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Quaternary Fault and Fold Database of the United States

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Utsalady Point fault (Class A) No. 573

Last Review Date: 2016-12-06

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Synopsis	The northwest-trending, subvertical Utsalady Point fault cuts across northern Whidbey Island and has a minimum length of 28 km. It forms the southern margin of a pre-Tertiary basement block on the west coast of Whidbey Island, where it has north-side-up offset. Offshore seismic-reflection data from east of Whidbey Island indicate that it bifurcates eastward into a broad (1.5-km-wide) zone of several splays. Onshore outcrops and subsurface logs from Camano Island indicate a probable reversal of offset (to south side up) along the zone and display both faulting and folding (dips as steep as 24°) in upper Pleistocene strata. The vertical fault trace(s), reversal of offset, and evidence for associated contractional deformation suggest the Utsalady Point fault is an oblique-slip, transpressional fault. Trenching studies suggest the most recent surface-deforming earthquake on this fault occurred less than 500 years ago.

Name comments	Gower (1980 #6229) first proposed the presence of a west-northwest-trending fault in the northern Whidbey Island region ("northern Whidbey Island fault") based on gravity and magnetic anomalies. Johnson and others (2001 #4749) showed that this part of northern Whidbey Island is cut by two faults, neither of which coincides with the fault trace shown by Gower (1980 #6229) and Gower and others (1985 #4725). Johnson and others (2001 #4749) designated the two structures the "Utsalady Point fault" and the "Strawberry Point fault," and recommended that the name "northern Whidbey Island fault" be abandoned. The Utsalady Point fault and the Strawberry Point fault [571] are shown and discussed herein as separate faults that cross the northern part of Whidbey Island.
County(s) and State(s)	ISLAND COUNTY, WASHINGTON
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:24,000 and 1:100,000 scale. *Comments:* Location in the eastern Strait of Juan de Fuca and Saratoga Passage (west and east of Whidbey Island, respectively) is based on interpretation of high-resolution seismic-reflection profiles and is well documented (Dadisman and others, 2000 #4748; Johnson and others, 2000 #4750; 2001 #4749). Location across northern Whidbey Island is based on stratigraphic analysis of water well logs and local bluff exposures, supplemented by interpretation of weak aeromagnetic anomalies. Location on Camano Island is based on stratigraphic and structural analysis of water well logs and uncommon outcrops (Johnson and others, 2001 #4749). Compilation based on Johnson and others (2001 #4749). Location of fault from GER_Seismogenic_WGS84 (http://www.dnr.wa.gov/publications/ger_portal_seismogenic_features.zip, downloaded 05/23/2016) attributed to Wagner and Tomson (1987 #6249), Dragovich and others (2005 #7600), and Johnson and others (2003 #6232).
Geologic setting	The northwest-trending Utsalady Point fault is located 3–10 km south of the Devils Mountain fault, near the northern boundary of the northward-migrating part of the forearc region of the Cascadia convergent margin (Wells and others, 1998 #4742; Miller and others, 2001 #4732). The fault cuts across the northern part of the Quaternary-Tertiary Everett basin (Johnson and others, 1996 #4751; 2001 #4749, 2004 #7632). Tomography studies (e.g., Brocher and others, 2001 #4718) indicate that the fault is located along the boundary between lower seismic velocities associated

	with a northwest trending projection of the Everett basin and higher velocity "basement" rocks to the north of the basin.
Length (km)	29 km.
Average strike	N62°W
Sense of movement	Left lateral, Reverse *Comments:* Vertical sense of slip changes across northern Whidbey Island from north side up (western Whidbey Island, Strait of Juan de Fuca) to locally south-side-up (Camano Island). Folded late Quaternary strata occur within the fault zone at Utsalady Point on Camano Island. Such slip reversals and evidence for contractional deformation are characteristic of transpressional strike-slip faults, hence oblique slip is inferred on the Utsalady Point fault (Johnson and others, 2001 #4749). Cumulative slip reported from trenching studies defines a range of left-lateral to vertical displacement of 1.3:1 to 2.3:1 (Johnson and others (2004 #7632).
Dip	90° *Comments:* Fault dip is documented by offshore seismic-reflection profiles (Johnson and others, 2001 #4749).
Paleoseismology studies	Johnson and others (2001 #4749; 2004 #7632) present information from marine high-resolution and conventional seismic-reflection surveys, aeromagnetic mapping, coastal exposures of Pleistocene strata, and lithologic logs of water wells to document the Utsalady Point fault. Duffers (573-1) and Teeka (573-2) trench sites of Johnson and others (2003 #6232; 2004 #7632). The results of these trenching studies include radiocarbon ages obtained from samples from deformed late Holocene sediments identified in two trenches cut across the scarp. Duffers trench exposed faulted glacial till and buried Holocene soil that suggest evidence for possibly two surface-deforming earthquakes resulting in 370–450 cm of vertical relief accommodated by faulting (~210 cm) and folding (~160 to 240 cm). Stratigraphic relations and radiocarbon ages from buried soil, colluvium, and fissure fill in the hanging wall suggest the deformation occurred 100–400 cal yr BP (A.D. 1550–1850) and 1,100–2,200 cal yr BP. Although they prefer the two-earthquake interpretation, they concede all of the observed deformation may have occurred during a single earthquake. The Teeka trench exposed offset deposits of glaciomarine drift and overlying post-glacial soil. The trench stratigraphy suggests a single event resulting in 95–150 cm of vertical and 200–220 cm of left-lateral slip. Radiocarbon ages from the buried soil and colluvium constrain the

	earthquake to 100–400 cal yr BP.
Geomorphic expression	High-resolution, "bald-earth" digital elevation models (DEMs) derived from recent Airborne Laser Swath (ALSM) led to the discovery of a 1.4-km-long, 2- to 4-m-high scarp across Utsalady Point fault on northwestern Whidbey Island (e.g., Haugerud and others, 2003 #6211). The scarp is referred to as the "Rocky Point scarp" in Haugerud and others (2003 #6211). Hayward and others (2006 #7633) present seismic data that implies that there is no Quaternary offset on this fault west of 122.8°W. The lack of additional evidence of late Quaternary faulting is because Washington's Puget Lowland was occupied at least five times during the Pleistocene by lobes of the continental ice sheet, with the most recent ice retreat occurring about 16 ka (Porter and Swanson, 1998 #6237). Most of the present landscape reflects this dynamic glacial history (Booth, 1994 #4719) and, as a result, tectonic landforms are generally buried or otherwise obscured.
Age of faulted surficial deposits	Trenching of the scarp along the Utsalady Point fault on northwestern Whidbey Island revealed faulted deposits that yielded dates as young as a few hundred years (Johnson and others, 2003 #6232; 2004 #7632). Strata that yielded radiocarbon ages of about 15 and 21 ka are faulted and folded at Utsalady Point on Camano Island. On offshore seismic-reflection data, inferred Quaternary strata are both folded and faulted by strands of the Utsalady Point fault (Johnson and others, 2001 #4749).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Trenching studies show late Holocene deposits are deformed by at least one earthquake (Johnson and others, 2003 #6232; 2004 #7632).
Recurrence interval	400–600 yr *Comments:* The most recent event exposed in the Teeka trench is interpreted to have occurred 0.1–0.5 ka; possible earlier folding event is suggested in the stratigraphy exposed in Duffers trench. Both events at Duffers site occurred between 0.1–0.1 and 1.1–2.2 ka. Johnson and others (2004 #7632) conclude based on this investigation and related recent studies, the maximum recurrence interval for large ground-rupturing crustal-fault earthquakes in the Puget Lowland is about 400 to 600 years or less. However they note, the trench stratigraphy should record all postglacial (past 15 ka) events. If surface displacement is considered

	independently, the minimum recurrence of large ground-rupturing earthquakes is about 6,700 to 14,000 years. Recurrence intervals for large earthquakes on the Utsalady Point fault appears to be irregular, with one or two events occurring in the late Holocene and no evidence for other earthquakes in the last 16 ka.
Slip-rate category	Less than 0.2 mm/yr *Comments:* Offshore, west of Whidbey Island, interpretation of seismic-reflection profiles suggests a minimum rate of 0.10–0.15 mm/yr for the Quaternary. Onshore, on western Whidbey Island, subsurface data suggest a minimum Quaternary vertical displacement rate of 0.15 mm/yr (Johnson and others, 2001 #4749).
Date and Compiler(s)	2016 Samuel Y. Johnson, U.S. Geological Survey Richard J. Blakely, U.S. Geological Survey, Emeritus Thomas M. Brocher, U.S. Geological Survey Elizabeth A. Barnett, Shannon & Wilson, Inc. Kathleen M. Haller, U.S. Geological Survey
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