37.00	36.09	36.92	37.10	39.23	40.17	37.02	52.27	52.32	52.50
TiO_2	4.30	4.29	3.80	4.31	4.27	3.87	4.12	4.14	4.49	0.20	0.16	0.13
Al_2O_3	12.59	12.70	12.52	12.04	12.54	12.44	12.45	12.30	12.96	0.75	0.83	0.71
FeO	21.23	20.07	20.36	22.32	22.21	21.82	16.04	15.52	17.30	8.95	8.52	9.67
MnO	0.98	1.10	0.99	0.65	0.50	0.55	0.80	1.47	0.88	1.75	1.75	1.92
MgO	10.02	10.54	10.36	9.07	9.96	9.61	13.66	12.25	12.60	12.54	12.99	12.50
BaO	0.00	0.00	0.00	0.30	0.10	0.00	0.00	0.73	0.65	0.03	0.00	0.00
CaO	0.04	0.07	0.03	0.02	0.00	0.00	0.00	0.30	0.01	21.75	21.69	21.73
Na_2O	0.62	0.54	0.62	0.53	0.52	0.65	0.64	0.50	0.54	0.52	0.64	0.57
K_2O	9.09	9.16	9.47	8.80	9.34	9.41	9.43	8.73	9.54	0.02	0.00	0.00
SUM	96.21	96.35	94.75	95.07	96.03	95.45	95.63	96.10	95.01	98.01	98.91	99.71
						Cation formula						
Si	5.625	5.705	5.752	5.716	5.711	5.757	6.000	5.909	5.628	1.987	1.984	1.987
Ti	0.496	0.488	0.442	0.500	0.495	0.451	0.460	0.464	0.513	0.005	0.004	0.003
Al	2.279	2.293	2.290	2.341	2.283	2.272	2.187	2.141	2.321	0.032	0.036	0.031
Fe	2.729	2.541	2.646	2.830	2.849	2.833	2.003	1.933	2.200	0.295	0.269	0.305
Mn	0.117	0.130	0.073	0.082	0.063	0.060	0.000	0.183	0.112	0.056	0.056	0.061
Mg	2.476	2.395	2.399	2.091	2.202	2.223	3.042	2.771	2.056	0.711	0.730	0.700
Ba	0.000	0.000	0.000	0.022	0.009	0.000	0.000	0.039	0.036	0.000	0.000	0.000
Ca	0.005	0.009	0.006	0.000	0.000	0.000	0.000	0.057	0.000	0.007	0.001	0.079
Na	0.301	0.166	0.182	0.154	0.154	0.195	0.194	0.139	0.154	0.038	0.047	0.041
K	1.701	1.702	1.875	1.750	1.836	1.850	1.797	1.654	1.848	0.000	0.000	0.000
SUM	15.607	15.560	15.662	15.544	15.626	15.656	15.530	15.344	15.670	4.000	4.012	4.000
						Mg/(Mg+Fe)						
	0.40	0.40	0.48	0.42	0.43	0.44	0.60	0.58	0.56	0.71	0.73	0.70

Topopah Spring Member of the Paintbrush Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-770

	N110A	N110B	N110C	N111A	N111B	N111C	N112A	N112B	N112C	P101A	P102A	P103A	P104A
	BIOTITE PHENOCRYSTS									PYROXENE PHENOCRYSTS			
SiO_2	37.41	37.98	37.30	37.56	38.32	38.15	37.27	37.30	37.31	52.50	52.12	52.57	52.33
TiO_2	6.36	5.57	5.60	5.53	5.71	5.55	5.93	5.70	5.83	0.29	0.21	0.21	0.26
Al_2O_3	13.74	13.34	13.61	13.15	13.17	13.41	13.67	13.62	13.34	1.18	0.87	0.84	1.14
FeO	14.38	13.78	14.30	14.33	15.14	14.68	14.63	14.17	14.23	9.25	8.42	9.03	8.98
MnO	0.29	0.30	0.30	0.00	0.41	0.44	0.34	0.41	0.38	0.00	0.00	0.00	0.00
MgO	14.67	14.82	14.22	14.64	14.68	14.50	14.37	14.40	14.47	13.32	13.96	13.53	13.60
BaO	0.26	0.00	0.40	0.00	0.00	0.00	0.56	0.33	0.21	0.03	0.26	0.14	0.06
CaO	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.04	21.96	22.24	21.90	21.73
Na_2O	0.77	0.64	0.71	0.60	0.65	0.66	0.70	0.80	0.66	0.70	0.67	0.70	0.71
K_2O	9.48	9.59	9.24	9.40	9.69	9.66	9.34	9.47	9.32	0.00	0.00	0.01	0.01
Sum	97.36	96.03	96.68	96.21	97.68	97.16	96.82	96.27	96.79	99.23	99.15	98.93	98.81
	Cation formula												
Si	5.493	5.629	5.572	5.618	5.613	5.614	5.620	5.541	5.561	1.975	1.968	1.983	1.976
Ti	0.702	0.618	0.627	0.619	0.627	0.612	0.661	0.645	0.652	0.008	0.006	0.006	0.007
Al	2.373	2.327	2.303	2.317	2.273	2.323	2.386	2.385	2.340	0.062	0.038	0.036	0.050
Fe	1.762	1.708	1.784	1.791	1.853	1.806	1.812	1.757	1.772	0.290	0.270	0.285	0.282
Mn	0.034	0.036	0.036	0.000	0.047	0.061	0.030	0.048	0.043	0.000	0.000	0.000	0.000
Mg	3.200	3.272	3.164	3.266	3.202	3.190	3.173	3.187	3.216	0.747	0.785	0.761	0.766
Ba	0.013	0.000	0.021	0.000	0.000	0.000	0.030	0.017	0.008	0.000	0.003	0.001	0.000
Ca	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.886	0.900	0.885	0.879
Na	0.215	0.182	0.202	0.171	0.184	0.186	0.196	0.226	0.183	0.061	0.049	0.061	0.062
K	1.776	1.810	1.757	1.791	1.788	1.813	1.765	1.792	1.772	0.000	0.000	0.000	0.000
Sum	15.574	15.578	15.566	15.572	15.586	15.603	15.582	15.598	15.562	4.000	4.026	4.007	4.011
	Mg/Mg+Fe												
	0.65	0.66	0.64	0.65	0.63	0.64	0.64	0.64	0.64	0.72	0.74	0.73	0.73

Microprobe analyses of mafic phenocrysts in USW-G2-898

	M120A	M120B	M120C	M121A	M121B	M121C	M122A	M122B	M122C	P103A	P103B	P103C	P104A
	BIOTITE PHENOCRYSTS									PYROXENE PHENOCRYSTS			
SiO_2	32.52	34.35	33.78	37.10	35.46	37.04	36.34	45.17	35.52	51.62	50.61	51.33	51.13
TiO_2	6.64	5.83	6.72	5.51	5.48	6.19	4.81	3.65	4.98	0.42	0.43	0.41	0.00
Al_2O_3	13.71	12.05	13.60	13.97	13.57	14.05	12.98	14.33	12.66	1.01	2.21	1.06	1.43
FeO	15.98	13.12	15.55	9.01	11.76	8.46	10.13	6.18	12.05	8.56	8.65	8.46	9.47
MnO	0.71	1.06	0.51	0.47	0.38	0.00	0.46	0.08	0.43	0.76	0.73	0.75	1.26
MgO	15.09	17.43	14.78	18.41	17.98	18.38	19.63	19.25	18.91	13.73	13.27	13.05	13.33
BaO	3.64	1.48	3.15	1.09	0.93	1.06	0.06	0.03	0.05	0.16	0.00	0.00	0.00
CaO	0.09	0.03	0.04	0.05	0.00	0.04	0.07	0.12	0.11	21.38	21.23	21.25	20.68
Na_2O	0.67	0.79	0.40	0.48	0.54	0.52	0.68	1.74	0.63	0.59	0.59	0.63	0.71
K_2O	7.32	8.25	7.70	8.57	8.40	8.75	8.67	9.46	8.40	0.00	0.00	0.00	0.00
SUM	96.78	95.19	98.31	95.13	94.50	94.91	93.78	98.02	94.17	98.98	97.74	98.56	98.42
	Cation formula												
Si	5.000	5.229	5.162	5.059	5.329	5.499	5.438	6.322	5.351	1.950	1.936	1.945	1.952
Ti	0.766	0.665	0.771	0.689	0.617	0.682	0.539	0.382	0.561	0.011	0.012	0.011	0.011
Al	2.481	2.302	2.462	2.023	2.400	2.436	2.272	2.362	2.246	0.000	0.099	0.042	0.064
Fe	2.052	1.664	1.986	1.157	1.478	1.101	1.263	0.723	1.566	0.271	0.276	0.260	0.303
Mn	0.090	0.136	0.062	0.056	0.049	0.000	0.057	0.000	0.053	0.023	0.023	0.023	0.040
Mg	3.547	3.948	3.363	4.038	4.028	4.011	4.373	3.200	4.295	0.773	0.755	0.701	0.759
Ba	0.216	0.086	0.180	0.061	0.053	0.061	0.004	0.000	0.000	0.002	0.000	0.000	0.000
Ca	0.014	0.004	0.005	0.004	0.000	0.004	0.008	0.017	0.013	0.861	0.870	0.863	0.846
Na	0.198	0.227	0.116	0.130	0.154	0.147	0.193	0.468	0.182	0.043	0.043	0.045	0.052
K	1.436	1.597	1.498	1.606	1.610	1.641	1.649	1.689	1.614	0.000	0.000	0.000	0.000
SUM	15.799	15.846	15.615	15.554	15.716	15.530	15.791	15.163	15.831	4.014	4.015	4.019	4.026
	Mg/Mg+Fe												
	0.63	0.70	0.63	0.78	0.73	0.78	0.78	0.82	0.73	0.74	0.73	0.74	0.71

Microprobe analyses of mafic phenocrysts in USW-G2-1420

	M125A	M125B	M125C	M126A	M126B	M126C
	BIOTITE PHENOCRYSTS					
SiO_2	34.76	35.81	36.16	34.89	35.20	35.82
TiO_2	4.29	3.87	3.81	4.07	4.03	3.84
Al_2O_3	12.82	12.24	12.41	13.11	12.29	13.09
FeO	24.47	24.84	23.82	21.38	20.11	18.37
MnO	0.68	0.61	0.73	0.80	0.98	0.89
MgO	9.99	10.51	10.55	13.00	13.91	13.84
BaO	0.00	0.00	0.00	0.55	0.35	0.38
CaO	0.07	0.09	0.07	0.07	0.06	0.07
Na_2O	0.57	0.55	0.65	0.50	0.52	0.60
K_2O	8.92	8.76	8.95	8.73	8.83	9.21
SUM	95.84	96.48	96.38	96.30	96.28	96.10
	Cation formula					
Si	5.474	5.559	5.603	5.286	5.414	5.472
Ti	0.509	0.451	0.440	0.473	0.465	0.439
Al	2.233	2.237	2.263	2.399	2.226	2.352
Fe	3.223	3.121	2.981	2.772	2.587	2.344
Mn	0.088	0.077	0.095	0.105	0.127	0.112
Mg	2.344	2.433	2.431	3.005	3.188	3.146
Ba	0.000	0.000	0.000	0.032	0.018	0.022
Ca	0.009	0.014	0.009	0.009	0.005	0.009
Na	0.171	0.164	0.195	0.150	0.153	0.174
K	1.799	1.732	1.744	1.725	1.729	1.793
SUM	15.844	15.787	15.762	15.951	15.913	15.863
	Mg/Mg+Fe					
	0.42	0.44	0.45	0.52	0.55	0.57

Microprobe analyses of mafic phenocrysts in USW-G2-1585

	N130A	N130B	N130C	N132A	N132B	N132C
	BIOTITE PHENOCRYSTS					
SiO_2	36.72	36.89	36.32	36.25	34.70	34.30
TiO_2	3.79	4.15	3.76	4.44	4.20	4.11
Al_2O_3	12.96	12.79	12.63	12.40	12.43	12.20
FeO	23.96	23.18	24.42	24.14	25.80	26.40
MnO	1.14	0.87	1.14	0.87	0.92	0.00
MgO	6.90	8.70	7.53	6.90	6.41	7.57
BaO	0.10	0.00	0.00	0.20	0.15	0.00
CaO	0.00	0.06	0.04	0.04	0.10	0.06
Na_2O	0.29	0.22	0.23	0.30	0.33	0.32
K_2O	8.80	9.13	9.34	9.42	9.31	9.06
Sum	93.80	96.13	94.62	94.23	93.97	94.10
	Cation formula					
Si	5.717	5.637	5.634	5.640	5.622	5.560
Ti	0.466	0.480	0.449	0.532	0.508	0.488
Al	2.443	2.364	2.412	2.357	2.360	2.324
Fe	3.204	3.042	3.260	3.236	3.486	3.576
Mn	0.150	0.115	0.140	0.117	0.123	0.000
Mg	1.644	2.066	1.780	1.660	1.542	1.821
Ba	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.014	0.000	0.006	0.005	0.014	0.006
Na	0.089	0.064	0.070	0.089	0.099	0.099
K	1.796	1.825	1.847	1.924	1.793	1.864
Sum	15.519	15.604	15.666	15.581	15.530	15.742
	Mg/Mg+Fe					
	0.34	0.40	0.36	0.34	0.31	0.34

Microprobe analyses of mafic phenocrysts in USW-G2-1664

	N140A	N140B	N140C	N141A	N141B	N141C	N142A	N142B	N142C
	BIOTITE PHENOCRYSTS								
SiO_2	37.33	36.80	37.13	37.33	36.92	36.79	38.66	38.14	36.09
TiO_2	4.03	4.16	3.91	3.60	3.96	4.16	4.40	4.50	4.63
Al_2O_3	12.82	12.67	12.63	12.88	12.67	12.71	13.01	12.80	13.05
FeO	23.57	21.96	23.18	23.30	23.57	22.66	15.08	14.96	15.84
MnO	0.00	0.00	0.56	0.00	0.00	0.47	0.57	0.61	0.55
MgO	9.56	9.40	9.57	8.90	9.38	9.40	14.58	14.55	14.61
BaO	0.03	0.03	0.00	0.00	0.13	0.15	0.00	0.00	0.00
CaO	0.04	0.02	0.04	0.13	0.04	0.07	0.06	0.04	0.02
Na_2O	0.60	0.54	0.58	0.57	0.63	0.54	0.67	0.65	0.70
K_2O	9.57	9.44	9.22	9.34	9.18	9.46	9.51	9.60	9.70
Sum	97.56	96.00	96.83	96.14	96.48	96.52	96.54	96.86	97.20
	Cation formula								
Si	5.684	5.732	5.706	5.760	5.698	5.678	5.726	5.693	5.641
Ti	0.461	0.484	0.451	0.426	0.457	0.480	0.487	0.503	0.512
Al	2.306	2.322	2.286	2.345	2.306	2.311	2.270	2.252	2.277
Fe	3.004	2.861	2.976	3.011	3.030	2.922	1.866	1.867	1.960
Mn	0.000	0.000	0.068	0.000	0.000	0.060	0.070	0.074	0.070
Mg	2.172	2.196	2.192	2.060	2.156	2.170	3.218	3.230	3.225
Ba	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.000
Ca	0.006	0.000	0.006	0.018	0.006	0.000	0.004	0.004	0.000
Na	0.174	0.160	0.171	0.168	0.186	0.150	0.191	0.188	0.200
K	1.863	1.874	1.808	1.841	1.802	1.862	1.796	1.827	1.830
Sum	15.670	15.631	15.661	15.626	15.652	15.668	15.624	15.648	15.714
	Mg/Mg+Fe								
	0.42	0.43	0.42	0.40	0.42	0.43	0.63	0.63	0.62

Microprobe analyses of mafic phenocrysts in USW-G2-1691

	H150A	H150B	H150C	H151A	H151B	H151C	H152A	H152B	H152C
				BIOTITE PHENOCRYSTS					
SiO_2	36.60	37.09	36.13	37.03	36.66	36.09	36.08	36.06	36.17
TiO_2	3.22	3.76	3.52	3.94	4.24	3.88	4.06	4.37	4.28
Al_2O_3	11.19	13.03	11.56	12.64	12.61	12.50	12.77	12.73	12.58
FeO	26.06	23.67	27.92	22.69	23.11	21.97	21.11	20.79	20.73
MnO	0.69	0.63	0.00	0.00	0.00	0.00	0.63	0.49	0.00
MgO	7.90	8.06	8.30	9.63	9.54	8.92	8.00	8.07	8.15
BaO	0.06	0.16	0.03	0.36	0.00	0.15	0.00	0.00	0.00
CaO	0.09	0.12	0.16	0.02	0.02	0.07	0.02	0.06	0.06
Na_2O	0.39	0.47	0.42	0.54	0.62	0.50	0.63	0.62	0.52
K_2O	7.00	9.05	8.16	9.25	9.31	9.07	9.60	9.40	9.29
SUM	94.01	96.79	95.18	96.14	96.02	95.16	95.41	96.09	95.78
				Cation formula					
Si	5.817	5.717	5.618	5.726	5.682	5.691	5.649	5.656	5.626
TiO_2	0.382	0.435	0.422	0.454	0.491	0.449	0.468	0.504	0.488
Al	2.096	2.366	2.177	2.301	2.302	2.278	2.306	2.301	2.291
Fe	3.529	3.036	3.732	2.932	2.993	2.842	2.706	2.686	2.696
Mn	0.079	0.081	0.000	0.000	0.000	0.000	0.081	0.062	0.000
Mg	1.891	2.035	1.975	2.218	2.202	2.066	2.076	2.086	2.306
Ba	0.000	0.009	0.000	0.018	0.000	0.009	0.000	0.000	0.000
Ca	0.014	0.018	0.023	0.000	0.000	0.009	0.000	0.006	0.006
Na	0.116	0.136	0.127	0.159	0.194	0.149	0.163	0.153	0.152
K	1.620	1.777	1.662	1.824	1.838	1.708	1.873	1.837	1.810
SUM	15.669	15.607	15.736	15.636	15.661	15.471	15.710	15.670	15.495
				Mg/(Mg+Fe)					
	0.36	0.40	0.35	0.43	0.42	0.42	0.48	0.48	0.47

Bedded Tuff Between the Topopah Spring Member of Paintbrush Tuff and Tuff of Calico Hills

Microprobe analyses of mafic phenocrysts in USW-G2-1745

	M101A	M101B	M102A	M102B	M103A	M103B	M104A	M104B
	BIOTITE PHENOCRYSTS							
SiO_2	36.14	36.67	36.33	34.66	36.07	36.64	36.79	38.90
TiO_2	4.22	4.20	3.73	3.86	4.36	4.58	4.06	3.53
Al_2O_3	12.75	12.94	13.16	12.37	12.83	13.24	13.31	13.29
FeO	23.96	24.21	20.58	22.91	23.55	24.12	24.40	21.72
MnO	0.52	0.57	0.51	0.42	0.32	0.50	0.46	0.43
MgO	7.99	8.28	10.86	10.18	7.91	8.16	8.36	7.41
BaO	0.06	0.00	0.04	0.48	0.11	0.11	0.00	0.08
CaO	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Na_2O	0.36	0.43	0.41	0.53	0.37	0.42	0.38	0.38
K_2O	8.62	9.21	9.21	8.68	9.41	9.38	8.98	6.26
SUM	93.84	96.54	95.42	94.11	94.90	97.16	96.76	93.98
	Cation formula							
Si	5.617	5.682	5.629	5.524	5.636	5.642	5.681	6.030
Ti	0.507	0.487	0.432	0.472	0.512	0.529	0.471	0.410
Al	2.403	2.360	2.401	2.320	2.379	2.401	2.419	2.426
Fe	3.200	3.139	2.666	3.060	3.080	3.105	3.140	2.817
Mn	0.071	0.072	0.063	0.056	0.041	0.063	0.064	0.056
Mg	1.900	1.910	2.606	2.400	1.853	1.872	1.920	1.711
Ba	0.000	0.000	0.022	0.028	0.006	0.006	0.000	0.006
Ca	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.113	0.127	0.162	0.163	0.111	0.127	0.108	0.100
K	1.797	1.820	1.819	1.764	1.886	1.840	1.746	1.629
SUM	15.667	15.667	15.718	15.776	15.564	15.582	15.569	15.190
	Mg/Mg+Fe							
	0.37	0.38	0.48	0.44	0.37	0.38	0.38	0.38

Microprobe analyses of mafic phenocrysts in USW-G2-1752

	M101A	M102A	M102B	M103A	M103B	M103C	M104A	M105A	M105B
	BIOTITE PHENOCRYSTS								
SiO_2	36.60	36.38	36.22	37.55	36.23	36.86	36.82	36.59	36.34
TiO_2	4.27	4.78	4.36	4.03	4.52	4.46	4.53	4.35	4.42
Al_2O_3	13.08	13.41	13.36	14.26	13.14	13.47	13.29	13.19	13.20
FeO	24.21	24.97	25.12	22.50	25.33	24.91	25.16	24.23	24.88
MnO	0.45	0.44	0.54	0.48	0.51	0.58	0.38	0.45	0.50
MgO	6.32	7.63	6.97	6.86	7.66	7.68	7.71	7.07	7.94
BaO	0.00	0.16	0.06	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.01	0.02	0.03	0.03	0.00	0.00	0.06	0.01	0.00
Na_2O	0.46	0.38	0.36	0.36	0.30	0.30	0.32	0.36	0.41
K_2O	9.17	9.34	9.60	8.97	9.50	9.56	9.64	9.39	9.49
SUM	96.62	97.56	97.76	96.07	97.32	96.91	96.96	96.46	97.21
	Cation formula								
Si	5.650	5.612	5.584	5.819	5.611	5.571	5.572	5.671	5.619
Ti	0.496	0.552	0.502	0.468	0.523	0.520	0.530	0.504	0.512
Al	2.382	2.436	2.426	2.604	2.399	2.468	2.434	2.406	2.406
Fe	3.131	3.218	3.226	2.914	3.281	3.240	3.274	3.138	3.216
Mn	0.060	0.064	0.068	0.060	0.063	0.073	0.046	0.069	0.063
Mg	1.915	1.752	1.866	1.582	1.767	1.779	1.786	1.614	1.829
Ba	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ca	0.000	0.000	0.006	0.006	0.000	0.000	0.006	0.000	0.000
Na	0.136	0.113	0.108	0.105	0.117	0.114	0.100	0.100	0.122
K	1.806	1.833	1.887	1.773	1.876	1.883	1.913	1.866	1.870
SUM	15.586	15.536	15.670	15.324	15.637	15.667	15.660	15.563	15.638
	Mg/Mg+Fe								
	0.38	0.36	0.36	0.36	0.36	0.36	0.36	0.37	0.36

Tuff of Calico Hills

Microprobe analyses of mafic phenocrysts in USW-G2-1798

	M101A	M101B
	BIOTITE PHENOCRYSTS	
SiO_2	35.31	35.38
TiO_2	3.67	3.77
Al_2O_3	13.22	13.43
FeO	25.27	24.38
MnO	0.41	0.45
MgO	7.85	7.62
BaO	0.00	0.02
CaO	0.04	0.07
Na_2O	0.43	0.47
K_2O	9.38	9.10
SUM	95.58	94.60
	Cation formula	
Si	5.501	5.615
Ti	0.436	0.447
Al	2.463	2.512
Fe	3.340	3.225
Mn	0.051	0.054
Mg	1.846	1.803
Ba	0.000	0.000
Ca	0.006	0.009
Na	0.130	0.129
K	1.874	1.841
SUM	15.725	15.646
	Mg/(Mg+Fe)	
	0.36	0.36

Microprobe analyses of mafic phenocrysts in USW-G2-2001

	M101A	M101B	M102A	M102B	M103A	M103B
	BIOTITE PHENOCRYSTS					
SiO_2	35.49	35.23	35.35	35.45	36.01	35.59
TiO_2	4.34	4.04	4.11	4.14	4.22	4.18
Al_2O_3	13.45	13.30	13.45	13.30	13.41	13.36
FeO	23.73	24.03	24.15	24.68	23.63	24.02
MnO	0.43	0.43	0.39	0.36	0.50	0.40
MgO	8.53	8.45	8.38	8.54	8.13	8.29
BaO	0.00	0.02	0.00	0.07	0.10	0.12
CaO	0.05	0.08	0.04	0.07	0.04	0.05
Na_2O	0.46	0.49	0.38	0.41	0.44	0.42
K_2O	8.63	9.03	8.57	8.93	8.81	8.95
SUM	95.13	95.09	94.79	95.93	95.34	95.39
	Cation formula					
Si	5.563	5.559	5.572	5.552	5.631	5.586
Ti	0.511	0.478	0.486	0.487	0.496	0.492
Al	2.484	2.473	2.500	2.455	2.469	2.469
Fe	3.110	3.169	3.185	3.231	3.088	3.150
Mn	0.056	0.056	0.050	0.046	0.064	0.050
Mg	1.992	1.987	1.948	1.990	1.895	1.934
Ba	0.000	0.000	0.000	0.000	0.005	0.005
Ca	0.005	0.009	0.005	0.009	0.005	0.005
Na	0.130	0.149	0.116	0.119	0.120	0.124
K	1.725	1.816	1.722	1.703	1.757	1.791
SUM	15.583	15.693	15.582	15.673	15.542	15.605
	Mg/(Mg+Fe)					
	0.39	0.39	0.38	0.38	0.38	0.38

Microprobe analyses of mafic phenocrysts in USW-G2-2078

	M101A	M101B	M102A	M102B	M103A	M103B	M104A
	BIOTITE PHENOCRYSTS						
SiO_2	34.91	35.38	35.29	35.23	35.27	34.68	35.91
TiO_2	4.41	4.56	4.35	4.29	4.55	4.22	4.05
Al_2O_3	13.52	13.38	13.64	13.72	13.37	13.21	13.75
FeO	24.17	24.04	23.80	24.15	23.57	23.12	22.67
MnO	0.49	0.50	0.49	0.48	0.41	0.48	0.43
MgO	8.26	8.15	8.02	8.35	8.56	8.31	7.77
BaO	0.27	0.17	0.00	0.00	0.31	0.50	0.10
CaO	0.06	0.02	0.01	0.00	0.00	0.04	0.01
Na_2O	0.35	0.40	0.36	0.36	0.36	0.37	0.35
K_2O	9.75	9.60	9.71	9.07	9.46	9.46	9.62
SUM	96.20	96.34	95.68	96.38	95.85	94.32	94.66
	Cation formula						
Si	5.478	5.531	5.540	5.503	5.527	5.500	5.660
Ti	0.521	0.533	0.512	0.490	0.534	0.506	0.476
Al	2.502	2.464	2.521	2.526	2.469	2.404	2.552
Fe	3.170	3.144	3.175	3.155	3.085	3.085	2.987
Mn	0.064	0.064	0.064	0.060	0.050	0.051	0.055
Mg	1.931	1.900	1.876	1.944	2.000	1.970	1.821
Ba	0.014	0.009	0.000	0.000	0.010	0.020	0.005
Ca	0.009	0.000	0.000	0.000	0.000	0.005	0.000
Na	0.101	0.119	0.105	0.110	0.105	0.113	0.106
K	1.949	1.920	1.945	1.907	1.889	1.927	1.932
SUM	15.737	15.696	15.688	15.756	15.677	15.716	15.595
	Mg/(Mg+Fe)						
	0.38	0.38	0.38	0.38	0.39	0.39	0.38

Microprobe analyses of mafic phenocrysts in USW-G2-2158

	N101A	N101B	N102A	N102B	N103A	N103B	N104A	N104B	N105A	N105B
					BIOTITE PHENOCRYSTS					
SiO_2	36.18	37.27	35.52	34.46	36.64	35.87	36.56	36.30	36.27	36.30
TiO_2	4.21	4.04	4.20	4.03	4.50	4.30	3.83	3.83	4.27	4.16
Al_2O_3	13.23	12.81	13.64	13.60	13.13	13.22	13.33	13.43	13.31	13.46
FeO	23.63	22.80	21.56	21.64	23.11	23.71	21.31	20.80	23.61	23.52
MnO	0.43	0.35	0.34	0.42	0.40	0.43	0.36	0.37	0.36	0.44
MgO	8.60	7.45	9.94	9.91	8.62	8.61	10.48	10.24	8.30	8.46
BaO	0.00	0.15	1.08	0.60	0.34	0.00	0.13	0.24	0.00	0.07
CaO	0.00	0.00	0.00	0.02	0.00	0.02	0.01	0.02	0.00	0.01
Na_2O	0.40	0.36	0.48	0.50	0.43	0.44	0.35	0.45	0.36	0.37
K_2O	9.68	9.26	9.52	9.57	9.80	9.36	9.72	9.60	9.80	9.73
SUM	96.21	94.60	96.33	95.25	96.13	95.46	95.27	95.41	96.36	95.50
					Cation formula					
Si	5.564	5.852	5.516	5.470	5.568	5.528	5.640	5.627	5.568	5.563
Ti	0.486	0.476	0.488	0.475	0.526	0.510	0.448	0.446	0.504	0.490
Al	2.450	2.360	2.483	2.530	2.416	2.466	2.449	2.452	2.460	2.482
Fe	3.110	3.094	2.799	2.830	3.010	3.122	2.779	2.702	3.108	3.083
Mn	0.056	0.046	0.040	0.056	0.064	0.056	0.046	0.045	0.046	0.056
Mg	1.974	1.742	2.287	2.317	2.004	1.976	2.426	2.366	1.960	1.980
Ba	0.000	0.016	0.063	0.037	0.018	0.000	0.006	0.014	0.000	0.000
Ca	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.120	0.105	0.146	0.152	0.128	0.129	0.105	0.126	0.106	0.111
K	1.946	1.863	1.883	1.917	1.940	1.861	1.931	1.916	1.960	1.963
SUM	15.721	15.460	15.720	15.784	15.761	15.744	15.808	15.782	15.729	15.725
					Mg/Mg+Fe					
	0.39	0.37	0.45	0.46	0.40	0.39	0.47	0.47	0.39	0.39

Microprobe analyses of mafic phenocrysts in USW-G2-2325

	N101A	N101B	N102A	N102B	N103A	N103B	N104A	N104B
					BIOTITE PHENOCRYSTS			
SiO_2	36.77	36.31	35.71	36.10	36.12	36.00	36.68	36.87
TiO_2	3.96	4.30	4.37	4.37	3.93	4.17	4.23	4.23
Al_2O_3	12.84	13.07	13.46	13.30	13.16	12.76	13.21	13.52
FeO	22.68	23.25	22.34	21.86	22.36	22.61	23.20	22.77
MnO	0.40	0.30	0.30	0.45	0.44	0.36	0.44	0.36
MgO	8.96	8.30	9.43	9.53	9.14	9.31	9.06	9.29
BaO	0.54	0.27	0.41	0.29	0.64	0.46	0.30	0.29
CaO	0.06	0.02	0.00	0.01	0.06	0.06	0.02	0.00
Na_2O	0.42	0.37	0.40	0.30	0.38	0.40	0.30	0.30
K_2O	9.91	9.44	9.42	9.27	9.30	9.21	9.63	9.32
SUM	94.56	95.16	95.06	95.46	95.44	95.27	96.24	96.05
					Cation formula			
Si	5.646	5.644	5.567	5.619	5.660	5.631	5.667	5.671
Ti	0.468	0.501	0.507	0.512	0.458	0.488	0.484	0.492
Al	2.385	2.306	2.466	2.422	2.424	2.368	2.426	2.476
Fe	2.902	3.020	2.904	2.842	2.923	2.966	3.026	2.964
Mn	0.050	0.050	0.037	0.056	0.055	0.045	0.055	0.045
Mg	2.167	2.012	2.167	2.211	2.129	2.173	2.106	2.151
Ba	0.032	0.014	0.023	0.014	0.037	0.023	0.023	0.014
Ca	0.006	0.000	0.000	0.000	0.006	0.006	0.000	0.000
Na	0.125	0.109	0.118	0.115	0.115	0.119	0.115	0.114
K	1.792	1.871	1.867	1.836	1.836	1.842	1.913	1.846
SUM	15.682	15.615	15.665	15.620	15.632	15.663	15.725	15.660
					Mg/Mg+Fe			
	0.41	0.40	0.43	0.44	0.42	0.42	0.41	0.42

Microprobe analyses of mafic phenocrysts in USW-G2-2430

	M101A	M102A	M103A	M104A	M105A	M106A
			BIOTITE PHENOCRYSTS			
SiO_2	36.15	36.46	36.16	36.21	36.43	36.74
TiO_2	3.81	4.05	3.93	4.09	4.16	4.11
Al_2O_3	13.66	13.82	13.19	13.23	13.01	13.04
FeO	21.47	19.95	21.15	20.06	19.92	20.93
MnO	0.30	0.30	0.30	0.41	0.33	0.32
MgO	9.71	9.90	10.37	10.10	10.05	10.50
BaO	0.24	0.22	0.57	0.52	0.79	0.64
CaO	0.04	0.07	0.02	0.02	0.02	0.02
Na_2O	0.30	0.30	0.36	0.41	0.37	0.45
K_2O	9.35	9.21	9.30	9.41	9.09	9.50
SUM	95.19	99.45	95.42	95.37	95.06	96.12
			Cation formula			
Si	5.621	5.661	5.624	5.638	5.671	5.519
Ti	0.442	0.469	0.457	0.474	0.484	0.476
Al	2.500	2.530	2.415	2.421	2.385	2.514
Fe	2.792	2.589	2.748	2.708	2.591	2.701
Mn	0.050	0.037	0.037	0.050	0.040	0.040
Mg	2.250	2.311	2.401	2.338	2.422	2.433
Ba	0.014	0.009	0.032	0.028	0.046	0.036
Ca	0.005	0.009	0.000	0.000	0.000	0.000
Na	0.114	0.109	0.106	0.123	0.109	0.131
K	1.853	1.823	1.840	1.860	1.802	1.867
SUM	15.638	15.047	15.075	15.639	15.628	15.717
			Mg/Mg+Fe			
	0.45	0.47	0.47	0.46	0.48	0.47

Microprobe analyses of mafic phenocrysts in USW-G2-2667

	M101A	M102A	M103A	M104A	M104B	M105A
			BIOTITE PHENOCRYSTS			
SiO_2	36.54	36.13	35.10	36.05	36.73	35.60
TiO_2	3.69	3.81	3.84	3.92	3.60	3.68
Al_2O_3	13.76	13.16	13.09	13.29	13.29	13.72
FeO	22.30	21.35	21.79	20.29	21.35	21.33
MnO	0.48	0.42	0.40	0.36	0.40	0.39
MgO	9.38	9.02	9.11	9.73	9.92	9.37
BaO	0.17	0.07	0.36	0.37	0.99	0.12
CaO	0.00	0.04	0.02	0.09	0.05	0.04
Na_2O	0.38	0.37	0.39	0.35	0.40	0.46
K_2O	9.24	9.16	9.12	9.01	9.30	9.24
SUM	96.01	94.38	93.95	93.92	96.21	94.00
			Cation formula			
Si	5.644	5.659	5.546	5.709	5.670	5.612
Ti	0.426	0.446	0.457	0.459	0.426	0.434
Al	2.502	2.426	2.549	2.449	2.417	2.543
Fe	2.878	2.795	2.885	2.657	2.757	2.881
Mn	0.059	0.056	0.061	0.061	0.050	0.050
Mg	2.160	2.209	2.150	2.271	2.295	2.192
Ba	0.009	0.000	0.010	0.010	0.059	0.005
Ca	0.000	0.005	0.000	0.014	0.005	0.005
Na	0.114	0.110	0.116	0.105	0.117	0.130
K	1.010	1.025	1.043	1.797	1.032	1.051
SUM	15.615	15.010	15.050	15.530	15.676	15.634
			Mg/Mg+Fe			
	0.43	0.45	0.43	0.46	0.45	0.44

Prow Pass Member of the Crater Flat Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-3250

	M101A	M101B	M101C	M102A	M102B	M102C
			BIOTITE PHENOCRYSTS			
SiO_2	36.66	36.88	36.52	36.26	36.04	36.56
TiO_2	4.24	4.43	3.96	4.29	4.48	4.54
Al_2O_3	14.11	14.00	14.04	14.04	14.34	14.32
FeO	18.54	18.58	18.64	17.09	16.94	17.30
MnO	0.59	0.60	0.63	0.30	0.46	0.38
MgO	11.52	11.64	11.72	12.62	12.68	12.79
BaO	1.74	2.16	1.25	1.67	1.96	1.63
CaO	0.00	0.00	0.00	0.00	0.02	0.00
Na_2O	0.56	0.48	0.52	0.53	0.44	0.50
K_2O	9.12	9.27	9.28	9.20	9.18	9.21
SUM	96.07	96.04	96.46	96.90	96.52	96.14
			Cation formula			
Si	5.482	5.408	5.480	5.526	5.406	5.425
Ti	0.468	0.514	0.448	0.488	0.516	0.519
Al	2.558	2.567	2.554	2.520	2.608	2.574
Fe	2.187	2.406	2.408	2.180	2.162	2.216
Mn	0.072	0.077	0.082	0.036	0.060	0.049
Mg	2.644	2.689	2.700	2.868	2.811	2.905
Ba	0.104	0.127	0.072	0.000	0.117	0.095
Ca	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.162	0.146	0.164	0.152	0.127	0.148
K	1.790	1.829	1.814	1.786	1.802	1.790
SUM	15.687	15.762	15.733	15.657	15.728	15.711
			Mg/Mg+Fe			
	0.53	0.53	0.53	0.57	0.57	0.57

Bullfrog Member of the Crater Flat Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-3308

	M101A	M101B	M101C	M102A	M102B	M102C	M103A	M103B	M103C	M104A	M104B	M104C	M104D
	BIOTITE PHENOCRYSTS												
SiO_2	34.76	35.30	35.60	33.84	35.01	35.35	34.15	37.10	35.10	36.30	35.56	34.98	35.93
TiO_2	4.02	3.90	3.83	4.07	3.99	4.29	3.98	3.87	4.00	4.02	4.13	3.89	4.22
Al_2O_3	13.60	12.64	12.94	13.23	13.04	13.24	13.30	14.75	13.96	12.69	13.05	12.71	13.14
FeO	23.17	22.43	22.19	23.24	22.73	22.02	21.90	19.36	22.10	21.74	22.95	23.30	22.07
MnO	0.64	0.68	0.71	0.70	0.71	0.66	0.91	0.64	0.74	0.65	0.69	0.56	0.66
MgO	8.46	9.32	9.54	8.43	8.47	8.14	8.15	7.30	8.10	9.14	8.76	9.09	9.12
BaO	1.71	0.22	0.15	1.29	0.67	1.04	0.98	1.15	1.19	0.39	1.09	0.15	0.92
CaO	0.00	0.00	0.00	0.04	0.00	0.02	0.02	0.05	0.01	0.00	0.02	0.00	0.02
Na_2O	0.60	0.58	0.53	0.54	0.57	0.56	0.55	0.64	0.61	0.55	0.55	0.54	0.60
K_2O	8.73	9.03	8.97	8.71	8.77	8.85	8.95	8.76	8.67	9.25	8.92	9.01	9.17
SUM	95.28	95.20	95.45	94.15	94.77	95.38	95.03	93.73	95.23	94.74	95.73	94.32	95.79
	Cation formula												
Si	5.469	5.670	5.688	5.451	5.655	5.588	5.691	5.804	5.532	5.703	5.594	5.569	5.610
Ti	0.545	0.468	0.446	0.491	0.473	0.506	0.471	0.455	0.540	0.470	0.484	0.462	0.495
Al	2.522	2.327	2.368	2.510	2.425	2.464	2.466	2.718	2.586	2.347	2.419	2.302	2.416
Fe	3.040	2.932	2.803	3.130	3.004	3.017	2.891	2.530	2.904	2.854	3.019	3.111	2.903
Mn	0.083	0.087	0.091	0.094	0.093	0.088	0.120	0.083	0.096	0.083	0.087	0.075	0.087
Mg	1.982	2.171	2.207	2.023	1.993	1.917	1.912	1.722	1.916	2.139	2.049	2.158	2.122
Ba	0.102	0.009	0.005	0.080	0.037	0.058	0.056	0.069	0.069	0.023	0.064	0.005	0.056
Ca	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000
Na	0.180	0.174	0.160	0.165	0.171	0.167	0.166	0.193	0.184	0.166	0.166	0.163	0.142
K	1.751	1.799	1.775	1.787	1.766	1.782	1.797	1.744	1.736	1.853	1.787	1.827	1.824
SUM	15.680	15.645	15.621	15.739	15.616	15.617	15.570	15.320	15.565	15.636	15.670	15.752	15.636
	Mg/Mg+Fe												
	0.39	0.43	0.43	0.39	0.40	0.39	0.40	0.40	0.40	0.43	0.40	0.41	0.42

Microprobe analyses of mafic phenocrysts in USW-G2-3366

	M101A	M102A
	BIOTITE PHENOCRYSTS	
SiO_2	34.95	34.52
TiO_2	3.46	4.20
Al_2O_3	11.98	12.92
FeO	23.06	23.30
MnO	0.91	0.85
MgO	9.19	7.08
BaO	0.00	0.95
CaO	0.05	0.24
Na_2O	0.55	0.60
K_2O	9.10	7.61
SUM	93.20	93.15
	Cation formula	
Si	5.640	5.572
Ti	0.416	0.507
Al	2.276	2.059
Fe	3.104	3.195
Mn	0.123	0.114
Mg	2.205	1.895
Ba	0.000	0.057
Ca	0.005	0.038
Na	0.171	0.186
K	1.869	1.564
SUM	15.808	15.645
	Mg/Mg+Fe	
	0.42	0.38

Tram Member of the Crater Flat Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-3671

	MICA
	BIOTITE PHENOCRYSTS
SiO_2	38.83
TiO_2	4.62
Al_2O_3	14.31
FeO	18.74
MnO	0.30
MgO	15.76
BaO	1.48
CaO	0.00
Na_2O	0.50
K_2O	8.83
SUM	94.46
	Cation formula
Si	5.668
Ti	0.517
Al	2.611
Fe	1.337
Mn	0.047
Mg	3.486
Ba	0.083
Ca	0.000
Na	0.143
K	1.676
SUM	15.447
	Mg/Mg+Fe
	0.72

Rhyodacite Lava Between the Tram Member of the Crater Flat Tuff and Lithic Ridge Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-4090

	M105A	M105B	M106A	M107A	M107B	M108B
			BIOTITE PHENOCRYSTS			
SiO_2	36.56	36.83	36.43	37.05	36.48	36.08
TiO_2	4.04	4.66	4.00	4.60	4.74	4.62
Al_2O_3	13.91	13.98	14.09	13.84	13.84	14.03
FeO	14.09	13.75	14.00	13.98	14.30	14.62
MnO	0.09	0.15	0.14	0.12	0.12	0.11
MgO	14.66	14.54	14.15	14.14	14.44	14.74
BaO	0.87	0.99	0.89	0.84	1.30	1.44
CaO	0.05	0.04	0.07	0.04	0.00	0.00
Na_2O	0.49	0.58	0.69	0.54	0.57	0.71
K_2O	0.59	0.61	0.72	0.63	0.55	0.61
SUM	94.18	94.22	94.01	93.89	94.40	95.02
			Cation formula			
Si	5.484	5.509	5.482	5.494	5.477	5.413
Ti	0.508	0.494	0.500	0.490	0.494	0.481
Al	2.277	2.293	2.318	2.267	2.267	2.296
Fe	1.636	1.596	1.630	1.625	1.662	1.697
Mn	0.008	0.017	0.017	0.012	0.012	0.012
Mg	3.036	3.004	2.941	2.932	2.994	3.051
Ba	0.045	0.053	0.045	0.045	0.070	0.077
Ca	0.004	0.004	0.000	0.004	0.000	0.000
Na	0.138	0.154	0.194	0.143	0.161	0.192
K	1.622	1.523	1.652	1.531	1.515	1.525
SUM	14.248	14.234	14.274	14.202	14.244	14.349
			Mg/Mg+Fe			
	0.65	0.65	0.64	0.64	0.64	0.64

Lithic Ridge Tuff

Microprobe analyses of mafic phenocrysts in USW-G2-4199

	N103A	N103B	N104A	N105A	N106B
	BIOTITE PHENOCRYSTS				
SiO_2	36.71	36.72	36.50	36.79	36.61
TiO_2	4.89	4.86	5.00	5.22	4.96
Al_2O_3	13.81	13.66	14.18	13.86	13.88
FeO	12.77	12.65	12.22	12.27	12.41
MnO	0.19	0.24	0.00	0.14	0.00
MgO	14.96	15.19	15.46	14.90	15.21
BaO	1.61	1.50	1.76	1.28	1.80
CaO	0.01	0.02	0.02	0.04	0.04
Na_2O	0.80	0.90	0.94	0.86	0.81
K_2O	8.42	8.27	8.36	8.52	8.29
SUM	93.18	93.07	94.51	93.03	93.06
	Cation formula				
Si	5.029	5.033	5.044	5.022	5.010
Ti	0.516	0.512	0.519	0.548	0.524
Al	2.280	2.266	2.307	2.291	2.300
Fe	1.500	1.480	1.411	1.438	1.450
Mn	0.020	0.025	0.000	0.017	0.000
Mg	3.136	3.188	3.184	3.136	3.180
Ba	0.086	0.083	0.094	0.070	0.096
Ca	0.000	0.000	0.000	0.004	0.004
Na	0.215	0.244	0.251	0.220	0.219
K	1.513	1.484	1.471	1.524	1.487
SUM	14.305	14.326	14.288	14.284	14.282
	Mg/Mg+Fe				
	0.68	0.68	0.68	0.68	0.68

Microprobe analyses of mafic phenocrysts in USW-G2-4467

	N106B
	BIOTITE PHENOCRYSTS
SiO_2	36.15
TiO_2	4.18
Al_2O_3	13.20
FeO	16.45
MnO	0.48
MgO	13.16
BaO	0.30
CaO	0.00
Na_2O	0.56
K_2O	8.88
SUM	93.32
	Cation formula
Si	5.134
Ti	0.437
Al	2.208
Fe	1.960
Mn	0.064
Mg	2.784
Ba	0.017
Ca	0.000
Na	0.150
K	1.608
SUM	14.347
	Mg/Mg+Fe
	0.58

Quartz Latite Lavas

Microprobe analyses of mafic phenocrysts in USW-G2-5206

	M102A	M105A	M105B
	BIOTITE PHENOCRYSTS		
SiO_2	38.00	36.67	37.21
TiO_2	5.55	4.82	5.14
Al_2O_3	15.19	15.06	15.27
FeO	8.29	13.25	13.50
MnO	0.00	0.07	0.03
MgO	16.46	13.38	11.96
BaO	1.57	1.63	1.40
CaO	0.04	0.05	0.06
Na_2O	0.26	0.21	0.18
K_2O	9.11	9.05	9.22
SUM	94.46	94.18	94.00
	Cation formula		
Si	5.129	5.094	5.176
Ti	0.562	0.501	0.538
Al	2.416	2.467	2.502
Fe	0.935	1.537	1.568
Mn	0.000	0.008	0.000
Mg	3.311	2.769	2.478
Ba	0.079	0.085	0.073
Ca	0.004	0.004	0.008
Na	0.067	0.053	0.049
K	1.565	1.602	1.637
SUM	14.065	14.171	14.029
	Mg/Mg+Fe		
	0.78	0.64	0.61

Microprobe analyses of mafic phenocrysts in USW-G2-5493

	M112B	M113A	M113B
	BIOTITE PHENOCRYSTS		
SiO_2	36.53	35.51	35.48
TiO_2	4.25	4.42	4.91
Al_2O_3	13.45	13.74	13.74
FeO	14.73	14.76	14.48
MnO	0.12	0.16	0.25
MgO	14.28	14.09	14.24
BaO	1.48	1.43	1.40
CaO	0.02	0.00	0.00
Na_2O	0.73	0.66	0.68
K_2O	0.67	0.70	0.90
SUM	94.18	93.46	94.07
	Cation formula		
Si	5.126	5.034	5.008
Ti	0.445	0.470	0.516
Al	2.223	2.292	2.278
Fe	1.725	1.747	1.703
Mn	0.012	0.017	0.029
Mg	2.985	2.976	2.989
Ba	0.074	0.079	0.074
Ca	0.000	0.000	0.000
Na	0.197	0.179	0.182
K	1.947	1.672	1.596
SUM	14.335	14.364	14.360
	Mg/Mg+Fe		
	0.63	0.63	0.64

2. MAFIC PHENOCRYST MICROPROBE DATA FOR UE25b-1H

Bullfrog Member of the Crater Flat Tuff

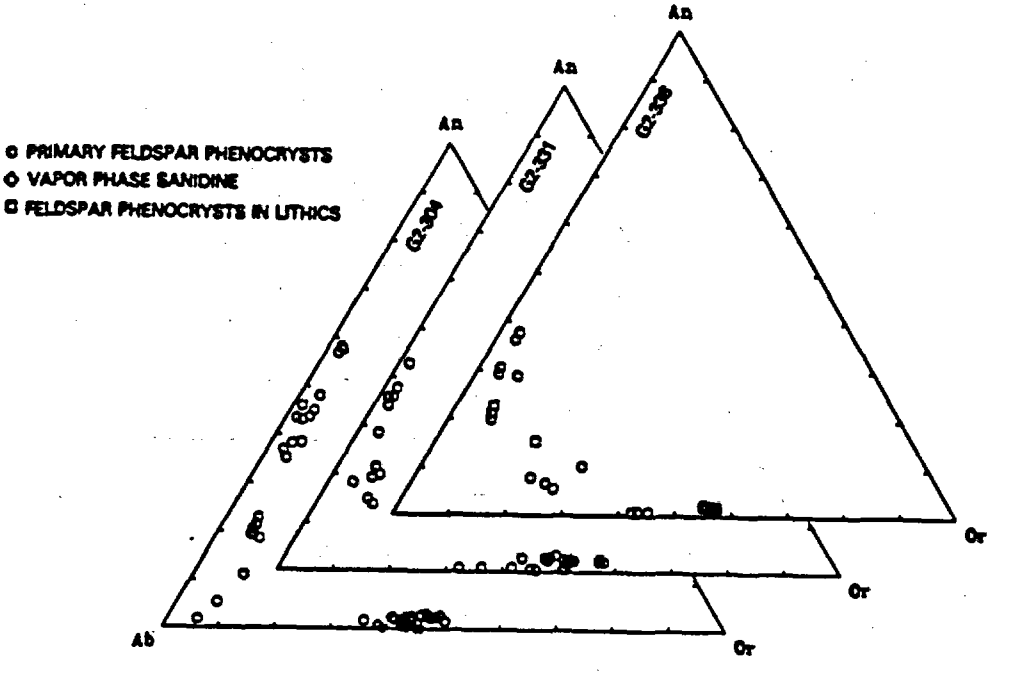
Microprobe analyses of mafic phenocrysts in UE25b-1H-2832

	N101A	N101B	N102A
	BIOTITE PHENOCRYSTS		
SiO_2	36.96	36.30	36.80
TiO_2	4.00	4.00	3.84
Al_2O_3	13.44	13.28	12.46
FeO	24.13	23.81	23.00
MnO	0.66	0.73	0.73
MgO	8.67	8.70	9.41
BaO	1.11	1.06	0.16
CaO	0.00	0.00	0.07
Na_2O	0.58	0.56	0.45
K_2O	9.36	9.40	9.19
SUM	96.91	96.82	96.12
	Cation formula		
Si	5.022	5.060	5.237
Ti	0.430	0.438	0.400
Al	2.272	2.246	2.080
Fe	2.887	2.866	2.736
Mn	0.080	0.088	0.087
Mg	1.866	1.867	1.946
Ba	0.059	0.056	0.008
Ca	0.000	0.000	0.008
Na	0.160	0.156	0.121
K	1.712	1.710	1.666
SUM	14.489	14.461	14.366
	Mg/Mg+Fe		
	0.39	0.39	0.42

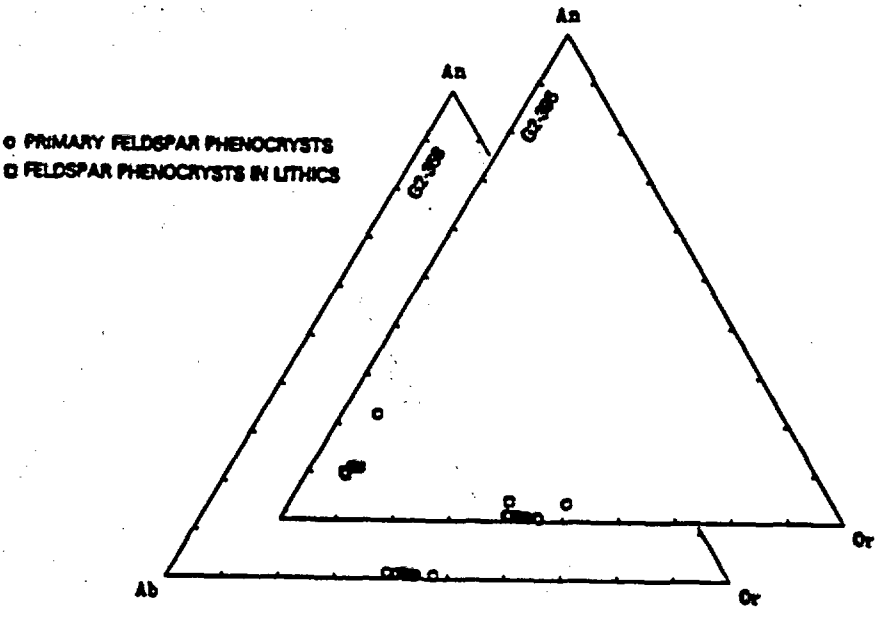
APPENDIX C

1. PLOTS OF FELDSPAR MICROPROBE DATA FOR USW-G2

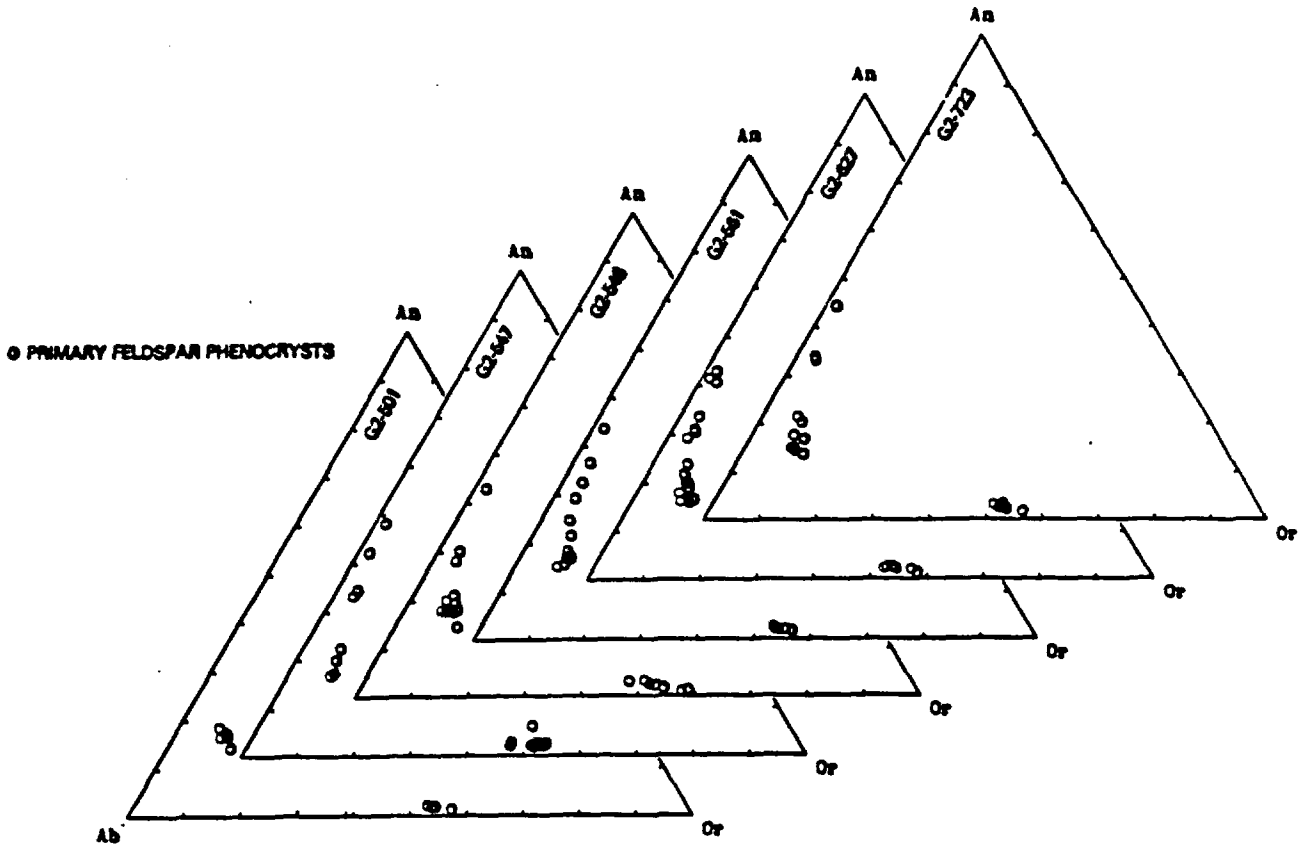
YUCCA MOUNTAIN MEMBER, PAINTBRUSH TUFF



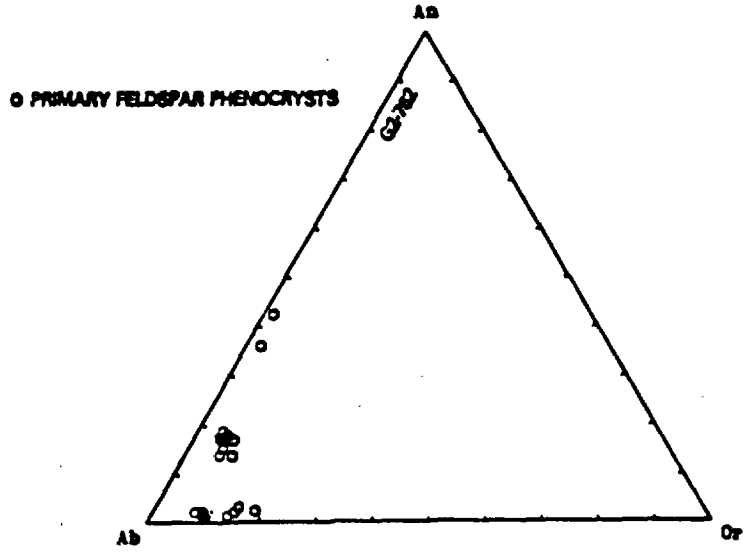
BEDDED TUFF BETWEEN YUCCA MOUNTAIN AND PAH CANYON MEMBERS, PAINTBRUSH TUFF



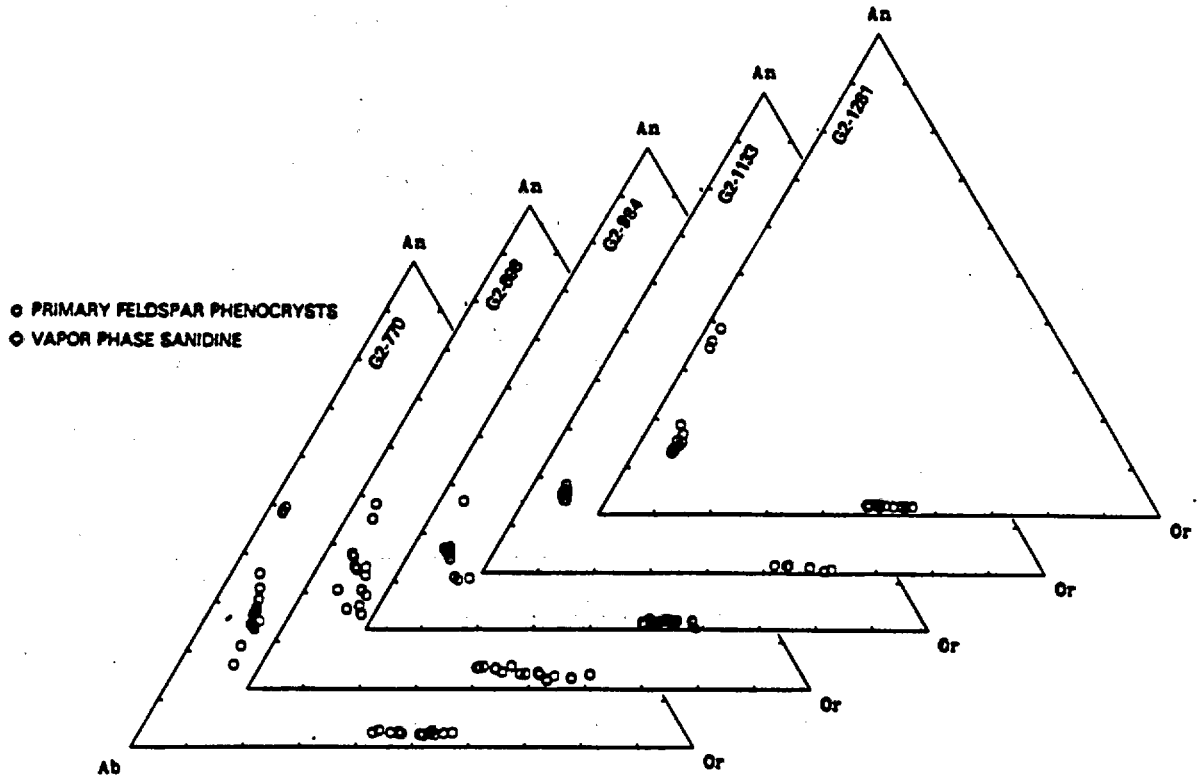
PAH CANYON MEMBER, PAINTBRUSH TUFF

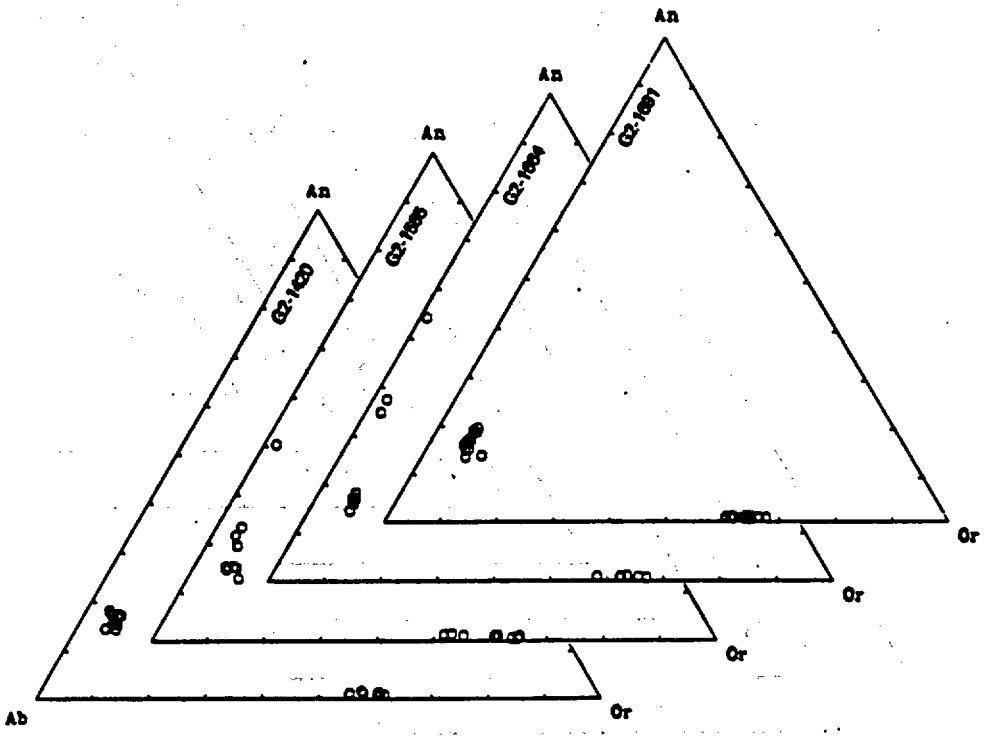


BEDDED TUFF BETWEEN THE PAH CANYON AND TOPOPAH SPRING MEMBERS OF THE PAINTBRUSH TUFF

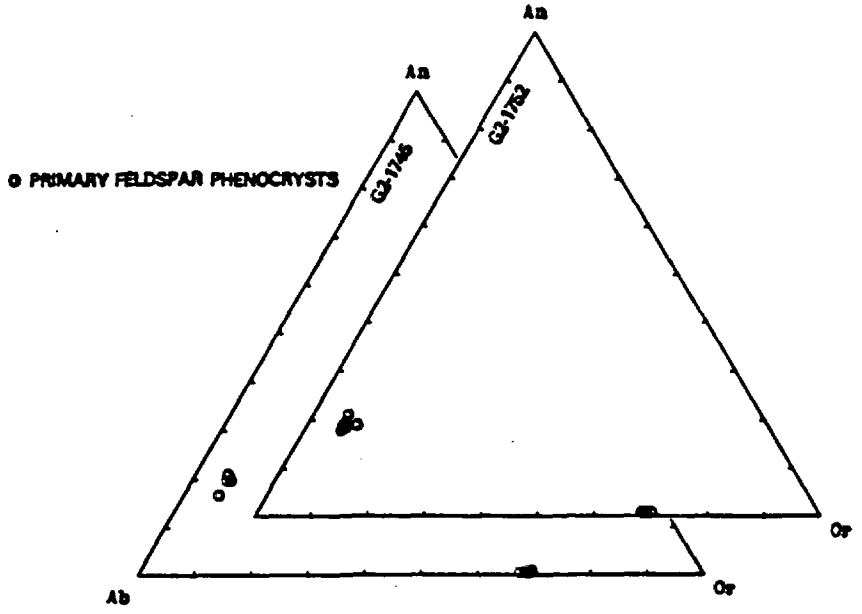


TOPOPAH SPRING MEMBER, PAINTBRUSH TUFF

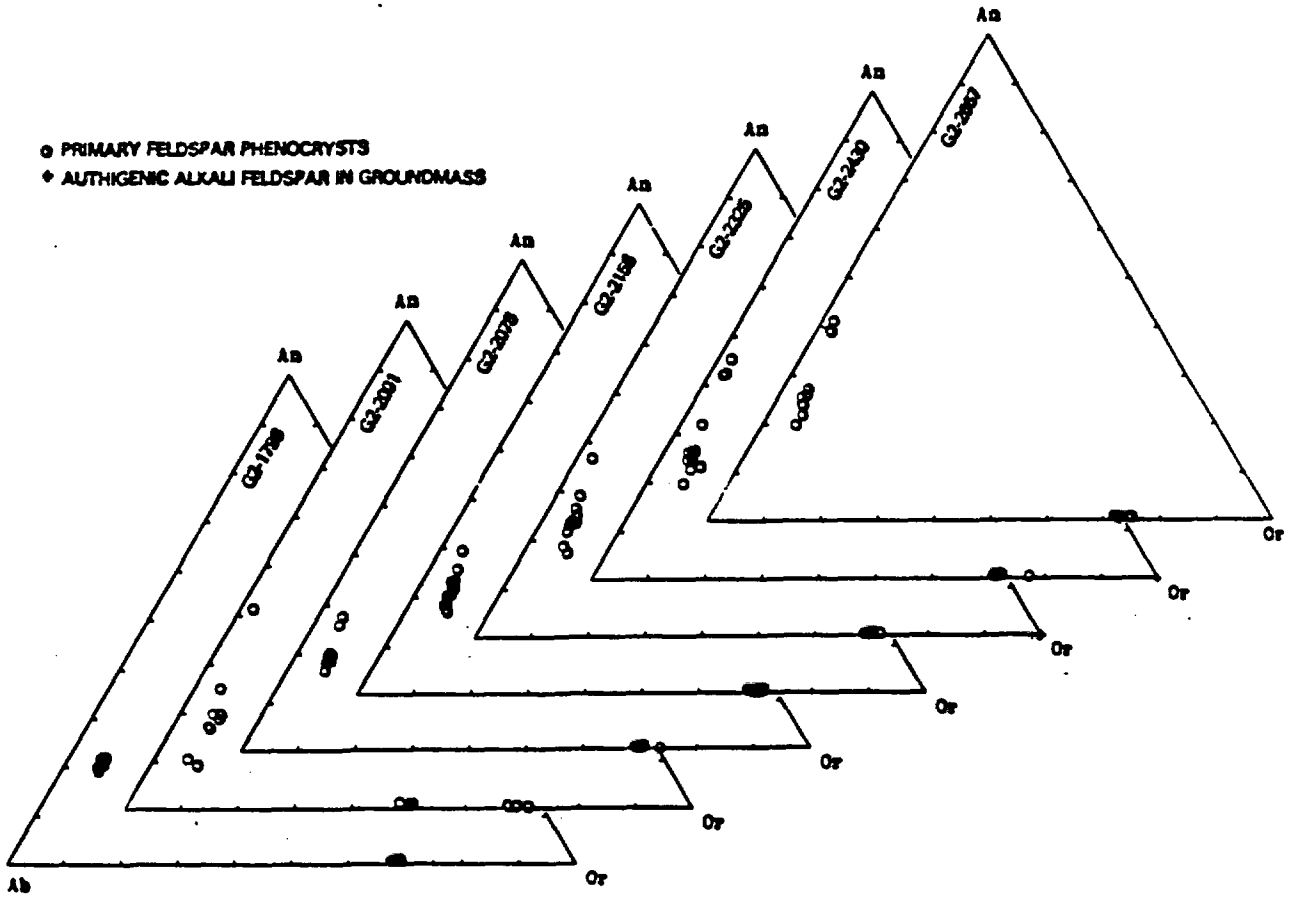




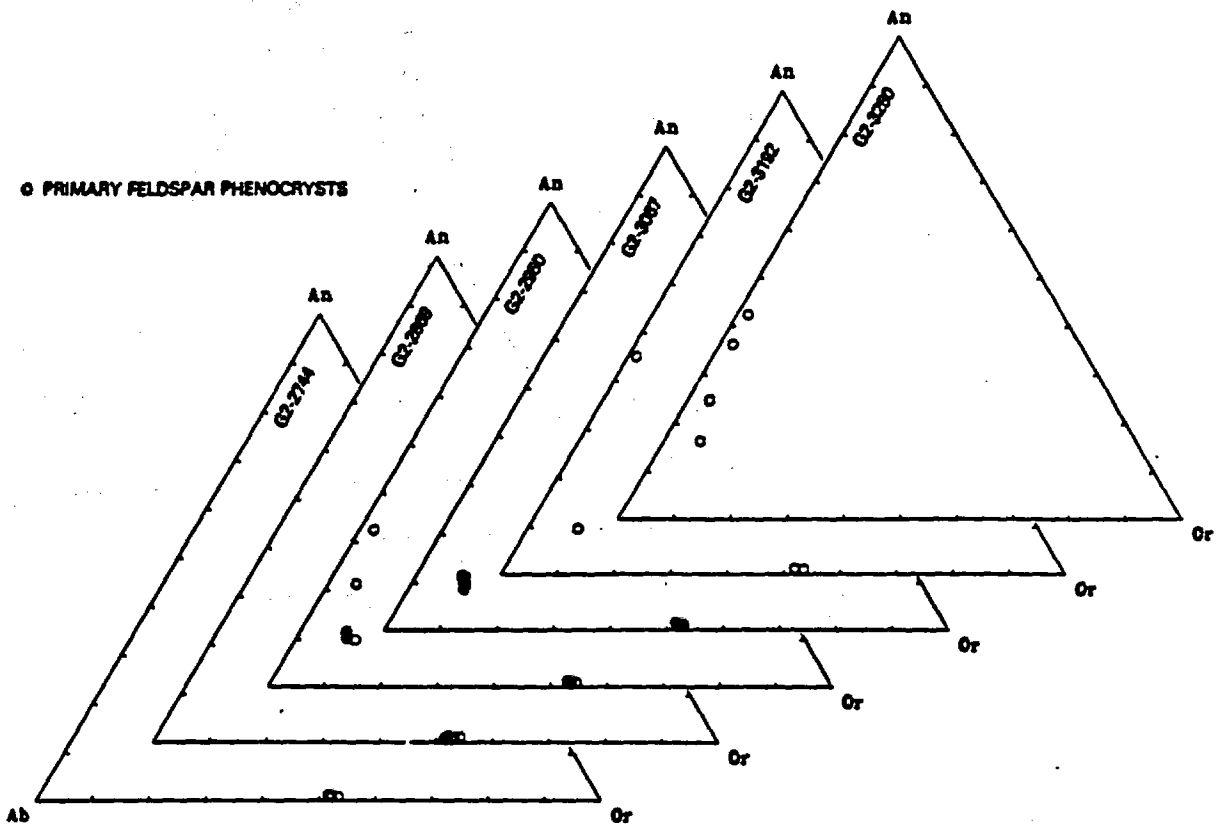
BEDDED TUFF BETWEEN TOPOPAH SPRING MEMBER OF PAINTBRUSH TUFF AND TUFF OF CALICO HILLS



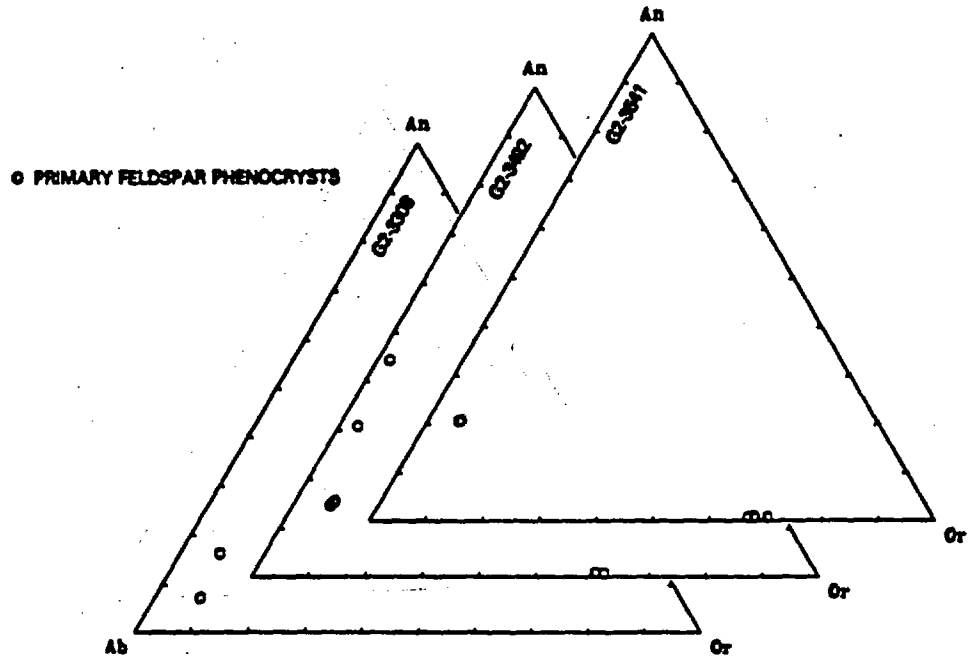
TUFF OF CALICO HILLS



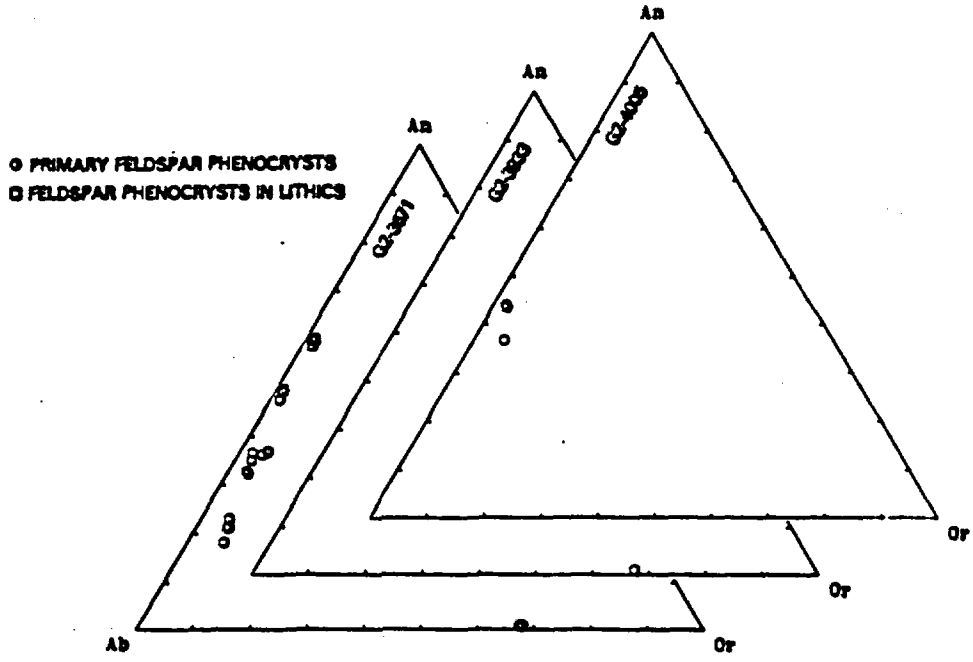
PROW PASS MEMBER, CRATER FLAT TUFF



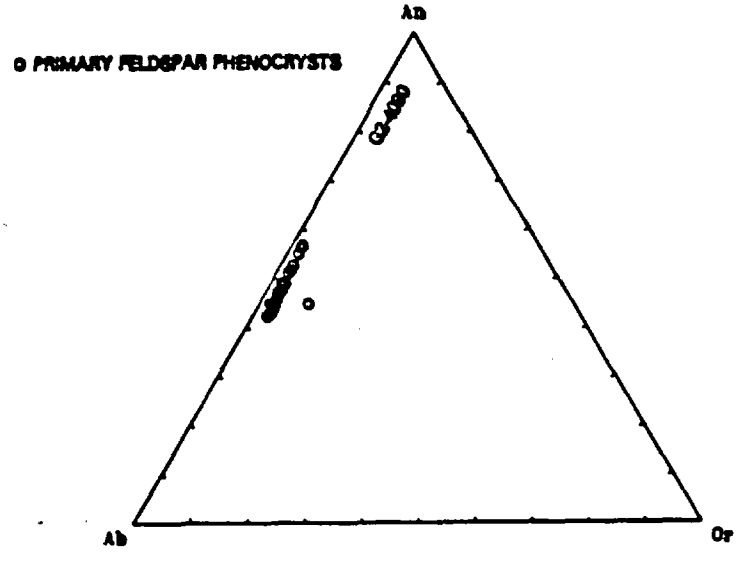
BULLFROG MEMBER, CRATER FLAT TUFF



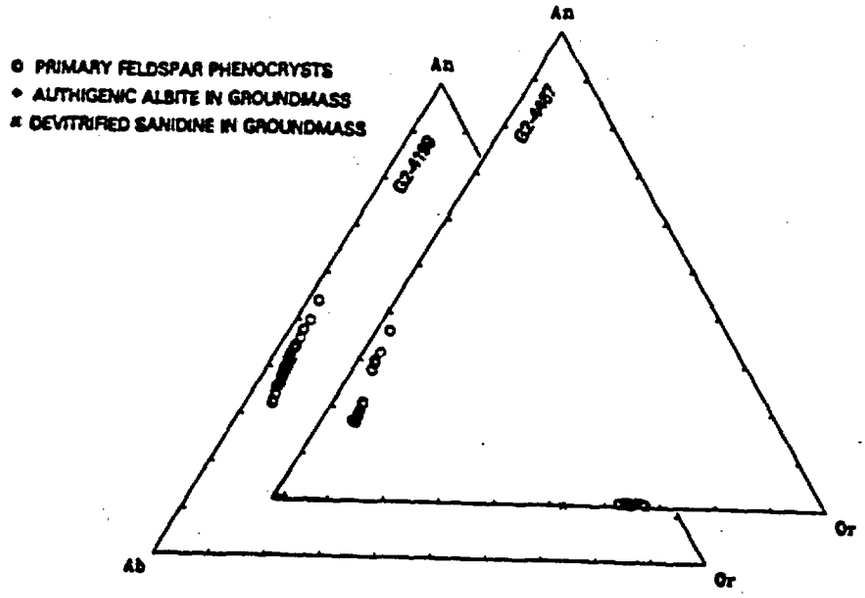
TRAM MEMBER, CRATER FLAT TUFF



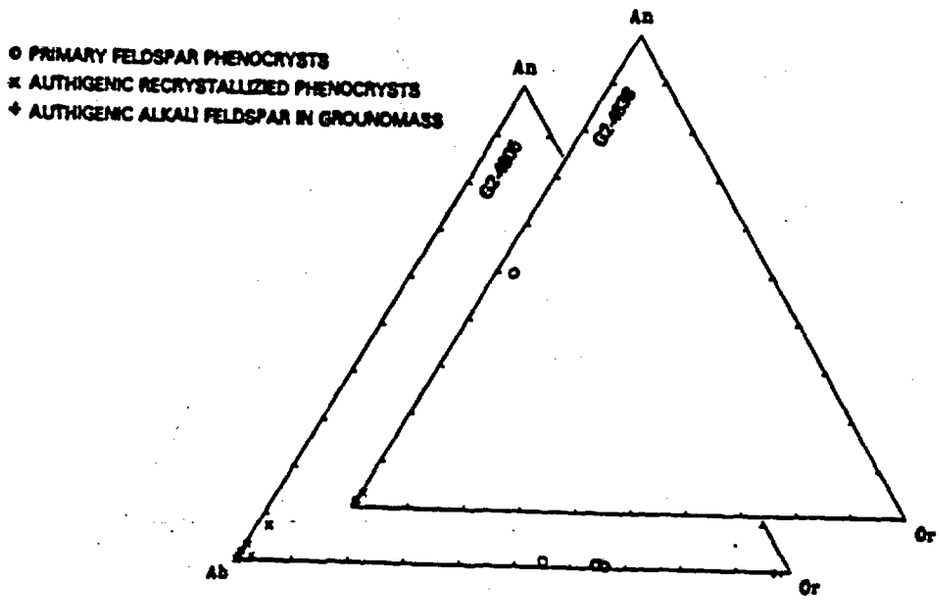
HORNBLENDE-BIOTITE RHYODACITE LAVA



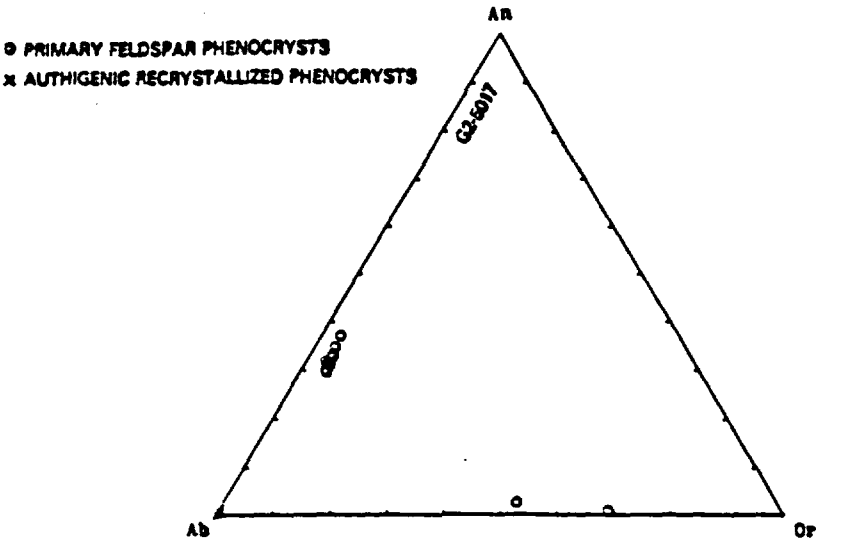
LITHIC RIDGE TUFF



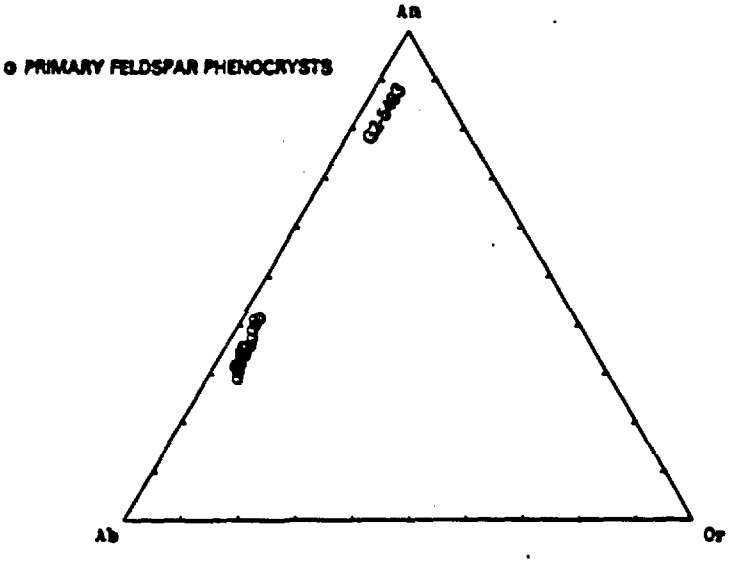
BEDDED TUFF AT BASE OF LITHIC RIDGE TUFF



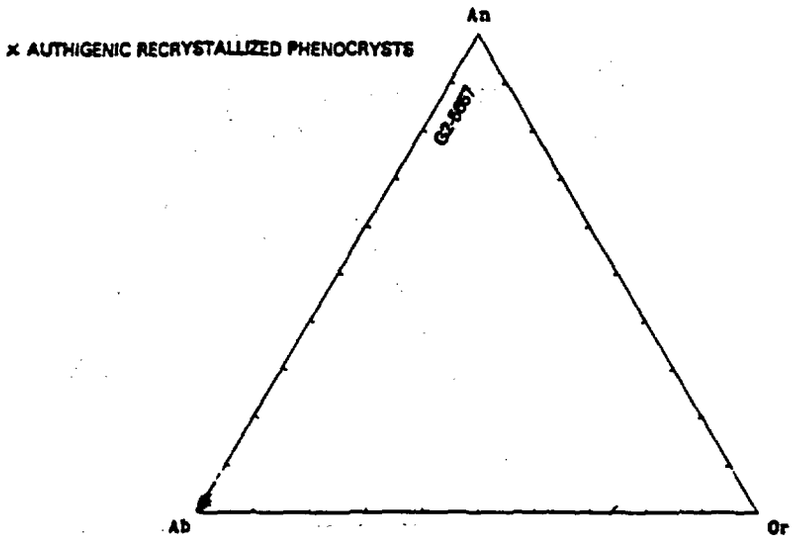
RHYOLITE LAVA



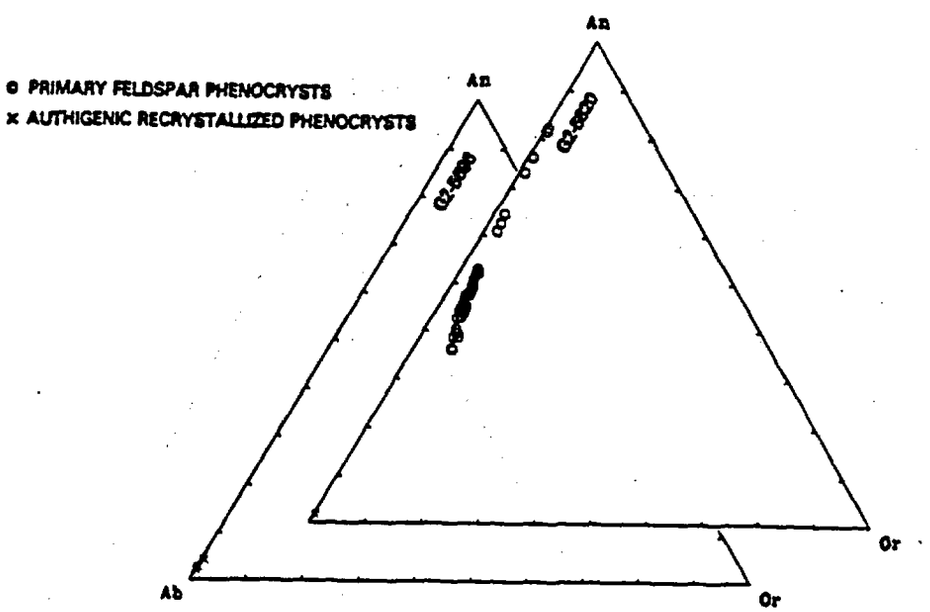
QUARTZ LATITE LAVA



UNNAMED ASH FLOWS

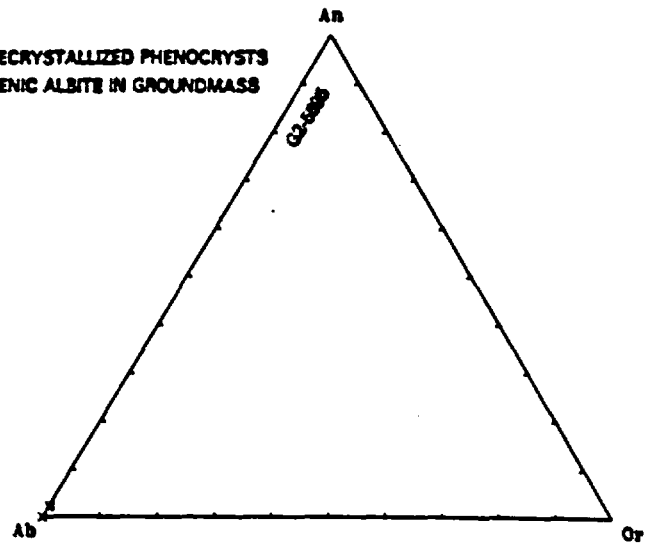


DACITE LAVA



BAKED CONGLOMERATE AND REWORKED TUFFS

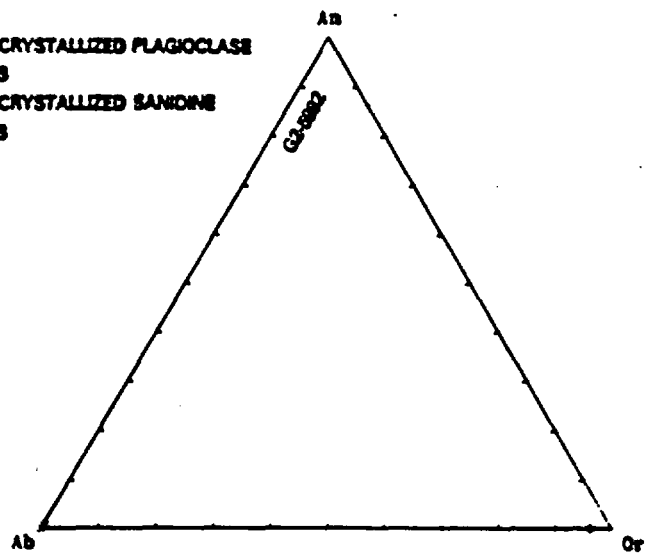
× AUTHIGENIC RECRYSTALLIZED PHENOCRYSTS AND AUTHIGENIC ALBITE IN GROUNDMASS



UNNAMED ASH FLOWS

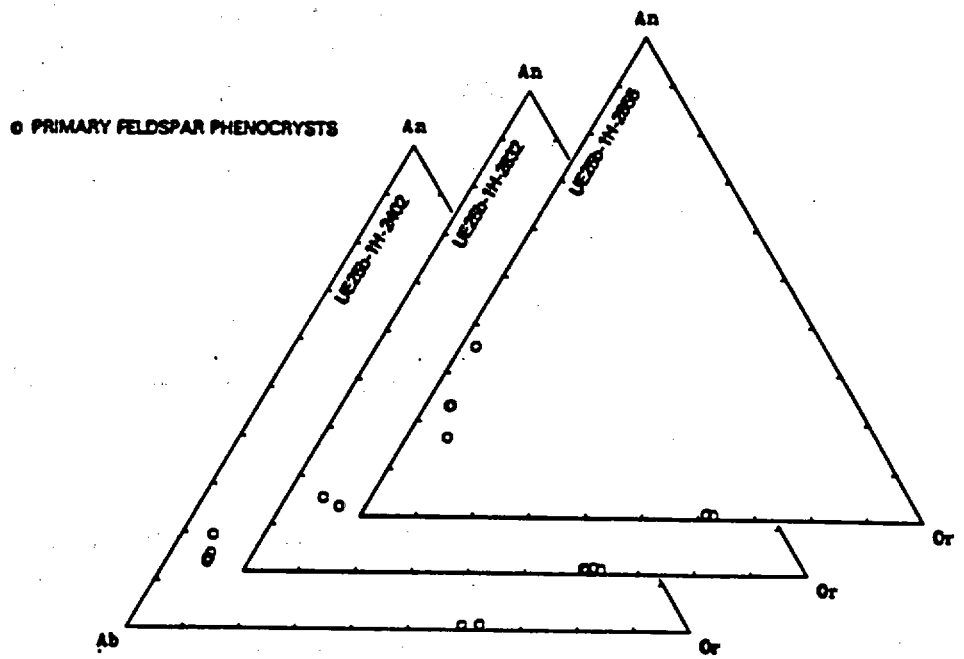
× AUTHIGENIC RECRYSTALLIZED PLAGIOCLASE PHENOCRYSTS

+ AUTHIGENIC RECRYSTALLIZED SANIDINE PHENOCRYSTS

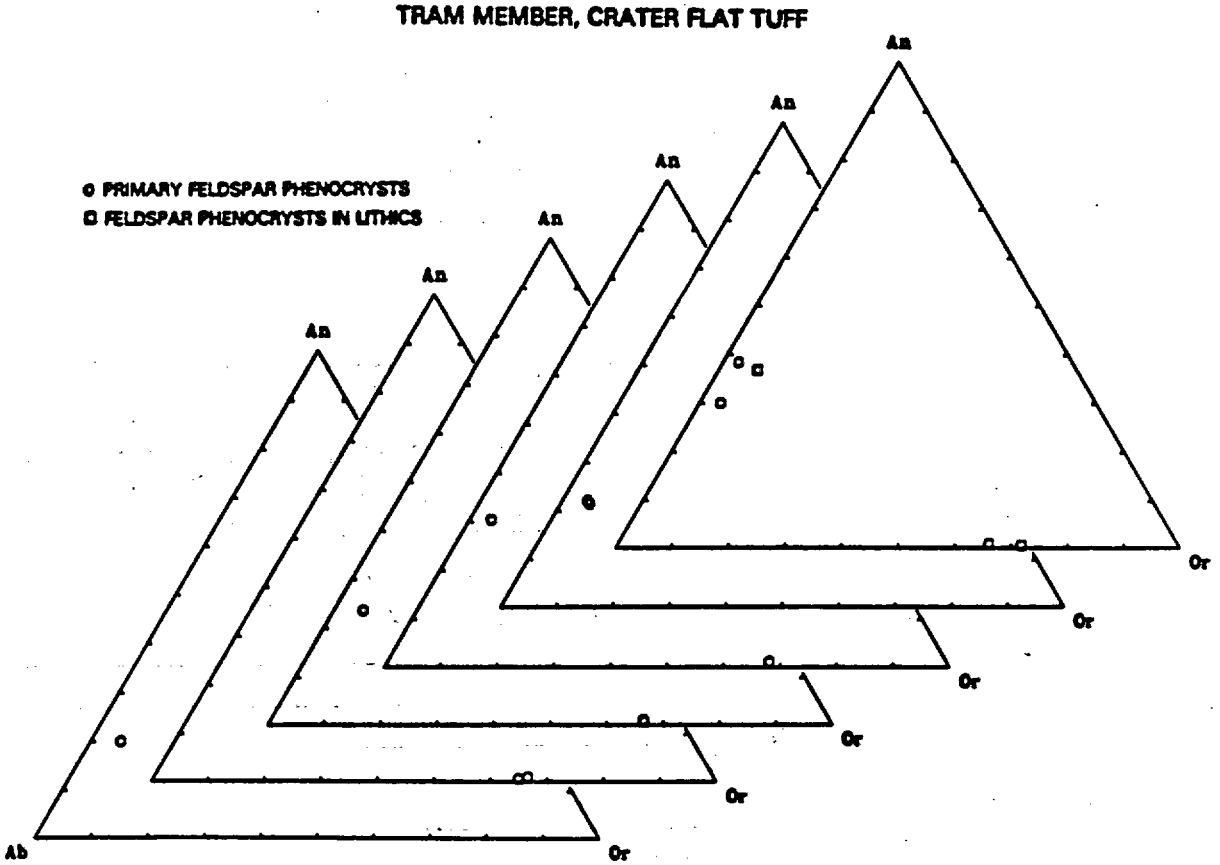


2. PLOTS OF FELDSPAR MICROPROBE DATA FOR UE25b-1H

BULLFROG MEMBER, CRATER FLAT TUFF



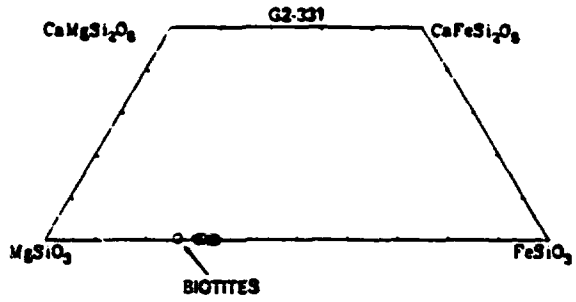
TRAM MEMBER, CRATER FLAT TUFF



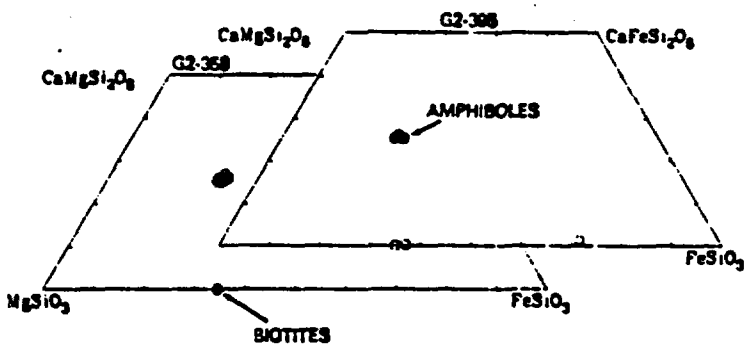
APPENDIX D

1. PLOTS OF MAFIC PHENOCRYSTS MICROPROBE DATA FOR USW-G2

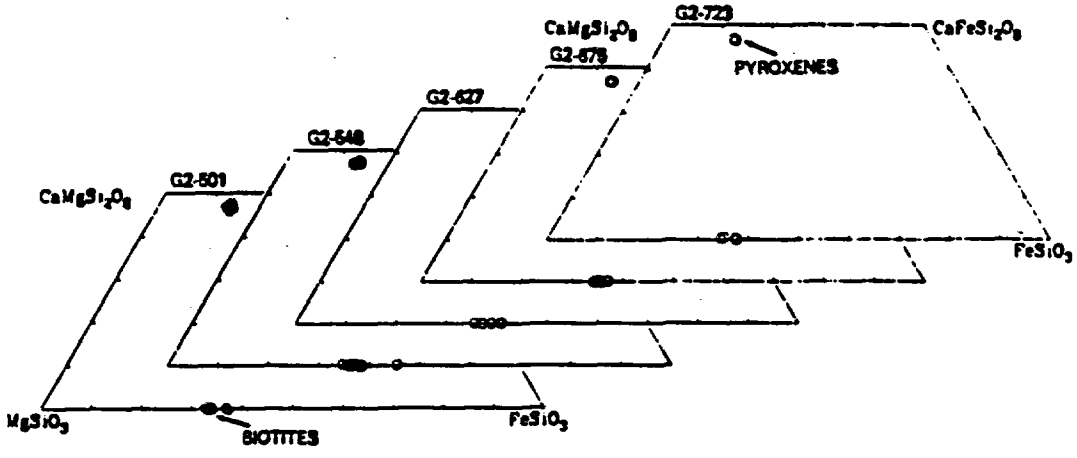
YUCCA MOUNTAIN MEMBER , PAINTBRUSH TUFF



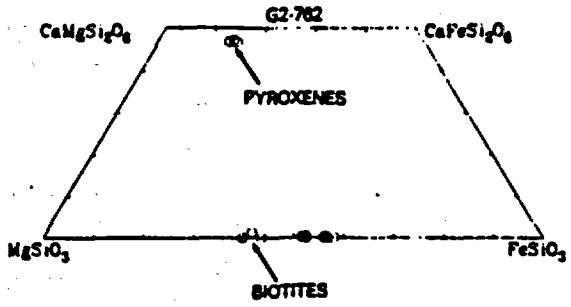
BEDDED TUFF BETWEEN YUCCA MOUNTAIN AND PAH CANYON MEMBERS, PAINTBRUSH TUFF



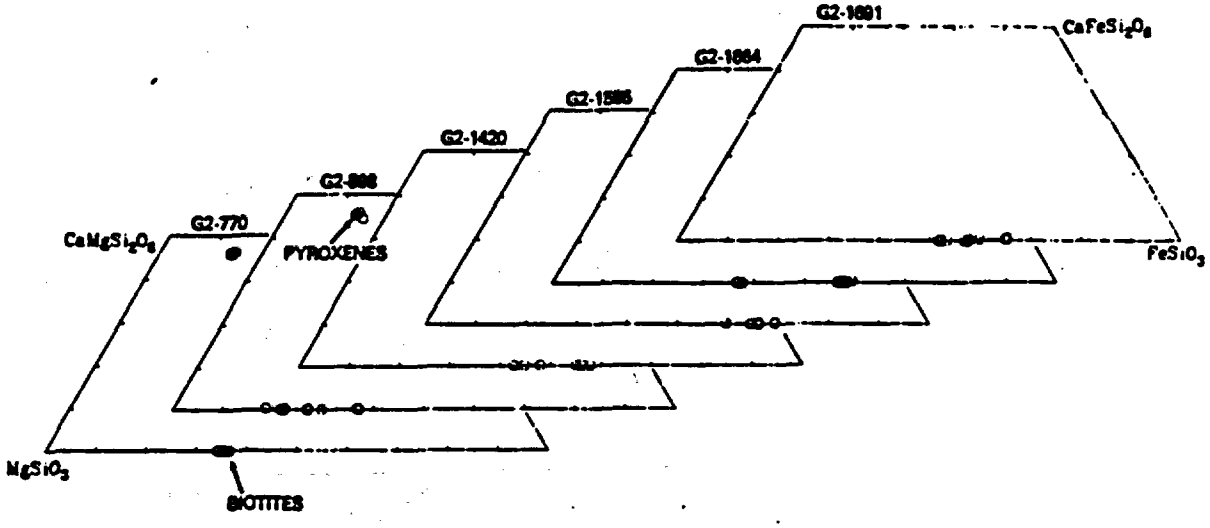
PAH CANYON MEMBER, PAINTBRUSH TUFF



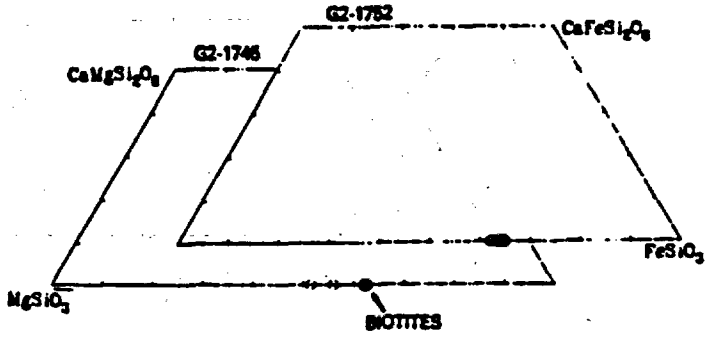
BEDDED TUFF BETWEEN PAH CANYON AND TOPOPAH SPRING MEMBERS OF THE PAINTBRUSH TUFF



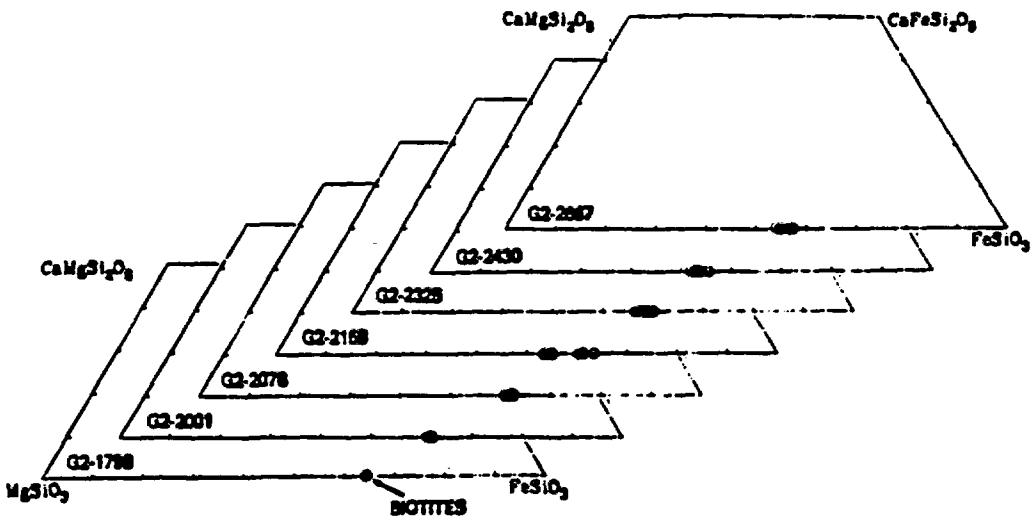
TOPOPAH SPRING MEMBER, PAINTBRUSH TUFF



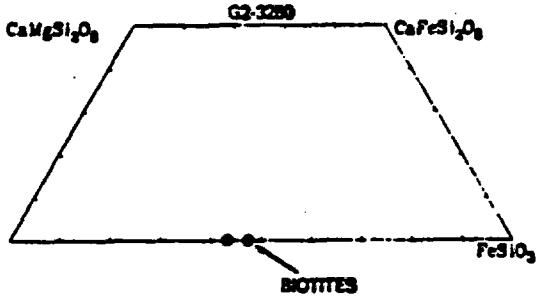
BEDDED TUFF BETWEEN TOPOPAH SPRING MEMBER OF THE PAINTBRUSH TUFF AND TUFF OF CALICO HILLS



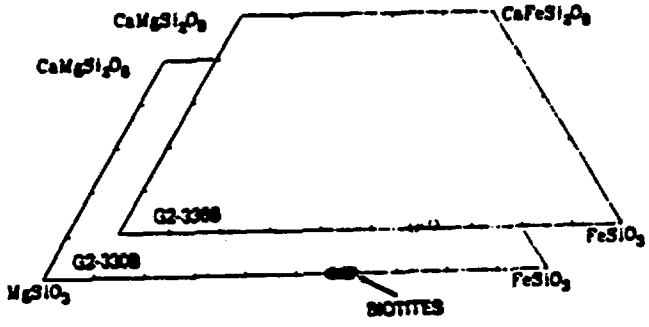
TUFF OF CALICO HILLS



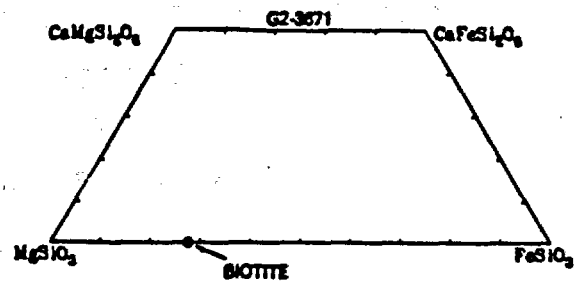
PROW PASS MEMBER, CRATER FLAT TUFF



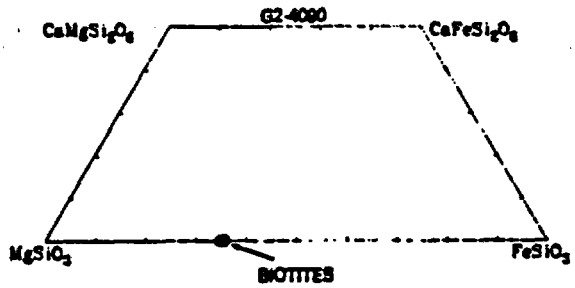
BULLFROG MEMBER, CRATER FLAT TUFF



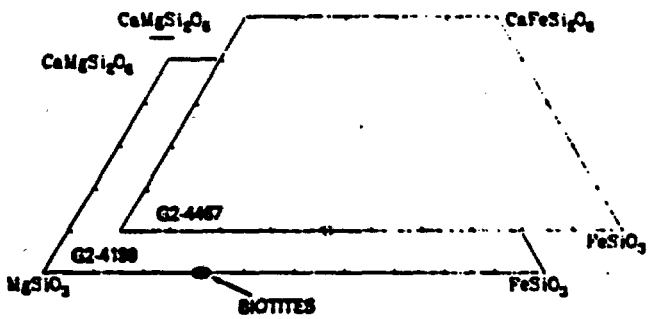
TRAM MEMBER, CRATER FLAT TUFF



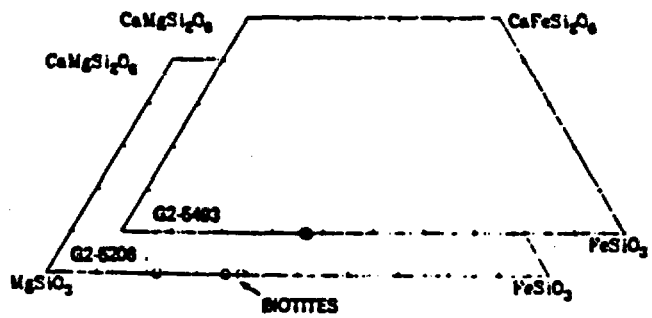
HORNBLENDE-BIOTITE RHYODACITE LAVA



LITHIC RIDGE TUFF

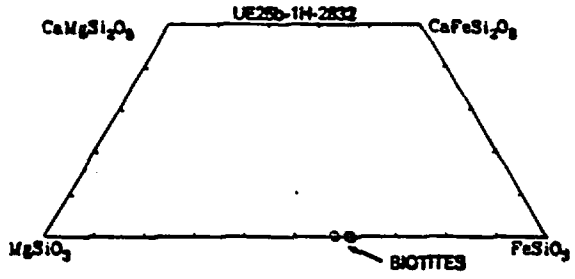


QUARTZ LATITE LAVA



2. PLOTS OF MAFIC PHENOCRYST MICROPROBE DATA FOR UE25b-1H

BULLFROG MEMBER, CRATER FLAT TUFF



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