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PRELIMINARY GEOLOGIC MAP OF THE COBURG 7.5′ QUADRANGLE, LANE AND LINN COUNTIES, OREGON

By

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Preliminary Geologic Map of the Coburg Quadrangle, Lane and Linn Counties, Oregon.

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Introduction

The Eugene-Springfield urban area is Oregon's second largest, and is home to a large and rapidly growing population. The adjacent cities of Eugene and Springfield have a combined 2000 population of over 190,000, and a growth rate over the preceding ten years greater than 20%. Population growth and development have also been rapid in the small towns and rural areas around the two major cities. Managing growth and development requires good geologic information for engineering, to manage landslide, flood and erosion hazards and to properly develop and regulate the heavily used groundwater resources. Existing geologic mapping for the area is poor, and new, detailed 1:24,000 scale maps complete with subsurface information are needed in the entire Eugene-Springfield urban area. In 2001, the Oregon Geologic Map Advisory committee selected the Eugene-Springfield urban area as a priority for new mapping. This map is a product of the resulting multi-year mapping study, carried out by the Oregon Department of Geology and funded by the State of Oregon and the U.S. Geological survey through the STATEMAP portion of the National Cooperative Geologic Mapping Program under assistance award #03HQAG0070. "*The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government*."

The study area is located (Figure 1) at the southern end of the Willamette Valley in western Oregon. The area straddles the Linn County- Lane County line, and includes the City of Coburg, part of the Willamette Valley floor and adjacent Coburg Hills. The area includes intensively farmed lands in the Willamette Valley, and privately owned timberland and rural residential areas in the hills.

Methods

This geologic map was prepared using a wide range of data, including existing mapping, new field observation, water well data, high-resolution topographic data, aeromagnetic data, oil industry test wells and seismic lines, geochemistry, geochronology, petrography and air photo interpretation. The spatial distribution of the various data sets is depicted on the map (Plate 1) and several datasets are included as digital appendices.

The quadrangle is covered by numerous geologic maps, most of which are regional compilations at scales of 1:100,000 to 1:250,000 (Peck and others, 1964; Peck, 1960; Walker and Duncan, 1989; Yeats and others, 1991, O'Connor and others, 2001). All of these are largely based on the one original map of the area, which was published at 1:62,500 (Vokes and others, 1951). Little new fieldwork has been done since 1951. A MS thesis map at a scale of 1:62,500 covers most of the map area (Lewis, 1950).

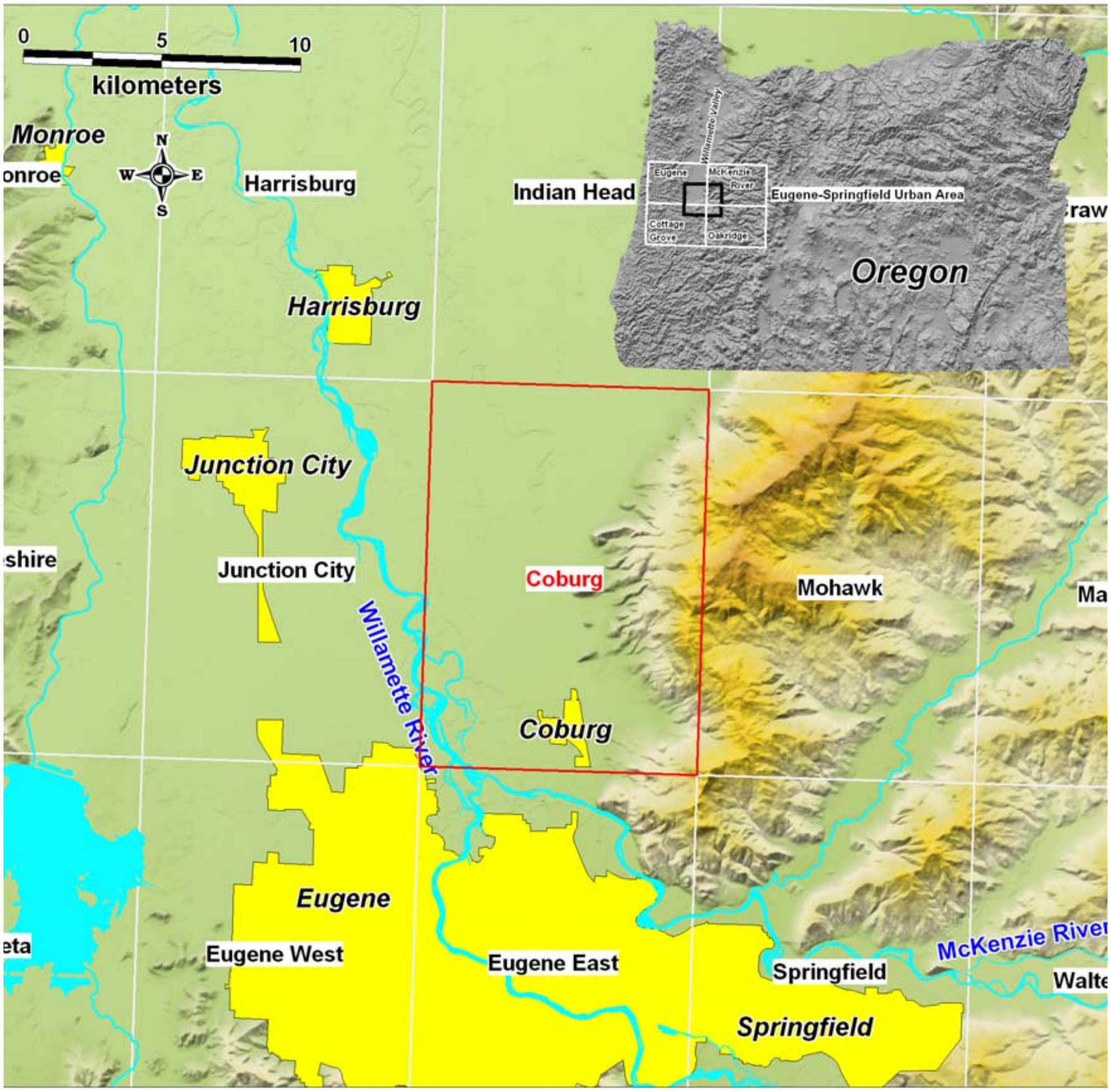

Figure 1. Location Map. Red-bordered quadrangle presented in this report.

New field data was collected throughout the Coburg Hills area, where relatively steep slopes and numerous logging roads provided reasonable exposure. Little field data was collected on the valley floor, where thick soils and intensive agriculture obscure the geology. Contacts were rarely observed, but it was relatively easy to find exposure that allows identification of lithology. Mapping was complicated by severe weathering or hydrothermal alteration of most of the rocks. Although the vast majority of the area is private land, it was possible to negotiate access for most parcels. The data map on Plate 1 shows the traverses made and the location of field stations. Field station locations along with brief notes are included in the data appendix. Outcrop photos are also included in the appendix, keyed to field stations. Several hundred samples were collected and described using a binocular microscope, and 22 samples were prepared for thin sections. Scanned images of the thin section are included in the appendices.

Over 170 water wells were located using digital taxlot data and in some cases GPS. Well locations, along with location method and estimated spatial accuracy are provided in the data appendix. Logs for all the located wells are available online at the Oregon Water Resources Department.

Explanation of Units

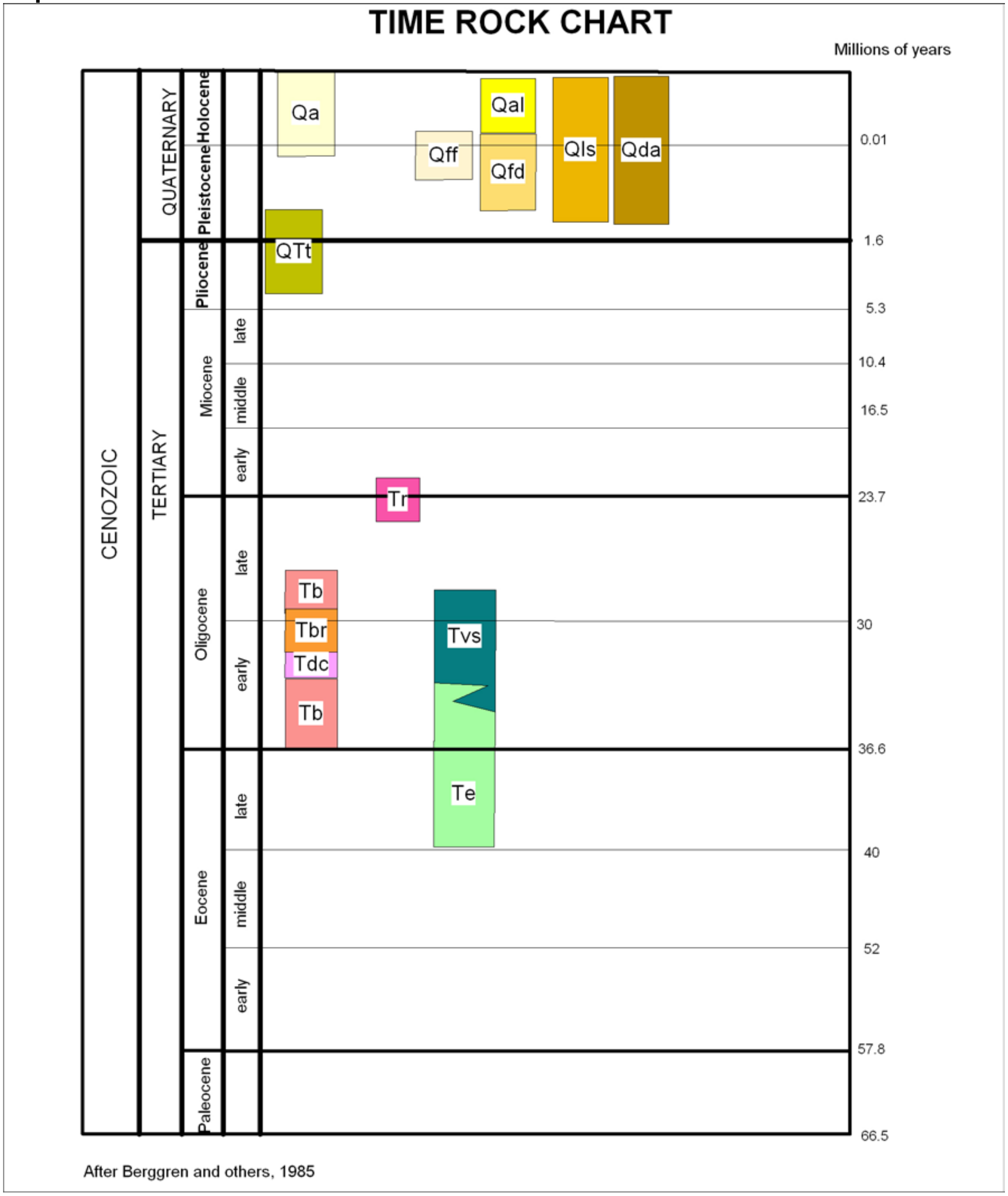

Figure 2. Time-rock chart showing age relations between units.

A high-resolution aeromagnetic map provided by Rick Blakeley of the USGS proved to have strong correlations with the distribution of normal and reversely magnetized basalt flows in the area. The aeromag map is included on Plate 1.

Selected volcanic rocks were analyzed for major and trace element chemistry by XRF. Analyzed samples are plotted on the map, and the chemical data presented in spreadsheet format in the data appendix. Samples were analyzed by XRD by Dr. Stan Mertzman at Franklin and Marshall College. The whole-rock analyses for major and trace elements were performed using a Phillips 2404 X-ray fluorescence vacuum spectrometer equipped with a 102 position sample changer. The Loss on Ignition (LOI) was determined by heating accurately pre-weighed amounts of sample rock powder to 950^{o} C for one hour, and then reweighing the sample to determine the relative percentage of weight gain and loss. The amount of ferrous Fe was titrated using a modified Reichen and Fahey (1962) method.

Two samples from just off the edge of the quadrangle were submitted for Ar^{39}/Ar^{40} dating at the Geochronology facility at Oregon State University. A detailed description of the methodology and the Ar^{39}/Ar^{40} spectra are provided in the appendices.

The paleontology of the Eugene area, and the Eugene Formation in particular has been well studied and documented. No new paleontological studies were carried out for this map. Published fossil locations from Vokes and others (1951) are plotted on the map. A data file linking the plotted points to sample locations in the references is provided in the appendix. Additional paleontologic data is presented in Retallack and others (In press).

Seismic reflection lines collected by Mobil Oil Corporation were used to infer subsurface geology beneath the Willamette Valley. Approximate line locations are shown on the data map on Plate 2, and approximately scaled interpretive diagrams of major reflector packages are shown on plate 2.

Digital soils data from the NRCS (NRCS 2004) was used to interpret Quaternary sedimentary units on the Willamette Valley floor.

Explanation of Units

Qa Fine Grained Alluvium—(Holocene)

Sand silt, clay and minor gravel deposited by local streams draining the Coburg Hills and the Willamette Valley floor at the foot of the hills. Boundaries largely drawn following NRCS 2004. Thickness does not exceed 25 ft (8m).

Qal Meander-belt Alluvium—(Holocene)

Sand, silt and gravel deposited in the active meander belt of the McKenzie River. The meander belt is incised into the surface of the underlying fan-delta, and represents a shift from braided channel morphology during the most recent glaciation in the Cascade Range to incision and meandering during the current interglacial. Mapped by O'Connor and others (2001) as unit Qalc which they considered Holocene in age. They report C 14 ages from the Wildish Gravel pit (Section 8 T 17S R 3W on the adjacent Eugene East quadrangle) ranging from modern at the surface to 0.53 ka at a depth of 4 ft (1.2m) to 3.7 ka from a depth of 4m. Mapped on the basis of the relatively sharp edge to meander belt geomorphology, generally marked by a steep cutbank. The boundary is somewhat indistinct southwest of Coburg. Water wells drilled in Qal show a varied sequence of sand, clay and gravel, which are typically difficult to distinguish in drillers logs from the underlying unit Qfd sand and gravel. Data from a few wells suggest that the Qal deposits are 15-25 ft (5-8 m) thick.

Qff Missoula Flood Deposits—(late Pleistocene)

Silt and clayey silt deposited during catastrophic floods caused by the repeated failure of the glacial ice dam that impounded glacial Lake Missoula (Bretz and others, 1956; Baker and Nummedal, 1978; Waitt, 1985; Allen and others, 1986). Date of most recent catastrophic flood is estimated to be 15,500 to 13,000 years B.P. (Mullineaux and others, 1978; Waitt, 1987). Flood deposits are mapped largely on the basis of interpretation of soils maps (NRCS 2004), and no good exposures of the unit were seen in the map area. Sparse water well data suggest that the thickness is a maximum of 20 ft (6m). In other areas with better exposure, flood deposits are predominantly mica bearing quartz silt, and display rythmic bedding, with fining upwards sequences 2-12 in (5-30 cm) thick and thin capping paleosols.

Qfd Fan-delta Alluvium—(Quaternary)

A broad fan of sand and gravel deposited by the Willamette and McKenzie rivers in the head of the Willamette Valley. Fan-delta sediments range from silt to boulder gravel, but are predominantly sandy pebble-cobble gravel. Mapped by O'Connor and others (2001) as units Qg1 and Qg2, this study finds only one depositional landform in the form of a large subtle fan centered on the adjacent (to the SW) Eugene East and West quadrangles. Exposures in gravel pits just SW of the map area (O'Connor, and others 2001) include lahars and tuffs. Obsidian in lahar from about 90 ft (30m) below the surface returned an Ar^{39}/Ar^{40} date of 418 +/-10 ka and 426 +/- 4 ka (O'Connor and others, 2001). Wells in the map area penetrate more than 370 ft (112 m) of gravel with minor sand and clay interbeds up to 45 ft (15m) thick. Wells in the adjacent Eugene East quadrangle penetrate up to 475 ft (145 m) of gravel, sand and clay, but it is not obvious that this entire thickness is part of unit Qfd. It is possible that part of this gravel is a remnant of older terrace gravels.

Figure 3. View west of ca 15 ft (5 m) high antithetic scarp (faces uphill) bounding headwall graben in large landslide complex.

Qls Landslide deposits—(Quaternary)
Unconsolidated masses of rock and colluvium deposited by landslides. Age uncertain, likely Pleistocene or early Holocene. Numerous large slide complexes originate high on the W face of the Coburg Hills, commonly creating steep headwall scarps, and slide masses marked by springs, ponds, irregular topography, and scarp and bench topography. Many of the slides originate along the tuff of Daniels Creek (unit Tdc), and others probably occur on hydrothermally altered zones in unit Tb and Tbr. Individual slides cover up to 0.75 mi 2 (2 km 2) and are up to 1.2 miles (2km) long and over 800 ft (245 m) high. These very large slides typically grade downslope into broad fans of debris avalanche deposits (unit Qda, described below) suggesting that the initial failures were rapidly moving. Fresh scarps on some slides indicate that parts are still active.

Qda debris avalanche deposits—(Quaternary)
Chaotic unconsolidated deposits of rock fragments ranging in size up to boulders larger than 1m in a matrix of clay . These deposits from distinctive fans at the toes of major landslides and are thought to represent debris avalanche deposits produced during the initial catastrophic failures of the major slides. Numerous water wells on these deposits penetrate up to 90 ft (27m) of boulders and clay, and the surfaces of the deposits are strewn with large blocks predominantly of basalt, with minor tuff.

Qt terrace deposits—(Quaternary)
Sandy silty pebble boulder conglomerate deposited by the early Willamette River or tributary. Forms a terrace surface with a base about 80 ft (25 m) above the valley floor. Clasts are predominantly basalt, rounded to subrounded and moderately cemented. The deposit is approximately 40 ft (12 m) thick, and may have been reworked from the toe of the adjacent Qda deposit to the east.

Tr rhyolite flow and breccia (Oligocene)
Rhyolite occurs in a small body along the southern edge of the quadrangle and is part of a much larger body on the adjacent Eugene East quadrangle. Typically chalky gray with abundant phenocrysts of plagioclase, lesser quartz and pyroxene, and trace biotite in a fine-grained crystalline matrix. Phenocrysts are subhedral to euhedral, rounded, seriate ≤ 3 mm, and variably altered. Fresh samples are dark gray, glassy. Locally brecciated. Thickness approximately 200 ft (60 m) in the map area, up to 525 ft (160 m) on the adjacent Eugene East quadrangle. Age based on position above 31.3 +/- 0.6 Ma Tuff of Spores Point (Retallack and others, 2004) and 31.1 +/- 0.9 Ma basalt on adjacent Eugene East quadrangle.

Tb/Tbr basalt flows—(Oligocene)
Numerous flows of olivine and pyroxene phyric basalt. Basalt is typically medium grained with seriate, moderately pilotaxitic plagioclase and common pyroxene and olivine phenocrysts to 1-2mm in diameter (Figure 4). Olivine and pyroxene phenocrysts typical altered to chlorite and smectite even in the freshest rock. Basalt flows are typically black to gray where fresh, ranging from massive to blocky jointed to columnar jointed (Figure 5-8). Flows are typically vesicular near flow tops. Most exposures are soft basalt that is brown, white, tan purple and red in color, and largely replaced by clay, either due to hydrothermal alteration, severe weathering, or both. Figure 7 shows a contact between two flows, with severe alteration restricted to the top of the lower flow suggesting weathering. Figure 8 shows a near vertical walled zone of intense alteration in otherwise fresh blocky jointed basalt that suggests hydrothermal alteration.
The basalt flows occur in two distinct configurations. On the upper slopes of the Coburg Hills, there is a thick sequence of flows with rare sediment or tuff interbeds, probably

erupted from a series of coalescing shield volcanoes. At the foot of the Coburg Hills there are several thick bodies of limited area that have been interpreted as intrusions by previous authors, but are most likely canyon filling flows. The most pronounced of these occurs at West Point, where a pelagonite matrix basalt fragment tuff underlies the coarsely columnar jointed flow. An analogous basalt body just S of the southern edge of the quadrangle at Spores Point was recently found to have alluvial pebbles plastered along the contact between the basalt and adjacent sandstone, confirming its origin as a canyon fill. We infer that the other minor basalt bodies at the base of the hills are also canyon fills.

Flows near the top of the Coburg Hills, above the Tuff of Daniels Creek, commonly had reversed magnetic polarity as measured with a fluxgate magnetometer and were associated with a pronounced negative aeromagnetic anomaly (Plate 2) and were therefore mapped as unit Tbr. Flows below the Tuff of Daniels Creek typically had normal magnetic polarity and were mapped as unit Tb. Flows for which polarity was not mapped were lumped with unit Tb. A few normal flows occur above the Tuff of Daniels creek at the SE corner of the map, and are associated with a strong positive aeromagnetic anomaly, suggesting that the flows of unit Tbr thin to the south.

Geochemically, the basalt flows are all true basalts according to the Le Bas and Streckeisen classification (Figure 10), and are tholeiitic basalts according to the Irving and Barager AFM diagram (Figure 11). Geochemistry for the basalts of unit Tb/Tbr is presented in spreadsheet form in the Appendix. The normalized values below are typical.

Specimen	SIO2N	TIO2N	AL2O3N	FE2O3N	FEON	MNON	MGON	CAON	NA2ON	K2ON	P2O5N
EW-616	50.89	1.11	16.36	4.26	5.15	0.16	6.59	10.61	2.26	0.64	0.22

The age of the basalts is Oligocene, and is bracketed by two recent $^{40}Ar/^{39}Ar$ dates on unit Tb flows from just outside the quadrangle. EW-616 was located just east of the quadrangle (UTM Zone 10 NAD 27 coordinates E 500443, N 4891882) and has a weighted plateau age of 31.39 ± 0.38 Ma. This sample is from near the top of the Tbr section. A second sample, 03RM-351 from the base of the Tb section Eugene East quadrangle (UTM Zone 10 NAD 27 coordinates E 497008, N 4884467) has a weighted plateau age of 31.12 ± 0.93. Although nominally the top of the section dates older than the base, the ages are indistinguishable at the reported uncertainty.

Peck and others (1964) grouped these rocks with the Little Butte Volcanics, and the age and lithology of unit Tb is consistent with the early Western Cascades volcanic episode of Priest and others (1983).

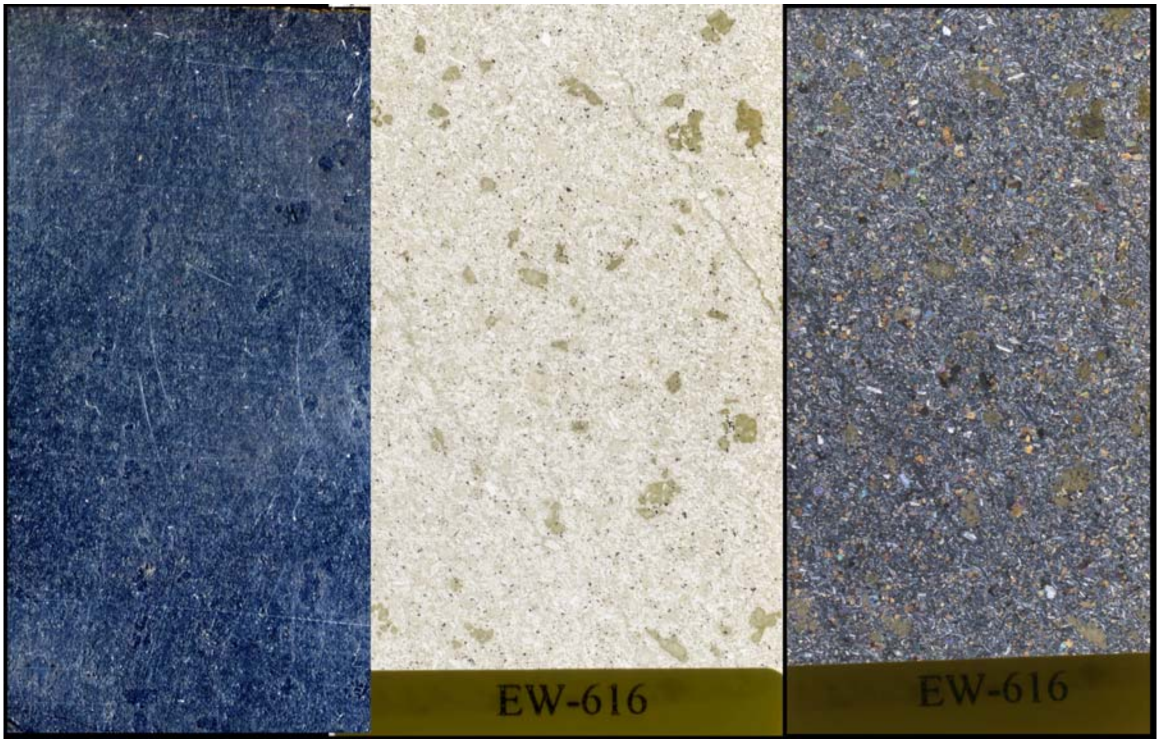

Figure 4. Petrographic image of Unit Tb basalt. Polished billet left, thin section under plain light center, thin section under crossed polars right. All images 4 cm by 2 cm.

Figure 5. Photo of unit Tb basalt in quarry. This flow is a canyon filling flow with well developed columnar jointing.

Figure 6. Severely weathered or hydrothermally altered blocky jointed basalt.

Figure 7. Contact between two basalt flows. Upper blocky jointed flow is relatively fresh, underlying flow has rubbly vesicular top that is soft, altered to clay voids filled with zeolites, overlain by about 1m of red basalt completely altered to clay with relict olivine and pyroxene phenocrysts visible.

Figure 8. Quarry exposures of fresh black basalt (on left) with 100 ft (30 m) wide vertical walled zone of purple-gray hydrothermally altered basalt.

Figure 9. Pelagonite matrix basalt block breccia at the base of canyon filling Tb flow at West Point.

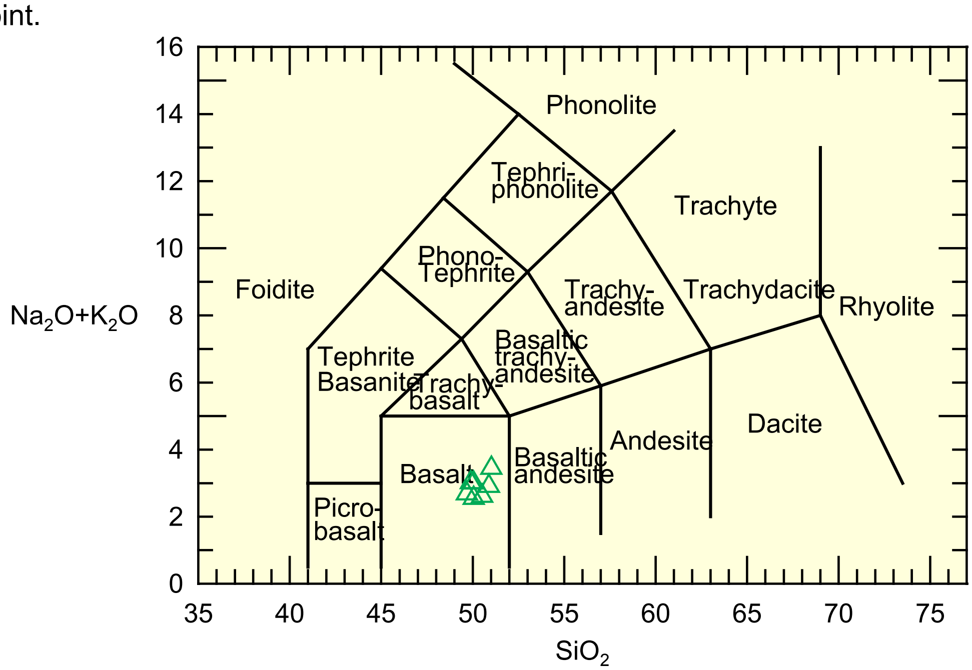

Figure 10. Le Bas and Streckeisen TAS classification for units Tb/Tbr.

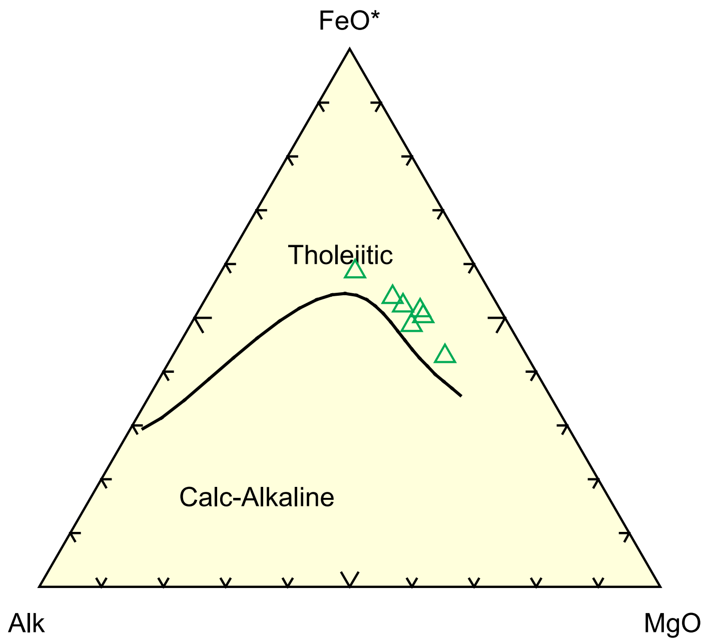

Figure 11. Irving and Barager AFM diagram.

Tuff of Daniels Creek—(lower Oligocene)

Silicic ash fall tuff present is a continuous layer near the top of the Coburg Hills. Two tuffs are included in the unit, with the lowermost always present, and the upper widely variable in thickness. The lowermost unit consists of massive welded tuff, with a matrix of recrystallized ash, polymict lithics to 1-2 cm, flattened pumice fragments up to 10 cm, abundant zoned, twinned and fractured rounded plagioclase to 2 or 3 mm, common rounded euhedra of quartz to 1-2 mm and some green clinopyroxene needles to 2 mm long (Figure 12, 13). The lower tuff typical forms massive outcrops (Figure 14), and is white to pale green where fresh, weathering tan to red-brown.

The upper tuff is non-welded, and has a matrix of partially recrystallized ash, with many relict shards visible. Lithics are common to 4 cm, as is pumice to 6 cm. Rounded, twinned and fractured plagioclase crystals to 1-2mm are abundant. Quartz is common as rounded and cariously eroded subhedral to 2 mm, pyroxene is common as fresh euhedra to 1 mm and magnetite is common as equant subhedral to 1 mm (Figure 15, 16). In outcrop, the upper tuff is massive and white, and at one site just off the NE edge of the quadrangle includes a carbonized fossil tree in growth position (Figure 17). Locally the two tuff units of the Daniels Creek are separated by a mud-flow breccia layer several meters thick.

Throughout the map area, the tuff of Daniels Creek is closely associated with the prominent aeromagnetic low at the base of the magnetically reversed unit Tbr, and the tuff also appears to be the horizon of failure for many of the major landslides along the rangefront. Locally, a mudstone bed greater than 30 ft (10m) thick was observed between the base of the tuff and the underlying Tb lava, which might also contribute to landslides.

Retallack and others (2004) correlated the tuff of Daniels Creek with the tuff of Mosser Mountain of Hladky (1992) and Murray (1994), largely on the basis of age. However the tuff of Mosser Mountain does not contain quartz, and is markedly different from the tuff of Daniels Creek according to Hladky and McCaslin, (2004). Therefore we use the local name Daniels Creek for this distinctive tuff, and have not made an effort to correlate to other tuffs regionally. We note that the occurrence of quartz phenocrysts is fairly rare in Western Cascade tuffs, and this unit may serve as a useful local or regional marker. Retallack and others (2004) dated the "Mosser Mountain" tuff at one site in the quadrangle (approximate coordinates UTM Zone 10, NAD 27 E 498868, N 4891781). The reported $^{40}Ar/^{39}Ar$ age is 32.3 +/- 0.6 ma. Although this age is consistent with the age of 31.4 +/- on unit Tbr, it is older than the underlying unit Tb age of 31.1 +/- .9 Ma and the underlying tuff of Spores Point (on the Eugene East quadrangle) at 31.3 +/- 0.6 Ma. However all of these ages overlap at the reported uncertainty.

Figure 12. Lower Tuff of Daniels Creek

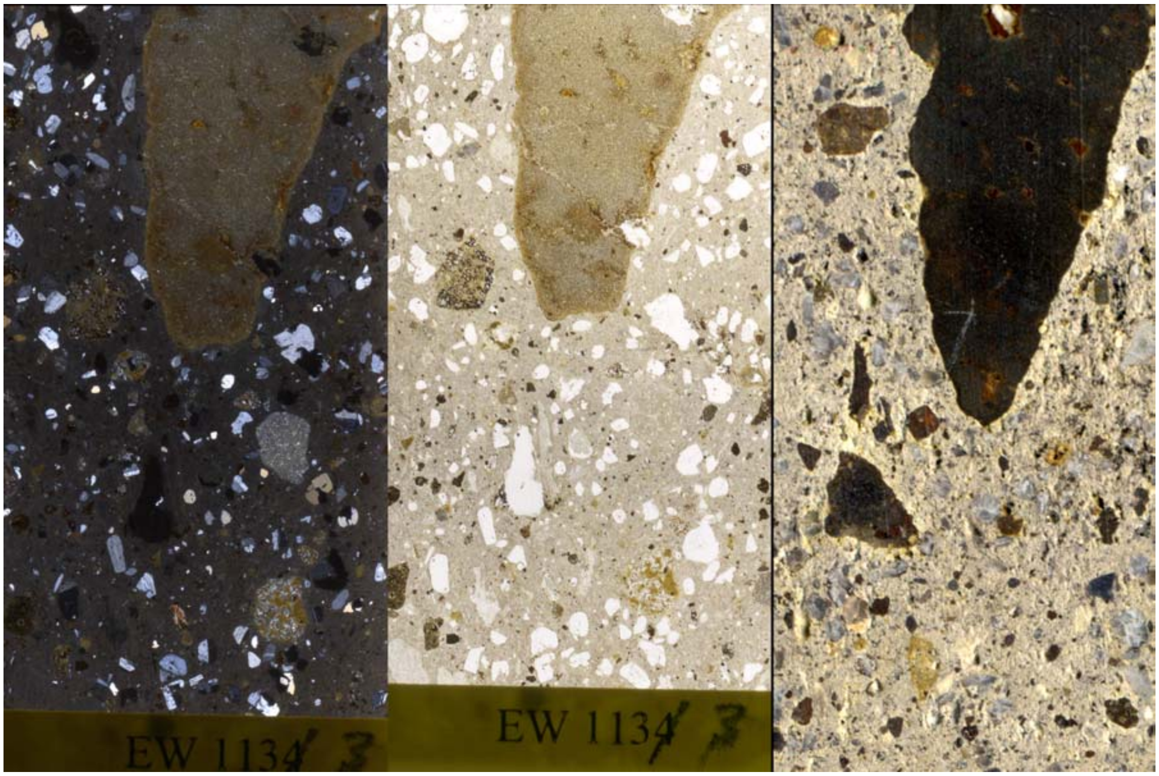

Figure 13. Petrographic Image, Lower Tuff of Daniels Creek, polished billet right, petrographic slide, plain light center, petrographic slide, crossed polarizers left.

Figure 14. Lower tuff of Daniels Creek.

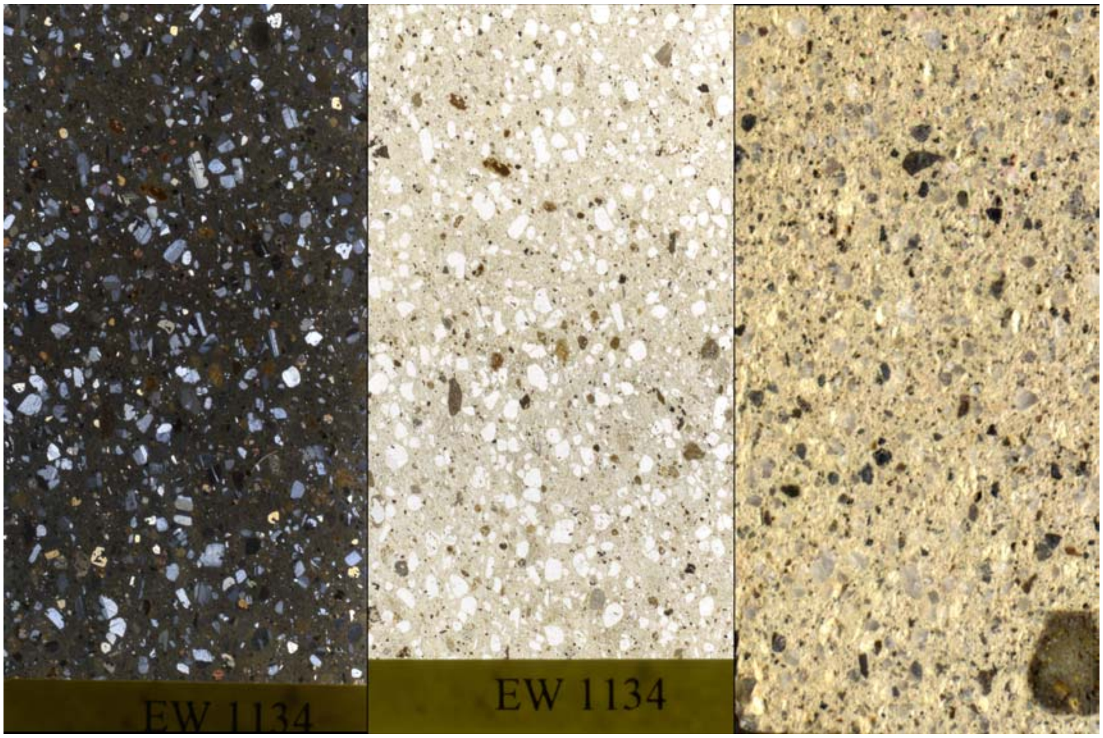

Figure 15. Petrographic Image, upper Tuff of Daniels Creek, polished billet right, petrographic slide, plain light center, petrographic slide, crossed polarizers left.

Figure 16. upper Tuff of Daniels Creek.

Figure 17. Carbonized tree fossil in growth position in upper tuff of Daniels Creek.

Tvs volcaniclastic sedimentary rocks—(lower Oligocene)
Volcaniclastic sedimentary rocks interbedded with volcanic flows and marine sedimentary rocks in the Coburg Hills. Predominantly massive mudflow breccia, muddy tuffaceous pebble-cobble conglomerate and tuffaceous pebbly sandstone and mudstone, with lesser amounts of tuff. Some exposures thin-bedded, but more typically crudely bedded or massive (Figures 18, 19). Locally includes carbonized plant material. Differentiated from underlying Eugene Formation sandstone by poor sorting, angular clasts, lack of marine fossils or glauconite and abundance of volcanic lithic clasts. The

volcaniclastic sedimentary rocks are typically strongly to severely weathered, and are many of the clasts are commonly completely converted to clay. The rocks are tan, white, red, red brown, purple brown and gray brown in color.
At several locations, the volcaniclastic sedimentary rocks are interbedded with Eugene Formation sandstones, but in general they overlie the Eugene Formation. In the southeast corner of the map, the volcaniclastic rocks are also interbedded with unit Tb basalt flows.

Figure 18. Unit Tvs mudflow breccia.

Figure 19. Unit Tvs mudflow breccia.

Descriptively similar to the terrestrial volcaniclastic rocks of the Fisher Formation on the adjacent Eugene East and West Quadrangles, they are here mapped separately because of their stratigraphic position at the top of the Eugene Formation. Correlates to the volcaniclastic sedimentary rock unit (unit Tos) of Madin and Murray (2004) on the adjacent Eugene East quadrangle.

Te Eugene Formation—(late Eocene-early Oligocene)
Shallow marine sandstone and siltstone with local/minor thin conglomerate beds. Predominantly thick bedded to massive (Figure 20) arkosic sandstone with glauconite and some mica, some is tuffaceous with matrix composed of glass shards. Typically tan to brown or white. Natural outcrops are rare, and the sandstone is generally soft and weathered, with weathering induced fabric that completely obliterates original bedding (Figure 21). Locally interbedded with unit Tvs volcaniclastic rocks near the top of the section. Commonly fossiliferous, see Vokes and others (1951) for descriptions of fossil assemblages from the map area.
Age is late Eocene to early Oligocene, bracketed by underlying tuff of Fox Hollow ($^{40}Ar/^{39}Ar$ age 41.0 +/-0.06 Retallack and others (2004)) on the Eugene West quadrangle some 20 km SW, and the overlying unit Tb basalt flows and tuff of Daniels creek.

Figure 20. Massive fine-grained quartzo-feldspathic sandstone of the Eugene Formation.

Figure 21. Spheroidally weathered Eugene Formation quartzo-feldspathic sandstone.

Structure
The first order structure of the area is gently NE dipping homocline. The oldest rocks are exposed at the foot of the Coburg Hills and the youngest rocks at the top of the Hills. This regional structure is cut by a few E-W trending faults and modified by a few N trending open folds along the base of the Coburg Hills. In the subsurface beneath the Willamette Valley floor, industry seismic lines indicate overall flat lying to slightly south dipping strata to depths of over 6500 ft (2000 m) with small areas of more intense folding which may be associated with faults.

In the Coburg Hills, good exposures for measuring bedding attitudes were rare, but overall topography and the behavior of contacts suggest that the strata in the Coburg Hills dip slightly to the east. Along the foot of the hills, where bedding in the Eugene Formation and volcaniclastic sediments was more commonly exposed, dips indicate a set of gentle N-S trending anticline-syncline pairs. These structures are defined on the basis of a relatively few dips, and may be artifacts of poor exposure and limited data. The Coburg Hills section is cut by three E-W trending faults, all likely to be strike slip. The northernmost Putnam Creek fault is a major structure. The fault plane was exposed in a borrow pit, where a 35 m wide vertical E-W trending shear zone in unit Tb basalt (Figure 22).


Figure 22. Putnam Creek fault, views looking east. On left view of central part of vertical shear zone in basalt, on right close up of sheared basalt.

The fault is associated with a major topographic escarpment to the east of the quadrangle, where an enormous landslide complex has its head along the north side of the fault. The front of the Coburg Hills steps back to the east across the fault at least 3 miles (5 km), and reconnaissance mapping on the N side of the fault encountered only distinctive coarsely pyroxene phyric basalts that were not seen anywhere south of the fault. The fault is also associated with a strong E-W aeromagnetic lineament. On the basis of the vertical shear zone, and eastward step of the range front, we infer that the fault is a right lateral strike slip fault. Deformation visible at the north end of seismic line 77M-24 (Plate 2) may be the westward extension of this fault. It is not apparent further W on seismic line 77M-23.

Another minor E_W trending fault crosses the crest of the Coburg Hills near the middle of the quadrangle. It offsets the tuff of Daniels Creek by 100-150 ft (15-30 m) S side down, and is associated with an aeromagnetic lineament and a topographic step of 200-300 ft (60-90 m) just east of the quadrangle.

A third minor E_W fault is inferred in the southeast corner of the map on the basis of aeromagnetic lineaments and apparent offsets of the tuff of Daniels Creek and several thin basalt flows. Exposure in this area was poor, and the existence of the fault is not certain.

Beneath the valley floor, the easternmost of the two N-S seismic lines (77M-24, Plate 2) shows a zone of ill-defined anticlinal deformation near the N edge of the quadrangle that may be associated with the Putnam Creek Fault. Yeats and others (1991) interpreted this deformation as part of the Pierce Creek fault, a NNE trending structure defined on the basis of interpretation of three seismic lines, including 77M-24 and 78M-65. However the fault is unambiguous only in a line several Km north of the quadrangle, and is in our opinion ambiguous on M77-24 (and possibly associated with the Putnam Creek fault) and absent on 78M-65 (where it should cross just W of the Mobil Ira Baker well). Proceeding S on line M77-24, the reflectors dip gently S, steepening at the southern end of line. On the westernmost of the two N-S lines, M77-23, the north end of the section shows mostly flat lying reflectors, but there is a zone of anticlinal deformation near the south end. The E-W line, 78-M65 shows generally flat lying reflectors.

There is some debate over the origin of the dramatic range front of the Coburg Hills, which rises almost 3000 ft (900 m) above the flat valley floor. Vokes and others (1956) drew a short N-S fault along the foot of the hills near West Point, and Retallack and others (2004) drew a N-S fault near the south end of the hills, based on correlations of the tuff of Spores Point. We found no evidence for a N-s trending fault along the Coburg Hills. We were unable to find any rocks that matched across the likely fault trace, in particular the over 1200 ft (400 m) thick section of basalt flows and tuff that makes up the top of the hills is clearly not repeated. We also saw no evidence in the aeromagnetic data (Plate 2) that is clearly very sensitive to the magnetic signal of the lavas at the surface, and should strongly reflect any significant fault.

Instead, we believe that the escarpment is present because it represents the position of the Eocene-Oligocene shoreline, and the transition from shallow marine deposition of Eugene Formation sandstone to the west, and terrestrial volcaniclastic and tholeitic shield volcanoes to the east. The more easily eroded marine sediments have worn away to leave the Willamette Valley floor, and the more resistant volcanics stand as the Coburg Hills front

Geologic History

The geologic history exposed in the map begins in the late Eocene with the deposition of Eugene Formation sandstones in a shallow sea. The provenance of the sandstone suggests that the basin was receiving sediment from a plutonic/metamorphic source, perhaps the Klamath Terrane to the south or the Idaho Batholith to the east. As sea level fell in the Oligocene, the terrestrial volcaniclastic sediments began to be interbedded with the Eugene Formation sandstones, probably as canyon fills. At the same time, basalt flows traveling down canyons in the Eugene Formation formed the basalt outliers that dot the foot of the Coburg Hills. As sea level fell further and volcanic activity increased, coalescing shield volcanoes of basalt built out over the old shoreline, with the scattered interbeds of tuff or volcaniclastic sediments. Eruption of the basalts lasted until about the middle of the Oligocene, after which there was no further deposition in the quadrangle until the Pleistocene.

During the Pleistocene, the Willamette Valley was incising, and the steep Coburg Front began to shed enormous landslides and debris avalanche fans. The ancestral Willamette River reworked some of the debris avalanche toes into small terrace deposits, most of which were eroded away as the valley incised further, leaving only one small remnant on the map. During the late Pleistocene fan-delta gravels deposited by a braided ice age Willamette River filled the valley to depths of over 400 ft (130m). At the end of the ice ages, the Willamette began to incise into the fan delta surface as it shifted from braided to meandering, and is now cutting further into the bedrock and fan delta gravels and leaving a swath of modern alluvium. At about the same time, glacial outburst floods from Lake Missoula in Montana repeatedly inundated the valley depositing a thin veneer of silt. During the Holocene, minor streams have eroded shallow channels in the fan delta and flood silt deposits, and landslides in the Coburg Hills continue to move.

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Appendix Contents (Data Files on CD)
All coordinates in UTM Zone 10 NAD 27

Appendix A, Photographs
Outcrop and specimen photos in .jpg format, keyed to locations in Field_Data.

Appendix B, Age Date Specta
Original analytical reports form the OSU Geochronological Laboratory in Excel Spreadsheet format.

Appendix C, Petrographic images
Scanned thin sections and polished thin section billets as .jpg files keyed to GIS File for Coburg Field Stations

Appendix D, Mobil Ira Baker Well
Scanned image of well lithology log in .pdf format.

Appendix E, GIS Files
Polygon, point and line data files that make up the map, in Mapinfo .tab and ESRI .shp format.

Appendix F, Geochemistry

XRF_Methods.txt	Discussion of analytical methods
Coburg Geochem.xls	Geochem Data in Excel spreadsheet format, with coordinates.