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Quaternary Fault and Fold Database of the United States

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Langley Hill fault zone (Class A) No. 587

Last Review Date: 2003-08-03

citation for this record: **McCrory, P.A., compiler, 2003, Fault number 587, Langley Hill fault zone, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, https://earthquakes.usgs.gov/hazards/qfaults, accessed 12/14/2020 03:04 PM.**

Synopsis	The fault zone near and offshore of Langley Hill is a 3-km-wide zone of reverse faults with varying dip directions (McCrory, 1997 #6323; McCrory and others, 2002 #5864). The fault zone consists of short discontinuous traces that together form a zone at least 35 km long. This fault zone is part of a broader convergent zone associated with a major forearc block boundary. Onshore the fault zone displaces Pleistocene gravels (McCrory, 1997 #6323); offshore the fault disrupts the seafloor.
Name comments	McCrory and others (2002 #5864) first mapped offshore fault strands of the fault zone near and offshore of Langley Hill, based primarily on new USGS high-resolution seismic reflection data (Cross and others, 1998 #6303; Foster and others, 1999 #6317; 1999 #6318; 2001 #6319) and sidescan-sonar data (Twichell and others, 2000 #6312; McCrory and others, 2003 #6324; 2003 #6325) collected in 1997 and 1998. The location and

	interpretation of recent activity on late Cenozoic faults previously mapped in the offshore area (Grim and Bennett, 1969 #6320; Wagner and others, 1986 #5670; Wolf and others, 1997 #6305) are superceded by this more recent publication (McCrory, 1997 #6323; McCrory and others, 2002 #5864). Onshore faults first noted and mapped by McCrory (1997 #6323). Two onshore strands of this zone strike east and east-northeast along Langley Hill; several offshore strands form a wide, east-northeast-trending zone of faults that extend to the west-southwest offshore of the coast west of Langley Hill.
County(s) and State(s)	GRAYS HARBOR COUNTY, WASHINGTON
Physiographic province(s)	PACIFIC BORDER
Reliability of location	Good Compiled at 1:250,000 scale. *Comments:* Offshore fault-trace locations are based on mapping of McCrory and others (2002 #5864) from seismic reflection profiles with 3- to 5-km grid spacing. One trace appears to extend onshore (McCrory, 1997 #6323; McCrory and others, 2003 #6324). Full westward extent of the fault zone offshore of Langley Hill has not been determined, as high-resolution data are not available for the outer continental shelf (>70-m water depth). The eastern extent of onshore traces has not been determined.
Geologic setting	The fault zone near and offshore of Langley Hill, occurs north of Grays Harbor and the leading northwestern edge of the Oregon Coast Range forearc block. This forearc block traverses coastal Washington, where it abuts subduction-complex rocks of the Olympic Mountains block to the north. Block kinematics of this region predicts north-northwest-directed contraction where the boundary trends east-northeast near Grays Harbor, Washington. Crustal deformation observed near and north of Grays Harbor is consistent with north-northwestward motion of the Oregon Coast Range block. Deformation is localized within the more ductile subduction-complex rocks of the Olympic coast rather than the more rigid basaltic rocks that underlie the Oregon Coast Range block (McCrory and others, 2002 #5864). Seismic-reflection and sidescan-sonar data image several zones of faults and folds that trend east-northeast on the inner continental shelf between Grays Harbor and Cape Elizabeth, across an area about 40 kilometers

	wide from south to north. The fault zone near and offshore of Langley Hill is one of these east-northeast-trending zones. Some structures in these zones extend onland to the east where Quaternary reverse faults have been mapped (McCrory, 1997 #6323). The primary mode of deformation appears to be folding, however the seismic reflection data do not penetrate deeply enough (<200 m) to rule out buried thrust faults beneath the anticlines. In fact, one nearshore well that penetrated an anticline in this region, did encounter a reverse fault at depth (Rau and McFarland, 1982 #6308). Furthermore, multiple thrust or reverse faults are known to occur on the flanks of the anticlines offshore. Onshore, multiple thrust faults also occur in the upper plate of an inferred master thrust fault (McCrory, 1997 #6323). Onshore, the fault zone near and offshore of Langley Hill consists of multiple strands with displacements in Quaternary strata ranging from 0.5-2.0 m, and cumulative offset of 4.5-5.0 m (McCrory, 1997 #6323). These onshore fault strands are interpreted as diffuse faulting in the upper plate of a buried, master thrust fault (McCrory, 1997 #6323).
Length (km)	35 km.
Average strike	N82°E
Sense of movement	Thrust *Comments:* Onshore fault strands of this zone are mapped and described as thrust or reverse faults (McCrory and others, 2002 #5864). Seismic reflection data suggests significant, or pure, dip-slip offset along nearly all of the offshore faults and they are inferred to be thrust or reverse faults because of their association with offshore anticlines or with thrust and reverse faults and anticlines mapped onshore (McCrory and others, 2002 #5864). The actual fault planes of the offshore faults, however, cannot be resolved with available seismic reflection data.
Dip	27°-63° *Comments:* Fault planes exposed onshore dip at low-moderate angles (27? to 63?) northward or southward, however the dominant dip direction is northward (McCrory, 1996 #6321). Seismic reflection data implies down-to-the-south dip-slip offsets along three offshore fault strands of this zone (Plates 1A in McCrory and others, 2002 #5864); the other offshore strands do not have an offset specified. The onshore fault strands are known

	to be thrust or reverse faults. The offshore fault strands are inferred to be thrust or reverse faults, based on their apparent dip-slip offsets and association with mapped thrust and reverse faults and anticlines nearby (McCrory and others, 2002 #5864). Offset directions discussed above, therefore suggest that these offshore faults also dip mostly to the north, perhaps at low-moderate angles like those onshore. The vertical exaggeration of seismic reflection data, however, precludes accurate determination of fault dip (all strands with dips >30? appear to have vertical dips).
Paleoseismology studies	
Geomorphic expression	The onshore portion of the Langley Hill fault zone occurs within a 9-km-long linear topographic ridge rising to 40 m in elevation, similar to ridges to the north and south (McCrory, 1997 #6323).
Age of faulted surficial deposits	The age of deposits at the seafloor varies across the continental shelf. The age of faulted seafloor deposits are as young as Holocene in an areas of active sediment accumulation. Faulted surficial deposits onshore are Pleistocene in age (McCrory, 1997 #6323).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Onshore fault strands cut Pleistocene gravels and are considered late Quaternary (<150 ka) in age. Four offshore fault strands disrupt the seafloor (Plate 1A in McCrory and others, 2002 #5864) and are considered Holocene or latest Quaternary (<20 ka) in age, however surficial sediments have not been dated directly in this location. Offshore age estimates are based on offset or deformation of: (1) the seafloor, considered less than 20 ka; (2) a late Pleistocene erosional surface, estimated to have been cut between 150 and 20 ka; or (3) an early-middle Pleistocene unconformity cut at either 600 ka or 900 ka (McCrory and others, 2002 #5864). Herein these strands are also assigned, respectively, to latest Quaternary and late Quaternary age categories. However, the upper age limits of these categories as shown herein are, respectively, <15 ka and <130 ka.
Recurrence interval	

Slip-rate category	Less than 0.2 mm/yr *Comments:* No information has been reported on rates of slip for these faults. Based mostly on this lack of information, a conservative rate of less than 0.2 mm/yr is tentatively assigned herein.
Date and Compiler(s)	2003 Patricia A. McCrory, U.S. Geological Survey
References	#6303 Cross, V.A., Twichell, D.C., Parolski, K.F., and Harrison, S.E., 1998, Archive of boomer seismic-reflection data collected aboard RV CORLISS cruise CRLS97007 off Northern Oregon and Southern Washington inner continental shelf: U.S. Geological Survey Open-File Report 98-351, 2 CD-ROM set. #6319 Foster, D.S., McCrory, P.A., and O'Brien, T.F., 2001, Archive of boomer subbottom data collected during USGS cruise MCAR 97013 (M1-97-WO) Washington shelf, 7-14 July, 1997: U.S. Geological Survey Open-File Report 01-048, 3 CD-ROM set. #6317 Foster, D.S., McCrory, P.A., Danforth, W.W., and O?Brien, T.J., 1999, Archive of chirp subbottom data collected during USGS cruise MCAR 98008 (M3-98-WO) Washington shelf, 24 June-5 July, 1998: U.S. Geological Survey Open-File Report 99-591, 2 CD-ROM set. #6318 Foster, D.S., McCrory, P.A., Danforth, W.W., and O?Brien, T.J., 1999, Archive of boomer and sparker subbottom data collected during USGS cruise MCAR 98008 (M3-98-WO) Washington shelf, 24 June-5 July, 1998: U.S. Geological Survey Open-File Report 99-592, 3 CD-ROM set. #6320 Grim, unpublished M.S. thesis, and Bennett, L.C., Jr., 1969, Shallow seismic profiling of the continental shelf off Grays Harbor, Washington: Seattle, University of Washington, Department of Oceanography Special Report 41, p. 72-92. #6321 McCrory, P.A., 1996, Tectonic model explaining divergent contraction directions along the Cascadia margin, Washington: Geology, v. 24, p. 929-932. #6323 McCrory, P.A., 1997, Evidence for Quaternary tectonism along the Washington coast: Washington Geology, v. 25, no. 4, p.

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#5670 Wagner, H.C., Batatian, L.D., Lambert, T.M., and Tomson, J.H., 1986, Preliminary geologic framework studies showing bathymetry, locations of geophysical tracklines and exploratory wells, sea-floor geology and deeper geologic structures, magnetic contours, and inferred thickness of Tertiary rocks on the continental shelf and upper continental slope off southwestern Washington between latitudes 46° N and 48°30'N and from the Washington coast to 125°20'W: Washington State Department of Natural Resources Open-File Report 86-1, 8 p., 6, scale 1:250,000.

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