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Quaternary Fault and Fold Database of the United States

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Powder River Peninsula fault zone (Class A) No. 713

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Synopsis	The Powder River Peninsula fault zone is a zone of short northwest- and north-striking sinistral-oblique normal faults with both east and west dips. The faults are located on the steep western flank of Hells Canyon, which now forms the western bank of Brownlee Reservoir, a large impoundment on the Snake River. Individual fault strands have dip-slip separations of 5–75 m across basalts of the Columbia River Basalt Group. The fault zone appears to be a transfer zone between the northwest-striking, northeast dipping Sturgill Peak and Halfway/Posy Valley normal faults. These larger faults have been included in the Olympic-Wallowa lineament, a regional-scale, northwest-trending alignment of topographic and geologic features. However, the tectonic significance of this alignment is controversial, so herein all these faults are simply considered a continuation of Basin-and-Range extension into western Idaho and northeastern Oregon.

	Some of the recent seismicity in the region may be related to the Powder River Peninsula fault zone. Most faults in the zone are located exclusively in Miocene bedrock, but four faults (Peninsula, Juniper, Coyote, and Tarter Gulch faults) offset Quaternary deposits. Two of these structures (Coyote and Tarter Gulch faults) offset Bonneville flood gravels that have been dated elsewhere at about 14 ka.
Name comments	The four most prominent faults in this zone have informally been named, from west to east, the Peninsula, Juniper, Coyote, and Tarter Gulch faults (Essman, 2003 #7369). These faults may be included in the West Pine Valley Seismic Zone of Zollweg and Wood (1993 #780). **Fault ID:** Some of these structures may be part of fault number 16 of Pezzopane (1993 #3544).
County(s) and State(s)	BAKER COUNTY, OREGON WASHINGTON COUNTY, IDAHO
Physiographic province(s)	COLUMBIA PLATEAU
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Location of faults are from 1:24,000-scale map of Essman (2003 #7369).
Geologic setting	Regional deformation is dominated by northeast-southwest directed crustal extension resulting from oblique rifting oriented between N 0°E and N 30°E (Essman, 2003 #7369).The Powder River Peninsula fault zone is a zone of numerous short northwest- and north-striking sinistral-oblique normal faults with both east and west dips. The faults are located on the steep western flank of Hells Canyon, which now forms the western bank of Brownlee Reservoir, a large impoundment on the Snake River. The area is underlain by basalts of the Columbia River Basalt Group (Brooks and others, 1976 #3573; Walker and MacLeod, 1991 #3646); these rocks have dip-slip separations of 5–75 m across individual fault strands and possible total normal-oblique slip across the zone of 400–700 m (Essman, 2003 #7369). The fault zone appears to be a transfer zone between the northwest-striking, northeast dipping Sturgill Peak (Idaho) and Halfway/Posy Valley [809b] normal faults (Essman, 2003 #7369). The Sturgill Peak

	and Halfway/Posy Valley faults have been included in the Olympic-Wallowa lineament, a regional-scale, northwest-trending alignment of topographic and geologic features (Mann and Meyer, 1993 #3535). However, the tectonic significance of this alignment is controversial (Reidel and Tolan, 1994 #3536; Mann, 1994 #3537), so herein these faults are simply considered a continuation of Basin-and-Range extension into western Idaho and northeastern Oregon. Some of the recent seismicity in the region may be related to this fault zone (Essman, 2003 #7369). Zollweg and Jacobson (1986 #3518) reported two magnitude 3.6 earthquakes which occurred south of the Wallowa Mountains and 15 aftershocks that clustered near the mouth of the Powder River. Zollweg and Wood (1993 #780) constructed composite focal mechanisms for the Powder River events; their focal mechanisms indicate both normal and sinistral-oblique events occurring on north to northwest striking faults located in the vicinity of the Powder River Peninsula fault zone (Zollweg and Jacobson, 1986 #3518).
Length (km)	5 km.
Average strike	N28°W
Sense of movement	Left lateral, Normal *Comments:* Sinistral normal-oblique sense of displacement is based on the attitudes of exposed slickensides found on the Coyote, Tarter Gulch, and Peninsula faults. In addition, field relationships on the Coyote and Tarter faults suggest the hanging wall has moved out of the slope, indicating sinistral slip (Essman, 2003 #7369). Sinistral normal-oblique sense of displacement is also consistent with composite focal mechanisms from an earthquake swarm in the area (Zollweg and Wood, 1993 #780).
Dip	60–85° SW; NE *Comments:* Dips are from direct measurements of exposed fault planes and projections based on fault surface traces (Essman, 2003 #7369).
Paleoseismology studies	
Geomorphic expression	The steep topography of Hells Canyon inhibits the preservation of fault scarps and significant deposits of Quaternary deposits are

	thin to nonexistent. However, where the Juniper fault crosses the plateau above Hells Canyon it forms a small, 2- to 5-m-high, 1-km-long escarpment on Miocene Columbia River Basalt Group bedrock. The entire fault zone consists of about twenty short traces, but only the four longest faults (Peninsula, Juniper, Coyote, and Tarter Gulch faults) demonstrably offset Quaternary deposits (Essman, 2003 #7369) and thus are the only structures shown on the map.
Age of faulted surficial deposits	Most faults in this zone are in basalt flows of the Miocene Columbia River Basalt Group. However, four exposures of faults in the zone show offsets in Quaternary deposits (Essman, 2003 #7369). Approximately 1 km southwest of Tarter Gulch on the north shore of Brownlee Reservoir, the Coyote fault offsets gravels deposited by the Bonneville flood (Essman and others, 2001 #5073) which have been dated elsewhere at about 14 ka (O'Connor, 1993 #5078). The Tarter Gulch fault also offsets Bonneville flood gravels and poorly bedded colluvium located on the south shore of Brownlee Reservoir about 0.9 km southwest of Cottonwood Creek. The Peninsula fault truncates a carbonate soil horizon formed in a Quaternary colluvial deposit 1.4 km southwest of Tarter Gulch on the north shore of Brownlee Reservoir. The Juniper fault cuts and deforms Quaternary soils and truncates an ash bed of unknown age on the south shore of Brownlee Reservoir about 1 km southwest of Cottonwood Creek. In addition, a thick (>20 m) deformed section of bedded Quaternary fanglomerate is present along the projections of the Peninsula, Juniper, and Coyote faults southeast of the south shore of Brownlee Reservoir, about 1.5 km southwest of Cottonwood Creek. The fanglomerate deposits contain two ash beds which have been correlated to the Mount Mazama Llao Rock East tephra (65–72 ka) and the St. Helens set Cw (approximately 46 ka) (I. P. Madin, personal commun., 1999, Essman and others, 2001 #5073), and are tilted 25–30° NE. This deformation is probably related to slip on the Juniper fault which projects beneath the fanglomerate (Essman, 2003 #73692).
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The four most prominent faults in the zone (Tarter Gulch, Coyote, Peninsula, and Juniper faults) offset Quaternary deposits in exposures along Brownlee Reservoir (Essman, 2003

	#7369). The best constrained of these deformed deposits is the offset of Bonneville flood gravels along the Coyote and Tarter Gulch faults; these deposits have been dated elsewhere at about 14 ka (O'Connor, 1993 #5078). The Bonneville gravels offset by the Tarter Gulch fault are less homogeneous and less well bedded than those deformed by the Coyote fault, and are intercalated with poorly bedded, 1.5-m-thick colluvial deposits. These stratigraphic relations indicate that the Tarter Gulch gravels have been reworked and thus the youngest movement on this fault may be even younger than on the other faults in the zone. The Juniper fault appears to deform fanglomerate deposits containing two late Pleistocene volcanic ashes, but does not appear to deform Bonneville flood gravels (Essman, 2003 #7369) so it appears to have been active in the late Quaternary. The latest movement on the Peninsula fault is poorly constrained, but the fault has similar geomorphology to the Juniper fault so it has also probably been active in the late Quaternary.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Slip rates, which include consideration of fault dip and rake of movement, for individual faults are presented by Essman (2003 #7369) that range from 0.01 to less than 3 mm/yr. The measured 87 m net offset of a contact in the Miocene Columbia River basalt and 10 m vertical offset of Bonneville gravels across the Tarter Gulch fault indicates a minimum net slip rate of 0.06 mm/yr, and a maximum net slip rate of 1.5 mm/yr. A net offset of 75 m for the same Columbia River basalt contact and 10 m vertical offset of Bonneville gravels across the Coyote fault suggests a minimum net slip rate of 0.01 mm/yr and a maximum net slip rate of 1.5 mm/yr. Net 97 m offset of the Columbia River basalt contact across the Juniper fault suggests a minimum slip rate of 0.01 mm/yr and an estimated maximum slip rate of about 1 mm/yr. Although, data presented by Essman (2003 #7369) suggest high rates of slip, he concludes that 0.7–0.8 mm/yr on these structures seems more likely.
Date and Compiler(s)	2016 Jim E. Essman, Oregon State University Stephen F. Personius, U.S. Geological Survey Kathleen M. Haller, U.S. Geological Survey

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