



Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington

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DESCRIPTION OF MAP UNITS

See pamphlet for detailed unit descriptions. Uncolored units (yellow boxes) are too small to show at map scale and are represented solely by geochronology and (or) geochemical sample locations, and (or) line or point geologic units. See Tables 1-4 for supporting analytical data.

Quaternary Unconsolidated Deposits

HOLOCENE TO LATE PLEISTOCENE NONGLACIAL DEPOSITS

- Qf** Artificial fill (Holocene)—Modified land and engineered and unengineered fill that obscure or substantially alter the original geologic deposit.
- Qa** Alluvium (Holocene)—Loose, stratified to massively bedded fluvial silt, sand, and gravel; typically well rounded and moderately to well sorted; locally includes sandy to silty estuarine deposits.
- Qp** Peat (Holocene to late Pleistocene)—Loose, locally very soft and wet, organic and organic-rich sediment, including muck, silt, and clay.
- Qts** Landslide deposits (Holocene)—Loose, unsorted, and unstratified clay, silt, soil, and organic matter and angular to rounded sand, gravel, and boulders. Absence of a mapped slide does not imply absence of sliding or hazard.
- Qaf** Alluvial fan deposits (Holocene)—Stratified and typically poorly sorted silt, sand, gravel, and boulders forming concentric lobes where streams emerge from confining valleys and reduced gradients cause sediment load to be deposited.
- Qxk** Electron Mudflow (Holocene)—Unsorted mixture of subangular andesitic rock fragments in a purplish-gray, clayey sand matrix, from Mount Rainier.
- Qv** Lahar deposits (Holocene to late Pleistocene)—Unsorted mixtures of andesitic rock fragments in a clayey sand matrix; post-glacial, Lahar runoff and overbank deposits of three lahars from Mount Rainier Summerland eruptive period. Unit Qv is represented on the map by geochronology sample sites no. 178-179 (Table 1).
- Qxk** Osceola Mudflow (Holocene)—Unstratified mixture of subrounded to subangular andesitic rock fragments in a plastic clayey sand matrix; grayish purple to medium or light gray, oxidizes to mottled yellowish brown; originated in a volcanic mudflow from Mount Rainier.
- Qx** Terrace deposits (Holocene to late Pleistocene)—Well-sorted, loose, fluvial sand and pebble to boulder gravel along the White and Green Rivers.

PLEISTOCENE GLACIAL DEPOSITS

Deposits of the Vashon Stage of the Fraser Glaciation

- Qgl** Vashon Drift—Stratified and unstratified silt, clay, silt, gravel, and diamict; deposited during glacial advance and retreat; includes undifferentiated advance outwash, recessional outwash, ice-dammed-lake sediment, and ice-contact features.
- Qgn** Recessional outwash—Silt, clay, sand, and gravel deposited by glacial meltwater; variably sorted; loose to compact; massive to well stratified; horizontal to steeply dipping beds; includes drumlins, eskers, kettles, kames, and deltas. Divided into:
 - Qgn1** Recessional glaciolacustrine deposits—Very fine grained sand, silt, and clay deposited in small ice-marginal, ice-marginal, and ice-dammed lakes; stratified sand with scattered dropstones and occasional lenses of till or silt.
 - Qgn2** Recessional outwash, ice-contact deposits—Sand, gravel, silt, and clay; tan to gray; loose; moderately to well sorted and rounded; good porosity and permeability; contains a mixture of dynamic ice and stagnant ice features, including drumlins, eskers (green lens), kettles, kames, and less-ordered hummocky topography.
 - Qgn3** Recessional outwash, delta deposits—Sand and pebble to cobble gravel, minimal silt and sand, and rare boulders; well sorted; predominantly unweathered; deposited beneath retreating ice front by meltwater streams.
 - Qgn4** Recessional outwash, Stillecoom Gravel—Pebbles with boulders; local crossbedding; kettles and other ice-contact depositional.
 - Qgn5** Recessional outwash, sand—Sand with lenses and beds of pebble gravel and silt; gray to brown; moderate to well sorted; matrix free; loose; moderate to well rounded; commonly associated with eskers and kettles.
- Qgl** Vashon Till—Clay, silt, sand, and gravel; gray to brown and yellowish brown where oxidized; unstratified and highly compact; angular to subangular; low permeability and porosity; includes moraines, drumlins, striations, and flutes.
- Qgn** Advance outwash—Sand and pebble to cobble gravel; light gray to light brown; poorly to well sorted; very compact. Divided into:
 - Qgn1** Advance outwash, sand—Fine to medium-grained sand with lenses of silt or gravel; fluvial and lacustrine facies; typically well rounded and well sorted; prone to deep-seated landslides; locally called Colvos or Experience Sand.
 - Qgn2** Lawton Clay—Laminated to massive silt, clayey silt, and silty clay interbedded with layers of crossbedded sand; light gray to dark blue-gray; local ripple marks.
- Qxk** Evans Creek Drift (Fraser Glaciation, Evans Creek Stage)—Till, poorly sorted sand and gravel, and boulders; complexly interbedded; forms moraines and terraces.
- Qv** Fraser-age continental glacial and nonglacial deposits—Undifferentiated glacial and nonglacial deposits of the Fraser Glaciation.

Pre-Vashon Glacial and Nonglacial Deposits

- Qv** Sediments of the Olympia nonglacial interval—Thin to thick interbedded sand and silt, with localized gravel and some laminated silt and clay sequences; abundant plant material, wood fragments, and shells.
- Qv** Pre-Fraser continental sedimentary deposits, nonglacial—Silt interbedded with fine sand; blue-gray to yellow-brown; massive to laminated; abundant post and organic debris and pumice layers.
- Qv** Pre-Vashon alpine glacial drift and nonglacial deposits—Undifferentiated alpine glacial and nonglacial deposits.
- Qv** Pre-Vashon continental glacial drift and nonglacial deposits—Composite geologic unit that includes combinations of all of the continental glacial and nonglacial deposits. Unit Qv is widespread in bluffs near Puget Sound and Hood Canal and in valley walls of major rivers.
- Qv** Pre-Olympia continental glacial and nonglacial deposits—Composite geologic unit that includes combinations from among all of the continental glacial and nonglacial geologic units older than Olympia nonglacial interval (Olympia beds, unit Qv).
- Qv** Possession Drift—Sand, gravel, compact sandy till, and glaciomarine drift, with lenses of sand and gravel; gray and oxidized near top of unit; locally contains shells and shell fragments.
- Qv** Pre-Fraser continental glacial drift—Clay, silt, sand, and gravel; moderately rounded; laminated to poorly bedded; compact to loose; locally oxidized; gravel clasts of northern provenance deposited by glacial ice.
- Qv** Whitely Formation—Fluvial sands and gravels and massive to laminated marine and lacustrine silt and clay; wide range of oxidation levels; contains organic material.
- Qv** Pre-Olympia continental sedimentary deposits, nonglacial—Silt, clay, gravel, sand, and peat; coarse to fine grained; massive to laminated; predominantly volcanic; abundant organic debris and pumiceous deposits.
- Qv** Hayden Creek Drift—Alpine glacial till and outwash sand and gravel; yellowish to dark brown and oxidized.
- Qv** Wingate Hill Drift—Alpine glacial till and outwash gravel; dark brown and oxidized, with weathering rinds; very compact; weathering rinds on clasts average 0.2 in. thick.
- Qv** Double Bluff Drift—Till, glaciomarine drift, glaciolacustrine sand and gravel, and glaciolacustrine silt; wood and shells abundant.
- Qv** Salmon Springs Drift—Medium to coarse sand, pebble to cobble gravel, and till, with thin beds and lenses of silt and clay; locally contains peat and volcanic ash; clasts covered with iron-oxide stain, some strongly weathered and decomposed; well sorted.

- Qv** Lily Creek Formation—Unconsolidated lahar deposits; sand and gravel interbedded with compact mudflows; mudflows interbedded with ash and silt to very fine sand and white pumice; wholly or partly altered to clay.
 - Qv** Pre-Double Bluff continental glacial and nonglacial deposits—Composite geologic unit that includes combinations from among all of the continental glacial and nonglacial geologic units older than the Double Bluff (unit Qv).
 - Qv** Pre-Salmon Springs continental glacial and nonglacial deposits—Composite geologic unit that includes some combinations of Puysallup Formation (unit Qv), Alderton Formation (unit Qv), Stock Drift, and Orting Drift (unit Qv).
 - Qv** Puysallup Formation—Alluvial and lacustrine silt, sand, and gravel; compact peat beds common; weathered to clay to a depth of -10 m; silt is laminated and pinkish-gray; sand is gray and medium to coarse; yellowish-gray pumice common.
 - Qv** Alderton Formation—Alluvial sand, pebble to boulder gravel, mudflows, and peat, with pumice and ruff. Ash deposition is estimated from an Ar-Ar analysis to be 1.6 Ma (Table 1).
 - Qv** Orting Drift—Deeply oxidized sand and gravel and minor amounts of till; reversely magnetized; very compact, unsorted, and unstratified.
- Tertiary Sedimentary, Volcanic, and Intrusive Rocks**
- Mv** Hammer Bluff Formation (late Miocene)—Clayey fluvial sand and gravel, with thin silt and clay lenses, wood fragments, volcanic ash and lignite, and lacustrine sand and clay; cohesive and compact.
 - Mv** Volcanic lahars (middle to late Miocene)—Pumice gravel, several ash layers, and three lahars containing carbonized wood.
 - Mv** Intrusive latite (Miocene to Oligocene)—Light gray to creamy tan latite; well jointed and breaks into play fragments; conchoid flow banding, drag folding, and many xenoliths.
 - Mv** Quartz diabase (Miocene to Oligocene)—Silt of dark gray quartz diabase (diortite), weathered to light greenish gray in places; appears chalky where felsophan have been strongly weathered; holocrystalline and medium grained.
 - Mv** Intrusive andesite and dacite (Miocene to Oligocene)—Light gray massive hornblende dacite porphyry and porphyritic pyroxene andesite sills and dikes; porphyry is deeply weathered in places; irregularly shaped cavities common.
 - Mv** Continental sedimentary rocks (Oligocene to Eocene)—Tuffaceous sandstone and conglomerate, mudstone, and shale; generally poorly indurated; locally cemented by calcite and zeolites; strongly iron-stained; partly weathered to clay.
 - Mv** Ohanapesh Formation (late Eocene to Oligocene)—Volcaniclastic conglomerate, sandstone, siltstone, and shale; typically greenish gray, though may be black, brown, red, or white; lower volcanic sandstones are poorly sorted.
 - Mv** Intrusive dacite (upper Oligocene)—Basaltic, andesitic, or dacitic rocks; medium dark gray to dark greenish gray; porphyritic.
 - Mv** Intrusive porphyritic andesite (Oligocene to Eocene)—Irregularly shaped intrusive bodies and a sill of porphyritic andesite, probably emplaced at shallow depth.
 - Mv** Continental sedimentary rocks of the Puget Group (early Eocene to early Oligocene)—Sandstone, siltstone, shale, carbonaceous shale, claystone, and coal; massive to crossbedded. Divided into:
 - Mv** Northcraft Formation (Eocene)—Andesite breccia; generally brownish or yellowish black, but may be black and dark gray; greenish gray or black; includes ruff and lesser amounts of volcanic conglomerate and volcanic sandstone interbedded with mafic breccia.
 - Mv** Porphyritic intrusive igneous rocks (Eocene)—Greenish-gray rocks composed of zoned and altered plagioclase and hornblende phenocrysts.
 - Mv** Intrusive porphyritic basalt and andesite (late Eocene)—Irregular masses of phenitic igneous rock containing plagioclase and small crystals of mafic minerals; black to varying shades of brown.
 - Mv** Crescent Formation (Eocene)—Fragilaceous pyroxene tholeiitic basalt with local diabase and gabbro; dark gray with a greenish tint, brown where weathered, and reddish and variegated along altered contact zones.

GEOLOGIC SYMBOLS

- Contact—Approximately located
- - - - - Fault—Dashed where concealed, short-dashed where inferred, queried where identity or existence questionable
- - - - - Reverse fault—Solid where location accurate; long-dashed where approximate; short-dashed where inferred; queried where identity or existence questionable; rectangles on upthrown block
- - - - - High-angle dip-slip fault—Solid where location approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable; U, upthrown block; D, downthrown block
- - - - - Normal fault—Solid where location approximate; short-dashed where inferred; dotted where concealed; bar and ball on downthrown block
- - - - - Anticline—Solid where location approximate; short-dashed where inferred; dotted where concealed; arrow indicates plunge direction
- - - - - Syncline—Solid where location approximate; short-dashed where inferred; dotted where concealed
- - - - - Monocline, synclinal bend—Location concealed, queried where identity or existence questionable; arrows show direction of dip; shorter arrow on steeper limb
- - - - - Monocline, anticlinal bend—Location concealed, queried where identity or existence questionable; arrows show direction of dip; shorter arrow on steeper limb
- Qv, Qv Geologic unit too thin to show as polygon—Location approximate; separates units
- Landslide scarp—Location accurate; identity and existence certain; hatchures point downslope
- BS Inclined bedding—showing strike and dip
- BS Inclined bedding—showing strike
- BS Inclined bedding in unconformable deposits—showing strike and dip
- BS Geochronology sample, fossil
- BS Geochronology sample, argon-argon (⁴⁰Ar/³⁹Ar)
- BS Geochronology sample, U-Pb, zirconium-lead
- BS Geochronology sample, radiocarbon (¹⁴C)
- BS Geochronology sample, fission-track
- BS Geochronology sample, luminescence
- BS Geochronology sample
- BS Geologic unit too small to be shown as a polygon or line
- BS Paleomagnetic sample, transitional magnetization
- BS Paleomagnetic sample, normal magnetization
- BS Paleomagnetic sample, reversed magnetization

Lambert conformal conic projection
North American Datum of 1983, in place on North American Datum of 1983, move the projection lines approximately 23 meters north and 94 meters east as shown by crosshair corner ticks
Base map from scanned and rectified U.S. Geological Survey Tacoma 1:100,000-scale quadrangle, 1991
Shaded relief generated from a 1-km bare-earth digital elevation model (available from Puget Sound Labor Consortium, <http://pugetsond.com/arcswat/washington.edu/>)
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