STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
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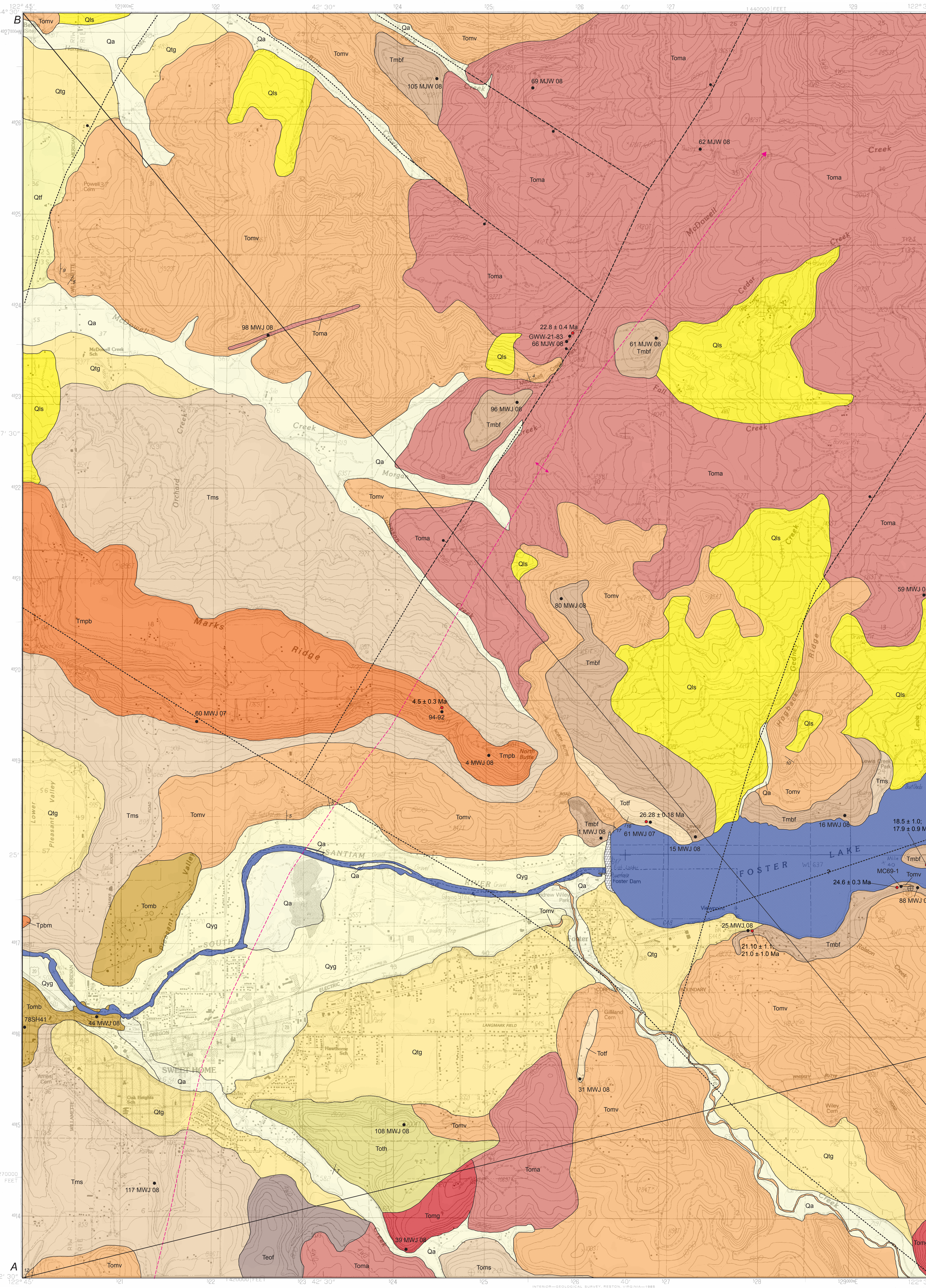
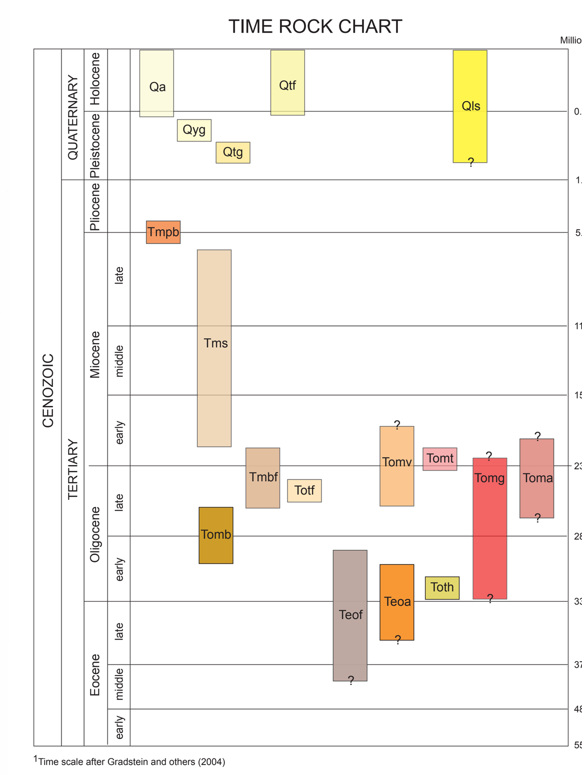
Preliminary Geologic Map of the Sweet Home 7.5′ Quadrangle, Linn County, Oregon

2009



TIME ROCK CHART



[1]Time scale after Gradstein and others (2004).

MAP SYMBOLS

- Contact — approximately located
- Fault — Dashed where approximately located; dotted where concealed; ball and bar on downthrown side
- Fold axis — anticline, approximately located; dotted where concealed. Arrow shows direction of plunge.
- Horizontal bedding
- Inclined bedding — showing strike and dip, measured or estimated
- 59 MWJ 08 — Location of whole-rock XRF geochemical analysis sample with sample number — see Table 1
- 22.8 ± 0.4 Ma — Location of radiometric age determination with age — see Table 2

INTRODUCTION

GEOLOGY

... cap Galena Mountain, 32 km (20 mi) northeast of Sweet Home. This stratigraphic correlation demonstrates that the ancestral channel of the Middle Santiam River, during the Late Miocene to early Pliocene, formed a west-trending drainage that passed beneath Galena Mountain on the northeast and extended west at least to Marks Ridge (Conrey and others, 2002). Deeply incised Tertiary geologic units in the quadrangle are unconformably overlain by Quaternary surficial fluvial sediments that border the modern thalweg of South Santiam River and its major tributaries.

EXPLANATION

Upper Cenozoic Surficial and Valley-Fill Deposits

Qa — **Alluvium (Holocene and late Pleistocene) –** Unconsolidated gravel, sand, and silt deposited in modern stream channels and on adjoining flood plains. Includes overbank sand, silt, and clay deposits in low terraces that rest directly on bedrock. The unit also includes hillslope colluvium marginal to upland streams and alluvial fan deposits too small to map separately at the mouths of small tributary streams. Equivalent, in part, to Qabs and Qau units of O'Connor and others (2001).

Qtf — **Colluvium (Holocene and Pleistocene) –** Slope wash, alluvial fan, and colluvial deposits found along the drainage divide between Hamilton and McDowell creeks in the northwest part of the quadrangle. The unit forms part of the modern erosional surface downslope of bedrock highs above the South Santiam and Calapooia rivers.

Qls — **Landslide deposits (Holocene and Pleistocene) –** Unconsolidated, poorly sorted, and unstratified chaotic mixtures of soil and rock deposited by gravity-driven mass-wasting processes (i.e., slumps, slides, and debris flows). The unit includes rockfall and colluvial deposits. Most landslide deposits in the map area are inferred on the basis of geomorphology and are mapped only where deposits cover underlying strata. The surfaces of landslide deposits are typically irregular and hummocky. More recent slides can be traced upslope to steep, headwall bedrock escarpments; the distal toes to these deposits retain a fan-shaped morphology. In water well logs, landslide deposits are typically referred to as mixtures of clay and boulders. Thickness of the landslide deposits is highly varied; maximum thickness is several tens of meters. Landslide deposits in the quadrangle are associated with rocks correlated to Little Butte Volcanic Series; mass movement typically occurs where density contrasts exist between strata, along bedding planes within dip-slopes, and along steeply dipping intrusive contacts. On the basis of relatively subdued geomorphic expression, most of the landslide deposits are considered to be old and inactive and have been modified by secondary erosional processes.

Qyg — **Lower terrace deposits (Pleistocene) –** Moderately dissected, unconsolidated deposits of gravel and sand, with subordinate amounts of silt and clay that form a low terrace along the South Santiam River between Foster Dam at Sweet Home and the confluence with the North Santiam River near Albany. The terrace reaches a maximum elevation of 182 m (598 ft) near Foster Dam. The unit locally may be up to 15 m (49 ft) thick but generally forms a thin carapace over intermittently exposed bedrock units. Equivalent to the Quaternary middle terrace of Beaulieu and others (1974) and in part to the Leffler gravels of Allison (1953), the Linn Gravels (Qli) of Alison and Felts (1956), and parts of units Qat and Qabs of O'Connor and others (2001). Allison and Felts (1956) interpreted the unit to define an older channel of the South Santiam River.

Qtg — **Upper terrace deposits (Pleistocene) –** Deeply dissected, unconsolidated to semi-consolidated deposits of gravel, sand, silt, and clay that form an upper alluvial terrace along the South Santiam River between Sweet Home on the south and Lebanon on the north. The unit also forms muted benches along the major tributaries of the South Santiam River in the Sweet Home 7.5′ quadrangle, including Hamilton, McDowell, Ames, and Wiley creeks. The terrace reaches a maximum elevation of 221 m (725 ft) near Sweet Home and 264 m (865 ft) along Wiley Creek. Unit may be as much as 45 m (148 ft) thick at Sweet Home, thinning to the west, into the Willamette Valley. In the map area, water well drillers generally describe the unit as gravel or sand and gravel in their well logs. Deposits in the quadrangle are interpreted as part of an incised alluvial fan and upland terrace complex formed by the South Santiam River. The unit is equivalent to the Lacomb gravels of Allison (1953) and Quaternary upper terrace (Qtu) of Beaulieu and others (1974). Also equivalent in part to unit Qat(2) of O'Connor and others (2001). Equivalent in part to the Linn and Leffler gravels of Allison (1953) and Allison and Felts (1956).

Tertiary Volcanic and Sedimentary Rocks

Early High Cascades

Tmpb — **Basalt of Marks Ridge (early Pliocene and late Miocene) –** Black to dark blue-gray, closed textured, fine-grained glassy basalt and basaltic andesite lavas that cap an east- to west-trending, 2 km (1.25 mi) wide ridge in the west-central portion of the quadrangle. The compound flow unit is as much as 160 m (525 ft) thick and, where exposed in rock pits, is marked by hackly jointing and wildly flaring and contorted pseudohexagonal columns up to 20 cm across. Petrographically, the basalt is microcrystalline, characterized by plagioclase laths and intergranular pyroxene, glass, and opaque minerals. Microphenocrysts of olivine and clinopyroxene < 1 mm across are sparsely distributed throughout the basalt. Chemically, the lava flow is a high silica basalt or basaltic andesite (Conrey and others, 2002) that contains between 50.86 and 53.57 weight percent SiO_2 and 1.75 to 1.93 weight percent TiO_2 (Table 1, Figure 2). Verplanck (1985) (in Walker and Duncan [1989]) reported a K-Ar age of 4.5 ± 0.3 Ma (Table 2). The base of the flow unit, which locally rests on clay-altered, cobble conglomerate, is approximately 100 m (328 ft) above the modern South Santiam River channel. Conrey and others (2002) consider the topographically inverted basalt of Marks Ridge to be an intracanyon lava that defines the course of an ancestral Middle Santiam River that extended eastward under Galena and Scar Mountains during the late Miocene and early Pliocene.

Early Western Cascades

Tms — **Conglomerate and sandstone (Miocene) –** Red- and gray-weathering, clay-altered, pebble-cobble conglomerate and sandstone that forms a widespread sedimentary unit in the southwest part of the quadrangle. Conglomerate units are typically clast-supported, poorly sorted, and heterolithic with subround to round clasts of basalt, andesite, and rhyolite. Clasts typically range from 1 to 3 cm across; sparsely distributed outsized cobbles are up to 15 cm across. Clasts are ubiquitously altered to the point where they can be easily cut by a knife blade. Conglomerate units are supported by a matrix composed of clay or poorly sorted coarse-grained sandstone. Sandstone interbeds within conglomerate units are marked by 1 to 2 m (3.3 to 6.5 ft) wide trough crossbeds marked by outsized cobbles and pebble-rich stringers and lenses. The unit locally includes a rhyolitic, white pumice-lithic tuff interbedded with conglomerate near the center of sec. 6, T. 14 S., R. 1 E., south of Sweet Home. The tuff contains comparatively high amounts of yttrium (94 ppm Y) and niobium (20 ppm Nb). Considered to be Miocene in age on the basis of stratigraphic position beneath the basalt of Marks Ridge and above basalt flows of unit Tomb.

Little Butte Volcanic Series

Late Oligocene to early Miocene Fe- and Ti-rich tholeiitic basalt lavas (Tomb, Tmbf), rhyolitic ash-flow tuff (Totf), and nonmarine volcaniclastic sedimentary rocks and tuff (Tomv). As mapped by Peck and others (1964), the Little Butte Volcanic Series includes both the Mehama Volcanics of Thayer (1939), the Mehama Formation of Smith (1958), and rocks correlative to the upper part of the Fisher Formation. The following units are considered part of the Little Butte Volcanic Series of Peck and others (1964) and for the Sweet Home 7.5′ quadrangle are subdivided on the basis of lithology into:

Tomv — **Mehama Formation (late Oligocene to early Miocene) –** Gray, green, yellow-brown, and white, indurated, nonmarine volcaniclastic conglomerate, breccia, and sandstone intercalated with thoeiitic basalt lavas and rhyolitic ash-flow tuff. The unit is also interfingered with andesite, basaltic andesite, and basaltic trachyandesite lavas to the northwest in the Lebanon and Onehorse Slough 7.5′ quadrangles (Ferns and McClaughry, 2008). Volcaniclastic conglomerate and breccia beds are massive, clast- to matrix-supported, and poorly sorted and generally weather to rounded boulders and coarse rocky soils. These deposits are heterolithic, composed of angular to subround fragments of basalt, andesite, rhyolite, pumice, and petrified wood. Clasts are held in an immature coarse-grained sandstone matrix composed of angular lithics and feldspar. The matrix is variably cemented by zeolite and calcite and, locally, outcrops are crosscut by zeolite and calcite veinlets. Laterally discontinuous, meter-scale beds of planar stratified to massive, tuffaceous lithic-crystal sandstone are commonly enclosed within conglomerate and breccia deposits.

Strata mapped as the Mehama Formation (Smith, 1958) were first referred to as the Mehama Volcanics by Thayer (1939) for exposures along the North Santiam River near the hamlet of Mehama. Allison and Felts (1956) extended the terminology "Mehama Volcanics" southward into the Lebanon area, and Eubanks (1962) correlated sedimentary rocks of similar lithology and stratigraphic position along Thomas Creek east of Scio with the Mehama Volcanics. Peck and others (1964) included both the Mehama Volcanics of Thayer (1939) and the Mehama Formation of Smith (1958) within the Little Butte Volcanic Series. Beaulieu and others (1974) considered the Mehama Volcanics to be correlative to their Little Butte Formation and the Little Butte Volcanic Series of Peck and others (1964). The unit is also equivalent to the clastic sedimentary rocks unit (Tus) of Walker and Duncan (1989).

In the Sweet Home area, this report considers the base of the Mehama Formation to be marked by the tuff of Holley (Toth) and the first occurrence of tholeiitic basalt lavas (Tomb) which have a K-Ar age of 25.40 ± 0.9 Ma in the adjacent Waterloo 7.5′ quadrangle (Ferns and McClaughry, 2009a). The upper part of the Mehama Formation in the Sweet Home 7.5′ quadrangle is interbedded with tholeiitic basalts along Foster Lake that range in age from 17.9 ± 0.9 Ma to 24.6 ± 0.3 Ma (K-Ar, Walker and Duncan, 1989) and the 26.28 ± 0.18 Ma tuff of Foster Dam ($^{40}Ar/^{39}Ar$). The formation is intruded by 22.8 ± 0.4 Ma anorthositic diabase near McDowell Creek Falls (K-Ar, Fiebelkorn and others, 1982; Walker and Duncan, 1989). Fossil leaves recovered from the Mehama Formation near Foster Dam have an age of ~ 25 Ma as reported by Retallack and others (2004) (north Sweet Home Flora). Northeast of the map area, an upper age to the Mehama Formation is defined by overlying mafic lavas exposed at Green Mountain that have a K-Ar age of 22.6 ± 0.30 (Walker and Duncan, 1989). Schlicker and Dole (1957) considered the Mehama Volcanics (Mehama Formation) to be Oligocene to early Miocene in age on the basis of numerous occurrences of Oligocene to Oligocene-Miocene fossil leaves and found these units to be equivalent in part to both the Eugene and Fisher formations. In the Sweet Home area, the unit overlies and likely grades westward into nonmarine volcaniclastic sedimentary rocks of the older Fisher Formation (Teof).

Tomt — **Ash-flow tuff (cross section only) (late Oligocene to early Miocene) –** White, red-purple, and red dacitic lithic ash-flow tuff mapped as an interbed within the Mehama Formation. Exposed only in the Onehorse Slough and Lacomb 7.5′ quadrangles to the north (Ferns and McClaughry, 2008). On the basis of structural dip observed in the tuff, 0.5 km (0.3 mi) north of Berlin (site) in the extreme southwest corner of the Lacomb 7.5′ quadrangle, the tuff is inferred to extend south in the subsurface beneath the Sweet Home 7.5′ quadrangle. The unit is shown only in cross section A-A′. Where exposed in outcrop, the tuff is typically heavily altered and marked by conspicuous red-purple and red iron-stained fractures. The base of the tuff overlies a fine-grained, gray-white air-fall tuff that contains carbonized fossil leaves. An analyzed sample of heavily oxidized, lithic tuff in the Lacomb 7.5′ quadrangle (sample 37 MWJ 07) is marked by low niobium (9.5 ppm Nb) and rubidium (6.2 ppm Rb) with moderate amounts of strontium (321 ppm Sr) and barium (288 ppm Ba).

Totf — **Tuff of Foster Dam (late Oligocene) –** White to tan and green, welded, pumice-lithic-vitric tuff interbedded with conglomerate and sandstone that are part of the Mehama Formation (Tomv). The tuff is most prominently exposed 0.3 km east of Foster Dam along the north shore of Foster Lake; thinner deposits are also exposed west of Wiley Creek along Chandler Mountain Road. The tuff is generally massive, with crude columnar jointing and weathers to angular platy chips. The lower 1 to 2 m (3.28 to 6.56 ft) of the tuff is characterized by gray crystal-lithic tuff sandstone that contains abundant carbonized wood fragments. Upward, the tuff becomes dominated by a mixture of poorly sorted pumice and lithics. Blue-green pumices constitute 30–40 percent of the tuff, are round to locally strongly welded, and average 3 to 4 cm across; some pumices reach diameters as much as 10 cm. Lithics consist of both andesite and flow-banded rhyolite that generally range in size from 3 to 6 cm across. The tuff contains < 5 percent broken phenocrysts of blocky sanidine and lath-shaped plagioclase feldspars up to 1 mm across, and lithic fragments set in a groundmass of cuspate glass shards. On the basis of chemical analyses, the tuff is rhyolitic with moderate contents of zirconium (335 to 346 ppm Zr), yttrium (~ 53.5 to 58.0 ppm Y), and niobium (~ 22.8 to 24.3 ppm Nb) (Table 1, Figure 2). Considered to be late Oligocene in age on the basis of an $^{40}Ar/^{39}Ar$ age of 26.28 ± 0.18 Ma(Table 2).

Tmbf — **Tholeiitic basalt (late Oligocene to early Miocene) –** Black to dark blue-gray, fine- to medium-grained, closed-textured, porphyritic basalt lavas exposed along Foster Lake and in discontinuous outcrops in the northeast part of the quadrangle. Outcrops are massive or have well-defined columnar jointing characterized by psuedohexagonal columns up to 1 to 2 m (3.28 to 6.56 ft) across. Locally massive flow cores are intermixed with vesicular zones, pillow basalt, and palagonitic breccia. Vesicles are locally filled by bladed white zeolite and quartz. Petrographically, the lavas are seriate textured consisting of 1 to 10 percent euhedral to subhedral plagioclase phenocrysts up to 4 mm long, plagioclase glomerocrysts up to 2 mm across, and sparse microphenocrysts of clinopyroxene and olivine set in a fine-grained groundmass of plagioclase and intergranular pyroxene, olivine, glass, and opaque minerals. Chemically, the unit is a tholeiitic basalt containing high amounts of titanium (1.51 to 2.16 weight percent TiO_2) and iron (> 12.85 to 14.59 weight percent FeO*) (Table 1, Figure 2). Considered to be late Oligocene to early Miocene in age on the basis of stratigraphic position and numerous whole rock K-Ar ages that range from 24.6 ± 0.3 to 17.9 ± 0.9 Ma (Fiebelkorn and others, 1982).

Tomb — **Tholeiitic basalt (Oligocene) –** Red and orange-weathering, black to dark blue-gray, closed-textured, aphyric basalt lavas that are well-exposed along the South Santiam River at White's Park (44 MWJ 08) west of Sweet Home and farther west into the Waterloo 7.5′ quadrangle. Where exposed in rock pits and along the South Santiam River, the basalt is characterized by narrow columnar joints. In the Waterloo 7.5′ quadrangle, the unit includes two different iron-rich lavas that are separated by a thick section of clay-rich tuffaceous sedimentary rocks. The basalt is characteristically fine grained and very sparsely phyric, containing less than 1 percent plagioclase and clinopyroxene phenocrysts as much as 1 mm across. Petrographically, the basalt is characterized by a well-defined pilotaxitic texture in which groundmass feldspar crystals are aligned. Very small, intergranular crystals of clinopyroxene and opaque iron-oxide minerals are also common. Chemically, the unit is a tholeiitic basalt containing high amounts of titanium (> 2.5 weight percent TiO_2) and iron (> 13.00 weight percent FeO*) (Table 1, Figure 2). On the basis of stratigraphic position and iron-rich geochemistry, these lavas are correlated with the Scorpion Mountain lavas of White (1980). Late Oligocene in age on the basis of stratigraphic position and a K-Ar age of 25.4 ± 0.9 Ma reported by Lux (1982). The basalt is considered by this report to form the base of the Little Butte Volcanic Series and Mehama Formation in the Sweet Home area.

Fisher Formation

Late Eocene to Oligocene nonmarine volcaniclastic sedimentary rocks and tuff and basaltic andesite, andesite, and dacite. Equivalent to the Fisher Formation of Schenck (1927), Vokes and Snavely (1948), Vokes and others (1951, 1954), Beaulieu (1971), and Retallack and others (2004). Subdivided in the quadrangle, on the basis of lithology, into:

Teof — **Fisher Formation (middle Eocene and early Oligocene) –** Light gray, gray-brown, brown, and pale brown to pale yellow, nonmarine feldspathic sandstone and pebbly tuffaceous sandstone poorly exposed west of Ames Creek in the southern part of the Sweet Home 7.5′ quadrangle and beneath basalt lavas of unit Tomb in the adjacent Waterloo 7.5′ quadrangle. Better exposed sedimentary units of the Fisher Formation in the Waterloo 7.5′ quadrangle include massive sandstone, finely laminated fine-grained sandstone and siltstone that contain wood debris, bentonitic claystone, and minor coal beds. Rocks of the Fisher Formation are commonly described as gray sandstone in water well logs. These deposits are equivalent to the coal-bearing, nonmarine volcanic sandstones and tuff identified by McKeel (1985) in the upper 914 m (3,000 ft) interval of the Hickey oil and gas well in the Lebanon 7.5′ quadrangle (Ferns and McClaughry, 2008). Considered to be middle Eocene and early Oligocene in age on the basis of stratigraphic position. The lower part of the Fisher Formation is interbedded with basaltic andesite and andesite of unit Teoa in the Brownsville and Lebanon 7.5′ quadrangles; in the Lebanon 7.5′ quadrangle, rocks of Teoa have been dated at 31.7 ± 0.4 Ma to 41.5 ± 0.9 Ma, but the K-Ar ages are of uncertain quality (Ferns and McClaughry, 2008; Ferns and McClaughry, 2009b). The upper part of the Fisher Formation is interbedded with the ~32 Ma tuff of Holley and is overlain by 25.4 ± 0.9 Ma tholeiitic basalt lavas of unit Tomb, which locally mark the base of the overlying Little Butte Volcanic Series (Lux, 1982; Ferns and McClaughry, 2009a). The Fisher Formation grades upward and eastward into volcaniclastic deposits of the Mehama Formation. In the Sweet Home 7.5' quadrangle, the Fisher Formation includes:

Toth — **Tuff of Holley (early Oligocene) –** White to light green, crystal-lithic welded ash-flow tuff exposed along Ames Creek in the southwest part of the Sweet Home 7.5′ quadrangle. Named for exposures north of the town of Holley, which lies just south of the quadrangle boundary. The unit includes welded and nonwelded ash-flow tuff and pumice-rich volcaniclastic conglomerate and volcaniclastic sandstone. The welded tuff forms massive outcrops that contain flattened pumice fiamme as much as 15 cm in length as well as numerous silicic rock fragments as much as 5 cm in diameter. The base of the tuff also contains, in places, carbonized or silicified wood. The tuff typically contains as much as 10 percent broken and zoned plagioclase crystals up to 3 mm in diameter. The tuff also contains minor amounts of clinopyroxene and rod-shaped opaque minerals up to 1 mm in diameter. The groundmass of the tuff forms a felted, cryptocrystalline mat of quartz and feldspar. Mafic phenocrysts are extensively altered to iron oxide or clay minerals. From geochemical analyses from the Brownsville, Waterloo, and Sweet Home 7.5′ quadrangles, the welded tuff is a dacite or rhyolite that contains comparatively low amounts of zirconium (209 to 223 Zr) and niobium (10.1 to 15.1 Nb) (Table 1, Figure 2). Retallack and others (2004) correlated this ash-flow tuff with tuff of Dexter exposed south near Eugene, for which they obtained a single-crystal $^{40}Ar/^{39}Ar$ age of 25.9 ± 0.06 Ma. Preliminary comparison of limited regional geochemical analyses from both tuff units suggests that the tuff of Holley is not directly correlative with the tuff of Dexter. On the basis of stratigraphic position, the tuff of Holley may be more closely correlative to the 32.3 ± 0.6 Ma ($^{40}Ar/^{39}Ar$) tuff of Daniels Creek, which underlies high-magnesium pyroxene basalt lavas in the Coburg 7.5′ quadrangle (Madin and others, 2006).

Teoa — **Basaltic andesite, andesite, and dacite (cross section only) (late Eocene and early Oligocene) –** Dark blue-gray, gray, and brown-gray basaltic andesite, andesite, and dacite lavas. Lavas are generally porphyritic and contain as much as 5 percent plagioclase phenocrysts. Where exposed in rock quarries, lavas are often platy-jointed or form thick, irregularly oriented columns. From water well logs, the unit as mapped locally includes tuffaceous sandstone lenses. Weathered surfaces are commonly brown or brownish yellow in color. Where exposed in rock pits, the transition zone between rock and mantling soil is marked by spheroidal-weathering zones where relict corestones are enclosed by deeply weathered chalky white clays. In thin section, the lavas are marked by a fine-grained pilotaxitic groundmass in which plagioclase lathes are strongly aligned in curvilinear trains. Phenocryst minerals in the basaltic andesites and andesites include, in order of abundance, plagioclase, clinopyroxene, and altered olivine crystals as large as 3 mm in length. Dacites typically contain orthopyroxene phenocrysts. Chemically, the unit includes basaltic andesite and andesite with between 52.0 and 56.5 weight percent SiO_2 and 2.26 to 4.8 weight percent MgO. The unit also includes more silicic andesite and dacite with between 56.5 and 63.08 weight percent SiO_2 and 1.43 to 4.38 weight percent MgO as well as minor amounts of basalt with 48.0 to 52.0 weight percent SiO_2 and 3.78 to 4.73 weight percent MgO (Ferns and McClaughry, 2009a). Whole rock K-Ar ages from neighboring quadrangles range from 31.4 ± 0.5 to 35.2 ± 0.8 Ma (Lux, 1982).

Tertiary Intrusive Rocks

Toma — **Anorthositic diabase (late Oligocene and early Miocene) –** Blue-gray, dense, closed-textured, coarse-grained megacrystic anorthositic diabase dikes, sills, and lavas (?) exposed across the northeast part of the Sweet Home 7.5′ quadrangle and in the headwaters area of Ames Creek. The unit includes a N65°E trending dike that intrudes sedimentary rocks of unit Tomv along McDowell Creek in the northwest part of the quadrangle; a chemically and lithologically similar N65°W trending dike has also been found intruding unit Tomv along Hamilton Creek in the Lacomb 7.5′ quadrangle on the north. Good outcrops of the diabase are rare, but where exposed in quarries, the rock tends to form massive to blocky exposures with zones of spheroidal weathering. More typically the diabase is exposed as fields of subrounded, meter-sized boulders capped by a brown- to red-colored grus soil mantle. Petrographically, the diabase has a seriate texture characterized by 50 to 60 percent, blocky equant to ragged anhedral plagioclase phenocrysts up to 1 cm across set in a fine-grained groundmass of equigranular plagioclase, intergranular pyroxene, and opaque minerals. Sparse amounts of clinopyroxene microphenocrysts and altered skeletal olivine phenocrysts up to 2 mm across are also present in the basalt. Remanant olivine phenocrysts are wholly replaced by mesh-textured serpentine pseudomorphs or are altered to iddingsite and/or chlorphaeite. An anorthositic diabase composition is indicated by chemical analyses characterized by 48.07 to 52.68 weight percent SiO_2, high amounts of aluminum (17.86 to 24.83 weight percent Al_2O_3), and calcium (9.88 to 11.74 weight percent CaO), and low amounts of magnesium (2.97 to 3.81 weight percent MgO) (Table 1, Figure 2). Considered to be late Oligocene to early Miocene in age on the basis of stratigraphic position and a K-Ar age of 22.8 ± 0.4 Ma reported by Walker and Duncan (1989) for exposures near McDowell Creek County Park.

Tomg — **Gabbro (Oligocene and early Miocene) –** Gray to light gray, medium- to coarse-grained, two-pyroxene olivine gabbro that forms a small intrusion along Ames Creek in the southern part of the Sweet Home 7.5′ quadrangle. The intrusion is deeply weathered, forming poorly exposed outcrops capped by orange, clay-rich, granular soils. The gabbro typically has a black and green to gray speckled aspect. In thin section, anhedral clinopyroxene crystals are intergrown with altered anhedral olivine crystals to form rounded clots as much as 1 cm in diameter. These mafic clots are contained within a groundmass characterized by randomly oriented subhedral plagioclase and opaque iron oxide crystals that are enclosed within larger ophitic orthopyroxene and clinopyroxene crystals. Olivine crystals are nearly completely altered to a brown amorphous mineral. The gabbro is basaltic in composition, with 50.02 to 52.78 weight percent SiO_2, 5.28 to 6.07 weight percent MgO, and ~ 8 ppm Nb (Table 1, Figure 2). Chemically and petrographically equivalent to a small gabbro intrusion exposed near Santiam Terrace in the adjacent Waterloo 7.5′ quadrangle, which there may be part of the vent source for basalt lavas of unit Teob (Ferns and McClaughry, 2009a). Considered to be Oligocene and early Miocene in age on the basis of stratigraphic position and an $^{40}Ar/^{39}Ar$ age of 25.75 ± 0.17 Ma obtained from a sample at Santiam Terrace (Ferns and McClaughry, 2009a).

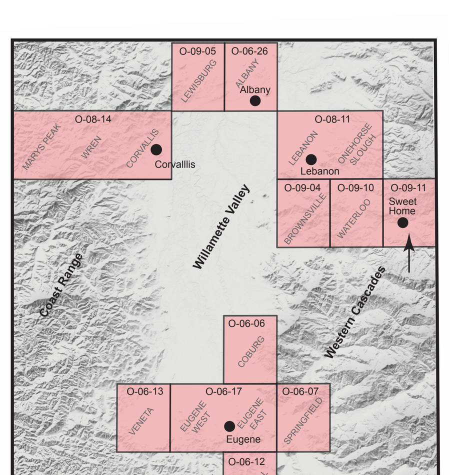


Figure 1. Shaded relief map from digital elevation model (DEM) for the southern Willamette Valley, showing quadrangles mapped between 2002 and 2008 and published as DOGAMI open-file reports under the USGS National Cooperative Geologic Mapping Program. Location of Sweet Home 7.5′ quadrangle shown by arrow.

OPEN-FILE REPORT O-09-11

Preliminary Geologic Map of the Sweet Home 7.5′ Quadrangle, Linn County, Oregon

By Jason D. McClaughry

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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.

STRUCTURE

Geologic structures in the Sweet Home 7.5′ quadrangle are inferred on the basis of topographic expression, the mapped distribution of geologic units, and bedding attitudes where available. No fault planes were observed in outcrop. The main apparent structural fabric in the quadrangle consists of broad, north-northeast plunging (<10°) folds characterized by shallowly dipping fold limbs (<17°). Folded strata are in places cut by a series of northeast (parallel to primary fold axes) and northwest (normal to primary fold axes) trending normal faults. However, the relative amount of offset along these normal faults is unclear due to a lack of distinct marker beds traceable over a significant distance. Rocks as young as late Oligocene to early Miocene are deformed by local folds and faults, but it is unknown whether late Oligocene to early Miocene intrusive rocks (Toma and Tomg) are affected by the folding, due to the lack of exposure and structural indicators in these rocks. A similar fold and fault pattern in late Eocene to early Miocene rocks to that observed in the Sweet Home 7.5′ quadrangle is reported in the adjacent Brownsville and Waterloo 7.5′ quadrangles on the west (Ferns and McClaughry, 2009a,b) and in the Albany 7.5′ quadrangle (Wiley, 2006) farther to the northwest.

The quadrangle is additionally bisected by the northwest-southeast trending Lebanon Fault (Graven, 1990) which forms a prominent topographic lineament that parallels the trace of Marks Ridge and the trace of Wiley Creek to the southeast. The correspondence of intracanyon lavas of the basalt of Marks Ridge with the inferred trace of the Lebanon Fault suggests that during the late Miocene to early Pliocene the ancestral course of the South Santiam River near Sweet Home may have been in part controlled by this structure. The basalt of Marks Ridge likely clogged the ancestral channel and forced the South Santiam River southward to its current geographic position. Analysis of air orthophoto quadrangless and 10-m DEMs suggest this lineament may extend at least 20 km (12 mi) southeast of the quadrangle. On the basis of apparent displacement of the unit Tob and Teob contact mapped in the Onehorse Slough, Waterloo, and Brownsville 7.5′ quadrangles, Ferns and McClaughry (2009a,b) interpret the Lebanon fault to be a dextral strike-slip fault. Apparent displacement of the mapped unit Teoa and Teob contact suggests that there may be as much as 7 km of dextral displacement along the Lebanon Fault, although a similar offset is not readily apparent eastward in the Sweet Home 7.5′ quadrangle.

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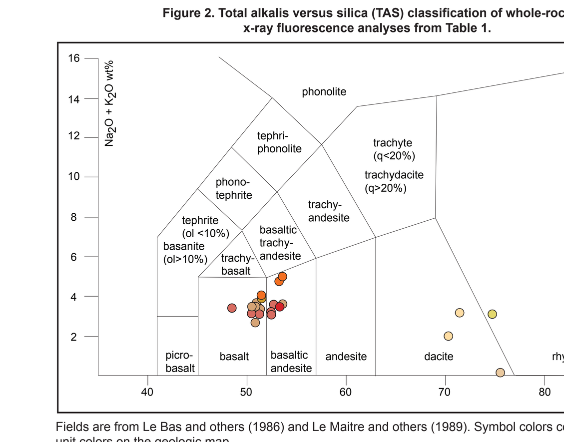
Figure 2. Total alkalis versus silica (TAS) classification of whole-rock x-ray fluorescence analyses from Table 1.



Fields are from Le Bas and others (1986) and Le Maitre and others (1989). Symbol colors correspond to unit colors on the geologic map.

Table 2. K-Ar and $^{40}Ar/^{39}Ar$ radiometric age determinations for the Sweet Home 7.5′ quadrangle, Linn County, Oregon.

Sample no.	Map Unit	Lithology	UTM Coordinates	WPMA Age (Ma)	Normal Isochron (Ma)	Inverse Isochron (Ma)	Method	Material Dated	K/Ca (±2 sigma)	Percent Ar in Plateau	MSWD
106*	Tpbm	basaltic andesite	4919600N 672022E	4.5 ± 0.3	nd	nd	K-Ar	whole rock	nd	nd	nd
105§	Toma	diabase	4923730N 525860E	22.8 ± 0.4	nd	nd	K-Ar	whole rock	nd	nd	nd
7791†	Tmbf	basalt	4917200N 527900E	21.10 ± 1.1; 21.0 ± 1.0	nd	nd	K-Ar	whole rock	nd	nd	nd
7792†	Tmbf	basalt	4917700N 529600E	24.6 ± 0.3	nd	nd	K-Ar	whole rock	nd	nd	nd
7799†	Tmbf	basalt	4917900N 529800E	18.5 ± 1.0; 17.9 ± 0.9	nd	nd	K-Ar	whole rock	nd	nd	nd
61 MWJ 07	Totf	tuff	4918368N 526786E	26.28 ± 0.18	25.99 ± 0.71	25.99 ± 0.71	^{40}Ar-^{39}Ar	plagioclase	0.101 ± 0.006	92.328	0.55

Note: nd = no data; ip = date in progress. Ages from:
*Verplanck, in Walker and Duncan (1989),
§Walker and Duncan (1989),
†Fiebelkorn and others (1982).

Table 1. Whole-rock x-ray fluorescence (XRF) analyses for volcanic and intrusive rocks in the Sweet Home 7.5′ quadrangle, Linn County, Oregon.

Oxides (wt. percent):

Field and Laboratory no.	UTM Coordinates	Elevation (ft)	Lithology	Map Unit	SiO_2	Al_2O_3	TiO_2	FeO*	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5
60 MWJ 07	4919461N 521814E	1100	bas. andesite	Tpbm	53.22	16.92	1.84	9.51	0.18	8.47	4.53	1.00	3.77	0.57
4 MJW 08	4919099N 525013E	1300	basalt	Tpbm	51.44	18.03	1.95	10.14	0.19	8.78	4.81	0.57	3.50	0.60
94-92*	4919600N 524500E	1400	bas. andesite	Tpbm	53.57	16.57	1.80	9.70	0.17	8.22	4.39	1.07	3.94	0.58
108 MJW 08	4915040N 524110E	1000	tuff	Toms	75.4 6	18.81	2.48	1.90	0.01	0.18	0.11	0.10	0.05	0.89
59 MJW 08	4920884N 529791E	1700	diabase	Toma	48.48	24.24	1.02	7.74	0.13	11.84	2.99	0.31	3.11	0.15
69 MJW 08	4926430N 525485E	1220	diabase	Toma	52.42	18.07	1.60	10.65	0.21	10.00	3.58	0.29	2.94	0.24
62 MJW 08	4925721N 527385E	1740	diabase	Toma	51.25	21.27	1.08	8.40	0.14	10.75	3.85	0.30	2.81	0.16
98 MJW 08	4923714N 522591E	600	diabase	Toma	50.46	21.24	1.15	8.93	0.17	11.00	3.74	0.31	2.83	0.16
GWW-21-83†	4923722N 525851E	1120	diabase	Toma	52.68	19.08	1.30	9.91	0.28	9.88	3.13	0.46	3.14	0.14
66 MJW 08	4923634N 525866E	1100	diabase	Toma	52.45	19.98	1.11	9.86	0.19	10.09	3.11	0.35	2.73	0.14
39 MWJ 08	4913633N 524151E	700	gabbro	Tomg	53.29	17.56	1.29	8.78	0.16	9.18	6.00	0.62	2.86	0.26
61 MJW 08	4923690N 526841E	1300	basalt	Tmbf	50.75	15.66	2.18	13.32	0.25	9.48	4.59	0.52	2.95	0.31
96 MWJ 08	4922980N 525315E	1140	basalt	Tmbf	50.49	15.76	2.18	13.36	0.24	9.58	4.61	0.55	2.94	0.30
105 MWJ 08	4926532N 524422E	1020	basalt	Tmbf	50.83	16.52	1.53	12.28	0.24	10.25	5.54	0.18	2.50	0.12
15 MWJ 08	4918212N 527289E	640	basalt	Tmbf	51.33	16.68	2.00	12.12	0.22	9.86	4.10	0.44	2.93	0.32
25 MWJ 08	4917183N 527870E	700	basalt	Tmbf	50.77	15.55	2.16	13.44	0.24	9.53	4.60	0.50	2.90	0.30
80 MWJ 08	4920822N 525815E	1380	basalt	Tmbf	50.86	15.72	2.14	13.16	0.24	9.55	4.55	0.45	3.04	0.30
MC69-1§	4918005N 529218E	640	basalt	Tmbf	51.09	16.11	2.05	12.85	0.26	9.34	4.51	0.40	3.08	0.32
16 MWJ 08	4918438N 528931E	640	basalt	Tmbf	50.94	15.88	2.15	13.01	0.25	9.22	4.57	0.73	2.95	0.32
88 MJW 08	4917661N 529689E	640	basalt	Tmbf	50.81	15.65	2.19	13.31	0.23	9.48	4.50	0.62	2.89	0.31
1 MWJ 08	4918214N 526313E	640	bas. andesite	Tmbf	53.58	17.17	1.53	11.98	0.23	8.64	3.06	0.51	3.11	0.19
61 MWJ 07	4918368N 526786E	640	tuff	Totf	71.3 7	14.83	0.49	4.45	0.14	4.64	0.80	1.11	2.07	0.10
31 MWJ 08	4915548N 526026E	780	tuff	Totf	70.24	17.51	1.05	1.82	0.02	5.79	1.34	0.55	1.45	0.22
44 MWJ 08	4916203N 520734E	540	basalt	Tomb	51.47	14.52	2.62	13.12	0.26	8.95	4.18	0.58	3.32	0.99
117 MJW 08	4914390N 521370E	760	tuff	Toth	74.6 5	14.56	0.67	3.48	0.02	2.49	0.85	1.93	1.18	0.18

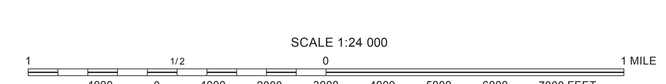
Trace Elements (parts per million):

Field and Laboratory no.	Ni	Cr	Sc	V	Ba	Rb	Sr	Zr	Y	Nb	Ga	Cu	Zn	Pb	La	Ce	Th	U	Co	LOI	Fe_2O_3	FeO
60 MWJ 07	17	54	30	256	392	12.9	643	155	30.9	8.3	21.7	59	107	4	14	35	1.1	<0.5	28	1.57	4.09	5.69
4 MJW 08	18	58	34	284	387	4.2	631	136	33.4	7.4	21.5	65	114	2	16	31	1.9	0	31	2.18	4.18	6.07
94-92*	13	54	30	253	406	12	600	132	29.0	9.9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
108 MJW 08	0	2	20	111	211	1.5	159	215	75.3	15.1	22	9	7	3	19	44	0	2	0	7.45	0.68	1.15
59 MJW 08	8	47	29	234	35	3.4	340	53	15.1	3.4	19.1	102	64	1	8	14	0	0	23	3.39	4.34	3.56
69 MJW 08	2	21	37	323	79	1.1	275	97	29.7	7.7	21.1	142	99	1	10	16	0.6	0	33	1.40	3.27	7.48
62 MJW 08	8	42	30	250	69	3.3	317	63	18.5	3	19.9	81	76	1	5	11	0	0	25	1.96	2.43	6.06
98 MJW 08	7	40	30	255	71	4.7	310	56	18.8	3.1	19.9	82	72	1	12	16	1.2	0	26	2.38	3.20	5.80
GWW-21-83†	nd	nd	nd	217	nd	nd	nd	96.3	nd	17.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
66 MJW 08	4	18	34	229	65	4.8	269	62	21.4	3.1	20.7	89	83	1	13	16	0.7	0	29	1.99	4.32	5.70
39 MWJ 08	63	140	23	212	211	10.9	588	99	16.1	6.5	19	67	98	1	12	21	1.6	0	28	3.93	3.32	5.39
61 MJW 08	1	26	38	398	160	15.8	331	97	27.9	6.1	20.2	32	119	1	12	26	2.4	0	39	2.04	4.01	9.37
96 MWJ 08	1	25	41	387	225	15.5	331	96	27.8	6.9	18.7	24	126	1	11	31	1.5	0.5	40	2.14	4.84	8.65
105 MWJ 08	14	55	48	424	59	5.4	224	63	25.4	4.3	16.7	195	102	2	11	17	0.5	0.5	43	2.07	3.91	8.49
15 MWJ 08	5	33	40	374	163	10.3	336	108	29	7	21.1	52	123	2	15	23	0.6	0	34	2.76	4.40	7.82
25 MWJ 08	1	26	40	410	167	8.2	329	95	27.2	6.1	20.8	30	130	1	14	21	2.1	0	39	2.06	4.40	9.15
80 MWJ 08	2	24	40	387	180	14.8	328	94	26.9	7.3	18.6	25	125	1	11	26	1.8	0.5	39	2.24	2.79	10.31
MC69-1§	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
16 MWJ 08	1	23	43	375	184	16	318	100	28.4	7	19.8	27	138	1	11	21	0.8	0	37	2.23	5.21	8.01
88 MJW 08	2	31	40	413	164	9.8	327	98	27.2	6.5	20.8	30	121	1	14	21	1.3	0	38	1.89	3.97	9.49
1 MWJ 08	3	15	38	294	93	12.9	247	83	28.5	5.2	20.7	139	116	1	11	18	0	0	34	1.08	5.68	6.68
61 MWJ 07	1	1	13	33	734	27.9	276	335	53.5	22.8	20.3	1	91	11	34	69	4.6	1.4	1	12.39	4.07	0.23
31 MWJ 08	0	3	23	61	461	11.9	315	346	58	24.3	21.1	7	159	2	26	74	3.4	2.6	0	14.4 9	1.60	0.12
44 MWJ 08	2	21	37	253	204	15.4	354	136	39.1	9.2	21.3	34	142	1	12	27	0	0	31	2.43	4.02	9.17
117 MJW 08	1	3	15	64	840	51.2	1870	314	94.2	20.1	17.5	6	137	0	52	91	3.9	1.8	0	11.32	2.68	0.67

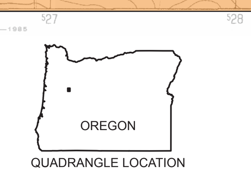
Note: Major-element determinations have been normalized on a volatile-free basis and recalculated with total iron expressed as FeO*. LOI, loss on ignition; bas. andesite, basaltic andesite; nd, no data or element not analyzed.
Geochemical analyses from *Conrey and others (2002), §U.S. Geological Survey (2008).

Base map by U.S. Geological Survey
Control by USGS and NOS/NOAA
Topography compiled by photogrammetric methods from aerial photographs taken 1980. Field checked 1982. Map edited 1984
Lambert conformal conic projection
Grid: 1000 meter universal transverse mercator - zone 10. 10,000 foot state grid ticks - Oregon north zone
UTM Grid declination 0° 13′ east
1980 magnetic north declination, 19° 30′ east
Vertical datum - National geodetic vertical datum of 1929
Horizontal datum - 1927 North American datum

UTM GRID AND 1980 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



CONTOUR INTERVAL 40 FEET



QUADRANGLE LOCATION

1	2	3
4	■	5
6	7	8

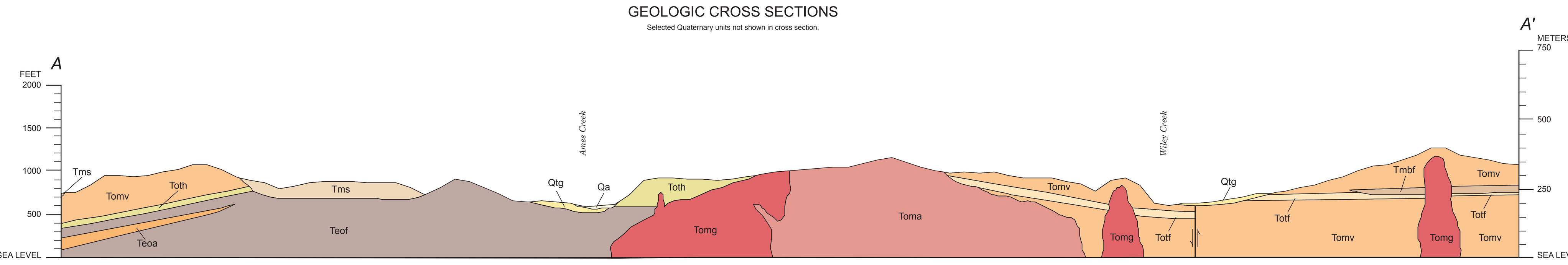
1 Onehorse Slough
2 Lacomb
3 Keel Mountain
4 Waterloo
5 Green Peter
6 Crawfordsville
7 Chandler Mountain
8 Farmers Butte

ADJOINING 7.5′ QUADRANGLE NAMES

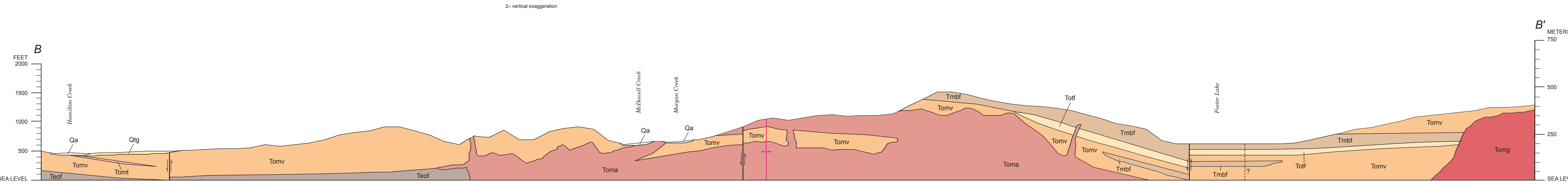
Geology by Jason D. McClaughry, Oregon Department of Geology and Mineral Industries
Field work conducted in 2008
Digital cartography by Jason D. McClaughry
Map version 12-14-2009
Software used: MapInfo Professional 8.0, Adobe Illustrator CS2, Adobe Acrobat 7.0.
Map sheet reviewed by Ian P. Madin, Oregon Department of Geology and Mineral Industries

GEOLOGIC CROSS SECTIONS

Selected Quaternary units not shown in cross section.



2x vertical exaggeration



2x vertical exaggeration