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PRELIMINARY GEOLOGIC MAP OF THE SURVEYOR MOUNTAIN 7.5' QUADRANGLE, KLAMATH COUNTY, OREGON

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Introduction

The Surveyor Mountain 7.5 minute quadrangle has as its focal point two large composite volcanoes, both Pliocene in age, that have been transected by a series of northwest – southeast trending normal faults. Buck Mountain and Surveyor Mountain were built over tens of thousands of years by eruptions of pyroclastic material, ash, cinders, and bombs, and extrusions of relatively fluid lava of a basaltic andesite composition. Anyone who has driven the Rim Road at Crater Lake National Park and has viewed Wizard Island or Llao Rock or walked down the trail to Cleetwood Cove to enjoy the boat ride on Crater Lake has viewed first-hand what the cross-section of a composite volcano looks like. If one were to dissect either Surveyor Mountain or Buck Mountain by cutting with an imaginary knife along a line passing through the centers of the ancient volcanoes, the resulting three dimensional view would be analogous to what one sees at Mount Mazama. This quadrangle occupies predominantly high terrain between the Johnson Prairie to the west and Spencer Creek to the east (see Figure 1). Topographically the elevation ranges from 1211 m where Sheepy Creek flows west into the Little Chinquapin Mountain quadrangle to 2018 m, the elevation of Summit Rock Point on the Surveyor Mountain ridge in the north-central part of the quadrangle.

The Klamath Falls to Ashland highway, Oregon route 66, cuts across the southern most portion of the Surveyor Mountain quadrangle. One paved road, the Keno Access Road, is oriented diagonally across the quadrangle, trending NW-SE just like both the faulting that is pervasive in this quadrangle and the Surveyor Mountain – Buck Mountain escarpment. This road connects the Dead Indian Memorial highway with Oregon route 66 and is used mainly by outdoor enthusiasts, tourists, and loggers. Generally speaking, the extrusive rocks are the oldest to the west-southwest (Lower Pliocene, 5.331 to 3.600 m.y. old) and are progressively younger to the northeast (Lower Pleistocene, 1.806 to 0.781 m.y. old) (Gradstein and others, 2004).

In quadrangles located further to the northeast that form the boundary region between the Sky Lakes Wilderness / Mountain Lakes Wilderness and the Upper Klamath Valley (see Figure 1), a steep east-facing mountain front formed by the linear arrangement of a series of Pleistocene volcanoes is part of an up-lifted fault block called a horst. The actual main fault extends parallel to the mountain front in a generally N – S orientation. To the east of the up-faulted ridge that has several thousand feet of relief over the surrounding terrain is a structural valley known as a graben. This down-dropped fault block, once drained of its shallow lakes and marshes, is currently home to productive pastureland and hay fields north and west of Klamath Falls. The actual fault plane itself does not break the land surface; rather it is buried beneath a blanket of sediment that is being shed from the western highland. At the intersection of mountain slope and valley floor a number of alluvial fans have developed. These alluvial fans are still being formed today, particularly when the winter snows are melting rapidly in the springtime. Similar faulting activity has sliced through many of the stratigraphic units in the Surveyor Mountain quadrangle. The strikes of the faults become more northwesterly in their orientation from the east side of the Spencer Creek quadrangle through the Surveyor Mountain quadrangle. Surveyor Mountain and Buck Mountain (see the geologic map) have both been cut by northwest – southeast trending faults wherein the southwest margins have been uplifted and tilted somewhat in a southwest direction while the blocks to the northeast of the faults have down-dropped in stair-step or en echelon fashion. Buck Lake and Spencer Creek in the adjoining Spencer Creek quadrangle are located at the low point of the structural valley known as a graben between two prominent fault block ridges, Surveyor and Buck Mountains on the west side and Aspen and Little Aspen Buttes on the east side.

Within the Surveyor Mountain quadrangle there are four excavated pits that supplied primarily road building material at one time or another. Three of the four are cinder pits marking volcanic vents that are Pliocene to Pleistocene in age. These excavations mostly contain poorly lithified layers of pyroclastic material; namely, volcanic ash, cinders, lapilli, and bombs / blocks (in order of increasing physical size) that can be relatively easily crushed and screened for the most usefully sized fragments. On occasion these pits reveal a lava flow or two and in one or two instances the excavation has intersected the dike or dikes with near vertical orientation that brought magma to the Earth's surface from shallow storage chambers called plutons. See Figures 2 and 3, which are photographs of the large cinder pit in the southwestern corner of the Surveyor Mountain quadrangle, just north of the Klamath Falls – Ashland highway. The pit is clearly visible from the highway. The dike cutting through the pyroclastic material is also clearly evident. These plutons are generally located at a depth of 5 to 7 km beneath the surface, a suggestion strengthened by experimental petrologic data that modeled magma chamber conditions for the 1980 eruptive period of Mount St. Helens in Washington (Rutherford and Devine, 1988, 1989). Petrologic and geophysical evidence indicate that shallow pluton - dike - vent structures are only the uppermost segment of a rather complex magma plumbing system that extends 50 to 125 km below the surface (Blatt and Others, 2006). For a first approximation numerous continental margin basaltic andesite to andesite composite volcanoes similar to Surveyor Mountain and Buck Mountain can be pictured to have similar plumbing systems to that described above. The solitary exception is a "hard-rock" quarry that is excavated into Surveyor Mountain lava flows of platy basaltic andesite and is located nearly 2 km to the southeast of Summit Rock Point on Surveyor Mountain. Figures 4 and 5 depict the pervasiveness of the platy jointing phenomenon and the relative thicknesses of individual plates of the basaltic andesite lava.

A comment on nomenclature: when geoscientists classify igneous rock samples they often come at it from two points of view. One is based on identifying the visible minerals in a hand sample (a modal mineral classification) and the other is based on a chemical analysis of that sample (a chemical classification of igneous rocks – see Figure 6 as an example). Naturally the latter is more precise and rigorous and the former is looser and less precise and is open to more opinions. The most common volcanic rocks (basalt, basaltic andesite, andesite, dacite, rhyolite) define a sequence in which the iron– and magnesium-bearing silicate minerals (olivine, orthopyroxene, clinopyroxene, hornblende, biotite) are most abundant on the left side of the sequence, forming upwards of 50 to 60 percent of the minerals present (as in basalt), and decrease to nearly zero percent composition to the right, namely, in rhyolite. The remaining 40 to 50 percent of the rock consists mostly of plagioclase feldspar, a non-iron magnesium bearing silicate mineral, plus a few percent of chromium, iron, and titanium dominated oxide minerals. With regard to rock chemistry, silica (SiO_2) increases from basalt to rhyolite and correlates directly with increasing viscosity and greater explosivity.

Table 1, which accompanies the Preliminary Geologic Map of the Surveyor Mountain 7.5’ Quadrangle, contains the chemical and age data for all the analyzed rock samples. Figure 1 also depicts the location of all the samples for which age dates exist, both within the Surveyor Mountain quadrangle and immediately adjacent to it. These adjacent ages are depicted because they are from extensions of the volcanic rock units found within the Surveyor Mountain quadrangle. The goal was to show all the ages for each volcanic unit discussed in the Explanation of Map Units. Figure 6 is a total alkali ($Na_2O + K_2O$) versus SiO_2 diagram that summarizes the rock names that are most germane for the volcanic materials present in this quadrangle. In addition the chemical data are displayed for each stratigraphic unit that is defined below using an individualized symbol that is summarized in the legend that accompanies Figure 6. Lastly, Mertzman (2000) and Mertzman (unpublished data, 2007) provide many new age dates that have been measured through October 2007. These radiometric ages have been derived from both a whole rock K-Ar method and $^{40}Ar/^{39}Ar$ technology.

Explanation of Map Units

Surficial Units

Qal **Alluvium (Holocene)** Unconsolidated sediment found in close proximity to modern drainages.

Volcanic Rocks

Tbv **Basaltic to basaltic andesite vent deposits (Pliocene)** Poorly lithified to unconsolidated lapilli to ash-sized cinders black to brown to red in color with lesser amounts of similarly colored lava spatter, bombs, and scoria. These deposits mark volcanic vents areas that are often cinder cones.

Qbbb **Basalt of Burton Butte (Middle Pleistocene)** Light gray to dark bluish gray in hand sample color, lava samples are consistently lighter in color than that of pyroclastic samples. Burton Butte cinder / scoria cone, the source of these lavas, is located in the southwest corner of the Lake of the Woods South quadrangle, immediately juxtaposed to the boundary with the Brown Mountain quadrangle. Pahoehoe lava flows from Burton Butte spread out in all directions from the vent complex, flowing outward and into the stream drainage system that was in existence at the time of eruption. Most samples have a diktytaxitic (sponge-like) texture with a larger sized set of vesicles present, several millimeters to one centimeter in diameter, that are often lined to partially filled with secondary mineralization, mostly carbonate with some silica and zeolitic minerals infrequently present. The larger sized set of vesicles is often stretched out to provide a lineation parallel to the last flow direction of the lava. Plagioclase, 0.5 to 2mm in diameter, is the most abundant mineral with 15 to 25 percent olivine and a similar amount of clinopyroxene. Chromite, present within early-formed olivine crystals, and titanomagnetite and ilmenite are the opaque minerals that constitute 8 to 10 percent of the minerals present in these basaltic lavas. One whole rock K-Ar age is available for this unit (see sample 91-3). Also, one $^{40}Ar/^{39}Ar$ age (see sample 91-5) has recently been determined and is preferable due to the very small amount of radiogenic Ar present in this basaltic lava. Burton Butte volcanic activity is 0.33 ± 0.12 Ma old. Both samples are located in the Lake of the Woods South quadrangle (see Figure 1 for exact sample location information).

Qbbp **Basalt of Buck Peak (Lower Pleistocene)** The volcanic source point for the lavas of this unit is located in the southwest corner of the Aspen Lake quadrangle. On freshly broken surfaces the lava has 10 to 15 percent small 1 to 3 mm phenocrysts of plagioclase and green olivine, some iridescent due to oxidation and partial alteration to iddingsite, with the plagioclase consistently being more abundant than olivine. Pyroxene is confined to the matrix of the sample. Buck Peak basalts are higher silica basalts (50 to 53 weight percent) and as a result are found as thicker lava flows less extensive in nature that may be vesicular in texture but never diktytaxitic. As an example the Basalt of Burton Butte is easily distinguishable from the Basalt of Buck Peak based solely on texture. The Basalt of Burton Butte is lower in silica (47 to 48 weight percent SiO_2) and as a result has a lower viscosity that results in the formation of a diktytaxitic texture, which is an important distinguishing characteristic. A $^{40}Ar/^{39}Ar$ age date is available for sample 99-31 of this material from the southeast corner of the Lake of the Woods South quadrangle (see Figure 1 for location information) that indicates these lavas were extruded in the early Pleistocene, 1.45 ± 0.01 Ma.

Qbbl **Basalt of Buck Lake (Lower Pleistocene)** Lavas that belong to this unit were erupted from fissures aligned in a similar direction to the conspicuous NW-SE normal faults that cut through the Surveyor Mountain and Spencer Creek quadrangles. Typical hand samples are medium gray to bluish gray in color, predominantly aphanitic with only several percent of 1 to 3 mm in diameter phenocrysts that are primarily olivine, partially converted to iddingsite, and plagioclase. In order of decreasing abundance plagioclase, pyroxene, and opaque minerals dominate the matrix that is often finely vesicular, spongy and almost but not quite diktytaxitic. Near the flow surfaces larger nearly spherical vesicles are encountered that are up to 1 cm in diameter and are thinly lined by cryptocrystalline material but are completely devoid of any secondary mineralization. Even though the radiometric ages for the Basalt of Buck Lake and the Basalt of Buck Peak are identical when the analytical error is taken into account, the Basalt of Buck Lake is older based on field data. Lava flows from Buck Peak flowed to the west and southwest and came in contact with earlier formed flows of the Buck Lake unit and were deflected in a southeast direction. Three $^{40}Ar/^{39}Ar$ age dates and one whole rock K-Ar age date are available to document the timing of the Buck Lake volcanic activity. Three samples (95-68, 98-91, and 00-99) are from the Spencer Creek quadrangle and one (99-62) is from the Lake of the Woods South quadrangle (see Figure 1). The four age dates range from 1.48 ± 0.10 to 1.19 ± 0.11 Ma.

Tpbas **Basaltic Andesite of Surveyor Mountain (Upper Pliocene to Lower Pleistocene)** This voluminous basaltic andesite unit is widespread in both the Spencer Creek and Surveyor Mountain quadrangles. Lavas of this unit are typically medium gray in color, darker as one approaches the more vesicular tops and bottoms of lava flows, and have 5 to 7 percent 1 to 2 mm in diameter phenocrysts of plagioclase and olivine. The matrix is characteristically quite aphanitic with scattered pinhead sized vesicles present. Plagioclase dominates the matrix together with both orthopyroxene and clinopyroxene and scattered titanomagnetite granules. The elongate plagioclase crystals in the matrix are often flow-aligned producing what is termed a trachytic texture. Platy jointing is a fixture on the outcrops of this unit with plates averaging 3 to 5 cm in thickness. Dendrites of pyrolusite (MnO_2) often are found as staining on the flow joint planes. The Basaltic Andesite of Surveyor Mountain has been cut by several predominantly normal faults trending NW-SE forming a classic fault-block mountain analogous to the Grand Teton Mountain front in Wyoming. The down-dropped blocks are located on the east-northeast sides of the faults forming the lowland in which Buck Lake and the Spencer Creek drainage reside. One $^{40}Ar/^{39}Ar$ age (see sample 03SM-84) and one whole rock K-Ar age (see sample 91-21) are available for the Basaltic Andesite of Surveyor Mountain (see Figure 1). The two ages are 1.98 ± 0.05 Ma and 1.88 ± 0.22 Ma respectively. The sample that produces the former age date is from the Little Chinquapin Mountain quadrangle and the latter date is generated from a sample from the Surveyor Mountain quadrangle.

Tpbcl **Basalt of County Line (Upper Pliocene**) The vents for the lava flows of County Line basalt that flow into the extreme southwest corner of the Surveyor Mountain quadrangle are located further to the west in the Little Chinquapin Mountain quadrangle. These lower silica basalt lava flows (49-50 percent SiO_2) often have remnants of pahoehoe surfaces preserved. Olivine is the most abundant phenocryst-forming mineral, ranging from 5 to 15 percent, and 2 to 5 percent plagioclase feldspar. Both minerals range in size between 2 and 4 mm in diameter. Both minerals occur as discrete crystals and in glomeroporphyritic clumps. The olivine has small euhedral mineral inclusions of Cr-rich spinel and is substantially altered to iddingsite around all the external margins and in fractures that cut through the olivine phenocrysts. Plagioclase dominates the groundmass surrounding the phenocrysts forming < 0.5 mm grains that are acicular to tabular in shape that are often flow-aligned. Forming grains that are similar in size or smaller than the plagioclase is pyroxene, the second most abundant mineral in the groundmass. The clinopyroxene augite is much more abundant than the orthopyroxene bronzite. Granular opaque mineral grains, most likely titanomagnetite, amount to 5 to 7 percent of the rock volume and form small crystals that range from 0.1 to 0.3 mm in diameter. Two $^{40}Ar/^{39}Ar$ ages are available for the Basalt of County Line, 2.10 ± 0.05 and 2.02 ± 0.07 Ma. The samples are 03SC-04 and 03SC-90 respectively and both are from the Little Chinquapin Mountain quadrangle. Only sample 03SC-04 is located on Figure 1; 03SC-90 is located too far west in the Little Chinquapin Mountain quadrangle to fit.

Tpbtc **Basalt of Tunnel Creek (Upper Pliocene)** Light gray in color with 10 to 15 percent olivine phenocrysts, 1 to 2 mm in diameter, this basaltic lava is reminiscent of the olivine-phyric lavas of Daley Prairie located in the central portion of the adjacent Brown Mountain quadrangle. Many of the olivine phenocrysts are partially to nearly completely altered to iddingsite that converts the normally green crystals to ones that range from iridescent purple to a dull dark brown. All the other usually encountered basaltic minerals including plagioclase, pyroxene, and several opaque oxide minerals are confined to the matrix. Once again, the early-formed olivine phenocrysts have numerous small spinel crystals included within them, strongly suggesting the spinel crystallized first from the basaltic magma followed some time later by the olivine. One whole rock K-Ar age is available for the Basalt of Tunnel Creek and its age is 2.32 ± 0.11 Ma old. The sample from which the age was derived (91-15) is located in the Surveyor Mountain quadrangle.

Tpbapm **Basaltic Andesite of Parker Mountain (Middle Pliocene to Lower Pleistocene)** Parker Mountain is a composite volcano located in the northern half of the Parker Mountain quadrangle, which is in a southwest direction from Surveyor Mountain (see Figure 1). Lavas, which have emanated from the summit region, extend outward in all directions and have flowed into the southwest corner of the Surveyor Mountain quadrangle. These lavas are medium gray in color with 8 to 10 percent plagioclase present forming rectangular-shaped crystals 1 to 2 mm in diameter. A lesser amount of olivine is present (3 to 5 percent) in somewhat larger crystals (2 to 4 mm in diameter) forming scattered glomeroporphyritic clumps of the two minerals. Each Parker Mountain hand sample examined will contain 5 to 10 easily visible clumps of plagioclase and olivine. Finer grained matrix forming minerals include much additional plagioclase together with 25 to 30 percent pyroxene and 5 to 7 percent scattered granules of titanomagnetite and olivine. Much of the olivine has rims and veins of secondary iddingsite development, a clear sign of hydrothermal alteration. The size of the matrix forming minerals is variable due to the cooling rate of the lava forming the flow. If the lava flow is thicker and the sample is from the central portion, the average size of the matrix forming minerals will be larger; thinner flows result in faster cooling and small-sized, matrix-forming minerals. The pyroxene in the matrix includes both ortho- and clinopyroxene. Two whole rock K-Ar ages are available for this unit, 2.48 ± 0.50 Ma (see sample 95-34) and 1.8 ± 0.2 Ma old (see sample 97-41). Both samples are from the Parker Mountain quadrangle (see Figure 1 for the exact locations).

Tpbsc **Basalt of Sheepy Creek (Middle to Upper Pliocene)** The vents for the Basalt of Sheepy Creek are a set of fissures aligned in a NNW-SSE direction. These vents are a series of scoria / spatter cone structures and one main cinder cone located in the extreme southwest corner of the quadrangle. The cinder cone has been excavated by the State of Oregon as a source of aggregate for road building purposes. This quarrying activity has exposed some of the internal plumbing system through which the basaltic magma moved to the Earth’s surface. Figures 2 and 3 illustrate the geology unearthed by the quarry activity—a vertically oriented dike cutting through crudely layered pyroclastic material that ranges in size from ash at the fine grained end of the size spectrum to bombs at the coarse end. In terms of hand specimen mineralogy at the vents, 8 to 10 percent phenocrysts of plagioclase feldspar and olivine are present and form singular crystals and glomeroporphyritic clumps 1 to 4 mm in diameter. The olivine, rather than being its typical green color, is iridescent in purple to black due to pervasive high temperature oxidation. In thin section the olivine appears like something akin to wormy wood with magnetite exsolving out of what used to be primary olivine. This process of exsolution is caused by exposure of olivine, which contains Fe^{+2} but no Fe^{+3}, to hot vapor that has some air mixed in with it. Air due to its nearly 21 percent O_2 content rapidly converts the Fe^{+2} to Fe^{+3}. However, the Fe^{+3} does not fit into the olivine mineral structure and therefore the no longer stable olivine breaks down to form two minerals, magnetite ($FeFe_2O_4$) and the Mg-rich orthopyroxene, enstatite (Haggerty and Baker, 1967).

Lava flows of Sheepy Creek basalt have the same phenocryst mineralogy as the vent facies rocks but with olivine more abundant than plagioclase feldspar. The olivine has not been affected by high temperature alteration but rather by primarily low temperature processes that have produced the secondary mineral assemblage known as iddingsite. Iddingsite is brown in color and is found filling the fractures that cut through many of the olivine phenocrysts. It is frequently found as a corona around the perimeter of the olivine crystals (Baker and Haggerty, 1967). With the exception of small opaque mineral grains enclosed within early-formed olivine crystals, titanomagnetite is largely confined to the groundmass. Pyroxene is also mostly found in the groundmass crystallizing after both plagioclase and olivine. Two absolute ages are available for Basalt of Sheepy Creek samples. One $^{40}Ar/^{39}Ar$ age and one whole rock K-Ar age are available for the Basalt of Sheepy Creek. The former age is 2.6 ± 0.2 Ma and was derived from sample (03SM-75) located near the eastern margin of the LCMQ (see Figure 1) while the latter age, 2.4 +/- 0.2 Ma , was determined on sample 97-22 from the northern portion of the Mule Hill quadrangle (see Figure 1).

Tpbab **Basaltic Andesite of Buck Mountain (Middle Pliocene)** The Buck Mountain composite volcano is centered in the southeast section of the Surveyor Mountain quadrangle (see Figure 1) and is segmented by NW-SE trending normal faults. Most of the lava flows within this unit are medium gray moderately porphyritic basaltic andesite but there are several basaltic lava flows intercalated amongst them. Phenocrysts constitute 10 to 12 percent of a typical hand specimen forming 1 to 3 mm in diameter crystals that are dominated by plagioclase with olivine constituting only 3 to 4 percent. The olivine has been marginally altered to iddingsite, which also permeates through the fractures present in the crystals. In the more mafic basaltic lavas olivine is the more abundant phenocryst-forming phase and plagioclase takes on a more secondary role. In either instance the matrix is dominated by plagioclase with a smaller amount of pyroxene, both ortho- and clinopyroxene, together with approximately 5 to 10 percent titanomagnetite and 3 to 5 percent olivine. Much of the matrix-forming plagioclase is lath-like to acicular in crystal form. One whole rock K-Ar age is available for the Basaltic Andesite of Buck Mountain and was determined using sample 95-46 from the Surveyor Mountain quadrangle. The measured age is 2.76 ± 0.16 Ma. It is abundantly clear that the pervasive faulting which cuts through both Buck Mountain and Surveyor Mountain post-dates the last eruptions associated with both these volcanoes. Therefore the faulting activity has to be < 1.8 Ma and Pleistocene in age.

Tpbak **Basaltic Andesite of Kent Peak (Middle Pliocene)** Younger volcanism and faulting has severed the Kent Peak extrusive rocks into two distinct areas on either side of the Surveyor Mountain NW – SE extending ridge. Kent Peak is a small composite volcano the vent of which has been the point source of both lava flow extrusion and ejection of pyroclastic debris. Plagioclase feldspar forms 10 to 15 percent phenocrysts of the typical hand specimen. These crystals are 1 to 3 mm in diameter and quite frequently tabular to lath-like in shape. The amount of visible olivine varies from 1 to 5 percent among the Kent Peak lava flows. Olivine suffers from varying degrees of alteration from minor serpentine or iddingsite along fractures / cracks through the crystals to occasionally being completely surrounded by a corona of these secondary minerals. The olivine phenocrysts range from 1 to 2 mm and have scattered poikilitic inclusions of spinel present and have reacted with the surrounding magma at the time the lava was solidifying to form coronas or rims of the mineral pyroxene, most frequently orthopyroxene. Plagioclase and pyroxene dominate the matrix mineralogy with 7 to 8 percent granular subhedral opaque oxide crystals, 0.1 to 0.2 mm in diameter, peppered through the rocks, quite noticeable when a thin section of a Kent Peak lava flow is observed with a petrographic microscope. Two whole rock K-Ar ages and one $^{40}Ar/^{39}Ar$ age are available from Kent Peak related volcanic rocks. These ages are 2.81 ± 0.14 Ma, 2.78 ± 0.10 Ma, and 2.74 ± 0.03 Ma respectively. All three samples, 94-4, 94-36, and 99-78 respectively, were collected from outcrops located within the Surveyor Mountain quadrangle.

Tpbap **Basaltic Andesite of Puckett Glade (Middle Pliocene?)** Currently the Basaltic Andesite of Puckett Glade, which does in fact contain several basalt lava flows too, is the only stratigraphic unit for which an absolute age has not been determined. Located in the far southwest corner of the Surveyor Mountain quadrangle and extending westward into the Little Chinquapin Mountain quadrangle, this basaltic andesite unit has flows of the Basalt of Sheepy Creek to the east and north, Basaltic Andesite of Parker Mountain lava flows to the south, and Basalt of County Line lava flows to the west, all lapping up against it. Respectively, the ages are 2.6 m.y., 2.48 to 1.8 m.y., and 2.10 to 2.02 m.y. old for the Sheepy Creek, the Parker Mountain, and the County Line stratigraphic units. The Basaltic Andesite of Puckett Glade has to be older than 2.6 m.y. Comparison of geomorphology between adjacent stratigraphic units from further to the west in the Little Chinquapin Mountain quadrangle that have radiometric ages available, suggest an absolute age between 3.0 and 3.5 m.y. old.

In hand sample plagioclase feldspar phenocrysts, 1 to 2 mm in diameter as singular crystals and 3 to 5 mm as glomeroporphyritic clumps, are the most noticeable petrographic features. Plagioclase constitutes 15 to 20 percent whereas olivine only makes up 1 to 2 percent of a hand sample. Much of the olivine has been altered to iddingsite. Pyroxene is abundant (20 percent of a typical sample) but it is confined to the matrix. Most of the pyroxene is clinopyroxene. Acicular titanomagnetite is also confined to the matrix and is also abundant forming 8 to 10 percent of a hand sample. Some vesicles found in pyroclastic samples or from samples taken near the top or bottom of lava flows are lined and partially filled with secondary minerals, most frequently calcite.

Tpbac **Basaltic Andesite of Camp Creek (Lower to Middle Pliocene)** This unit can be found at the southern margin of the Surveyor Mountain map and spreads out southward and eastward into both the Spencer Creek and Chicken Hills quadrangles (see Figure 1). Hand samples are characteristically light to medium gray in color and have 20 to 25 percent plagioclase phenocrysts that are 1 to 4 mm in diameter. Besides being notable for the pronounced porphyritic texture, these basaltic andesite lavas are somewhat unusual in that they contain nearly equal amounts of olivine and clinopyroxene phenocrysts (2 to 3 percent of each mineral) that range from 1 to rarely 3 mm in diameter. The olivine is substantially altered to iddingsite while the clinopyroxene is pristine. Glomeroporphyritic clumps up to 5 mm across are dominated by clinopyroxene with only minor amounts of plagioclase, olivine, and orthopyroxene present. These features make the Basaltic Andesite of Camp Creek relatively easy to identify. In addition to these petrographic characteristics outcrops of the Basaltic Andesite of Camp Creek exhibit distinctive well-developed spheroidal weathering patterns. In areas that have been heavily logged the surface is littered with rounded to ellipsoidal boulders 0.5 to 1 m in diameter. Two whole rock K-Ar ages and one $^{40}Ar/^{39}Ar$ age are available; however, none of the three samples are located within the Surveyor Mountain quadrangle. The K-Ar ages are 3.79 ± 0.10 (see sample S97-87) and 3.44 ± 0.12 Ma (see sample 95-77) and the $^{40}Ar/^{39}Ar$ age is 3.85 ± 0.10 Ma (see sample S97-73). All three samples are from the Mule Hill quadrangle (see Figure 1 for exact locations).

Tpbgb **Basalt of Grouse Butte (Lower to Middle Pliocene)** The Grouse Butte scoria cone / cinder cone complex is located in the southwestern part of the Surveyor Mountain quadrangle. In hand sample the most noticeable feature is that plagioclase feldspar and olivine phenocrysts are nearly equal in abundance and size, 8 to 10 percent and 1 to 3 mm respectively. These two minerals exist as individual mineral grains and in glomeroporphyritic clumps that can reach 5 mm in diameter. Every olivine phenocryst contains one or more quite small opaque mineral grains as inclusions within the larger sized olivine. This texture is referred to as poikilitic and indicates the opaque mineral crystallized first from the magma and at some later time the olivine solidified around it. The opaque grains are most likely members of the spinel solid solution series, the general formula for which is AB_2O_4. Mineral examples include spinel ($MgAl_2O_4$), titanomagnetite ($Fe(Fe,Ti)_2O_4$), and chromite ($FeCr_2O_4$). Along both fractures that cut across the olivine phenocrysts at a 90° angle to the crystal’s direction of elongation and around the perimeter of the grains, the olivine has been altered to the yellow-brown to dark brown colored secondary mineral assemblage known as iddingsite. This alteration is a product of olivine being exposed to a vapor-phase that contains both O_2 and H_2O at a relatively low to moderate temperature, 300 to 500°C. In those portions of lava flows where cooling was relatively fast and in pyroclastic material, pyroxene is confined to the matrix in crystals that are <0.5 mm in diameter. Plagioclase, which is more abundant than the pyroxene in the matrix, forms elongated rectangular shaped crystals called laths that are flow aligned, thus forming the texture known as trachytic. In addition to forming early in the crystallization sequence (often termed near-liquidus) an opaque mineral phase also formed late in the sequence (termed near-solidus). Small 0.1 mm granular opaque mineral grains are peppered through the matrix and constitute 5 to 7 percent of the typical hand sample. In the more slowly cooled portions of lava flows the pyroxene minerals dominated by augite are larger in size, typically 0.5 to 0.7 mm in diameter, and form microphenocrysts. One whole rock K-Ar age (see sample 97-28) is available for this unit, 3.7 ± 0.3 Ma old.

Tmaob **Andesite of Old Baldy East (Upper Miocene)** This unit is atypical for this particular segment of the Cascade volcanic province in that the silicate mineral hornblende, a double chain hydrous ferromagnesian mineral, is present as scattered 3 to 5 mm long phenocrysts that constitute 2 to 3 percent of a hand sample. Strong chemical zoning is apparent in plagioclase feldspar, the most abundant mineral present in this andesite unit. It is present as singular phenocrysts and in glomeroporphyritic clumps 1 to 3 mm in diameter that constitute 10 to 12 percent of the lava and thoroughly dominates the matrix in terms of abundance. Orthopyroxene is a significant mineral as well, constituting 7 to 10 percent of the total volume of the rock in crystals ranging up to 2 mm in diameter. Once again spheroidal weathering is a ubiquitous physical feature observed at most outcrops of this unit. One whole rock K-Ar age is available for this unit, 5.77 ± 0.09 Ma old. Please note, however, that this sample (91-84) is located in the Brown Mountain quadrangle (see Figure 1 for exact location).

Acknowledgments. I thank Isaac Weaver for his on-going help and cheerful support in bringing this geologic map to closure. His computer skills, particularly with regard to MapInfo and Adobe Illustrator, have been particularly valuable. I also thank Karen Mertzman for all her efforts in the x-ray lab, carefully preparing and analyzing countless samples on my behalf. I thank Franklin and Marshall College for its generous support of fieldwork over the past decade that has led to the completion of this geologic map. Support from the NSF and Franklin and Marshall College to facilitate the operation of the XRF laboratory in the Earth and Environment Department is greatly appreciated.

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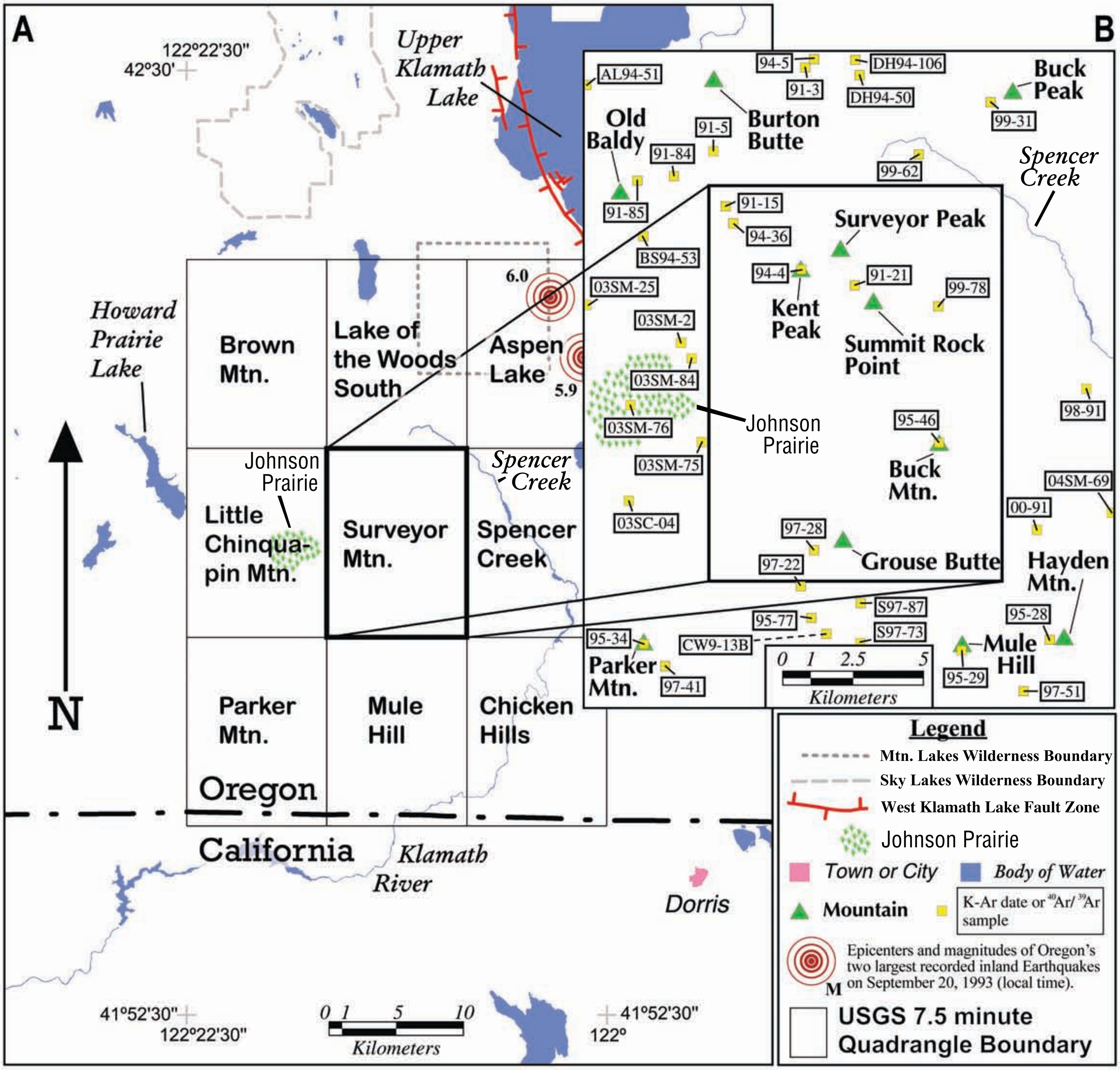

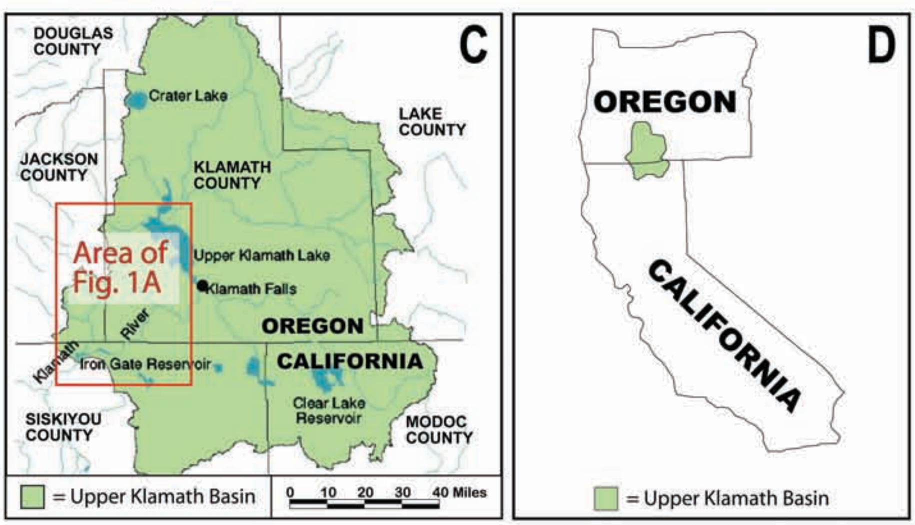

Figure 1. This series of location maps (A through D) provides a broad context in which to place the Preliminary Geologic Map of the Surveyor Mountain 7.5' Quadrangle, Klamath County, Oregon. Figures 1C and 1D were modified from U.S. Geological Survey (2006). Earthquake epicenter location and magnitude data are from The Pacific Northwest Seismic Network (2003).

Figure 2. This large scale cross-sectional view of a cinder quarry located in the extreme southwest corner of the Surveyor Mountain quadrangle just north of Oregon state route 66 depicts the rather unconsolidated nature of the pyroclastic fragments that constitute the vast majority of the overall structure. One or more nearly vertically oriented feeder dikes act as conduits bringing magma from either crustal or upper mantle depths to the surface.

Figure 3. Close-up of welded pyroclastic material in close proximity to the dike exposed in the cinder quarry (Figure 2). This compacted material deters further excavation in this direction because rock crushing rather than just screening out the correct size fraction necessary for road building activity would be required.

Figure 4. Platy jointing I. As lava moves down slope under the influence of gravity it is losing heat and therefore its viscosity is increasing. A point is reached where the lava has become so stiff (like taffy) it will no longer flow. Since lava flows lose heat more rapidly from their margins and the interiors cool less quickly this temperature zonation sets the stage for platy jointing to form. Imagining a deck of playing with each one slipping past the one beneath it is a reasonably good analogy.

Figure 5. Platy jointing II. In the previous image (Figure 4) the distance between flow joint planes was greater than that depicted in this image. As a general rule, the thicker the plates the more likely the rock chemical composition will be that of a basaltic andesite (52 to 57% SiO_2). The thinner the individual plates the more likely the lava flow is andesitic in composition; that is, 57 to 63% SiO_2.

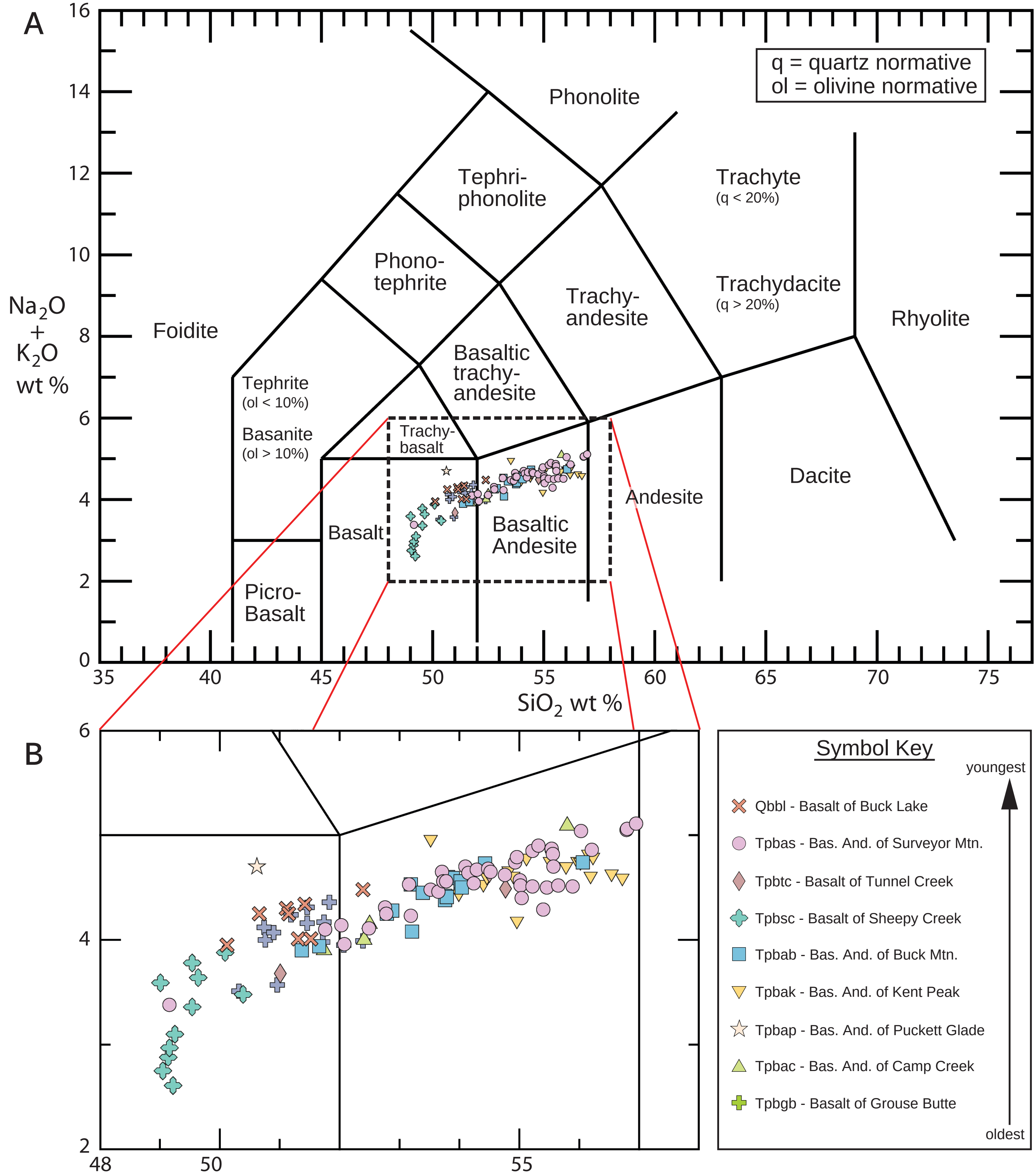

Figure 6. IUGS (International Union of Geological Sciences) classification system for volcanic rocks, which is based on total alkali ($Na_2O + K_2O$) vs. silica (SiO_2) content, with the data from analyzed Surveyor Mountain 7.5’ USGS quadrangle samples (Table 1) superimposed (see Le Maitre, 2002).

Table 1 (Page 1). Whole rock chemical data and potassium-argon (K-Ar) ages ([a] indicates an argon-argon age) for the samples from the Preliminary Geologic Map of the Surveyor Mountain 7.5' Quadrangle, Klamath County, Oregon. The major element oxides are presented in weight percent and the trace elements are reported in parts per million (ppm). The chemical data are X-ray fluorescence (XRF) results and were measured in the X-ray laboratory of the Department of Earth and Environment, Franklin and Marshall College, Lancaster, Pennsylvania. The UTM coordinate values are according to the UTM Zone 10 (NAD 27 for US) projection. All UTM coordinates have been rounded to the nearest 10 m. The 1/4 of 1/4, 1/4, Section (Sec.), Township (T.), and Range (R.) columns are location descriptors of the Public Land Survey System (PLSS) (Willamette meridian and base line). In the Lithology column (Lith.), B = basalt (SiO_2 = 45-52%) and BA = basaltic andesite (SiO_2 = 52-57%) (consult Figure 6 of OFR O-08-03). See Figure 6 and Le Maitre (2002) for details regarding lithological classification. Please consult the detailed descriptions in Open-File Report O-08-03 or the geologic map for the full unit names. Please note that this table is 3 pages long.

Map no.	Sample no.	K-Ar Age([a]) Ma	1/4 of 1/4	1/4	Sec.	T. (S.)	R. (E.)	UTM E m	UTM N m	Unit	Lith.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI (%)
1	97-28	3.7 +/- 0.3	SW	NW	35	39	5	565680	4664840	Tpbgb	B	51.83	1.00	18.04	2.66	5.69	0.15	6.23	9.59	3.49	0.87	0.36	0.47
2	03SM-78	--	SW	NE	34	39	5	564850	4664990	Tpbgb	B	50.32	0.86	16.82	9.20	0.76	0.15	7.00	8.91	2.87	0.64	0.17	1.81
3	97-30	--	NW	SW	27	39	5	563900	4666260	Tpbgb	B	50.74	1.06	16.93	2.30	6.76	0.16	7.55	8.73	3.43	0.69	0.34	0.50
4	03SM-69	--	SE	NE	27	39	5	565330	4666700	Tpbgb	B	50.76	1.31	17.44	4.46	5.40	0.17	5.38	8.06	3.25	0.75	0.41	2.31
5	97-18	--	NE	SW	35	39	5	566300	4664470	Tpbgb	B	50.90	0.94	17.77	5.98	2.77	0.15	5.98	9.54	3.30	0.77	0.34	0.90
6	03SM-77	--	SW	NE	34	39	5	564850	4664990	Tpbgb	B	50.96	0.81	15.94	3.15	5.40	0.14	9.21	9.41	2.97	0.60	0.19	0.88
7	97-29	--	SW	NW	35	39	5	565500	4664900	Tpbgb	B	51.19	1.04	17.99	3.10	5.45	0.15	5.79	9.37	3.45	0.79	0.39	0.64
8	97-19	--	NW	SE	35	39	5	566350	4664640	Tpbgb	B	51.46	0.94	17.40	3.80	4.77	0.15	6.85	9.32	3.38	0.78	0.34	0.39
9	97-20	--	SE	NE	35	39	5	566730	4665140	Tpbgb	B	51.46	1.03	17.92	6.91	2.40	0.15	5.70	8.52	3.55	0.76	0.36	0.38
10	03SM-63	--	SW	NW	36	39	5	567260	4665020	Tpbgb	B	51.72	1.13	17.32	2.95	6.21	0.17	5.74	8.98	3.18	0.80	0.40	1.15
11	03SM-66	--	SE	SW	26	39	5	565950	4665750	Tpbgb	B	51.74	1.23	17.31	3.60	5.92	0.16	5.62	8.60	3.46	0.71	0.39	0.95
12	03SM-67	--	SE	SW	22	39	5	564500	4667280	Tpbgb	BA	52.07	1.06	16.55	2.59	6.62	0.16	7.45	8.59	3.24	0.71	0.34	0.69
13	03SM-65	--	NW	NW	1	40	5	567030	4663820	Tpbgb	BA	52.39	1.05	17.64	2.67	5.98	0.16	5.57	9.34	3.11	0.88	0.40	0.99
14	CM04-48	--	SW	SW	33	39	6	572120	4664080	Tpbac	B	51.74	0.96	18.20	4.10	4.98	0.15	6.24	8.53	3.38	0.52	0.21	0.76
15	CM04-47	--	SW	SW	33	39	6	572280	4664130	Tpbac	BA	52.41	0.95	17.63	2.61	6.09	0.15	6.23	8.23	3.37	0.63	0.22	0.98
16	97-44	--	SW	SE	31	39	6	569960	4664030	Tpbac	BA	52.50	0.96	17.87	2.12	6.54	0.14	6.66	8.46	3.52	0.63	0.22	0.49
17	03SM-64	--	SW	SW	36	39	5	567300	4664190	Tpbac	BA	55.80	1.02	17.77	2.94	4.50	0.13	3.55	7.75	4.04	1.05	0.31	1.02
18	97-25	--	SE	SW	28	39	5	562710	4665730	Tpbap	B	50.62	1.30	17.96	3.96	5.34	0.15	4.25	8.57	3.81	0.89	0.67	1.55
19	94-36	2.78 +/- 0.10	SE	NW	28	38	5	562740	4676270	Tpbak	BA	53.52	1.05	17.69	2.95	5.07	0.13	5.63	8.04	3.83	1.13	0.36	0.83
20	94-4	2.81 +/- 0.14	SE	NE	34	38	5	565160	4674690	Tpbak	BA	54.40	0.83	18.20	2.51	5.15	0.12	5.12	8.47	3.74	0.79	0.15	0.98
21	99-78	2.74 +/- 0.03[a]	NE	NE	6	39	6	570000	4673470	Tpbak	BA	55.97	0.90	18.05	2.21	4.82	0.12	4.16	7.69	3.83	0.92	0.27	1.03
22	94-37	--	NW	NW	33	38	5	562530	4674860	Tpbak	BA	53.99	0.79	18.27	1.96	5.61	0.13	5.23	8.62	3.69	0.75	0.15	0.62
23	MR94-93	--	NW	SE	34	38	5	564780	4674360	Tpbak	BA	54.46	0.84	19.15	3.04	4.88	0.12	4.72	8.80	3.86	0.74	0.14	--
24	MR94-91	--	NE	SE	34	38	5	565440	4674290	Tpbak	BA	54.82	0.79	18.65	2.04	5.28	0.12	4.82	8.48	3.85	0.81	0.16	--
25	MR94-10	--	SE	NE	34	38	5	565120	4674690	Tpbak	BA	54.90	0.82	18.26	2.45	4.96	0.12	5.02	8.45	3.78	0.83	0.16	--
26	03SM-5	--	SE	NE	32	38	5	562140	4674740	Tpbak	BA	54.96	0.80	17.91	2.93	4.56	0.12	4.95	8.24	3.41	0.77	0.15	1.21
27	MR94-105	--	SW	NW	31	38	6	568920	4674790	Tpbak	BA	55.12	0.92	18.06	3.14	4.56	0.12	5.31	7.76	3.85	0.93	0.29	0.01
28	MR94-68	--	NE	SW	27	38	5	564410	4675650	Tpbak	BA	55.51	0.83	19.18	2.48	4.52	0.12	4.09	8.04	3.92	0.83	0.16	0.01
29	99-28	--	SE	SW	5	39	6	570790	4672410	Tpbak	BA	55.78	0.90	18.17	3.22	3.96	0.12	4.14	7.77	3.80	0.90	0.27	1.24
30	06SM-11	--	NW	SE	32	38	6	571460	4674320	Tpbak	BA	56.02	0.88	18.72	2.92	3.88	0.11	4.32	7.28	3.78	0.96	0.26	1.42
31	MR94-104	--	NE	SW	31	38	6	569160	4674250	Tpbak	BA	56.15	0.88	18.54	3.02	4.12	0.11	4.34	7.84	3.94	0.88	0.26	0.01
32	04SM-28	--	SE	NE	36	38	5	568450	4674770	Tpbak	BA	56.19	0.83	18.01	2.95	3.92	0.11	3.99	7.77	3.71	0.90	0.24	1.26
33	99-67	--	SW	SE	30	38	6	569530	4675560	Tpbak	BA	56.23	0.84	18.08	2.91	3.96	0.11	3.95	7.28	3.89	0.90	0.24	1.29
34	04SM-23	--	NE	NE	5	39	6	571770	4673420	Tpbak	BA	56.54	0.84	18.12	2.98	3.81	0.12	3.98	7.65	3.71	0.92	0.24	0.82
35	04SM-26	--	NE	NE	36	38	5	568400	4675100	Tpbak	BA	56.72	0.82	18.03	3.38	3.30	0.12	3.97	7.52	3.72	0.87	0.23	1.07
36	95-46	2.76 +/- 0.16	NE	NE	19	39	6	570060	4668630	Tpbab	BA	54.02	1.02	17.95	2.38	5.99	0.14	5.13	8.11	3.72	0.82	0.29	0.55
37	06SM-23	--	SE	SE	17	39	6	571700	4668920	Tpbab	B	51.37	1.06	18.21	4.15	4.71	0.15	6.73	8.75	3.48	0.42	0.20	0.83
38	99-86	--	SW	NW	31	39	6	568840	4664890	Tpbab	B	51.66	0.94	18.42	2.42	6.46	0.15	6.45	8.48	3.45	0.49	0.22	1.18
39	06SM-36	--	SW	NW	20	39	6	570320	4668100	Tpbab	BA	52.79	1.01	18.63	2.84	5.52	0.14	5.50	8.01	3.63	0.62	0.31	1.26
40	06SM-37	--	SW	NW	18	39	6	568750	4669610	Tpbab	BA	52.88	1.01	18.67	2.12	6.25	0.14	5.22	8.29	3.65	0.63	0.30	1.14
41	99-85	--	SW	SE	24	39	5	568000	4667590	Tpbab	BA	53.19	1.03	18.30	1.97	6.37	0.15	5.12	8.00	3.84	0.69	0.32	0.71
42	04SM-21	--	SW	NW	16	39	6	572240	4669790	Tpbab	BA	53.21	1.06	17.50	2.95	5.74	0.15	6.28	8.36	3.46	0.62	0.22	0.55
43	06SM-24	--	SE	NW	17	39	6	571030	4669940	Tpbab	BA	53.39	0.97	18.51	1.82	6.01	0.14	5.37	8.05	3.59	0.86	0.32	1.02
44	95-44	--	NW	SE	17	39	6	571370	4669400	Tpbab	BA	53.76	1.08	17.61	1.80	6.22	0.14	5.59	8.14	3.69	0.73	0.26	0.94
45	CM04-28	--	SW	NE	32	39	6	571260	4664960	Tpbab	BA	53.76	1.05	17.66	2.27	6.08	0.15	4.97	7.87	3.52	0.86	0.32	0.92
46	06SM-35	--	SE	SW	19	39	6	569420	4667320	Tpbab	BA	53.79	0.99	18.31	1.85	6.18	0.14	5.35	7.99	3.64	0.77	0.31	1.01
47	CM04-29	--	SE	SW	32	39	6	571150	4664070	Tpbab	BA	53.81	0.93	18.45	3.84	4.01	0.14	4.51	7.87	3.73	0.87	0.22	1.44
48	06SM-34	--	NW	NE	32	39	6	571540	4665310	Tpbab	BA	53.89	1.05	18.26	1.93	6.20	0.14	5.15	7.69	3.78	0.81	0.32	0.92
49	95-45	--	NW	SW	17	39	6	570410	4669550	Tpbab	BA	54.02	0.97	18.14	2.49	5.53	0.14	5.18	8.03	3.66	0.90	0.31	0.74
50	97-45	--	NE	NW	36	39	5	567860	4665550	Tpbab	BA	54.04	0.95	18.01	2.38	5.56	0.14	5.01	7.99	3.71	0.79	0.29	0.99
51	99-84	--	NE	NW	24	39	5	567740	4668780	Tpbab	BA	54.43	0.96	18.16	2.65	5.40	0.14	4.74	7.78	3.90	0.83	0.31	0.74
52	99-82	--	NW	NE	13	39	5	568120	4670200	Tpbab	BA	56.06	0.82	18.34	2.32	4.85	0.13	4.68	6.72	4.08	0.66	0.20	1.13

Map no.	Total (%)	Fe_2O_3T	Rb	Sr	Y	Zr	V	Ni	Cr	Nb	Ga	Cu	Zn	Co	Ba	La	Ce	U	Th	Sc	Pb	Yb	Be
1	**100.38**	8.98	7.6	738	19	95	214	54	118	6.9	19.0	94	72	29	592	16	43	<0.5	2.7	--	--	--	--
2	**99.51**	10.04	8.9	716	17.9	71	161	214	393	4.3	19.4	67	80	46	278	16	32	0.6	4.3	28	4	--	--
3	**99.19**	9.81	6.9	698	30.2	91	170	117	275	6.4	20.5	82	79	32.2	407	20.3	36.1	1.2	3.2	25.1	6.2	--	--
4	**99.70**	10.46	10.6	636	38.9	97	215	58	137	6.1	20.7	65	83	30	511	28	52	<0.5	1.4	24	5	--	--
5	**99.34**	9.06	7.3	776	17.9	95	172	83	200	5.9	19.7	65	71	26.9	375	12.4	36.1	0.5	2.8	25.2	6.4	--	--
6	**99.66**	9.15	9.3	735	16.3	64	212	178	368	4.0	18.7	68	75	43	259	9	19	0.5	3.9	27	4	--	--
7	**99.35**	9.16	6.8	709	27.1	112	176	50	110	7.2	20.6	77	72	22.7	458	22.5	39	0.8	1.9	25.7	7.6	--	--
8	**99.58**	9.10	7.7	789	17.6	97	213	82	204	6.3	19.4	77	79	27	393	15.4	38.7	1.3	2.9	26.1	6	--	--
9	**99.14**	9.58	8.5	661	17.3	91	213	89	150	6.4	19.6	49	89	29.7	380	9.8	38.2	0.4	1.4	25.3	8.2	--	--
10	**99.75**	9.85	12.1	556	28	111	196	52	110	7.5	19.9	65	71	27	564	21	46	<0.5	1.7	25	6	--	--
11	**99.69**	10.18	9.9	690	53.9	91	203	65	147	6.3	20.5	69	78	33	507	20	41	0.8	1.9	24	6	--	--
12	**100.07**	9.95	9.8	683	24.8	87	182	113	261	5.0	20.4	71	71	35	469	18	39	<0.5	1.7	23	5	--	--
13	**100.18**	9.32	11.4	571	31.1	112	204	52	112	7.1	19.7	75	78	29	545	19	43	0.6	1.1	26	6	--	--
14	**99.77**	9.63	5.1	667	16.2	63	166	108	169	3.4	20.0	75	77	33	403	--	--	<0.5	1.3	22	5	--	--
15	**99.50**	9.38	8.9	651	24	64	155	98	163	3.3	19.4	382	70	32	410	--	--	<0.5	2.4	21	5	--	--
16	**100.11**	9.39	6.6	648	13.8	51	200	102	219	4.0	20.2	70.3	76	29.2	324	7.6	23	0.4	2.1	23.9	8.1	--	--
17	**99.88**	7.94	15.0	757	36	100	194	26	75	6.2	21.0	90	75	19	505	23	46	<0.5	1.5	21	6	--	--
18	**99.07**	9.89	7.5	749	26.8	141	206	27.3	54	9.8	21.2	99	89	23.2	521	19.4	55.1	0.1	1.5	26.2	7.5	--	--
19	**100.23**	8.58	11.5	1118	22.7	110	192	76	134	5.5	22.8	90	74	17	527	21.1	45.8	1	3.3	24	5.8	2.5	1.6
20	**100.46**	8.23	11.3	723	17.1	58	204	42	75	3.5	22.6	170	64	24	319	9	19	1.3	4.3	22	4.3	1.7	1.3
21	**99.97**	7.57	10.6	903	21.2	111	170	41	82	6.3	20.5	62	73	22	379	16	36	1.7	2.4	19	6	--	--
22	**99.81**	8.19	10.5	740	26.5	55	201	45	93	2.5	19.3	86	66	17	325	--	21	<.5	<.5	26	--	2.3	1.1
23	**100.75**	8.46	9.5	743	--	69	233	37	49	2.2	20.2	92	68	29	254	13	15.3	0.2	0.9	27.1	--	1.5	1.8
24	**99.82**	7.91	11.9	728	15.6	76	210	53	67	2.9	19.7	88	66	28	312	6	17.1	0.7	2	24.3	--	1.5	1.6
25	**99.75**	7.96	11.9	693	13.9	71	209	52	71	2.5	20.2	184	63	28	303	3	16.7	1	0.8	25.2	--	1.4	1.7
26	**100.01**	8.00	11.4	711	18.5	69	192	47	95	3.1	20.6	68	64	27	444	11	24	0.7	2.3	22	5	--	--
27	**100.07**	8.21	12.6	807	17.3	98	174	94	109	4.6	18.9	68	74	31	383	12	29.5	1	0.3	20.5	--	1.6	1.7
28	**99.69**	7.50	10.9	721	3.5	77	222	27	36	3	20.9	128	63	24	332	16	16.2	0.2	<.5	24.9	--	1.8	1.8
29	**100.27**	7.62	8.4	910	17.8	101	178	38	64	6.2	21.9	80	72	24	341	16	31	1.3	5.3	19	7	--	--
30	**100.55**	7.23	12.7	1070	19.8	117	168	42	44	5.1	20.4	39	76	23	469	17	35	<0.5	1.8	19	6	--	--
31	**100.09**	7.60	11.6	940	1.4	106	167	51	51	3.7	19.2	63	70	24	355	19	27.9	1	0.3	20	--	1.7	1.7
32	**99.88**	7.31	12.2	940	19.2	103	168	56	47	4.1	19.9	63	74	23	370	--	--	0.7	1.2	18	5	--	--
33	**99.68**	7.31	9.7	966	25.3	108	164	39	75	5.7	20.5	65	70	20	334	20	29	1.3	2.7	18	6	--	--
34	**99.73**	7.21	12.0	994	29.5	100	154	44	44	4.5	20.2	220	66	23	412	--	--	<0.5	1.4	19	4	--	--
35	**99.75**	7.05	10.9	967	22.2	100	158	45	44	4.3	20.0	50	70	22	370	--	--	<0.5	1.4	18	5	--	--
36	**100.12**	9.04	12.1	689	16.7	86	177	53	88	5.5	20.5	40	75	24	408	12.7	31.4	0.6	1.2	23.6	8.8	--	--
37	**100.06**	9.38	3.9	596	19.8	94	181	128	171	3.8	19.0	82	83	37	289	11	23	<0.5	<0.5	29	7	--	--
38	**100.32**	9.60	2.8	623	23.8	71	179	84	194	4.7	19.5	77	76	30	328	13	27	0.8	2.6	25	4	--	--
39	**100.26**	8.97	5.2	766	19.6	95	193	78	94	5.5	20.0	77	85	30	518	13	27	0.5	1.1	22	7	--	--
40	**100.30**	9.07	6.5	739	20.2	100	192	58	78	5.0	19.7	75	82	30	516	15	29	<0.5	0.8	23	7	--	--
41	**99.69**	9.05	5.0	701	21.4	94	168	56	111	6.6	20.9	71	77	26	345	11	29	1.7	2.1	23	6	--	--
42	**100.10**	9.33	8.4	568	23.2	93	147	100	150	4.0	19.4	71	71	30	354	--	--	<0.5	1.1	23	5	--	--
43	**100.05**	8.50	11.7	757	19.8	94	192	72	91	5.4	19.5	84	86	31	466	15	27	0.9	1	23	7	--	--
44	**99.96**	8.71	9.9	598	21.7	97	166	72	136	5.8	19.3	73	73	27	362	12.6	28.4	0.9	1.7	22.3	8.8	--	--
45	**99.43**	9.03	12.6	689	26.8	94	183	54	84	4.9	20.0	62	77	24	497	--	--	1.5	1.2	21	6	--	--
46	**100.33**	8.72	9.7	758	17.8	95	185	70	86	5.6	19.8	75	82	29	479	13	29	0.8	0.8	22	7	--	--
47	**99.82**	8.30	6.6	556	20.6	70	171	132	249	3.1	18.3	62	71	41	299	--	--	<0.5	1	24	4	--	--
48	**100.14**	8.82	12.7	720	28.9	98	192	61	79	5.4	20.1	74	81	28	478	17	25	0.8	<0.5	20	7	--	--
49	**100.11**	8.64	11.7	730	14.2	80	194	67	109	5.6	20	68	80	24	400	12.1	43.7	0.7	2.3	24.4	8.6	--	--
50	**99.86**	8.56	10.9	662	25.8	80	189	57	99	6.4	20.2	68.6	80	24.9	372	17.5	38.5	0.7	1.6	23.4	8.3	--	--
51	**100.04**	8.65	10.0	704	21.9	97	184	58	118	6.5	19.5	83	78	24	394	16	33	1.2	2.5	22	6	--	--
52	**99.99**	7.71	6.4	631	18.1	88	126	68	162	4.3	19.4	64	70	22	287	6	27	1.3	1.5	17	5	--	--

(continued on next page)

Table 1 (page 2).

Map no.	Sample no.	K-Ar Age[a] Ma	1/4 of 1/4	1/4	Sec.	T. (S.)	R. (E.)	UTM E m	UTM N m	Unit	Lith.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI (%)	Total (%)	Fe_2O_3T	Rb	Sr	Y	Zr	V	Ni	Cr	Nb	Ga	Cu	Zn	Co	Ba	La	Ce	U	Th	Sc	Pb	Yb	Be
53	97-32	--	NW	NE	21	39	5	563250	4668560	Tpbsc	B	49.01	1.21	17.74	4.51	5.77	0.17	7.14	9.44	3.20	0.39	0.25	0.62	**99.45**	10.92	3.6	513	19.9	75	238	126	215	4.6	18.7	70	78	36.7	217	9	21.6	0.8	1.7	27.1	6.1	--	--
54	03SM-81	--	NE	NW	21	39	5	562870	4668730	Tpbsc	B	49.05	1.02	17.67	5.16	4.69	0.17	7.56	10.73	2.56	0.19	0.13	0.84	**99.77**	10.37	3.0	407	24	55	218	83	202	2.9	17.3	80	62	41	129	5	11	<0.5	<0.5	36	3	--	--
55	03SM-71	--	SW	NW	21	39	5	562550	4668360	Tpbsc	B	49.14	1.09	17.38	4.03	5.97	0.18	7.36	10.65	2.68	0.20	0.14	1.31	**100.13**	10.66	2.7	424	31.3	57	225	86	201	3.3	17.3	89	65	43	160	7	13	<0.5	<0.5	34	3	--	--
56	97-26	--	NW	NE	28	39	5	563200	4666850	Tpbsc	B	49.16	0.84	18.17	2.60	6.39	0.16	7.99	10.66	2.66	0.31	0.15	0.80	**99.89**	9.70	3.4	444	17.6	36	238	107	199	3.5	18.0	69	68	34.8	198	5.6	16.4	0.6	1.1	30.3	6	--	--
57	03SM-70	--	SE	SE	21	39	5	563680	4667430	Tpbsc	B	49.22	0.73	18.05	1.51	6.82	0.16	8.62	11.09	2.41	0.20	0.13	0.84	**99.78**	9.09	2.9	421	16.3	37	209	122	233	2.4	17.0	85	64	41	173	4	10	<0.5	1.8	30	4	--	--
58	97-31	--	SE	NE	28	39	5	563670	4666520	Tpbsc	B	49.25	0.83	18.38	4.35	4.58	0.15	7.37	10.91	2.79	0.31	0.15	0.61	**99.68**	9.44	3.9	467	17	38	216	105	175	3.6	18.7	80	67	31.6	186	5.7	15.3	0.4	1.5	28.2	6.1	--	--
59	03SM-72	--	NW	SE	21	39	5	563310	4667730	Tpbsc	B	49.54	1.17	17.39	3.83	6.00	0.17	7.31	9.25	2.95	0.41	0.25	1.50	**99.77**	10.50	6.0	500	22.7	80	207	108	185	3.7	17.4	66	69	39	238	6	16	0.6	1	27	5	--	--
60	97-24	--	NW	NE	33	39	5	563400	4665270	Tpbsc	B	49.54	1.17	17.21	4.69	5.16	0.16	6.79	9.76	3.36	0.42	0.26	0.86	**99.38**	10.42	2.7	493	22.2	83	214	113	196	4.7	17.7	75	74	33.3	239	5.8	19.1	0.6	--	32.1	5.8	--	--
61	97-27	--	SE	SE	34	39	5	565120	4664190	Tpbsc	B	49.64	1.15	17.19	2.27	7.36	0.18	7.78	9.15	3.23	0.41	0.25	0.87	**99.48**	10.45	3.9	481	30	81	216	117	221	5.4	18.0	62	72	32.5	299	11.2	25	0.7	1.5	29.7	6.3	--	--
62	97-23	--	NW	NW	3	40	5	564030	4663890	Tpbsc	B	50.09	1.15	18.06	9.77	0.73	0.17	5.86	9.49	3.45	0.43	0.27	0.18	**99.65**	10.58	4.0	512	21.9	84	173	117	218	5.0	18.3	76	79	36.4	200	8.5	18.2	1.1	0.3	31.1	6.6	--	--
63	03SM-80	--	NW	NW	34	39	5	564110	4665490	Tpbsc	B	50.39	1.13	17.03	1.73	7.80	0.17	7.80	9.17	3.08	0.40	0.25	0.81	**99.76**	10.40	4.8	483	26.5	83	197	110	220	4.6	17.5	63	68	41	240	7	17	<0.5	0.9	29	4	--	--
64	91-15	2.32 +/- 0.11	SW	SW	21	38	5	562470	4676880	Tpbtc	B	51.01	0.91	17.64	2.31	5.92	0.13	7.70	8.72	3.18	0.50	0.16	1.27	**99.45**	8.89	3.6	876	15.9	44	221	106	306	2.9	20.5	79	69	34	215	9	22	1.1	3.5	25	3	1.1	1.3
65	BS94-94	--	SW	SW	21	38	5	562440	4676930	Tpbtc	BA	54.50	1.05	18.31	2.98	5.04	0.10	5.14	7.77	3.88	0.76	0.27	1.16	**100.96**	8.58	11	574	22.4	106	140	68	112	5.8	18.9	67	73	24	365	15	25.5	0.7	0.4	21.3	7.9	2.1	0.9
66	BS94-20	--	NW	NW	28	38	5	562560	4676730	Tpbtc	BA	54.77	0.87	18.73	1.81	5.65	0.14	5.10	7.89	3.80	0.69	0.22	0.47	**100.14**	8.09	11.7	589	18.8	76	137	60	144	5.1	17.8	37	67	21	366	11.5	28	0.8	--	21	6.8	0.8	2.1
67	91-21	1.88 +/- 0.22	NE	SE	35	38	5	567030	4674140	Tpbas	BA	53.71	1.05	17.88	3.27	5.00	0.14	5.24	7.93	3.89	0.76	0.27	0.81	**99.95**	8.83	10.7	592	24.5	97	171	61	118	4.3	18.7	70	73	28	368	14	31	1	4.7	22	5.9	2.4	1.5
68	MR94-97	--	NW	SE	26	38	5	566680	4675810	Tpbas	B	49.16	1.19	21.07	6.74	2.60	0.16	5.22	7.22	3.22	0.16	0.31	0.07	**97.12**	9.63	1.8	387	18.5	91	125	62	95	4.2	20.5	68	83	27	306	--	36	1.2	0.6	20	--	1.6	1.1
69	06SM-13	--	SE	SE	8	39	6	571900	4670520	Tpbas	B	51.76	1.11	18.65	1.95	6.56	0.15	5.92	8.20	3.60	0.50	0.27	1.23	**99.90**	9.24	4.0	647	31.5	107	183	87	117	5.0	19.5	86	83	33	404	15	25	1.1	0.8	25	8	--	--
70	04SM-19	--	NE	SE	5	39	6	571590	4672580	Tpbas	BA	52.03	1.01	18.26	3.76	5.20	0.15	5.75	7.93	3.48	0.66	0.21	1.17	**99.61**	9.54	10.8	641	19.8	76	162	92	111	3.7	19.7	272	75	34	409	--	--	<0.5	<0.5	21	4	--	--
71	04SM-20	--	NE	NE	8	39	6	571740	4671750	Tpbas	BA	52.08	1.10	18.02	2.41	6.27	0.15	5.85	8.37	3.46	0.50	0.27	0.99	**99.47**	9.38	5.2	596	42.2	105	155	77	128	5.4	19.9	374	72	32	457	--	--	1	2.2	24	6	--	--
72	04SM-22	--	SE	SE	7	39	6	570150	4670540	Tpbas	BA	52.49	1.11	18.00	1.40	7.08	0.15	5.72	8.24	3.55	0.56	0.29	1.05	**99.64**	9.27	6.5	610	38.3	109	179	75	122	5.5	20.0	80	77	29	452	--	--	<0.5	1.2	23	6	--	--
73	MR94-89	--	SE	SW	22	38	5	564590	4676910	Tpbas	BA	52.76	1.08	19.21	2.60	5.68	0.15	5.09	8.07	3.81	0.50	0.28	0.01	**99.24**	8.91	4.6	596	29.4	102	184	67	107	3.7	20.3	74	76	30	396	23.6	21	0.1	1.5	24	--	2.4	1.2
74	99-83	--	NW	NE	13	39	5	567860	4670270	Tpbas	BA	52.78	1.06	17.77	2.61	5.92	0.15	6.02	8.36	3.68	0.57	0.23	0.75	**99.90**	9.19	4.2	579	22.6	102	143	91	177	5.3	19.1	65	75	28	322	8	26	1.9	1.8	22	6	--	--
75	91-28	--	SE	NE	35	38	5	566850	4674520	Tpbas	BA	53.16	1.00	17.69	2.47	5.70	0.15	5.61	8.00	3.81	0.72	0.27	0.71	**99.29**	8.80	9.9	585	22.4	109	162	82	162	6.0	18.5	62	79	28	316	13	28	1	2.4	23	6	--	--
76	04SM-29	--	SW	NE	11	39	5	566570	4671540	Tpbas	BA	53.19	1.05	18.91	2.86	5.23	0.15	4.33	8.03	3.70	0.53	0.28	1.43	**99.69**	8.67	6.1	671	26.0	114	178	41	66	4.8	20.5	73	80	24	531	--	--	0.6	1	22	7	--	--
77	99-27	--	NW	NW	8	39	6	570280	4671800	Tpbas	BA	53.52	1.06	17.96	1.74	6.27	0.15	5.67	8.17	3.82	0.66	0.27	0.80	**100.09**	8.71	3.8	569	21.6	101	187	71	138	5.7	21.2	68	74	29	335	11	23	1	3.6	23	6	--	--
78	MR94-88	--	NE	NW	27	38	5	564590	4676690	Tpbas	BA	53.65	1.08	19.10	2.17	5.72	0.14	4.77	8.03	3.91	0.55	0.28	0.01	**99.41**	8.53	4.6	612	10.9	109	180	55	85	4.3	19.6	76	73	29	391	14.8	25	0.7	0.3	24	--	2.1	1.5
79	MR94-36	--	NE	NW	1	39	5	567780	4673440	Tpbas	BA	53.73	1.06	18.49	3.25	5.00	0.14	5.36	8.27	3.91	0.65	0.28	--	**100.14**	8.81	7	606	6.2	116	178	75	109	3.9	19.1	53	74	30	371	16.7	24.6	1.2	0.8	24	--	2	1.3
80	99-80	--	NE	NW	1	39	5	567700	4673530	Tpbas	BA	53.78	1.03	17.85	2.33	5.77	0.15	5.36	7.98	3.83	0.73	0.28	0.81	**99.90**	8.74	9.5	590	23.3	111	175	73	147	6.1	19.2	73	78	26	345	11	29	1.2	1.9	22	6	--	--
81	MR94-101	--	SE	SE	26	38	5	566760	4675520	Tpbas	BA	54.10	1.03	18.23	1.64	6.24	0.14	5.18	7.93	3.93	0.77	0.27	--	**99.46**	8.57	11.9	609	21.6	103	180	78	111	3.7	18.2	54	75	30	370	11	27	<.5	--	23	--	2	1.1
82	MR94-107	--	SW	SW	36	38	5	567430	4673810	Tpbas	BA	54.15	1.03	18.47	1.96	5.60	0.14	5.22	7.84	3.88	0.76	0.27	0.01	**99.33**	8.18	9.5	521	18.3	93	161	82	114	4.1	19.2	60	66	30	322	6	27	1.6	<.5	21	--	2	1.5
83	98-79	--	NW	SW	8	39	6	570330	4671020	Tpbas	BA	54.24	0.85	19.00	2.49	5.05	0.13	4.68	8.07	3.84	0.70	0.16	0.84	**100.05**	8.10	4.8	771	15	65	185	42	64	3.9	20.2	63	70	24	287	6	23	<0.5	<0.5	22	8	--	--
84	MR94-15	--	SE	SW	24	38	5	567520	4677090	Tpbas	BA	54.29	1.10	19.03	8.48	0.44	0.12	4.38	6.90	3.96	0.71	0.21	0.01	**99.63**	8.97	9.2	641	5	93	131	88	82	3	19	41	80	32	321	11	18.8	0.7	<.5	19.4	--	2	1.5
85	MR94-47	--	SW	SW	23	38	5	565580	4676820	Tpbas	BA	54.48	1.05	18.34	2.22	5.88	0.14	4.86	7.76	3.91	0.77	0.28	0.01	**99.70**	8.75	11.1	588	20.9	98	175	70	109	3.8	19.2	75	71	28	362	10.3	25	<.5	<.5	23	--	2.2	1.8
86	MR94-37	--	SE	SW	36	38	5	567670	4673650	Tpbas	BA	54.52	1.03	18.60	1.45	6.24	0.14	5.11	7.69	3.88	0.77	0.27	0.01	**99.71**	8.38	11.4	567	19.7	98	172	79	112	3.8	19.3	40	67	30	341	4.3	23	--	--	22	--	1.7	1.4
87	MR94-31	--	SW	SE	26	38	5	566540	4675410	Tpbas	BA	54.76	1.03	18.26	1.89	6.00	0.14	5.08	7.90	3.87	0.75	0.28	--	**99.96**	8.56	10.6	586	20.6	101	182	73	103	3.7	18.6	45	66	29	367	8.9	29.2	0.4	<.5	22	--	1.8	1.3
88	MR94-61	--	NE	NE	26	38	5	566940	4676720	Tpbas	BA	54.93	1.04	18.33	2.88	5.00	0.14	4.73	7.76	3.92	0.82	0.26	0.01	**99.82**	8.44	13.4	572	19	102	176	60	95	4.5	19	65	71	27	386	14	23	0.3	0.9	23	--	2.3	1
89	99-81	--	NE	NE	13	39	5	568380	4670230	Tpbas	BA	54.96	1.02	17.99	1.92	5.82	0.14	4.47	7.60	3.95	0.84	0.28	0.81	**99.80**	8.39	11.2	618	27.2	116	138	43	100	5.8	19.8	75	71	23	409	16	34	1.8	2.6	20	6	--	--
90	04SM-30	--	SE	NE	11	39	5	566780	4671240	Tpbas	BA	55.01	1.02	17.79	2.52	5.39	0.14	4.73	7.74	3.74	0.83	0.27	0.66	**99.84**	8.51	13.0	625	20.5	107	158	56	83	4.9	19.4	60	74	25	454	--	--	<0.5	0.6	22	7	--	--
91	91-18	--	NE	NE	35	38	5	566800	4674880	Tpbas	BA	55.02	0.98	18.01	2.75	4.93	0.14	4.77	7.71	3.60	0.92	0.28	1.16	**100.27**	8.23	13.9	629	19.2	106	179	71	93	5.1	19.0	57	80	25	422	13	30	<0.5	1	23	7	--	--
92	MR94-98	--	NE	SE	36	38	5	568400	4674210	Tpbas	BA	55.04	0.91	19.39	3.40	3.76	0.12	4.10	8.02	3.65	0.75	0.24	0.02	**99.40**	7.58	9.2	1002	17.2	93	172	52	56	3.9	20.3	74	78	27	343	10.2	30.5	0.7	1.4	20		1.5	1.7
93	91-17	--	NE	NE	35	38	5	566780	4674810	Tpbas	BA	55.22	0.92	17.44	1.93	5.78	0.14	5.77	7.49	3.66	0.85	0.26	0.70	**100.16**	8.35	14.1	619	18.8	100	168	94	131	4.6	18.8	15	79	28	400	9	23	0.8	1	21	6	--	--
94	99-26	--	NW	NW	7	39	6	568630	4671860	Tpbas	BA	55.22	1.00	18.13	2.63	5.08	0.14	4.43	7.78	4.02	0.83	0.27	0.78	**100.31**	8.28	9.3	613	19.4	105	162	37	77	5.8	21.4	43	64	21	378	13	29	1	4.1	17	6	--	--
95	MR94-46	--	NW	SE	22	38	5	564840	4677420	Tpbas	BA	55.32	1.05	18.37	2.12	5.28	0.14	4.31	8.00	4.06	0.84	0.27	--	**99.76**	7.99	12.9	614	7.6	112	181	49	74	4	19.4	79	65	27	380	15.6	25.9	1.2	<.5	24	--	2	1.5
96	03SM-68	--	NE	NW	22	39	5	564380	4668640	Tpbas	BA	55.40	0.78	17.27	3.10	4.39	0.13	5.92	7.38	3.66	0.63	0.19	0.72	**99.57**	7.98	7.9	589	19.1	77	147	101	248	3.0	18.6	40	68	27	275	7	15	<0.5	0.7	22	6	--	--
97	03SM-83	--	SE	SW	9	39	5	562810	4670620	Tpbas	BA	55.46	0.93	17.44	3.32	4.44	0.13	4.89	7.28	3.64	0.86	0.25	1.02	**99.66**	8.25	13.4	607	31.4	100	166	77	133	5.5	18.9	54	77	28	467	34	61	<0.5	<0.5	22	8	--	--
98	MR94-16	--	NE	NE	35	38	5	566810	4674910	Tpbas	BA	55.54	0.94	18.14	2.67	5.32	0.13	5.01	7.35	3.99	0.87	0.27	--	**100.23**	8.58	12.9	577	17.9	94	154	81	111	4	18.3	64	74	27	373	6.5	29	0.2	--	18	--	1.7	1.4
99	MR94-9	--	SE	SE	27	38	5	565110	4675550	Tpbas	BA	55.54	1.07	18.74	4.23	3.68	0.14	4.08	8.07	4.03	0.84	0.29	--	**100.71**	8.32	11.1	604	26	109	183	32	64	4	19.5	69	70	24	441	14.4	27.9	1.3	<.5	23	--	2.3	1.4
100	MR94-102	--	NW	NW	36	38	5	567140	4675120	Tpbas	BA	55.56	0.93	18.13	2.15	5.56	0.13	5.29	7.39	3.95	0.87	0.26	--	**100.22**	8.33	13.2	609	18	94	160	93	128	4.2	18.5	49	75	29	384	8	24	1.3	1.2	20	--	1.8	1.6
101	MR94-17	--	NE	NE	35	38	5	566800	4674830	Tpbas	BA	55.57	0.96	18.27	3.23	4.60	0.13	4.77	7.61	3.83	0.87	0.27	--	**100.11**	8.34	12.9	674	20.5	108	175	67	99	4.6	18.4	53	77	26	422	12	29	2.2	<.5	21	--	1.8	1.4
102	04SM-31	--	SW	SW	2	39	5	565440	4672110	Tpbas	BA	55.65	0.92	18.09	3.25	4.04	0.12	4.00	7.29	3.58	0.94	0.27	1.85	**100.00**	7.74	12.1	902	18.3	105	157	42	46	3.9	20.0	66	72	25	472	--	--	1.1	1.2	19	5	--	--
103	03SM-82	--	NE	SE	16	39	5	563460	4669320	Tpbas	BA	55.89	0.92	17.53	2.79	4.65	0.13	4.62	7.46	3.66	0.85	0.25	0.80	**99.55**	7.96	13.9	618	28.1	98	152	58	103	5.3	19.6	50	70	25	426	15	31	<0.5	<0.5	21	7	--	--
104	MR94-90	--	SE	SE	34	38	5	565240	4673820	Tpbas	BA	56.03	0.99	18.33	2.07	5.16	0.13	3.92	7.42	4.10	0.94	0.26	--	**99.35**	7.80	14.8	626	20.2	112	173	35	55	4	19.8	69	69	22	443	10	25	0.1	1.2	21	--	1.8	1.7
105	91-19	--	SE	SW	26	38	5	566050	4675390	Tpbas	BA	56.21	0.99	18.18	2.09	5.11	0.14	3.73	7.52	3.91	0.95	0.26	0.74	**99.83**	7.77	15.4	602	24.7	110	172	22	42	5.1	19.6	58	74	20	491	18	37	0.5	1.5	21	7	--	--
106	MR94-35	--	NE	SE	35	38	5	566910	4674370	Tpbas	BA	56.79	0.97	18.56	1.36	5.92	0.13	3.76	7.58	4.12	0.93	0.26	--	**100.38**	7.94	14.8	629	19.8	108	175	28	50	3.8	19.6	47	63	21	430	10	28	--	<.5	21	--	1.8	1.3
107	MR94-34	--	SE	NE	35	38	5	566860	4674540	Tpbas	BA	56.80	0.98	18.45	0.60	6.12	0.13	3.72	7.51	4.11	0.95	0.26	0.01	**99.64**	7.40	14.4	638	5.9	110	167	30	45	4	19.2	54	67	22	432	18	26	0.9	0.9	22	--	2	1.7
108	MR94-39	--	SW	SE	35	38	5	566460	4673720	Tpbas	BA	56.95	0.98	18.40	1.75	5.04	0.13	3.69	7.35	4.15	0.96	0.27	--	**99.67**	7.35	14.8	607	4.8	107	166	28	43	4.1	19.6	63	66	21	464	17	26	1	1	21	--	1.8	1.6
109	06SM-9	--	SW	SW	21	38	6	572150	4677160	Qbbl	B	50.12	1.23	19.12	1.31	7.66	0.15	6.19	8.78	3.49	0.46	0.29	1.52	**100.32**	9.82	5.8	627	24.4	91	206	92	125	3.5	19.7	76	82	38	293	11	20	<0.5	2.2	26	6	--	--
110	06SM-12	--	NW	NW	4	39	6	572040	4673360	Qbbl	B	50.66	1.25	19.02	3.68	5.54	0.15	5.75	8.20	3.69	0.56	0.22	1.20	**99.92**	9.84	9.2	654	22.1	89	189	90	76	3.0	19.6	72	82	37	310	12	17	<0.5	<0.5	21	6	--	--
111	99-65	--	NW	NE	32	38	6	571340	4675010	Qbbl	B	51.11	1.22	18.52	3.16	5.85	0.15	5.76	8.60	3.78	0.52	0.23	1.05	**99.95**	9.66	4.4	594	26.3	95	172	85	146	4.7	19.6	67	73	31	289	10	21	1.2	2	24	4	--	--
112	99-64	--	NE	NW	29	38	6	570920	4676490	Qbbl	B	51.15	1.21	18.67	5.88	3.50	0.16	5.55	8.62	3.75	0.50	0.24	0.81	**100.04**	9.77	2.5	588	22.9	95	222	93	139	5.0	19.2	61	83	35	253	9	19	1	1.7	27	5	--	--
113	04SM-25	--	NW	NW	30	38	6	568780	4676490	Qbbl	B	51.31	1.22	17.97	2.09	6.94	0.15	5.93	8.58	3.46	0.55	0.21	0.96	**99.37**	9.80	9.1	583	23.2	87	170	70	101	4.1	19.9	71	66	32	372	--	--	<0.5	1.4	22	5	--	--

(continued on next page)

Table 1 (page 3).

Map no.	Sample no.	K-Ar Age([a]) Ma	1/4 of 1/4	1/4	Sec.	T. (S.)	R. (E.)	UTM E m	UTM N m	Unit	Lith.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI (%)	Total (%)	Fe_2O_3T	Rb	Sr	Y	Zr	V	Ni	Cr	Nb	Ga	Cu	Zn	Co	Ba	La	Ce	U	Th	Sc	Pb	Yb	Be
114	99-29	--	NE	NE	30	38	6	570110	4676720	Qbbl	B	51.42	1.32	18.37	2.30	6.94	0.16	5.54	8.50	3.82	0.52	0.24	0.89	**100.02**	10.01	3.6	569	25.2	95	208	51	106	4.9	22.2	77	69	31	314	10	19	0.8	3.6	23	5	--	--
115	04SM-24	--	SW	SW	19	38	6	568760	4677180	Qbbl	B	51.52	1.22	18.36	1.59	7.22	0.15	5.92	8.83	3.46	0.55	0.22	0.80	**99.84**	9.61	8.7	592	22	90	179	71	98	3.9	19.9	62	69	30	355	--	--	<0.5	<0.5	21	5	--	--
116	04SM-27	--	NE	NE	5	39	6	571790	4673610	Qbbl	BA	52.39	1.10	18.69	3.06	5.69	0.14	5.09	8.15	3.83	0.65	0.18	0.63	**99.60**	9.38	11.5	718	17.8	77	167	68	33	2.8	20.8	75	69	32	367	--	--	<0.5	0.5	20	5	--	--