Quaternary Fault and Fold Database of the United States

As of January 12, 2017, the USGS maintains a limited number of metadata fields that characterize the Quaternary faults and folds of the United States. For the most up-to-date information, please refer to the interactive fault map.

North Ninitat fault zone (Class A) No. 594

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citation for this record: **McCrory, P.A., compiler, 2003, Fault number 594, North Ninitat 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 North Ninitat fault zone is a 2-km wide zone that extends at least 100-km from the abyssal plain to the continental shelf edge. The fault is apparently a young fault (~400 ka) with a relatively high slip rate (~5.5-8.3 mm/y). Available seismic reflection data, swath bathymetry, side-scan sonar data, and visual observations via manned submersible suggest that the fault zone accommodates left-lateral, strike-slip motion within the Juan de Fuca plate as it descends into the Cascadia subduction trench. The North Ninitat fault zone is one of nine left-lateral, strike-slip faults whose motion is attributed to the oblique component of convergence along the Cascadia subduction zone [#781].
Name comments	Goldfinger and co-workers (e.g., Goldfinger and others, 1997 #4090) first recognized, mapped, and named the North Ninitat fault zone and similar faults offshore of Oregon and Washington using a combination of seismic reflection data, swath bathymetry,

	side-scan sonar data, and observations via manned submersible dives.
County(s) and State(s)	GRAYS HARBOR COUNTY, WASHINGTON (offshore)
Physiographic province(s)	PACIFIC BORDER (offshore)
Reliability of location	Poor Compiled at 1:>250,000 scale. *Comments:* Traces not published on a bathymetric base map. The fault-trace locations are based on mapping of Goldfinger and others (1997 #4090) using a combination of seismic reflection data, swath bathymetry, and side-scan sonar data. The data set used to map this fault zone and similar ones offshore Oregon and Washington are adequate to provide reasonably good locations, however, to date the Washington fault traces have only been released as page-sized illustrations in journal articles.
Geologic setting	The North Ninitat fault zone is one of nine west-northwest-striking, left-lateral, strike-slip faults that cut obliquely across the Pacific Northwest continental slope as mapped by Goldfinger and co-workers (Personius and others, 2003 #6313). Goldfinger and others (1997 #4090) interpret these faults as forearc block boundaries that accommodate clockwise rotation (Goldfinger and others, 1996 #4088) resulting from dextral shear associated with oblique subduction. Goldfinger has proposed three different origins for these faults: (1) upper plate faults accommodating the transverse component of oblique subduction (Goldfinger and others, 1996 #4088); (2) lower plate faults accommodating the transverse component of oblique subduction (Goldfinger and others, 1997 #4090); (3) lower plate faults associated with tangential hydrodynamic drag on the slab as it descends into the mantle (Goldfinger and others, 2002 #6315). Some of the faults cut through the Juan de Fuca oceanic plate just west of the trench, favoring the interpretation that these structures originate in the down-going plate. If true, then rotation of the overlying forearc blocks would represent passive deformation. Ninitat turbidite fan strata above the abyssal plain are offset 2.2? 0.3 km left laterally (Goldfinger and others, 1997 #4090) along the North Ninitat fault zone. Faulting began 400 ka?50 ky based on the pattern of offset fan strata and estimated age of these strata. The western end of fault zone is within the Juan de Fuca plate,

	however, available data do not resolve offset of oceanic crust. Although the fault zone has a relatively high slip rate compared with other known faults associated with the Cascadia plate boundary, no earthquakes have been recorded along this zone during the past 40 years. In fact only one strike-slip earthquake with magnitude greater than 5 has been recorded along any of the nine fault zones (Daisy Bank fault, offshore Oregon, in Goldfinger and others, 1997 #4090). Therefore, the seismic hazard posed by this fault zone and related ones remains unresolved.
Length (km)	76 km.
Average strike	N67°W
Sense of movement	Left lateral *Comments:* Strike-slip (left-lateral), with minor component of dip-slip, southwest side down (Goldfinger and others, 1997 #4090).
Dip	85°-90°? *Comments:* Assumed to have sub-vertical dip (85?-90?) to the north based on predominantly strike-slip displacement (Goldfinger and others, 1997 #4090). 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	Sidescan sonar images of the North Ninitat fault (Goldfinger and others, 1997 #4090) revealed several geomorphic features associated with recent faulting: (1) 150-m left-lateral offset of slump debris, slump scarp, and submarine channel at base of continental slope; (2) 150-m left-lateral offset of frontal thrust-fold axis; (3) 300- to 400-m left-lateral offset of proto-thrust-fold axes; (4) left-lateral offset of margin-parallel anticlinal ridges in lower to middle continental slope; and (5) multiple parallel fault scarps. However, little or no offset of main subduction fault was found at the base of the continental slope, which presumably ruptured 300 years ago (Atwater and others, 1995 #4215).

Age of faulted surficial deposits	Ages of faulted seafloor deposits are unknown and presumed to vary from Holocene to late Pliocene (Barnard, 1978 #6314) depending on location with respect to trench axis. Faulted channel-fill deposits are inferred to be as young as latest Quaternary (<24 ka) (Goldfinger and others, 1997 #4090).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Age of displaced submarine channel walls is assumed to be ca. 16-20 ka or 12-24 ka (Goldfinger and others, 1997 #4090) based on analogy to channels elsewhere that were active during most recent glacial maximum. Few wells or boreholes have been drilled offshore; therefore, the age of seismic stratigraphic units, and in turn, the age of fault activity are not well constrained. The North Ninitat fault is assigned a latest Quaternary (<15 ka) age category herein, however, this age assignment is not tightly constrained.
Recurrence interval	
Slip-rate category	Greater than 5.0 mm/yr *Comments:* >5 mm/yr geologic slip rate; specific slip rates of 8.3?4 mm/yr since ca. 24 ka; 8.3?1 mm/yr since ca. 20 ka; and 5.5?2 mm/yr since ca. 400 ka reported by Goldfinger and others (1997 #4090)
Date and Compiler(s)	2003 Patricia A. McCrory, U.S. Geological Survey
References	#4215 Atwater, B.F., Nelson, A.R., Clague, J.J., Carver, G.A., Yamaguchi, D.K., Bobrowsky, P.T., Bourgeois, J., Darienzo, M.E., Grant, W.C., Hemphill-Haley, E., Kelsey, H.M., Jacoby, G.C., Nishenko, S.P., Palmer, S.P., Peterson, C.D., and Reinhart, M.A., 1995, Summary of coastal geologic evidence for past great earthquakes at the Cascadia subduction zone: Earthquake Spectra, v. 11, no. 1, p. 1-18. #6314 Barnard, W.D., 1978, The Washington continental slope: Quaternary tectonics and sedimentation: Marine Geology, v. 27, p. 79-114. #6315 Goldfinger, C., Dziak, R.B., and Fox, C.G., 2002, Offshore

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#4088 Goldfinger, C., Kulm, L.D., Yeats, R.S., Hummon, C., Huftile, G.J., Niem, A.R., and McNeill, L.C., 1996, Oblique strike-slip faulting of the Cascadia Submarine Forearc—The Daisy Bank fault zone off central Oregon, *in* Bebout, G.E., Scholl, D.W., Kirby, S.H., and Platt, J.P., eds., Subduction top to bottom: Geophysical Monograph 96, p. 65-74.

#4090 Goldfinger, C., Kulm, L.D., Yeats, R.S., McNeill, L., and Hummon, C., 1997, Oblique strike-slip faulting of the central Cascadia submarine forearc: Journal of Geophysical Research, v. 102, no. B4, p. 8217-8243.

#6313 Personius, S.F., Dart, R.L., Bradley, L.-A., and Haller, K.M., 2003, Map and data for Quaternary faults and folds in Oregon: U.S. Geological Survey Open-File Report 03-095, 579 p., 1 pl., scale 1:750,000.

Questions or comments?