WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGY AND EARTH RESOURCES

Geologic Map of the Shelton Valley 7.5-minute Quadrangle, Mason County, Washington

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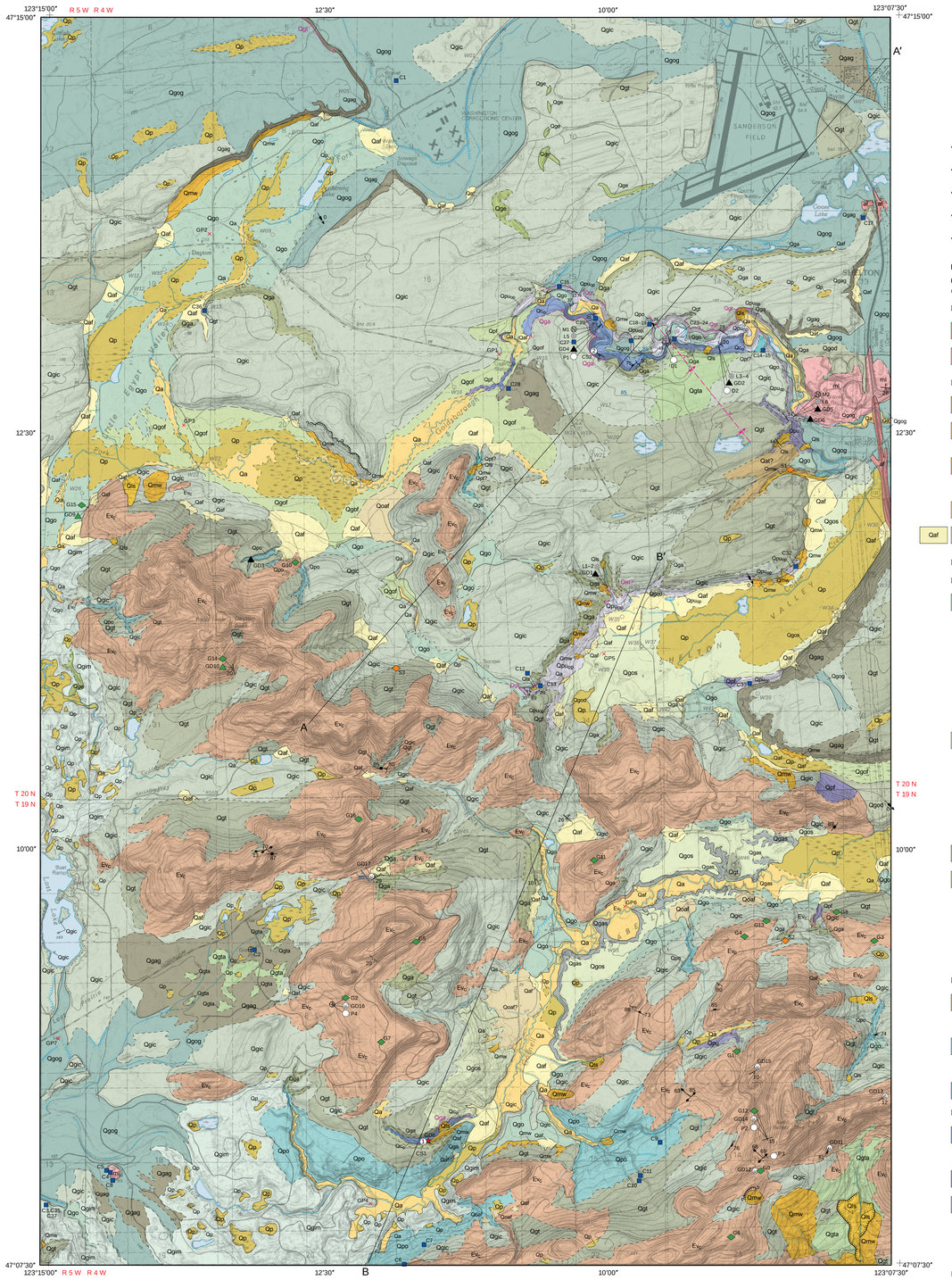

Lambert conformal conic projection
North American Datum of 1927; to place on North American Datum of 1983, move the projection lines approximately 24 meters north and 95 meters east as shown by crosshair corner ticks
Base map from scanned and rectified U.S. Geological Survey Shelton Valley 7.5-minute quadrangle, 1981
Shaded relief generated from a lidar bare-earth digital elevation model (available from Puget Sound Lidar Consortium, http://pugetsoundlidar.ess.washington.edu/)
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Digital cartography by Daniel E. Coe and Ian J. Hubert
Editing and production by Alexander N. Steely, Jessica L. Czajkowski, and Daniel E. Coe

SCALE 1:24.000

1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

contour interval 10 meters

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16°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2016

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MAJOR FINDINGS

- Strong magnetic and gravity anomalies previously interpreted as the Olympia structure are colocated with intense deformation of Quaternary sediment in the quadrangle; however, that deformation could be glaciotectonic.
- Two new $^{40}Ar/^{39}Ar$ ages of 50.51 ±0.21 and 50.14 ±0.17 Ma from the Black Hills suggest that the Crescent Formation may be slightly younger than indicated by some earlier analyses.
- Sixteen new whole-rock geochemical analyses in the quadrangle suggest that basalt of the Black Hills is geochemically distinct from basalt of the Crescent Formation elsewhere.
- North of the Black Hills, subsurface sediment is mostly sourced from the basalt-rich Olympic Mountains; glacial and nonglacial sediment in the Black Hills is generally derived from polymict, northern-sourced material.
- New radiocarbon, luminescence, and pollen analyses indicate that alpine glaciers from the Olympic Mountains likely advanced into the quadrangle, producing voluminous drift, during Marine Isotope Stage 3 (MIS 3).

DESCRIPTION OF MAP UNITS

(see pamphlet for detailed map unit descriptions)

Quaternary Unconsolidated Deposits

HOLOCENE NONGLACIAL DEPOSITS

af — **Artificial fill**—Major road fill placed to elevate the land along US 101; likely engineered; may include sand, cobbles, pebbles, boulders, silt, clay, organic matter, rip-rap, and concrete, in varied abundance.

ml — **Modified land**—Boulders, cobbles, pebbles, sand, silt, clay, diamicton, and organic matter, in varied amounts; locally derived but redistributed to modify topography.

LATEST PLEISTOCENE TO HOLOCENE NONGLACIAL DEPOSITS

Qp — **Peat**—Organic and organic-rich sediment; includes peat, gyttja, muck, silt, and clay; typically in closed depressions.

Qls — **Landslide deposits**—Cobbles, pebbles, sand, silt, clay, boulders, and diamicton, in varied abundance, in slide bodies and toes; angular to rounded clasts and grains; unsorted; generally loose, jumbled, and unstratified, but locally retains primary bedding and compaction.

Qmw — **Mass-wasting deposits**—Cobbles, pebbles, sand, silt, clay, boulders, and diamicton, in varied abundance; loose; generally unsorted, but locally stratified; shown along potentially or demonstrably unstable slopes; includes colluvium and (or) landslides too small to map separately; locally includes compact and disturbed or undisturbed older deposits.

Qa — **Alluvium**—Sand, pebbles, silt, clay, peat, and cobbles; loose; moderately to well sorted; stratified to massive; deposited in flood plains and on terraces.

Qaf / Qoaf — **Alluvial fan deposits**—Pebbles, sand, silt, cobbles, and boulders, in varied abundances; loose; moderately to poorly sorted; stratified; lobe-shaped where streams emerge from valleys. Unit **Qoaf** where relict.

PLEISTOCENE GLACIAL AND NONGLACIAL DEPOSITS

Deposits of the Vashon Stade of the Fraser Glaciation

Qgo — **Vashon Stade recessional outwash**—Sand and pebble to cobble gravel; some silt and clay; moderately fresh; loose; subrounded clasts; moderately to well sorted; unstratified. Locally subdivided into:

Qgog — **Vashon recessional outwash, gravel**—Pebble gravel with cobbles and sandy matrix; brown and gray, loose to moderately dense; subrounded to rounded clasts; well sorted.

Qgos — **Vashon recessional outwash, sand**—Sand with pebble lenses, silt, and clay; gray to pale-brown; clasts moderately to well rounded; moderately to well sorted; loose.

Qgof — **Vashon recessional outwash sediment, fine-grained**—Silt, clay, and mixtures of both, locally contains fine sand; may contain dropstones; pale gray to light-green-gray; loose, soft; planar bedded to massive.

Qgod — **Vashon recessional glacial delta deposits**—Pebble gravel, sand, and silt; gray to pale brown; loose; moderately sorted; delta sedimentary structures with topset, foreset, and bottomset beds.

Qgic — **Vashon ice-contact deposits**—Diamicton (ablation till, flow till, and poorly compacted or patchy lodgment till), less commonly contains pebble and cobble gravel, sand, mud, and isolated boulders; pale gray, tan, or brown; slightly weathered; compaction, sorting, and stratification vary. Locally subdivided into:

Qgim — **Vashon Puget lobe end moraine**—Deposits similar to unit Qgic, but specifically interpreted as a moraine.

Qgta — **Vashon ablation till**—Diamicton, sand, silt, clay, and gravel; gray to tan and reddish brown; loose to compact; unsorted; unstratified; clasts commonly striated and faceted.

Qge — **Vashon esker**—Pebble to cobble gravel and sand; gray; loose; clasts rounded to well rounded; typically well sorted; forms elongate, sinuous hills deposited by water beneath stagnant ice.

Qgt — **Vashon lodgment till**—Diamicton; gray to brown; lightly to unweathered; unsorted; unstratified; compact, commonly resembles concrete.

Qga — **Vashon advance outwash, undivided**—Sand, pebble gravel, cobble gravel, silt, and clay, in varied amounts, commonly coarsening-upsection; gray to tan; compact; typically well rounded and sorted; very thinly to very thickly bedded. Locally subdivided into:

Qgag — **Vashon advance outwash, gravel**—Cobble and pebble gravel, some sand, silt, and clay; pale gray to gray or yellowish brown; well-rounded; well-sorted; compact; thinly to very thickly bedded.

Qgas — **Vashon advance outwash, sand**—Sand, locally pebbly; locally planar-bedded with silt interbeds; gray, pale gray, or pale brown; compact; subrounded to well rounded; moderately to well sorted; mostly lacustrine, planar-bedded, and quartzo-feldspathic.

Pre-Vashon Glacial Deposits

Qaf? — **Pre-Vashon alpine till?**—Basalt-rich diamicton; reddish brown to dark brown; unsorted; unstratified; compact; commonly resembles concrete, except for dark color; highly to severely weathered, suggesting age(s) significantly older than the Vashon Stade; interpreted as likely lodgment till of unknown age deposited by glaciers from the Olympic Mountains.

Qpo — **Pre-Vashon outwash, undivided**—Pebble gravel, sand, laminated silt (locally contains dropstones), and diamicton in varied amounts; gray, light brown, or tan; compact; moderately to well sorted (except where diamicton); rounded to subangular clasts; laminated, cross-bedded, or massive; clasts are northern-sourced; includes both advance and recessional outwash.

Qpt? — **Pre-Vashon till**—Diamicton; gray to brown or tan; lightly or moderately weathered; unsorted; unstratified; compact, locally resembles concrete; clasts are northern-sourced.

Pre-Vashon Glacial and Nonglacial Deposits, Undivided

Qc_O — **Pre-Vashon sediment of MIS 3**—Pebble gravel, and less commonly sand, silt, clay, diamicton (including possible till), peat, and detrital wood; light brown, brown, gray, or dark gray; compact; moderately well sorted (except where diamicton); planar bedded, cross-bedded, or massive; northern-sourced clasts in the Black Hills, but mostly Olympic Mountains-sourced clasts farther to the north.

Qpf — **Pre-Vashon sediment, fine-grained**—Silt, clay, and mixtures of both, locally ranges to fine sand, dropstones common; pale to dark-gray or brown; compact; planar bedded or massive.

Qpu — **Pre-Vashon sediment, undivided**—Pebble gravel, sand, silt, clay, diamicton, organic sediment, and boulders, in varied amounts; color, weathering, rounding, sorting, and bedding vary; compact. Locally subdivided into:

Qpu_{Op} — **Pre-Vashon sediment, undivided, mostly Olympic Mountains-sourced**—Pebble gravel, sand, diamicton (including some tills), silt, clay, and peat; reddish brown to tan or gray; variously weathered; compact; moderately sorted.

Pre-Quaternary Bedrock

ΦEm — **Undifferentiated sedimentary rocks (Eocene to Oligocene)(Cross Section A only)**—Sandstone, siltstone, mudstone, and conglomerate, in varied amounts; inferred above Crescent Formation in the Tacoma Basin. Not exposed in outcrop or intersected by borings or wells; inferred based on geophysics and regional considerations.

Ev_C — **Crescent Formation basalt (early to middle Eocene)**—Basalt flows and pillows, with minor lenses and interbeds of sedimentary rock between pillows or flows; dark gray, weathers to brown and yellowish brown; aphanitic to porphyritic; locally vesicular.

GEOLOGIC SYMBOLS

Contact—Solid where location accurate; long-dashed where approximate; short-dashed where inferred

Monocline, anticlinal bend—Identity or existence questionable, location approximate. Arrows show direction of dip; shorter arrow on steeper limb

A — A′ Cross section line

Qgt Geologic unit too thin to show as a polygon—Solid where location accurate; short-dashed where inferred; queried where identity or existence questionable

Fluvial terrace—Identity and existence certain, location accurate. Hachures point down slope

Landslide scarp—Solid where identity or existence certain; queried where identity or existence questionable. Location accurate. Hachures on downslope side

85 Clastic dike—Showing dip and dip direction

Direction of downslope movement of landslide

10 Inclined bedding—showing strike and dip

Horizontal bedding

17 Inclined bedding in unconsolidated sedimentary deposits—showing strike and dip

28 Inclined foreset bedding in unconsolidated sedimentary deposits—showing strike and dip

20 Approximate orientation of inclined bedding in unconsolidated deposits or bedrock—showing approximate strike and dip

37 Inclined warped, undulatory, or contorted bedding—showing approximate strike and dip

10 Inclined flow bands, lamination, layering, or foliation in igneous rock—showing strike and dip

49 Small fault or shear—showing strike and dip

85 Slickenside—showing strike and dip

83 Inclined slickenline, groove, or striation on fault surface—showing bearing and plunge

75 Small, minor inclined joint—showing strike and dip

Small, minor vertical or near-vertical joint—showing strike

Inclined flow direction, including sole mark, tool mark, scour mark, flute mark, groove, or channel in sedimentary materials—showing bearing and plunge

Younger glacial striation or groove—showing measured bearing and direction of flow

GD13 Age site, fossil

GD9 Age site, ^{14}C, carbon-14

GD10 Age site, $^{40}Ar/^{39}Ar$, argon-argon

GD8 Age site, infrared stimulated luminescence (IRSL)

G2 Geochemistry sample location

W21 Water well

S1 Significant site

P2 Location of photograph (P) or schematic diagram (D)

CS1 Location of columnar section (CS)

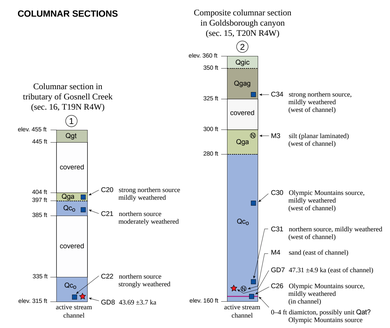
GP3 Geophysical data collection location

M2 Paleomagnetic sample—normal magnetization

L5 Pollen sample

C5 Clast count sample

COLUMNAR SECTIONS



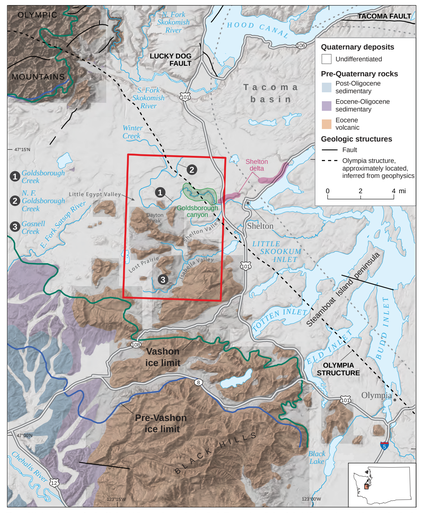
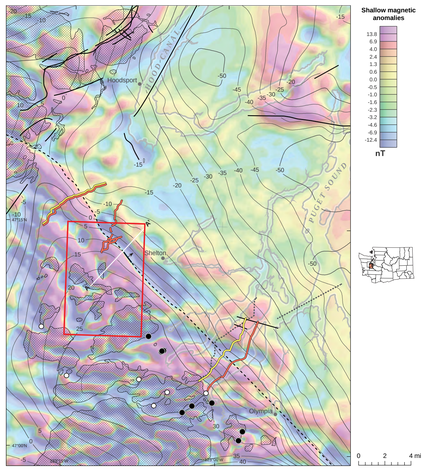


Figure M1. Location map for the Shelton Valley quadrangle (red outline). The southern limits of glacial ice are shown with green (Vashon) and blue (pre-Vashon) lines and are modified from Carson (1970) and Logan (1987, 2003). The location of the Shelton delta is modified from Bretz (1910, 1913) and Thorson (1981). Gray dotted lines show the margins of the Tacoma basin. Lucky Dog fault is from Polenz and others (2010) and fault across the Steamboat Island peninsula is from Clement and others (2010). Geologic units, faults, and folds are from 1:250,000-scale mapping (Washington Division of Geology and Earth Resources, 2010a). Dashed black line is the Olympia structure, which is approximately located, inferred from geophysics, and modified from Danes and others (1965), Blakely and others (2009), and Clement and others (2010).

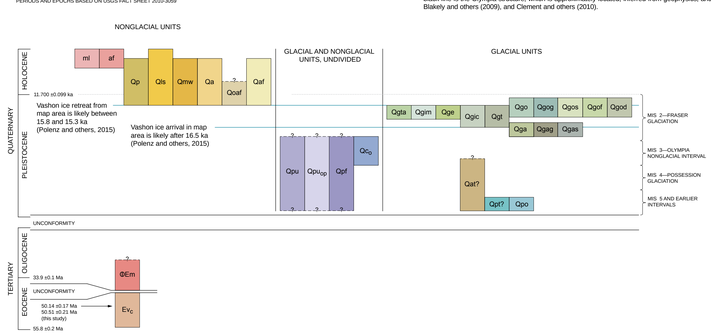


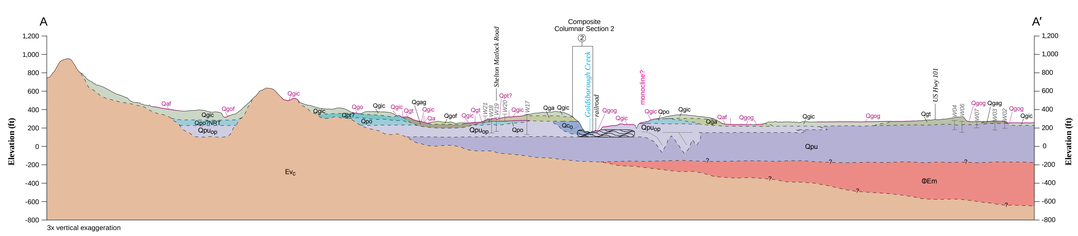
Bouguer anomaly contours
5 mGal interval
25 mGal interval
Polarity (Globerman, 1981)
Normal
Reversed
Data collection line (magnetics)
Data collection line (gravity)
Monocline in Goldsborough canyon
Outcrop of Crescent Formation
Seismic line
A — A′ Cross Section A
Fault
Olympia structure, approximately located, inferred from geophysics

Figure M2. Gravity and aeromagnetic gradients in and around the Shelton Valley quadrangle (red rectangle). Marine shorelines are in gray. Aeromagnetic anomaly image is from Richard Blakely (USGS, written commun., 2016) and bouguer gravity anomaly contours are from unpublished data of S. Magsino (National Academy of Sciences, written commun., 2016). Paleomagnetic data are shown as black (normal) and white (reverse) dots and are from Globerman (1981). Marine seismic lines are from Pratt and others (1997); land-based seismic lines are from J. Odum (USGS, written commun., 2014, 2015, 2016). Data collection lines for gravity (yellow) and magnetics (red) are unpublished data from S. Magsino (written commun., 2016). Stippled polygons of the Crescent Formation and faults are from 1:100,000-scale mapping (Washington Division of Geology and Earth Resources, 2010b); the monocline in the Shelton Valley quadrangle is from this project. Dashed black line is the Olympia structure, which is approximately located, inferred from geophysics, and modified from Danes and others (1965), Blakely and others (2009), and Clement and others (2010).

CORRELATION OF MAP UNITS

PERIODS AND EPOCHS BASED ON USGS FACT SHEET 2010-3059





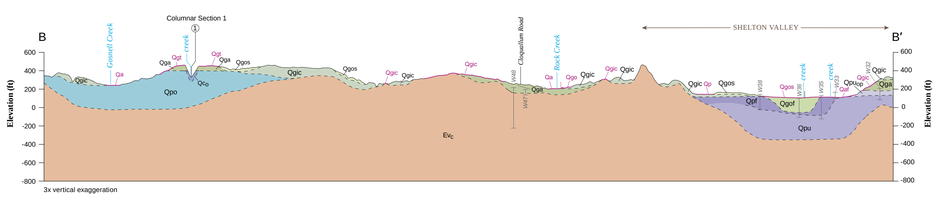
CROSS SECTION EXPLANATION

Qls — Geologic units too thin to show as polygons at the scale of the cross section. Tick marks separate units.

Zone of intense deformation of unconsolidated units represented in Figure 4. See *Structures in the Map Area* for further explanation.

W2145 — Water well or boring

Bedding form lines



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