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Quaternary Fault and Fold Database of the United States

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Lacamas Lake fault (Class A) No. 880

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Synopsis	The northwest-striking Lacamas Lake fault forms part of the northeastern margin of the Portland basin; this basin may be a right-lateral pull-apart basin in the forearc of the Cascadia subduction zone or a piggyback synclinal basin formed between antiformal uplifts of the Portland fold belt. The fault is mapped on the basis of exposures of slickensides and shear zones of unknown orientation along Lacamas Creek, and is also based on subsurface well, gravity, and aeromagnetic data. The fault has been mapped as a normal fault with down-to-the-southwest displacement, and has also been described as a steeply northeast or southwest-dipping oblique (right-lateral) slip fault. The trace of the Lacamas Lake fault is marked by the very linear lower reach of Lacamas Creek. No fault scarps on Quaternary surficial deposits have been described, but the Columbia River jogs northwestward and parallels the strike of the fault, suggesting that the river may have been influenced by the fault. The Lacamas

	Lake fault may offset 0.6 Ma rocks of the Boring Lava, but seismic-reflection suggest that the most recent event predates the latest Pleistocene age of Missoula flood deposits in the area.
Name comments	The Lacamas Lake fault was first mapped by Mundorff (1964 #4061), during groundwater investigations in Clark County Washington. The fault was informally named (and apparently misspelled) "Lackamas Creek lineament" and "Lackamas Creek fault" by Davis (1988 #3975); this usage was continued by Unruh and others (1994 #3597) and Geomatrix Consultants, Inc. (1995 #3593). The fault was renamed the "Lacamas Lake fault" after nearby Lacamas Lake by Blakely and others (1995 #4021); this name is spelled correctly and appears to be in current usage (Wong and others, 1999 #4073; Wong and others, 2000 #5137), so is retained herein. The fault is included in the Sandy River fault zone, as part of the Portland Hills-Clackamas River structural zone of Beeson and others (1985 #4022; 1989 #4023), and is also included in the postulated Frontal fault zone of Yelin and Patton (1991 #4020) by Pratt and others (2001 #5136). **Fault ID:** This structure is part of fault number 3 of Pezzopane (1993 #3544) and fault number 22 of Geomatrix Consultants, Inc. (1995 #3593).
County(s) and State(s)	CLARK COUNTY, WASHINGTON MULTNOMAH COUNTY, OREGON
Physiographic province(s)	PACIFIC BORDER CASCADE-SIERRA MOUNTAINS
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* The fault trace is from 1:250,000-scale mapping of Unruh and others (1994 #3597).
Geologic setting	The northwest-striking Lacamas Lake fault forms part of the northeastern margin of the Portland basin; this basin may be a right-lateral pull-apart basin in the forearc of the Cascadia subduction zone (Beeson and others, 1985 #4022; Davis, 1988 #3975; Beeson and others, 1989 #4023; Yelin and Patton, 1991 #4020; Blakely and others, 1995 #4021; Blakely and others, 2000 #4333), or a piggyback synclinal basin formed between antiformal uplifts of the Portland fold belt (Unruh and others, 1994 #3597; Unruh and others, 1994 #4007). The fault is mapped

	on the basis of exposures of slickensides and shear zones of unknown orientation along Lacamas Creek, with a down-to-the-southwest displacement direction (Mundorff, 1964 #4061). The fault trace is also based on subsurface well, gravity, and aeromagnetic data (Mundorff, 1964 #4061; Davis, 1988 #3975; Blakely and others, 1995 #4021).
Length (km)	24 km.
Average strike	N43°W
Sense of movement	Right lateral, Normal *Comments:* Mundorff (1964 #4061) mapped the Lacamas Lake fault as a down-to-the-southwest normal fault. Beeson and others (1989 #4023) followed Davis (1988 #3975) and assumed dip slip and right-lateral strike-slip on faults in their Sandy River fault zone. A focal mechanism from a 1989 Mc 3.7 earthquake located a few kilometers southwest of the mapped trace of the Lacamas Lake fault suggests right-lateral-strike slip on a steeply southwest dipping fault plane (Yelin and Patton, 1991 #4020). The very linear trace of the fault suggests the fault is very high angle, which is consistent with a component of strike-slip displacement. Pratt and others (2001 #5136) postulate that the fault dips northeast, based on compatibility with the modern northeast direction of maximum principle compressive stress in the region (Yelin and Patton, 1991 #4020; Werner and others, 1991 #4127).
Dip	>75° *Comments:* The linear trace of the fault suggests the fault is very high angle. If the 1989 earthquake occurred on the Lacamas Lake fault, then the fault must dip to the southwest at a steep (>75?) angle (Geomatrix Consultants Inc., 1995 #3593).
Paleoseismology studies	
Geomorphic expression	The trace of the Lacamas Lake fault is based on the very linear lower reach of Lacamas Creek. However, no fault scarps on Quaternary surficial deposits have been described (Unruh and others, 1994 #3597; Geomatrix Consultants Inc., 1995 #3593), and the fault is shown as buried by Quaternary surficial deposits on geologic maps (Mundorff, 1964 #4061; Walsh and others, 1987 #3579). The Columbia River jogs northwestward and

	parallels the strike of the fault, suggesting that the river has been influenced by the fault (Blakely and others, 1995 #4021). An alternative, nontectonic explanation for the jog in the Columbia River is growth of the Sandy River delta from lahar deposition from the Old Maid Flat eruption of Mount Hood (I.P. Madin, pers. commun., 2001).
Age of faulted surficial deposits	On the basis of subsurface data, the Lacamas Lake fault offsets Pliocene Troutdale Formation, and perhaps Plio-Pleistocene Boring Lava (Mundorff, 1964 #4061). K-Ar analyses on one nearby sample of Boring Lava yielded an age of about 0.6 Ma (Conrey and others, 1996 #4025). However, preliminary results of Ar/Ar dating of Boring Lava in the Portland basin have yield much younger ages of 100-125 ka (Fleck and others, 2002 #5149), so these rocks may be younger than previously believed. No fault scarps on Quaternary surficial deposits have been described, and recent seismic reflection data across the probable trace of the fault under the Columbia River yielded no unequivocal evidence of displacement of the unconformity underlying latest Pleistocene Missoula flood deposits (Pratt and others, 2001 #5136).
Historic earthquake	
Most recent prehistoric deformation	middle and late Quaternary (<750 ka) *Comments:* If the Lacamas Lake fault displaces 0.6 Ma rocks of the Boring Lava (Mundorff, 1964 #4061; Conrey and others, 1996 #4025), then the fault has been active in the middle and late Quaternary. Seismic-reflection data (Pratt and others, 2001 #5136) suggest that the most recent event predates the latest Pleistocene age of Missoula flood deposits in the area. Pezzopane (1993 #3544) and subsequent compilations (Geomatrix Consultants Inc., 1995 #3593; Madin and Mabey, 1996 #3575) mapped the fault as active in the middle and late Quaternary (<700-780 ka). Unruh and others (1994 #3597) concluded that the fault is potentially active, and Wong and others (1999 #4073; 2000 #5137) mapped the fault as a possible seismogenic fault.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr

	Comments: No detailed slip rate data have been published. Geomatrix Consultants, Inc. (1995 #3593) and Wong and others (1999 #4073; 2000 #5137) calculated preferred slip rates of 0.05-0.2 mm/yr in their analyses of the earthquake hazards associated with the Lacamas Lake fault.
Date and Compiler(s)	2002 Stephen F. Personius, U.S. Geological Survey
References	#4022 Beeson, M.H., Fecht, K.R., Reidel, S.P., and Tolan, T.L., 1985, Regional correlations within the Frenchman Springs member of the Columbia River Basalt Group—New insights into the middle Miocene tectonics of northwestern Oregon: Oregon Geology, v. 47, no. 8, p. 87-96. #4023 Beeson, M.H., Tolan, T.L., and Anderson, J.L., 1989, The Columbia River Basalt Group in western Oregon-Geologic structures and other factors that controlled flow emplacement patterns, *in* Reidel, S.P., and Hooper, P.R., eds., Volcanism and tectonism in the Columbia River Flood-Basalt Province: Geological Society of America Special Paper 239, p. 223-246. #4333 Blakely, R.J., Wells, R.E., Tolan, T.L., Beeson, M.H., Trehu, A.M., and Liberty, L.M., 2000, New aeromagnetic data reveal large strike-slip (?) faults in the northern Willamette Valley, Oregon: Geological Society of America Bulletin, v. 112, p. 1225-1233. #4021 Blakely, R.J., Wells, R.E., Yelin, T.S., Madin, I.P., and Beeson, M.H., 1995, Tectonic setting of the Portland-Vancouver area, Oregon and Washington—Constraints from low-altitude aeromagnetic data: Geological Society of America Bulletin, v. 107, no. 9, p. 1051-1062. #4025 Conrey, R.M., Uto, K., Uchiumi, S., Beeson, M.H., Madin, I.P., Tolan, T.L., and Swanson, D.A., 1996, Potassium-Argon ages of boring lava, northwest Oregon and southwest Washington: ISOCHRON/WEST, v. 63, p. 3-9. #3975 Davis, S.A., 1988, An analysis of the eastern margin of the Portland Basin using gravity surveys: Portland State University, unpublished M.S. thesis, 135 p. #5149 Fleck, R.J., Evarts, R.C., Hagstrum, J.T., and Valentine, M.J., 2002, The Boring volcanic field of Portland, Oregon area—

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#5136 Pratt, T.L., Odum, J., Stephenson, W., Williams, R., Dadisman, S., Holmes, M., and Haug, B., 2001, Late Pleistocene and Holocene tectonics of the Portland Basin, Oregon and Washington, from high-resolution seismic profiling: Bulletin of the Seismological Society of America, v. 91, no. 4, p. 637-650.

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