GEOLOGIC MAP OF THE MALTBY 7.5-MINUTE QUADRANGLE, SNOHOMISH AND KING COUNTIES, WASHINGTON

Download the publication



Skyler P. Mavor—Washington Geological Survey, Department of Natural Resources; Colorado State University Mitchell Allen—Forest Practices Division, Washington Geological Survey, Department of Natural Resources

Jeffrey H. Tepper—University of Puget Sound

Elizbeth A. Nesbitt—Burke Museum, University of Washington Shannon A. Mahan—U.S. Geological Survey, Denver Federal Center

Recep Cakir—Washington Geological Survey, Department of Natural Resources

Bruce A. Stoker—Earth Systems

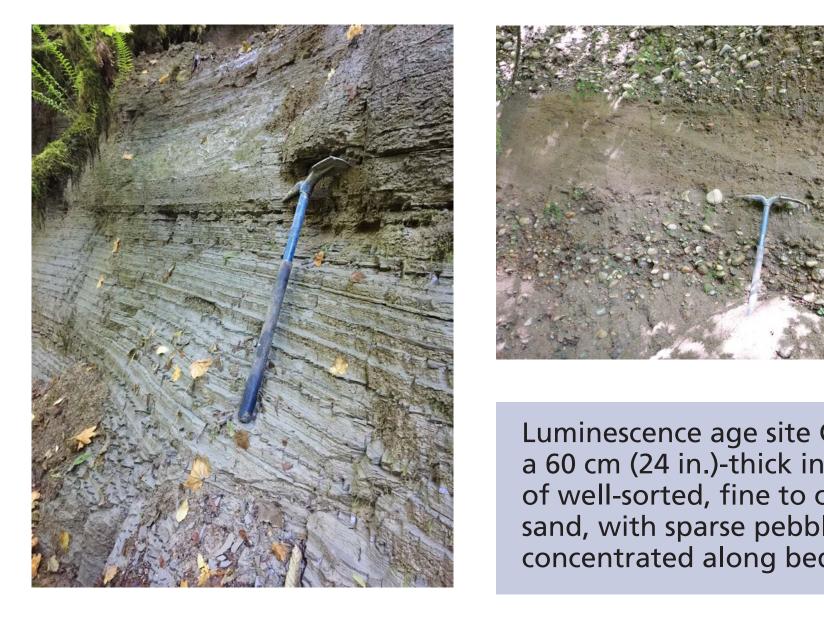
M.L. Anderson—Colorado College

Abstract—No. 387-4 (304000):

We present a new geologic map of the Maltby 7.5-minute quadrangle at 1:24,000 scale. The densely populated quadrangle located 30 km northeast of Seattle, which has not been mapped in detail since the 1980s, spans the projected intersections of several active regional tectonic structures. We support the map with new field work, lidar, existing subsurface explorations, geochemistry, palynology, and U-Pb, luminescence, radiocarbon, and biostratigraphic chronology. We compare mapped geology with new isostatic gravity and existing aeromagnetic data for further observations of structural features in this complex area.

New radiocarbon and luminescence chronology constrains pre-Vashon stratigraphy of the Olympia non-glacial interval and may provide a limiting date for the end of the Possession Glaciation. New U-Pb zircon ages for both volcanic (~44 Ma) and sedimentary (~28 Ma) bedrock units are presented. Geochemical analyses of 18 samples of the volcanic rocks of Mount Persis range from andesite to dacite and most have adakite affinities.

We compare these data with existing analyses of the volcanics and discuss a relation to the earliest stages of subduction-related magmatism as the modern Cascade arc initiated in the Eocene. We refine the stratigraphy of fossiliferous Tertiary sedimentary bedrock with constraints from U-Pb zircon chronology, as well as foraminiferal and molluscan biostratigraphy, and describe an Eocene-Oligocene transition from continental to mid-shelf environments with evidence for diffuse methane seep colonies. Biostratigraphy leads us to infer that most of the exposed sedimentary bedrock predates the Blakeley Formation type section, in contrast to correlations drawn by previous workers. A major bedrock anticline in the map area reflects Oligocene or later NNE-SSW compression and may be tied to a complex interaction of regional structures concealed by Quaternary cover. Detailed mapping is unable to further constrain the surficial trace of the active Southern Whidbey Island Fault zone or Monroe Fault, though geophysical lineaments indicate that strands of these structures extend through the quadrangle and merge with previously mapped faults to the southeast. Our new map concludes a decade-long campaign of detailed geologic mapping by the Washington Geological Survey in the eastern Puget Lowland.

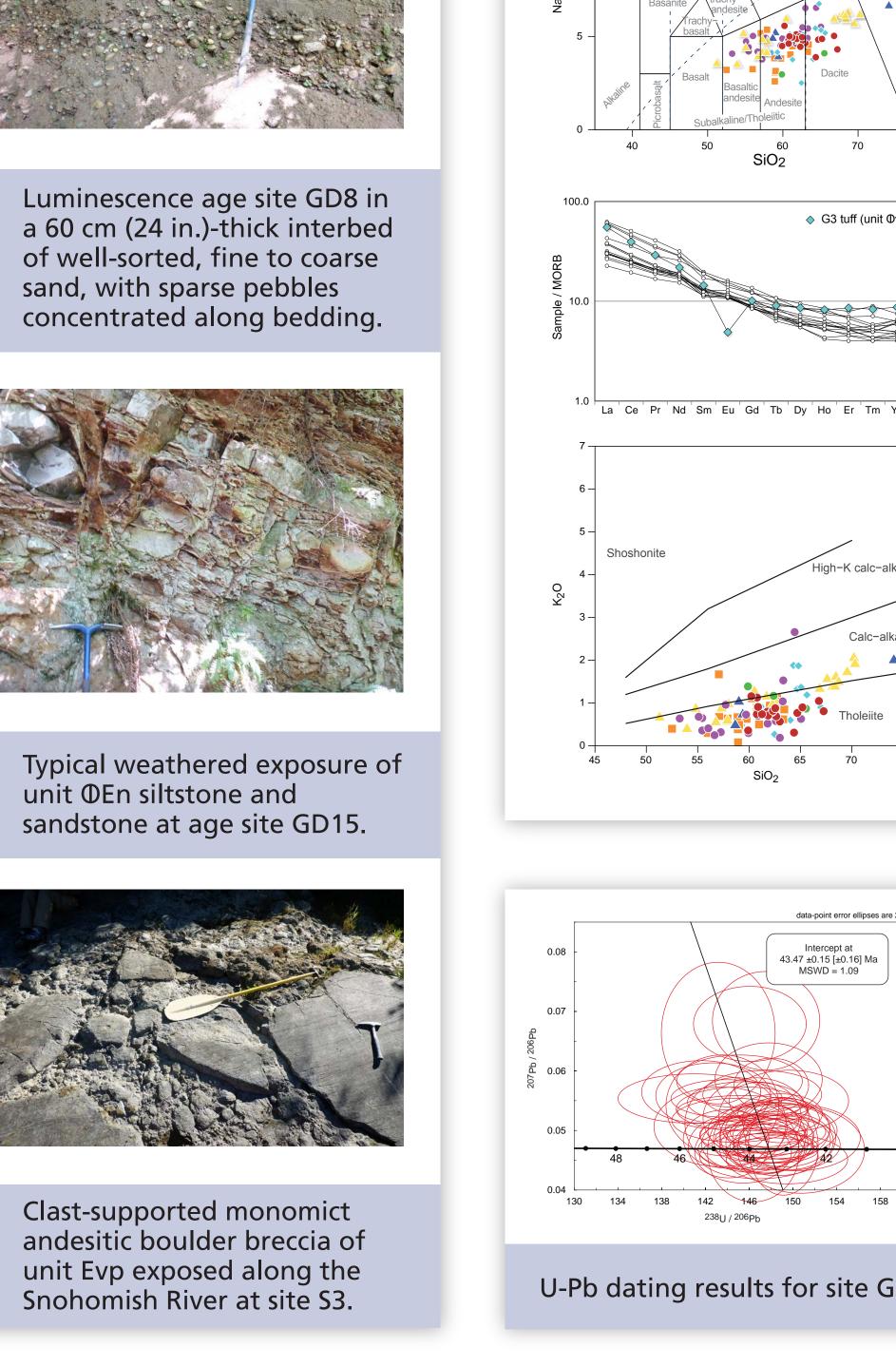


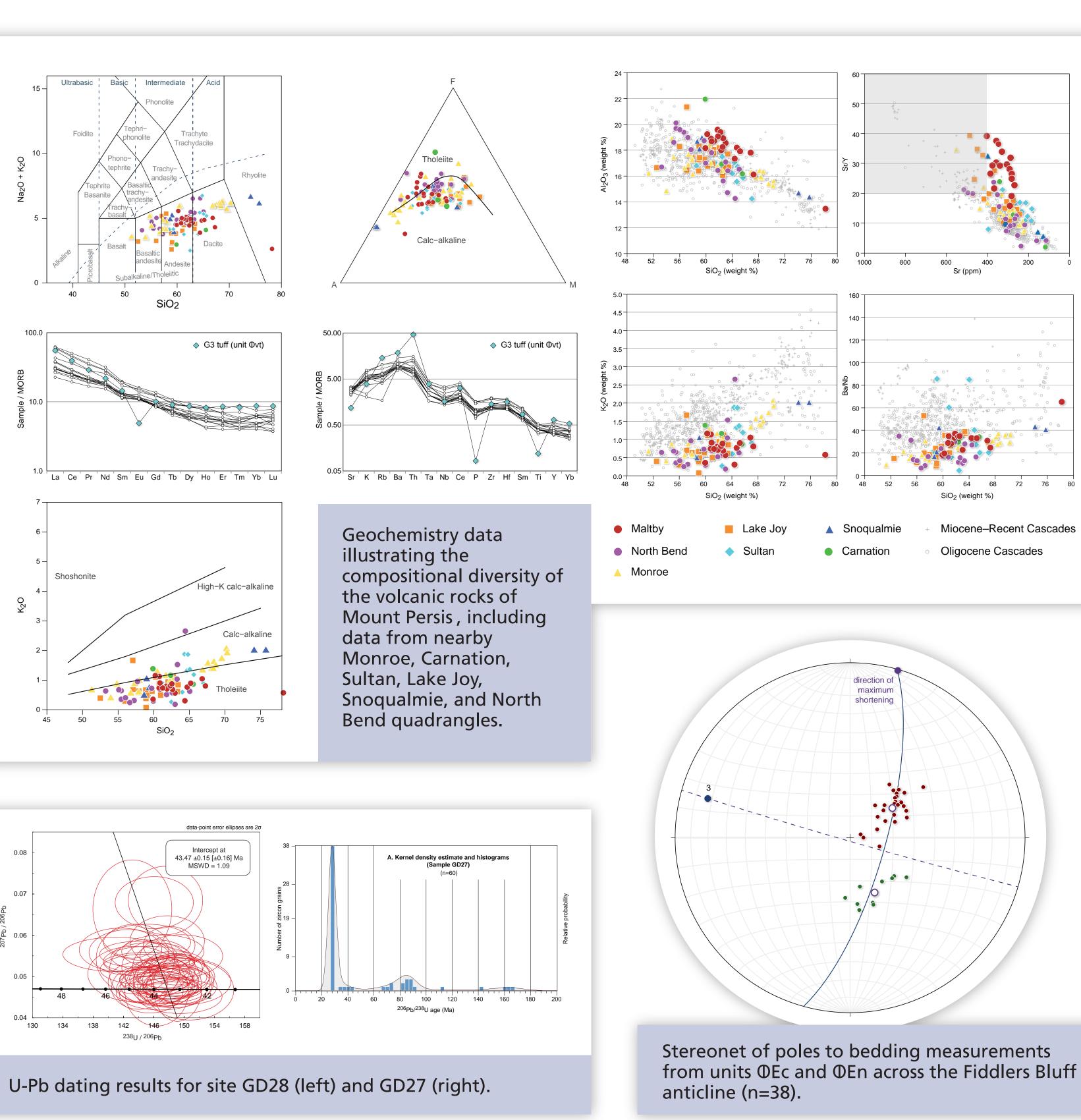


lacustrine sedimentation.



Deciduous and coniferous terrestrial plant fossils preserved in a detached boulder of unit OEc.





Geologic Map of the Maltby 7.5-minute Quadrangle, Snohomish and King Counties, Washington Mitchell D. Allen, Skyler P. Mavor, Jeffrey H. Tepper, Elizabeth A. Nesbitt, Shannon A. Mahan, Recep Cakir, Bruce A. Stoker, and Megan L. Anderson MAJOR FINDINGS Eighteen new geochemical samples and a new ~44 Ma U-Pb date from the volcanic rocks of Mount Persis refle-Nearshore sedimentary rocks (Oligocene to late Eocene)—Siltstone to coarse-grained sandstone ran Refugian-stage foraminiferal and Galvinian-stage molluscan biostratigraphy below a ~28 Ma U-Pb date of pebble conglomerate; brown or gray to dark gray; orange-brown or tan to dark gray on weathered surfaces interbedded tuff shows that sedimentary rocks are older than previously inferred and record an Eocene or early with hackly concentric weathering pattern; typically tuffaceous and fossiliferous; well lithified to friable; nassive to very thickly planar bedded; rare crossbedding. Locally subdivided into: Tuff (Oligocene)—Coarse rhyolitic crystal vitric (ash) tuff; white to light gray on fresh faces, tan to gray on weathered surfaces; very strongly lithified; massive with local faint stratification; Marine Isotope Stage 2 (MIS 2), and MIS 4. Results may demark a minimum limiting age for the Possession A west-northwest tracing bedrock anticline records late Oligocene or younger north-northeast-directed shortening and may connect to other regional structures Continental sedimentary rocks (early Oligocene to Eocene)—Sandstone and pebble and cobble here weathered; well indurated but locally friable; clasts subrounded; crossbedded and imbricated; errestrial plant fossils and thin coal stringers common. see pamphlet for detailed map unit descriptions Volcanic rocks of Mount Persis of Tabor and others (1993), undivided (mid- to late Eocene) Quaternary Unconsolidated Deposi[,] boulder breccia; gray to dark gray; well indurated; fine to coarse grained; massive; columnar jointed. Artificial fill—Major road fill placed to elevate the land along road or railways; likely engineered; may Dikes—Andesite and dacite dikes around the flanks of Lord Hill; steeply dipping with various include sand, cobbles, pebbles, boulders, silt, clay, organic matter, rip-rap, and concrete, in varied orientations; planar to gently undulating; locally glassy with rare andesite xenoliths. Puget Group, undivided (Eocene)(cross sections only)—Arkosic sandstone, tuffaceous sandstone, tuff, Modified land—Boulders, cobbles, pebbles, sand, silt, clay, diamicton, and organic matter, in varied amounts; locally derived but redistributed to modify topography; underlying units exposed in some areas ATEST PLEISTOCENE TO HOLOCENE NONGLACIAL DEPOSITS **Peat**—Organic material and organic-rich sediment; includes peat, gyttja, muck, silt, and clay, with plant or woody debris; rare volcanic ash or pumicite; dark brown or olive-brown; soft; typically wet and may where inferred; dotted where concealed; queried where identity or existence Alluvium—Sand, pebbles, silt, clay, peat, cobbles, and organic material; dark brown to gray; loose; Gradational contact—Identity or existence questionable; location inferred Alluvial fan deposits—Pebbles, sand, silt, cobbles, and boulders, in varied amounts; typically brown gray; loose; moderately to poorly sorted; weakly to well stratified; forms gently dipping lobe-shaped ----- Fault, unknown offset—inferred; identity or existence questionable surfaces where streams emerge from confining valleys. where concealed; queried where identity or existence questionable PLEISTOCENE GLACIAL AND NONGLACIAL DEPOSITS Holocene nonglacial Eocene rhyolite of Geologic unit too thin to show as a polygon—Solid where location accurate; Deposits of the Vashon Stade of the Fraser Glaciation Pleistocene glacial long-dashed where approximate; short-dashed where inferred; dotted where concealed; queried where identity or existence questionable Vashon recessional outwash—Sand and pebble to cobble gravel; some silt and clay; gray to tan where fresh; loose or soft to medium soft; subangular to well-rounded polymict clasts; moderately to well sorted; Dike—Identity or existence certain; Solid where location accurate; long-dashed where weakly to well stratified. Locally subdivided into: approximate; ; short-dashed where inferred; showing dip value and direction Vashon recessional outwash, sand—Sand with silt, rare pebbles, and clay; gray to pale brown A ——— A' Cross section line Oligocene-Eocen where fresh, orange-brown where weathered; sand subangular to subrounded; moderately to well sorted; loose to medium dense; massive to poorly bedded. Fluvial terrace—Identity and existence certain, location accurate; hachures point downslope Cretaceous–Jurassic Western mélange belt Vashon ice-contact deposits—Diamicton (ablation till, flow till, or melt-out till and supraglacial Landslide scarp—Solid where identity or existence certain; location accurate; hachures on orange-brown where weathered; compaction, sorting, and degree of stratification varied; supraglacial, subglacial, or ice-marginal origin; often associated with hummocky or irregular morphology. Vashon lodgment till—Diamicton; gray to brown; lightly to unweathered; unsorted; unstratified; Stream—Perrennial where solid; dotted and dashed where intermittent compact; stiff to very stiff; gravel to very large boulders angular to subrounded and supported in a matrix 29 Inclined bedding—showing strike and dip Horizontal bedding Vashon advance outwash, undivided—Sand, pebble to cobble gravel, silt, and clay, in varied amounts approximate strike and dip Inclined bedding, where top direction of beds known from local features—showing strike and dip Vashon advance outwash, sand—Sand and sparse gravel; pale gray to pale brown; Small, minor inclined joint—showing strike and dip orange-brown where weathered; loose to dense; clasts subangular to subrounded; well sorted Small, minor inclined fault—showing strike and dip Inclined generic small, minor fold axial surface—showing strike and dip Vashon advance outwash, silt and clay—Silt and clay with sparse gravel; blue-gray to gray-brown where fresh, dark brown where weathered; stiff to hard; well sorted; locally sandy; Inclined slickenline, groove, or striation on fault surface—showing bearing and plunge mostly glaciolacustrine with dropstones; thinly bedded to laminated with rhythmic bedding. Slickenside—showing strike and dip **Pre-Vashon Glacial and Nonglacial Deposits** Inclined flow direction, including sole mark, tool mark, scour mark, flute mark, groove, or channel in sedimentary materials—showing bearing and plunge **Deposits of the Olympia nonglacial interval (MIS 2–3), sand and silt**—Sand and silt with minor clay Inclined bedding in unconsolidated sedimentary deposits—showing strike and dip and gravel; blue-gray to brown-gray where fresh, orange-brown where oxidized, dark brown where organic-rich; very stiff to hard; moderately to very well sorted; micaceous; medium bedded to laminated Inclined foreset bedding in unconsolidated sedimentary deposits—showing strike and dip Inclined flow bands, lamination, layering, or foliation in igneous rock—showing strike and dip and matrix, rare small boulders; gray-brown to dark brown, orange-brown where weathered; matrix- to GD25 Age site, fossil clast-supported; clasts subrounded to rounded; moderately to well sorted; weakly stratified and imbricated 09-54Z Age site, U-Pb, uranium-lead Pre-Vashon sand—Medium sand; pale brown to light gray where fresh, orange-brown to gray-brown on GD1 ▲ Age site, ¹⁴C, carbon-14 weathered faces; medium dense to dense; well sorted; massive or thin to medium planar bedded; iscontinuous, thin lens-shaped beds of pebbly sand; centimeter-scale ripple bedforms. GD10 ★ Age site, luminescence (OSL and (or) IRSL) Geochemistry sample location **Pre-Vashon till**—Diamicton; locally sandy; gray, blue-gray, or brown where fresh, orange brown on reathered faces; massive; compact, locally resembles concrete; local shear fabric; polymict clasts. ^{W50} ○ Water well Significant site **Pre-Vashon glacial and nonglacial deposits, undivided**—Sand, silt, clay, pebble gravel, diamicton, Ovt Geologic unit too small to show as a polygon at map scale organic debris, and boulders, in varied amounts; color, weathering, rounding, sorting, and bedding varied; CS1 Location of columnar section (CS) GP7 x Geophysical data collection location B10 ♦ Drill hole or test pit CORRELATION OF MAP UNITS P1 Reference Pollen sample 5 mGal interval Southern Whidbey Island fault SB Seattle Basin A A' cross section A geophysical lineament EB Everett Basin Lambert conformal conic projection North American Datum of 1927; to place on North American Datum of 1983, move the projection lines approximately 26 meters north and Figure M2. Reduced-to-pole aeromagnetic anomaly imagery is from Richard Blakely (USGS, written commun., 2016). Isostatic 000 0 1000 2000 3000 4000 5000 6000 92 meters east as shown by crosshair corner ticks gravity anomaly contours are from this study. The Maltby quadrangle boundary is shown in red. Faults within the quadrangle Base map from scanned and rectified U.S. Geological Survey boundary correspond to the Grace and Cottage Lake lineaments of Sherrod and others (2008). The Fiddlers Bluff anticline and Maltby 7.5-minute quadrangle, 1981—base map modified to contour interval 20 feet geophysical lineaments are from this study (see pamphlet, Geophysical Observations). reflect mapped lakes. Shaded relief generated from a lidar bare-earth digital elevation model (available from the Washington Geological Survey, This geologic map was funded in part by the http://lidarportal.dnr.wa.gov/) J.S. Geological Survey National Cooperative Geologic Mapping Program GIS by Mitchell D. Allen and Skyler P. Mavor under USGS award number G16AC00286, 2016–2017. Digital cartography by Daniel E. Coe Editing and production by Jessica L. Czajkowski, Jaretta M. Roloff, and Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G16AC00286. The views and conclusions contained in this document are those of th authors and should not be interpreted as necessarily representing the Disclaimer: This product is provided 'as is' without warranty of any kind, either expressed or implied official policies, either expressed or implied, of the U.S. Government. **COLUMNAR SECTION 1** including, but not limited to, the implied warranties of merchantability and fitness for a particular use. The near High Bridge Washington Department of Natural Resources and the authors of this product will not be liable to the user of **CROSS SECTION EXPLANATION** (sec. 34, T28N R6E) this product for any activity involving the product with respect to the following: (a) lost profits, lost savings or any other consequential damages; (b) fitness of the product for a particular purpose; or (c) use of the Geologic units too thin to show product or results obtained from use of the product. This product is considered to be exempt from the 145.5 ±4.0 Ma as polygons at the scale of the Geologist Licensing Act [RCW 18.220.190 (4)] because it is draft geological research conducted by or for the State of Washington, Department of Natural Resources, Washington Geological Survey. JURASSIC cross section. Bedding form lines—solid where accurate; long dashed where inferred - GD8: 34,890 ±2,790 yr (IRS (sec. 23, T27N R6E)