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PRELIMINARY GEOLOGIC MAP OF THE ASPEN LAKE 7.5′ QUADRANGLE, KLAMATH COUNTY, OREGON

By
Stanley A. Mertzman[1], Stephen G. Weaver[2], Andrew Gavin[3], Karyn Powers[3]

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[1]Franklin & Marshall College, Department of Earth and Environment, Box 3003, Lancaster, Pennsylvania 17604
[2]Colorado College, Department of Geology, 14 East Cache la Poudre, Colorado Springs, Colorado 80903
[3]Formerly at The College of Wooster, Department of Geology, 944 College Mall, Scovel Hall, Wooster, Ohio 44691

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Introduction

Nearly one third of the Aspen Lake Quadrangle (ALQ) falls within the confines of the Mountain Lakes Wilderness Area, which covers an area equal to one township (108 km^2). The U. S. Congress designated the Mountain Lakes region as wilderness in 1984. Figure 1 provides exact location information on several levels; where in the Pacific Northwest to where in south-central Oregon and to the local geographic context in which the ALQ is situated. The dominant two access points to the Mountain Lakes Wilderness are Varney Creek Trailhead on the north side and Clover Creek Trailhead on the west side of the Wilderness Area. Topographically the elevation ranges from 1262m in the northeast corner of the map where Denny Creek flows north into the Pelican Bay quadrangle following the trace of a normal fault in that area to 2502m, the summit of Aspen Butte, the highest point in Mountain Lakes and in the ALQ. Anyone who has either read about or visited regions within the higher portions of the Cascade Mountains knows that the landscape is an interesting mix of volcanic and glacial features, often referred to by the imagination-inciting phrase “fire and ice.” For example, glacial features formed through erosion like U-shaped valleys, arêtes, and cirques are easily distinguished, and glacial lakes, the largest of which is Lake Harriette, the centerpiece of the Mountain Lakes Wilderness, are numerous if one hikes the Mountain Lakes Loop Trail.

When viewed from a distance the Mountain Lakes region topographically forms a broad rather flat-topped elevated area that covers nearly 100 km^2 (see Figure 2). At first blush it reminds one of the Crater Lake region when viewed from a distance, particularly on the south side from the Upper Klamath valley. That similarity in topographic profile has led some people to believe that an individual composite volcano like Mount Mazama existed in the Mountain Lakes region that also “blew its top” sometime in the geologic past. That is not the case, however. With violent explosive andesite volcanic activity, which is often followed by collapse and caldera formation, fragmental volcanic rocks known as welded tuffs or ignimbrites are invariably erupted. Driving into Crater Lake NP from the south along Annie Creek provides a splendid view of the welded tuff blanket that was deposited as part of the violent demise of Mount Mazama and the formation of Crater Lake approximately 7,000 years ago. When traversing the Mountain Lakes region from any direction, no welded tuffs or ignimbrites are encountered. This observation convincingly argues no such violent geologic event occurred in this region. To be sure dozens of volcanic eruptions led to the extrusion of both basaltic andesite and andesite lava flows from a number of individual volcanoes in the region, but none led to an event like the climactic final caldera-forming events that took place at Mount Mazama.

Mount Harriman, Aspen Butte, and Little Aspen Butte are prominent topographic high points within the Aspen Lake Quadrangle. All three are volcanic vents from which copious amounts of lava poured. The former two have been substantially modified by glacial erosion, whereas the latter still maintains its original volcanic morphology due to the fact it is situated at a substantially lower elevation (<2134m) than either Mount Harriman or Aspen Butte (see Figure 3). In particular, a small alpine glacier has substantially eroded the north-facing side of Aspen Butte. Headwall erosion associated with the southernmost cirque has exposed the near-surface (within 100 to 200 m) conduit-forming plutonic rocks. This shallow pluton has the approximate geometric shape of a cylinder that is 30 to 50 m in diameter. The color of the pyroxene diorite forming the intrusive mass is much lighter than the compositionally equivalent lava flows because the matrix mineralogy is very much dominated by plagioclase feldspar, a light colored mineral (see Figure 4). Extrusive rocks from Aspen Butte and Little Aspen Butte volcanoes dominate the western two-thirds of the quadrangle. Lavas from these two volcanoes cannot be distinguished from one another based on hand-sample mineralogy and texture. Field relations suggest they are very similar in age. It is worth noting that all the rocks within the ALQ are Pleistocene in age; that is, they range between 1.8 million and 11,500 years old (Gradstein and others, 2004).

Aspen "Lake" is located in a linear valley oriented in a N-S direction that has been largely drained and has water in it during the early spring after a period of rapid snow melt. Most times, however, the land is used for grazing purposes. Water drains to the north out of the depression and eventually forms Denny Creek in the northeast corner of the map area. On September 20, 1993, at 8:28 and 10:45 PM PDT earthquakes of magnitude 5.9 and 6.0 respectively, occurred. The epicenters for these two earthquakes are located between Aspen Butte and Aspen "Lake" (see Figure 1 and the geologic map for the epicenter locations). Both Braunmiller and others (1995) and Dreger and others (1995) reported hundreds of aftershocks centered east and southeast of these two epicenter locations. With the depth to the focus of these earthquakes being nearly 10 km and that the earthquake mechanism was that of a normal fault with mostly dip slip movement, these clues strongly suggest the Lake of the Woods fault zone is at the heart of this latest episode of seismic activity. The surface trace of the Lake of the Woods fault zone is located further to the west in the adjoining Lake of the Woods South quadrangle.

The steep east-facing mountain front formed by Mt. Harriman – Aspen Butte – Little Aspen Butte – Clover Butte is part of an uplifted fault block, with the actual fault extending parallel to the front in a N10 to 20ºW direction, and Aspen "Lake" resides in the structural valley known as a graben between this fault and a subparallel adjacent fault in the Howard Bay quadrangle. The actual fault plane itself does not break the surface itself; rather it is buried beneath a blanket of sediment that is being slowly moved down slope under the influence of gravity. At the intersection of mountain slope and valley floor a number of alluvial fanlike features have been developed, most prominently displayed at the northwest end of the valley, adjacent to Aspen Butte, where much glacial debris has been transported down slope over the past several hundred thousand years.

Known absolute ages for samples from the ALQ range from 1.45 to 0.47 Ma. Including samples from immediately adjacent areas enlarges the range to ~2.0 to 0.45 Ma. As you will read below, but it is a point worth making now, the three youngest volcanic units, the Andesite of Whiteface Peak, the Basaltic Andesite of Aspen Butte, and the Basalt of Round Lake Hill, all overlap in geologic age, suggesting they may have erupted or at least had the potential for erupting nearly simultaneously.

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 5 as an example). The latter is more precise and rigorous, the former is looser and less precise and is open to more opinions. The most common volcanic rock names (basalt, basaltic andesite, andesite, dacite, rhyolite) define a sequence in which the iron – 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 and decreases to nearly zero to the right, namely, in rhyolite. The remaining 40 to 50 percent of the rock consists mostly of plagioclase feldspar, non-iron magnesium bearing silicate mineral, and 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 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 ALQ and adjacent to it. These adjacent ages are depicted because they are from extensions of the volcanic rock units found within the ALQ. The goal was to show all the ages for each volcanic unit discussed in the Explanation of Map Units. Figure 5 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 the ALQ. 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 5. Lastly, Mertzman (2000) and Mertzman (unpublished data, 2007) provide many new age dates, derived from both a whole rock K-Ar method as well as $^{40}Ar/^{39}Ar$ technology, that have been measured through October 2007.

Explanation of Map Units

Surficial Units

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

Qg **Undifferentiated colluvium and alluvium (Holocene and Pleistocene)** Unconsolidated sediment whose origin is related to glacial activity.

Qs **Lacustrine deposits (Holocene and Pleistocene)** Unconsolidated sediment found in association with the Aspen "Lake" enclosed basin that is for most or all of the year (depending on spring melt of the previous winter's snow) a large hay field in which numerous cattle graze at one time or another.

Volcanic Rocks

Qbv **Basaltic to basaltic andesite vent deposits (Pleistocene)** 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.

Qbrl **Basalt of Round Lake (Middle Pleistocene)** One vent of this unit occurs in the extreme southeast corner of the ALQ. Additional vents stretch out in a linear array to the southeast into the Keno quadrangle, culminating in Round Lake Hill, the main focal point for this extrusion event. The lava is medium gray, somewhat diktytaxitic with 3 to 5 percent glomeroporphyritic clumps of olivine and plagioclase 0.5 to 2 mm across, as well as individual phenocrysts of the same minerals. Taken as a whole, this lava consists on average of 50 percent plagioclase, 25 percent clinopyroxene that is mostly confined to groundmass status, 20 percent olivine some of which is partially altered to iddingsite, and 5 percent titanomagnetite. In terms of sample geochemistry this unit is most similar to the Basalt of Denny Creek; that is, a low silica, high-alumina, relatively low K_2O basalt. One $^{40}Ar/^{39}Ar$ age date is available for a sample just off the Aspen Lake map onto the Keno quadrangle (see Hladky and Mertzman, 2002). Its age is 0.45 ± 0.17 Ma.

Qbdc **Basalt of Denny Creek (Lower to Middle Pleistocene)** Gray colored primarily diktytaxitic lava that frequently has glomeroporphyritic clumps that range from 1 to 4 mm in diameter and consist of plagioclase and olivine, much of which is green in color with only infrequent crystals showing signs of oxidation indicated by an iridescent play of colors including purple. Plagioclase is the most abundant mineral often constituting nearly half of the lava with olivine making up nearly a quarter. Pyroxene and titanomagnetite constitute the remaining quarter of the mineralogy. A network of irregularly shaped minute gas cavities that have acicular plagioclase crystals projecting into them produces the spongy nature of the lava. In terms of geochemistry this unit is consistently a low potassium <0.3 weight percent), high alumina (>17 weight percent) lower silica basalt (47 to 49 weight percent) that is characterized by relatively low viscosity which enables it to form widespread but relatively thin lava flows. Interestingly, this unit is most similar to those basalts known as MORB, mid-ocean ridge basalt, the most common type of volcanic rock found on Earth. Nowhere is either the top or bottom of this unit exposed. One $^{40}Ar/^{39}Ar$ age date is available for the Basalt of Denny Creek, 0.84 ± 0.09 Ma. What is most interesting about this age is that it is much younger than the adjacent basaltic andesite from Doaks Mountain to the east in the Howard Bay quadrangle. The radiometric age makes clear that the Doaks Mountain basaltic andesite was in place and some time later the Basalt of Denny Creek was extruded and lapped up against the Doaks Mountain volcanic rocks.

Qbaa **Basaltic Andesite of Aspen Butte (Lower to Middle Pleistocene)** Nearly one-half of the Aspen lake quadrangle is covered by medium gray, aphanitic, platy basaltic andesite that originates from both Aspen and Little Aspen Buttes. The lavas from these two volcanoes are indistinguishable in hand specimen and have very similar major and trace element geochemistry. They have 2 to 5 percent small 1 to 2 mm phenocrysts of fresh green olivine, plagioclase, and orthopyroxene, both in clumps and as separate crystals, immersed in a fine-grained aggregate of the same minerals together with titanomagnetite and clinopyroxene. Plagioclase is the most abundant mineral. Two whole rock K-Ar age dates are available suggesting this pulse of basaltic andesite volcanism spanned from 0.86 ± 0.02 to 0.47 ± 0.04 Ma. Late Pleistocene glaciation has substantially modified the summit region of Aspen Butte and clearly exposed numerous interbedded layers of lava and pyroclastics; thus, Aspen Butte is a composite volcano. The glacial erosion has been sufficiently intense that the conduit has been uncovered and can be easily recognized by the much more granular texture of the constituent rock, clearly marking the slower rate of cooling for this intrusive mass (see Qid description below).

Qbah **Basaltic Andesite of High Knob (Lower Pleistocene)** High Knob, situated on the southwest flank of Crater Mountain, is the residual vent structure for a number of basaltic andesite lava flows. The High Knob lavas have been segmented into several discontinuous areas because of younger lavas flowing down from vents located further uphill and to the north leaving in their wake islands of older material surrounded by younger volcanic rock. These “islands” of older rock are referred to as kipukas. Hand samples from the High Knob unit are light to medium gray in color with 10 to 15 percent small phenocrysts (< 2 mm in diameter) with plagioclase decidedly more abundant than pyroxene that in turn is more abundant than olivine. Both orthopyroxene and clinopyroxene are present in hand-sample but the identification is made more difficult than usual because the olivine phenocrysts are strongly altered to iddingsite and therefore take on a surface color that is similar to pyroxene. Some of the altered olivine produces an iridescent array of purple color on fracture surfaces that helps distinguish it from pristine pyroxene phenocrysts. Pyroxene and plagioclase are the most abundant minerals in the matrix of this unit followed by the Fe-Ti oxide mineral titanomagnetite. Two whole rock K-Ar age dates are available for this unit, 1.08 ± 0.05 and 0.90 ± 0.05 Ma. Both samples are located in the adjacent Lake of the Woods South quadrangle.

Qbac **Basaltic Andesite of Clover Butte (Lower Pleistocene)** Clover Butte is a prominent volcanic vent and is part of a fissure system that extends for more than two kilometers along a N20ºW orientation. Following a line of that same orientation to the north and west passes through Little Aspen Butte and Aspen Butte; thus, suggesting a significant fracture in the Earth’s crust controls the location of these Lower Pleistocene basaltic andesite volcanic vents. This N10º to 20ºW fracture-forming event could be associated temporally with the advent of Basin and Range tectonism in this part of southern Oregon. Pyroclastic samples ranging from cinders and lapilli to bombs are all relatively aphyric with only 1 to 2 percent small phenocrysts 0.5 to 1.5 mm in diameter. Plagioclase is much more abundant than iddingsitized olivine, the only two visible minerals present in these vesicular variably oxidized volcanic materials. Lavas contain 5 to 7 percent phenocrysts that are 1 to 2 mm in diameter with plagioclase much more abundant than olivine. No pyroxene is evident. Much incipient platy jointing is noticeable on the outcrop, which is a clue that this material is more siliceous than typical basalt. One $^{40}Ar/^{39}Ar$ age date, 1.12 ± 0.07 Ma., is available for the Basaltic andesite of Clover Butte,

Qbbp **Basalt of Buck Peak (Lower Pleistocene)** The volcanic source point for the lavas of this unit is located the southwest corner of the ALQ. 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 less extensive lava flows. The margins of lava flows of Basalt of Buck Peak are vesicular in texture but never diktytaxitic. The Basalt of Buck Peak is easily distinguished from the Basalt of Denny Creek by the exact nature of the vesicular texture. The Basalt of Denny Creek is always diktytaxitic. A $^{40}Ar/^{39}Ar$ age date is available for a sample of this material from the adjacent southeast corner of the Lake of the Woods South quadrangle and it indicates these lavas were extruded in the Lower Pleistocene, 1.45 ± 0.01 Ma.

Qamh **Andesite of Mount Harriman (Lower Pleistocene)** Although andesite is the dominant rock type present in this unit, please note that there is significant basaltic andesite and to a much lesser extent basalt, particularly to the north in the Pelican Bay quadrangle into which this unit prominently extends. Nearly a dozen cinder and scoria cones extend north and east of Mount Harriman toward Rocky Point and Odessa. A major Oregon Department of Transportation cinder pit has substantially consumed the northernmost cinder cone, which is a source for road building and repairing materials. A number of large volcanic basaltic bombs are scattered about in the cinder pit that contain 10 to 15 percent unaltered olivine. Other scoria and cinder cones are basaltic andesite in their primary rock composition while several others are more siliceous and are best classified as andesite. Andesite hand samples from this unit are typically light to medium gray in color and have ~25 percent small, 1 to 3 mm, phenocrysts with plagioclase > orthopyroxene > clinopyroxene in modal abundance. Outcrops often consist of numerous platelike fragments; that is, relatively thin (1 to 3 cm thick) rectangular rock fragments that are developed as a result of lava flowage and cooling, from the outside edges of the lava flow on all sides towards the interior of the flow. This cooling pattern produces what is termed a flow-jointing pattern that reflects the higher silica content of these andesite lavas. It is a very common physical feature found in association with blocky andesite lava flows when all three dimensions are visible. Basaltic andesite hand samples have a nearly equal abundance of plagioclase and pyroxene together with several percent olivine. There are no basalt lava flows in this unit, but several basaltic cinder and scoria cones are surrounded by more siliceous younger volcanic material. Five whole rock K-Ar age dates are available for this unit, suggesting volcanic activity ranged from 1.47 ± 0.04 Ma to 1.13 ± 0.02 Ma. Two of the samples for which age dates are available are from the ALQ, and three are from the adjacent Pelican Bay quadrangle (see Figure 1).

Qawp **Andesite of Whiteface Peak (Lower to Middle Pleistocene)** The modal mineralogy of these andesite lava flows varies from 3 to 20 percent phenocrysts that are nearly equal amounts of plagioclase, orthopyroxene and clinopyroxene, sporadically with minor amounts of olivine and hornblende. The andesite flow exposed at Crater Peak has nicely preserved examples of the dehydration breakdown reaction of hornblende to pyroxene + plagioclase + magnetite. that is, cores of hornblende phenocrysts have survived both the coronas or rims are made of the anhydrous mineral assemblage pyroxene + plagioclase + magnetite. Phenocrysts of hornblende have been partially resorbed from the perimeter in towards the center of the crystal as a result of dehydration chemical reactions. Rims added to the corroded margins of the original hornblende are composed of the anhydrous mineral assemblage pyroxene + plagioclase + magnetite. The matrix is dominated by a granular aggregate of 0.5 to 1 mm plagioclase crystals with interstitial pyroxene and titanomagnetite crystals. Many outcrops of this unit are characterized by widespread flow jointing that has been strongly enhanced by the freezing and thawing and the abundance of water given the glacial activity in this region over the past 0.5 to 1 million years. The individual plates are 2 to 5 cm thick and the size of loose-leaf paper. Six whole rock K-Ar age dates are available for this unit, all of which are from the adjoining Lake of the Woods South quadrangle (see Figure 1), and range between 1.55 ± 0.04 Ma to 0.57 ± 0.10 Ma.

Qid **Diorite conduit-forming intrusive rocks of the Aspen Butte composite volcano (Middle Pleistocene)** Substantial Pleistocene glacial erosion has exposed the shallow (hypabyssal) intrusive rocks that constitute the conduit through which the basaltic andesite magma moved from some depth to the Earth's surface. Due to cooling beneath the surface the rate at which the temperature decreased was distinctly slower as evidenced by the much more granular, phaneritic matrix texture, which leads to the use of the rock name diorite, the plutonic equivalent of the Aspen Butte basaltic andesite. On a fresh broken surface, the rock is light gray with 10 to 12 percent phenocrysts and glomeroporphyritic clumps of orthopyroxene, olivine, and plagioclase situated in a matrix greatly dominated by plagioclase (65 to 70 percent) with imbedded small crystals of pyroxene and titanomagnetite.

Acknowledgment I thank Isaac Weaver for his on-going help and 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. Generous grants from the W. M. Keck Foundation supported fieldwork in the Aspen Lake quadrangle in 1992 and 1994. 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. Lastly, I thank Franklin and Marshall College for its generous support of continued fieldwork over the past decade that has led to the completion of this geologic map.

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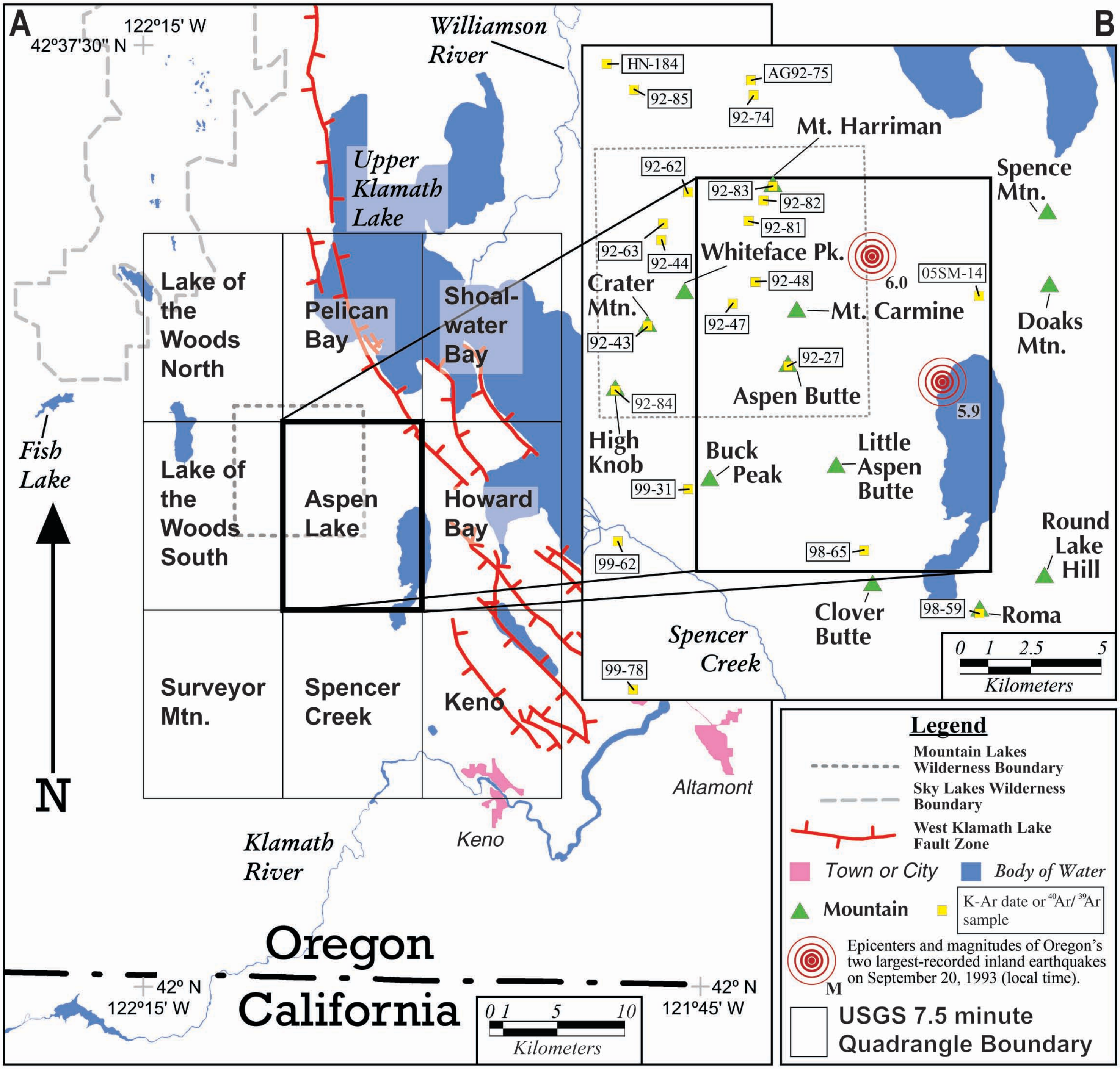

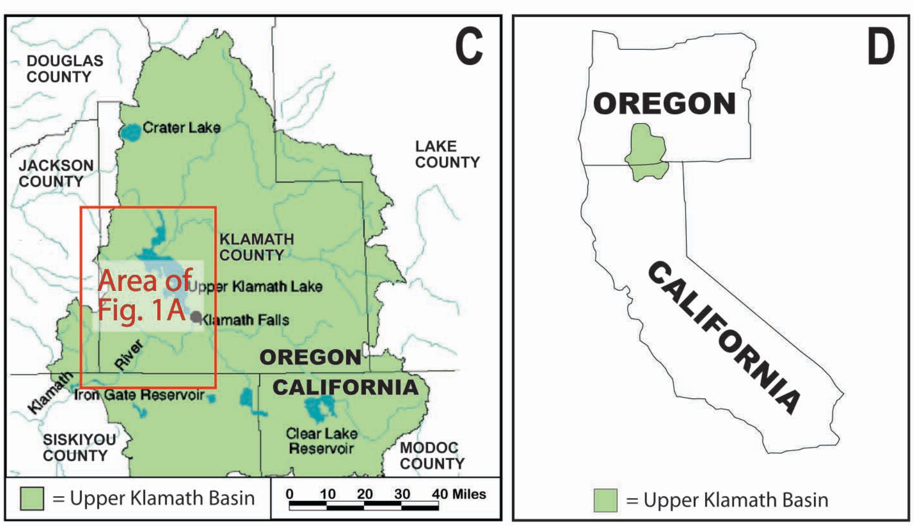

Figure 1. This series of location maps (A through D) provides a broad context in which to place the Preliminary Geologic Map of the Aspen Lake 7.5' Quadrangle, Klamath County, Oregon. Figures 1C and 1D were modified from U.S. Geological Survey (2006). Earthquake epicenter location and magnitude information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

Figure 2. Mount Harriman is the central pyramidal high point with the nearly flat-topped Mountain Lakes Wilderness immediately behind it as seen from the northeast. This image was taken from near Fort Klamath in the Upper Klamath Valley.

Figure 3. Looking west across the Aspen Lake Valley from the north side of Doak's Mountain, a north-south profile of the Mountain Lakes Wilderness can be seen. From right to left: Mount Carmine is the high point followed by a glacial U-shaped valley, the eroded plug of the Aspen Butte volcano, the summit of Aspen Butte, with Little Aspen Butte prominently displayed further to the left. Mount Carmine is an eroded segment of the Aspen Butte composite volcano. With regard to the 6.0 magnitude earthquake of September 20, 1993 its epicenter is located on the visible hill slope of Mount Carmine to the far right of the image while the epicenter for the 5.9 magnitude earthquake of the same date is located near the open area in the center of the image at the bottom of the slope below Aspen Butte.

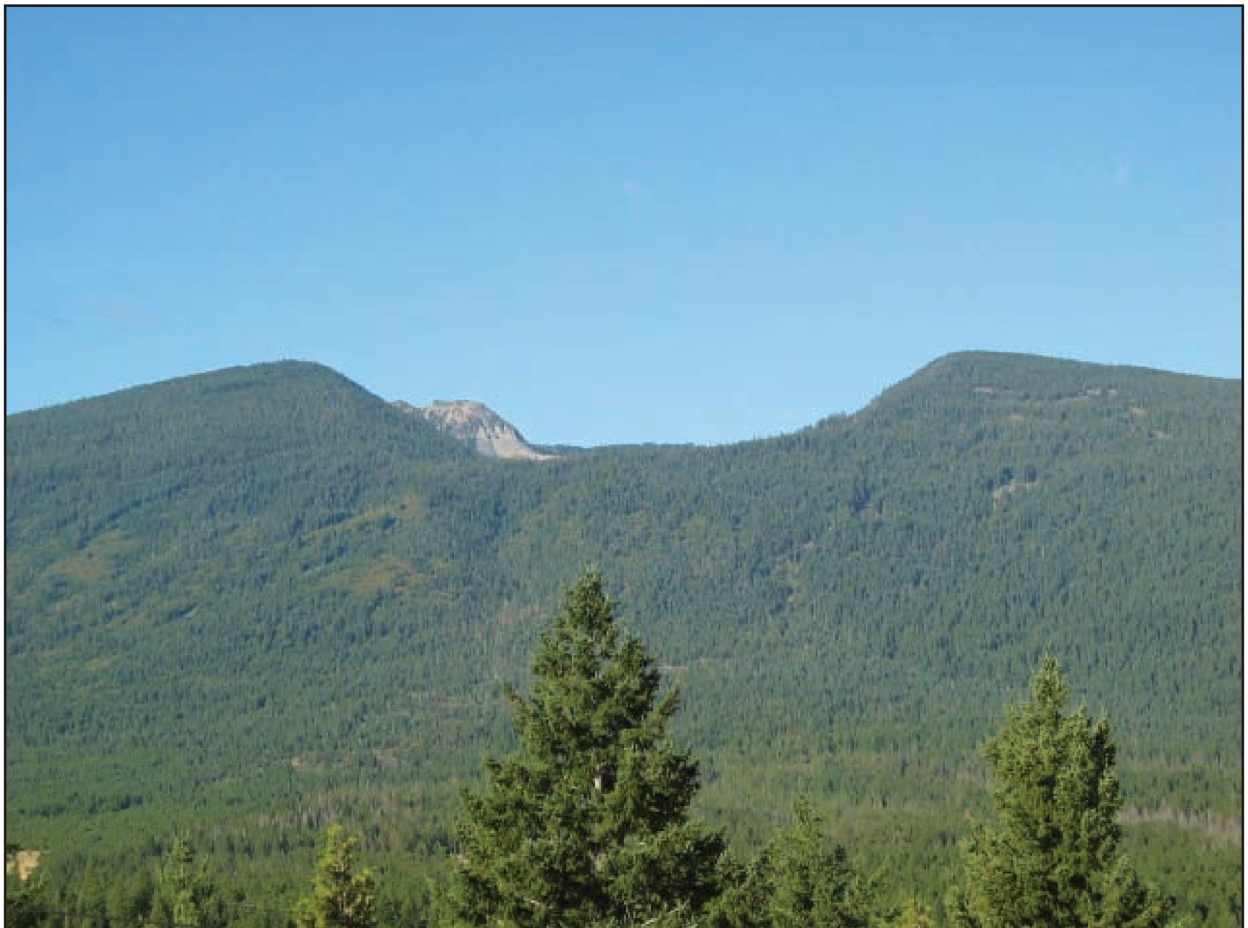

Figure 4. A close-up image of the U-shaped valley that separates Aspen Butte summit to the far left from Mount Carmine to the far right. The light colored mass is the eroded plug of the Aspen Butte volcano and is a pyroxene diorite in terms of its mineral composition. It is the plutonic equivalent to all the basaltic andesite lava flows that constitute all the bedrock exposed in this image.

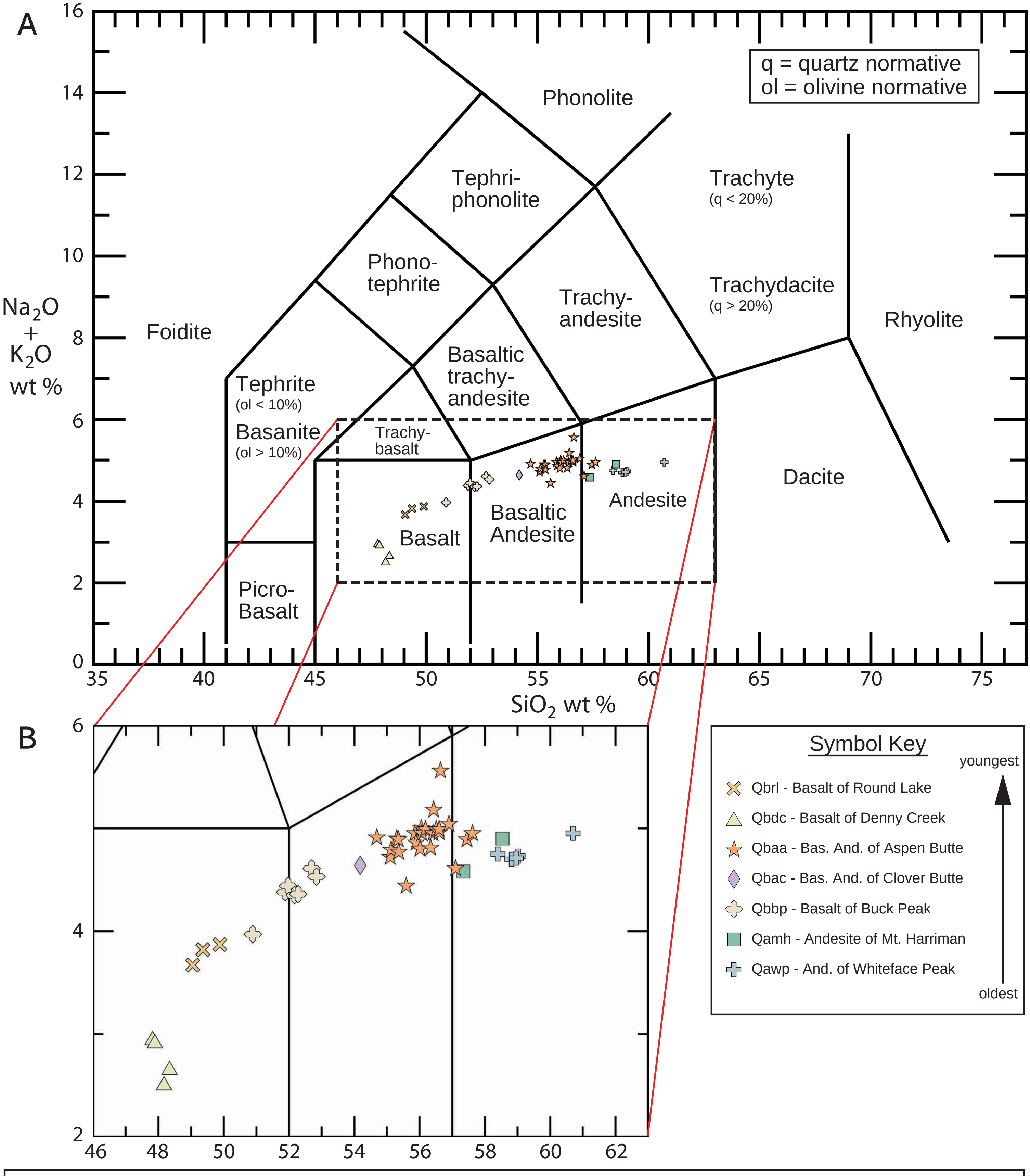

Figure 5. IUGS (International Union of Geological Sciences) classification system for volcanic rocks, which is based on total alkali ($Na_2O + K_2O$) vs. silica (SiO_2) content, with the data from analyzed Aspen Lake quadrangle samples (Table 1) superimposed (see Le Maitre, 2002). Although the two diorite samples are not volcanic rocks, they have been included in this graph as part of the Qbaa unit to show that they are chemically equivalent to the Basaltic Andesite of Aspen Butte and differ physically because of the different conditions in which they formed.

Table 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 Aspen Lake 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%), BA = Basaltic Andesite (SiO_2 = 52-57%), A = Andesite (SiO_2 = 57-63%), and Di = Diorite. See Figure 5 and Le Maitre (2002) for details regarding lithological classification. Please consult the detailed descriptions above or the geologic map for the full unit names.

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
1	92-47	0.77 +/- 0.04	NE	SE	21	37	6	573330	4687210	Qawp	A	59.02	0.68	18.48	2.47	3.38	0.10	3.69	7.17	3.88	0.85	0.13	0.29	100.14	6.23	13	1215	14.2	50	131	21	37	3.2	22.3	24	57	20	316	13	27	1.2	3	15	4	0.9	1
2	92-81	0.57 +/- 0.10	SE	SW	10	37	6	573890	4690150	Qawp	A	60.70	0.67	17.81	2.98	2.49	0.09	3.09	6.31	3.78	1.17	0.15	0.55	99.79	5.75	16.7	982	15	63	125	77	31	3.9	21.1	45	49	19	439	13	27	1.5	5	14	6.3	1.3	1.3
3	92-49	--	NW	SE	22	37	6	574420	4687100	Qawp	A	58.40	0.69	18.50	2.20	3.49	0.10	3.67	7.09	3.93	0.82	0.16	0.50	99.55	6.08	12.1	1254	13.1	48	138	21	39	2.4	20.1	41	56	21	321	16	28	--	--	14	--	1	0.9
4	92-46	--	NW	SE	21	37	6	572790	4687300	Qawp	A	58.82	0.68	18.33	2.60	3.18	0.10	3.48	7.10	3.90	0.80	0.17	0.53	99.69	6.13	9.8	1270	11.3	70	120	28	40	3	22.1	34	63	18	280	11.3	27.9	1.2	3.3	13.7	6.6	--	--
5	92-45	--	SE	NW	21	37	6	572290	4687570	Qawp	A	58.96	0.68	18.27	0.61	4.93	0.10	3.51	7.19	3.93	0.78	0.16	0.59	99.71	6.09	8.9	1294	11.3	68	127	28	33	3.2	22.3	19	58	18	275	12.9	30.4	1.2	3	14.6	4.9	--	--
6	92-82	1.13 +/- 0.02	SW	NE	10	37	6	574420	4690880	Qamh	A	57.34	0.60	19.10	1.87	3.89	0.09	3.90	7.55	3.60	0.98	0.10	1.04	100.06	6.19	14.4	800	13.2	44	136	36	43	2.9	20.8	62	57	21	303	9	16	0.7	3.4	17	5	0.8	1
7	92-83	1.36 +/- 0.04	NE	NE	10	37	6	574760	4691390	Qamh	A	58.54	0.65	18.84	2.89	2.75	0.08	3.05	7.11	3.86	1.04	0.12	0.80	99.73	5.95	18.3	788	15.1	55	134	24	16	2	19.1	65	44	20	376	9	20	1.4	4.1	17	5.9	1.3	1.3
8	98-72B	--	NE	SW	9	38	6	572550	4680780	Qbbp	B	50.89	1.04	19.16	4.98	3.54	0.14	5.26	8.16	3.21	0.76	0.21	2.64	99.99	8.91	9.7	622	21.9	89	205	82	113	5.9	19.7	45	83	30	315	12	24	0.7	<0.5	27	9	--	--
9	91-35	--	SE	NW	9	38	6	572570	4680960	Qbbp	B	51.88	0.99	18.46	2.38	5.54	0.13	5.79	9.21	3.67	0.71	0.20	0.84	99.80	8.54	11.5	705	19.9	71	196	64	98	3.7	18.9	126	72	32	298	--	32	0.6	1.1	24	--	--	--
10	91-36	--	SE	NW	9	38	6	572570	4680960	Qbbp	B	51.97	1.01	18.38	3.83	4.34	0.14	5.47	8.96	3.70	0.74	0.20	1.21	99.95	8.65	10.7	686	21	75	207	63	99	3.6	18.8	46	85	30	314	--	30	1.5	1.5	24	--	--	--
11	98-71	--	NW	NE	16	38	6	572910	4680080	Qbbp	BA	52.17	0.97	18.53	3.45	4.53	0.13	5.50	9.18	3.64	0.71	0.20	0.62	99.63	8.48	7.0	683	17.6	84	207	66	109	5.2	18.8	61	72	26	290	10	24	0.8	1.4	25	8	--	--
12	98-70	--	NW	NW	15	38	6	573580	4680000	Qbbp	BA	52.28	0.98	18.57	1.86	5.89	0.13	5.68	9.26	3.66	0.70	0.20	0.48	99.69	8.41	5.8	685	17.9	85	194	60	106	4.9	19.9	63	68	25	299	11	25	0.7	1.1	22	8	--	--
13	99-32	--	NE	NW	9	38	6	572350	4681670	Qbbp	BA	52.69	1.02	19.06	0.81	6.72	0.14	5.01	8.76	3.83	0.78	0.22	1.43	100.47	8.28	8.8	717	20.8	85	143	50	85	3.9	21.2	67	66	24	368	11	25	1.7	4.1	21	4	--	--
14	98-72A	--	NE	SW	9	38	6	572550	4680780	Qbbp	BA	52.84	1.03	18.75	1.95	5.69	0.14	4.65	9.30	3.73	0.80	0.23	0.74	99.85	8.27	9.3	690	19.5	94	221	40	85	5.6	20.9	62	77	22	320	12	25	<0.5	<0.5	25	9	--	--
15	98-65	1.12 +/- 0.07 ([a])	NE	NE	24	38	6	578040	4678370	Qbac	BA	54.18	0.87	18.89	7.92	0.21	0.12	4.69	8.07	3.87	0.77	0.17	0.38	100.14	8.15	6.1	756	15.2	70	173	44	67	4.2	19.2	57	73	22	278	7	27	1.8	0.9	21	8	--	--
16	92-48	0.86 +/- 0.02	NE	NW	22	37	6	574130	4687980	Qbaa	BA	54.69	1.01	17.44	3.25	4.54	0.14	4.60	7.30	3.86	1.05	0.39	0.92	99.19	8.30	17.1	606	26.8	140	167	69	102	8.2	20.7	67	84	28	494	23	43	0.6	3.5	21	7.1	2.1	1.3
17	92-27	0.47 +/- 0.04	SW	SW	26	37	6	575290	4685000	Qbaa	A	57.10	0.87	17.55	1.88	5.04	0.12	4.22	7.36	3.45	1.16	0.27	1.05	100.07	7.48	19.5	614	21.5	113	154	39	49	7.2	21.1	58	72	24	528	17	36	1.7	4.2	19	8.2	1.9	1.6
18	99-35	--	NE	NW	15	38	6	574010	4680060	Qbaa	BA	55.10	1.01	18.07	2.04	5.69	0.14	4.53	7.44	3.77	0.95	0.32	1.29	100.35	8.36	11.3	597	24.5	149	139	59	104	7.9	20.2	52	80	25	528	21	41	1.4	3.3	19	7	--	--
19	98-66	--	SW	NE	13	38	6	577630	4679500	Qbaa	BA	55.13	0.98	18.24	1.55	5.68	0.13	4.50	7.45	3.78	1.01	0.32	1.02	99.79	7.86	11.3	606	22.1	134	158	56	85	7.9	19.9	42	76	22	486	15	39	0.8	1	19	12	--	--
20	92-59	--	SW	NE	14	38	7	575950	4679610	Qbaa	BA	55.30	0.98	17.74	1.91	5.52	0.13	4.50	7.20	3.80	1.10	0.32	0.92	99.42	8.04	16.3	607	24.5	130	168	49	94	6.1	19.2	56	75	26	470	18	35	--	0.5	19	--	1.8	1.2
21	98-67A	--	SW	SW	1	38	6	576970	4681930	Qbaa	BA	55.35	0.93	18.10	7.77	0.14	0.14	4.31	7.16	3.91	0.98	0.30	0.78	99.87	7.93	9.2	585	21.3	129	95	65	123	7.2	19.0	47	80	21	457	16	39	1	1.1	20	11	--	--
22	99-56	--	NE	NE	31	37	7	579640	4684930	Qbaa	BA	55.36	0.80	18.53	1.80	4.98	0.12	4.55	7.91	3.78	0.99	0.24	1.28	100.34	7.33	11.4	807	18.9	116	179	51	95	6.8	20.4	66	74	22	403	14	36	2.2	4.2	22	6	--	--
23	98-67B	--	NW	NW	12	38	6	576940	4681640	Qbaa	BA	55.59	0.96	17.82	3.43	4.06	0.15	4.40	7.19	3.48	0.96	0.32	1.57	99.93	7.94	13.0	576	21.6	136	151	62	97	7.8	18.4	51	86	22	458	16	37	1	<0.5	21	11	--	--
24	99-36	--	NW	NE	15	38	6	574500	4679810	Qbaa	BA	55.86	0.97	17.95	1.74	5.69	0.14	4.43	7.39	3.87	1.08	0.32	0.76	100.20	8.06	12.9	613	22.5	130	171	56	95	6.5	19.5	56	81	23	457	14	31	1.2	3.3	21	8	--	--
25	92-31	--	SW	NE	27	37	6	574620	4686020	Qbaa	BA	55.89	0.92	17.86	1.86	5.41	0.12	4.51	7.35	3.71	1.15	0.31	0.88	99.97	7.87	19.1	593	20.7	155	144	50	87	8.1	19.2	51	72	18	504	19.6	42	1.1	1.4	19.6	8.4	--	--
26	92-58	--	SE	SE	2	38	6	576430	4682130	Qbaa	BA	56.01	0.93	17.67	3.10	4.21	0.13	4.28	7.18	3.78	1.02	0.34	0.69	99.34	7.78	17.7	601	22.1	128	165	60	92	6.2	18.7	43	81	23	462	16	34	1.1	1.1	22	8	--	--
27	99-59	--	NE	SW	8	38	7	580520	4680630	Qbaa	BA	56.05	0.98	18.10	2.52	5.11	0.14	4.23	7.10	4.03	0.97	0.30	0.88	100.41	8.20	12.1	625	25.8	130	133	55	96	7.4	20.0	66	73	22	431	22	38	1.6	3.4	20	7	--	--
28	92-50	--	NE	NE	27	37	6	574990	4686380	Qbaa	BA	56.07	0.98	17.55	1.86	5.56	0.14	4.44	7.20	3.81	1.14	0.34	0.74	99.83	8.04	18.3	581	25.3	150	166	48	108	7.3	19.1	58	77	26	505	23	45	1.1	1.2	19	--	2	1.3
29	99-34	--	SE	NE	4	38	6	573350	4682660	Qbaa	BA	56.18	0.96	17.75	1.45	5.88	0.14	4.26	6.96	3.87	1.12	0.32	1.45	100.34	7.98	16.6	576	24.6	146	139	56	103	7.5	19.5	61	77	22	507	19	40	1.4	3.5	19	6	--	--
30	92-56	--	SW	NW	1	38	6	576720	4682670	Qbaa	BA	56.34	0.96	17.55	1.66	5.46	0.13	4.14	7.11	3.52	1.29	0.35	1.01	99.52	7.73	22.0	567	23.5	161	160	51	69	9.2	18.6	46	80	24	544	19	43	<0.5	1	21	8	--	--
31	92-57	--	NE	NW	2	38	6	575520	4683050	Qbaa	BA	56.41	0.95	17.46	1.93	5.35	0.14	4.35	7.28	3.66	1.29	0.34	0.50	99.66	7.88	20.4	577	21.6	164	153	55	115	9.5	21	63	80	24	528	19.6	40.6	1.7	3.9	21.4	7.6	--	--
32	92-30	--	SE	SE	27	37	6	574890	4685260	Qbaa	BA	56.43	0.86	17.89	1.82	5.04	0.12	3.99	6.95	4.04	1.14	0.28	0.84	99.40	7.42	20.7	606	19.6	144	135	46	67	7.7	19.8	54	69	19	553	17.5	41.6	1.4	1.7	18.6	8.5	--	--
33	99-33	--	SW	SW	3	38	6	573840	4681940	Qbaa	BA	56.51	0.97	17.58	2.07	5.27	0.14	4.22	7.10	3.83	1.16	0.34	1.06	100.25	7.93	17.9	566	26.9	155	144	53	101	8.6	19.5	61	76	20	531	27	44	1.2	2.5	20	7	--	--
34	92-51	--	SE	SE	22	37	6	574880	4686850	Qbaa	BA	56.60	0.96	17.75	3.08	4.46	0.13	4.40	7.18	3.91	1.05	0.32	0.43	100.27	8.04	16.7	605	24.2	126	164	49	96	6.3	18.8	71	78	26	477	19	39	--	0.5	19	--	1.9	1.2
35	92-52	--	NW	SW	23	37	6	575080	4687370	Qbaa	BA	56.60	0.97	17.84	2.58	4.94	0.14	4.36	7.15	3.93	1.06	0.33	0.48	100.38	8.07	18.1	604	23.8	126	164	49	96	5.7	18.7	42	80	26	483	20	39	0.6	--	18	--	2	1.2
36	92-29	--	SW	SW	26	37	6	575070	4685090	Qbaa	BA	56.64	0.86	17.96	1.96	4.93	0.12	4.02	7.09	4.41	1.15	0.28	0.59	100.01	7.44	21.8	601	20.2	144	129	44	68	6.1	18.7	56	68	18	510	16.7	41.5	2.6	2.6	19.6	9.1	--	--
37	92-28	--	SE	SW	26	37	6	575460	4685320	Qbaa	Di	56.90	0.85	17.92	1.86	4.98	0.11	3.96	7.34	3.93	1.11	0.27	0.69	99.92	7.39	21.3	620	16.1	122	117	41	56	6.7	20.1	60	60	17	541	14.4	42.6	2.4	2.4	16.2	9.8	--	--
38	94-1	--	SE	SW	26	37	6	575460	4685220	Qbaa	Di	57.45	0.86	17.96	1.57	4.99	0.12	3.81	7.08	3.74	1.15	0.27	0.77	99.77	7.12	23.7	606	19	133	146	46	46	6.3	19.1	46	62	20	548	15	32	1.2	0.6	16	9	--	--
39	95-43	--	NE	NW	35	37	6	575800	4684800	Qbaa	A	57.62	0.86	17.78	1.64	4.88	0.12	4.06	7.10	3.72	1.23	0.27	1.24	100.52	7.06	21.2	609	17.5	133	154	50	61	7.8	19.6	57	74	19	502	15	43.6	1.4	2	17.6	10.3	--	--
40	05SM-14	0.84 +/- 0.09 ([a])	SE	NW	21	37	7	582110	4687470	Qbdc	B	48.34	1.11	17.27	1.35	8.32	0.17	8.82	10.59	2.51	0.14	0.13	0.89	99.64	10.60	2.7	331	24.0	65	214	158	178	2.3	18.1	121	64	46	102	5	12	<0.5	0.6	34	1	--	--
41	99-57	--	NE	NW	21	37	7	582000	4688190	Qbdc	B	47.82	1.14	17.46	1.49	8.48	0.18	8.90	10.69	2.77	0.17	0.11	1.24	100.45	10.91	<0.5	345	26	75	202	157	235	3.2	17.8	94	67	44	193	7	7	1.5	1.8	29	3	--	--
42	99-58	--	SW	SW	9	37	7	581630	4690190	Qbdc	B	47.89	1.11	17.76	2.62	7.34	0.18	8.61	10.87	2.76	0.15	0.11	0.94	100.34	10.78	<0.5	347	25.8	76	194	164	224	3.4	17.7	99	66	43	103	4	10	<0.5	2.8	28	3	--	--
43	05SM-13	--	NE	NE	17	37	7	581300	4689650	Qbdc	B	48.17	0.98	17.36	1.45	8.13	0.18	9.08	10.78	2.38	0.12	0.12	0.81	99.56	10.49	2.9	330	24.2	56	211	167	190	1.8	17.3	110	62	48	203	6	14	<0.5	1.1	34	<1	--	--
44	99-55	--	SE	NW	21	38	7	582160	4678110	Qbrl	B	49.05	1.46	17.11	4.48	6.43	0.18	7.37	9.17	3.29	0.38	0.24	0.94	100.10	11.63	1.5	411	29.5	109	208	138	277	5.5	19.1	62	83	41	204	6	20	0.9	2.5	27	3	--	--
45	99-54A	--	NE	SW	16	38	7	582180	4679060	Qbrl	B	49.36	1.43	17.15	11.51	0.06	0.18	6.58	9.17	3.42	0.40	0.22	0.53	100.01	11.58	4.0	392	32.2	106	172	120	276	5.3	19.0	68	89	40	184	10	16	1.7	3.4	32	4	--	--
46	99-54B	--	NE	SW	16	38	7	582180	4679060	Qbrl	B	49.88	1.47	17.24	11.62	0.05	0.18	5.92	9.33	3.43	0.44	0.21	0.46	100.23	11.68	4.6	395	32.6	109	167	111	261	4.8	18.8	76	91	41	177	7	20	0.7	3.3	30	4	--	--