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Quaternary Fault and Fold Database of the United States

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Saddle Hill fault zone (Class A) No. 588

Last Review Date: 2017-01-17

citation for this record: **McCrory, P.A., compiler, 2003, Fault number 588, Saddle 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 Saddle Hill fault zone is a 3.5-km-wide zone of thrust or reverse faults associated with an anticlinal fold (McCrory and others, 2002 #5864). The fault zone consists of short discontinuous traces that together form a zone at least 26 km long. This fault zone is also part of a broader convergent zone associated with a major forearc block boundary. Offshore petroleum well data indicate reverse faults within basement rocks (Rau and McFarland, 1982 #6308). Onshore well data indicate large discrepancies in the thickness and character of onlap strata between adjacent wells (Rau and McFarland, 1982 #6308; Palmer and Lingley, 1989 #6327; McCrory and others, 2002 #5864). Some of the offshore traces displace a lower Pleistocene erosional surface (McCrory and others, 2002 #5864) estimated to have been cut during a sea-level high stand at either 600 or 900 ka. One onshore fault trace displaces Pleistocene gravels (Moore, 1965 #6326).

Name comments	Palmer and Lingley (1989 #6327) first mapped the Saddle Hill fault zone based on seismic reflection data collected by the USGS, University of Washington, and Portland State University on 4 cruises between 1967 and 1985. McCrory and others (2002 #5864) named the fault and substantially revised the orientation and location of specific fault strands based 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the offshore area (Grim and Bennett, 1969 #6320; Wagner and others, 1986 #5670; Wolf and others, 1997 #6305) have been superceded by these more recent publications (McCrory, 1997 #6323; McCrory and others, 2002 #5864). Onshore faulting first noted by Moore (1965 #6326). Subsurface onshore fault offset first recognized by Palmer and Lingley (1989 #6327). McCrory (1997 #6323) first mapped the onshore fault traces. Two onshore strands of this zone strike east-northeast along Saddle Hill; several offshore strands form an east-northeast-striking zone of faults that extend to the west-southwest offshore of the coast west of Saddle 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. Two traces appear to extend onshore (McCrory, 1997 #6323; McCrory and others, 2002 #5864). Full westward extent of the Saddle Hill fault zone 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 Saddle Hill fault zone occurs directly 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 Saddle Hill fault zone is one of these east-northeast-trending zones. Some of these structures extend onland to the east where Quaternary reverse faults have been mapped (McCrory and others, 2002 #5864). 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). Quaternary folds range in length from 3 to 15 kilometers and have amplitudes as great as 160 m. The Saddle Hill fault zone appears to be a major north-northeast-striking zone of structures near the forearc block boundary based on evidence for significant fault offset in basement rocks and overlying onlap strata. However, onshore exposures needed to document Quaternary activity are minimal.
Length (km)	27 km.
Average strike	N69°E
Sense of movement	Thrust *Comments:* Onshore, Moore (1965 #6326) documented slickensides on a fault trace exposed in a road-cut that indicated pure dip-slip motion with no strike-slip component. Palmer and Lingley (1989 #6327), however, proposed a large component of strike-slip displacement along the Saddle Hill fault based on mismatched Neogene lithofacies on either side of the fault zone.

	Onshore parts of fault strands in this zone are mapped as thrust faults (McCrory and others, 2002 #5864). Offshore petroleum well data indicate reverse faults within basement rocks (Rau and McFarland, 1982 #6308). Seismic reflection data suggests significant, or pure, dip-slip offset along most or all of the offshore faults (McCrory and others, 2002 #5864). These onshore and offshore faults are inferred to be thrust or reverse faults, based on evidence for dip-slip offset and their association with mapped thrust and reverse faults and anticlines nearby and at depth (McCrory and others, 2002 #5864). The actual fault planes of the offshore faults, however, cannot be resolved with available seismic reflection data.
Dip Direction	S; N *Comments:* Seismic reflection data imply down-to-the-south or down-to-the-north dip-slip offsets along indiviual offshore fault strands and offshore parts of fault strands in this zone (plate 1A and figure 18B in McCrory and others, 2002 #5864). One offshore strand has no specified offset (McCrory and others, 2002 #5864). Moore (1965 #6326) reported evidence for dip slip along one onshore fault strand, but did not report a dip. The onshore parts of fault strands of the zone are mapped as north- and south-dipping thrust faults, but specific evidence for dip directions and angles for the onshore faults has not been reported (McCrory and others, 2002 #5864). These onshore and offshore faults are inferred to be thrust or reverse faults, based on evidence for dip-slip offset and their association with mapped thrust and reverse faults and anticlines nearby and at depth (McCrory and others, 2002 #5864). Offset directions discussed above, therefore suggest faults of this zone dip both north and south in about equal numbers. Dip angles are inferred to be low-moderate (<45?). The vertical exaggeration of seismic reflection data, however, precludes accurate determination of fault dip for the offshore fault strands (all strands with dips >30? appear to have vertical dips).
Paleoseismology studies	
Geomorphic expression	A short fault strand at the southwestern end of the zone displaces the seafloor and seafloor deposits that may be as young as Holocene in age; other offshore strands have no geomorphic expression. Onshore the fault zone occurs within a 7-km-long linear topographic ridge that reaches 40 m in elevation--similar to

	ridges to the north (McCrory, 1997 #6323).
Age of faulted surficial deposits	The age of deposits at the seafloor varies across the continental shelf. The age of seafloor deposits are as young as Holocene in areas of active sediment accumulation. A short fault strand at the southwestern end of the zone displaces the seafloor and seafloor deposits that may be as young as Holocene in age. Faulted deposits onshore are Pleistocene in age (McCrory, 1997 #6323).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The southwesternmost offshore strand disrupts the seafloor (plate 1A in McCrory and others, 2002 #5864) and is considered latest Quaternary (<20 ka) in age, however, seafloor sediments have not been dated directly in this location. Two northern offshore strands are late Quaternary (<150 ka); other onshore and offshore strands are middle Quaternary (<780 ka) (plate 1A in McCrory and others, 2002 #5864). The age of fault activity offshore in this area is based on offset or deformation of (1) the seafloor, estimated to have formed less than 20 ka in areas of active sedimentation or (2) disruption of a late Pleistocene erosional surface, estimated to have been cut between 150 and 20 ka (McCrory and others, 2002 #5864). Onshore estimates are based on offset or deformation of lower to middle Pleistocene gravel deposits (McCrory, 1997 #6323). Herein these strands are assigned to latest Quaternary, late Quaternary, and middle or late Quaternary age categories, even though the upper age limits of these categories are <15 ka, <130 ka, and <750 ka, respectively.
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 <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

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