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La Pine graben faults (Class A) No. 838

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Synopsis	These structures are a group of normal faults located in the La Pine graben or bas central Oregon. The basin is filled with Quaternary sediments which bury a comp graben structure bisected by a north-trending horst block coincident with a chain aligned volcanic vents (Gilchrist, Wampus, and Pringle Buttes). The subsurface structure is inferred from regional gravity data, which shows the horst block divic the basin into two subbasins. Four possible faults that may bound the basin margi inferred from gravity data now have no topographic expression and have no demonstrated offset in Quaternary deposits. In contrast, numerous traces of the Wampus fault zone offset Plio-Pleistocene volcanic rocks and may uplift middle Pleistocene sediments in the horst block. The Dilman Meadows fault offsets midc and late Quaternary alluvial and lacustrine sediments in a cutbank of the Deschut River. The distributed fault pattern and association with young volcanic rocks ma indicate some of these faults are volcanic in origin.
Name comments	These faults are located in the La Pine basin near the town of La Pine in central Oregon (MacLeod and Sherrod, 1992 #3566; Geomatrix Consultants Inc., 1995 #

	Sherrod and Smith, 2000 #5165). Hawkins and others (1989 #2947) named the m prominent of these faults the Wampus fault, after nearby Wampus Butte. Ake and others (2001 #5035) renamed this structure the Wampus fault zone, and include i zone the Dilman Meadows fault; the latter was informally referred to as the Hane fault in earlier internal Bureau of Reclamation documents (Ake and others, 2001 #5035). The Gilchrist Butte fault (Hemphill-Haley, 2001 #5036) or Gilchrist Butt faults (Ake and others, 2001 #5035) are also included in the Wampus fault zone. other possible faults inferred from gravity data (La Pine Basin I, II, III, and IV fa have no topographic expression or demonstrated offset in Quaternary deposits, b probably form the margins of the composite La Pine graben (Ake and others, 200 #5035). **Fault ID:** This group of structures is fault number 50 of Geomatrix Consultants, (1995 #3593) and is included in fault number 28 of Pezzopane (1993 #3544).
County(s) and State(s)	DESCHUTES COUNTY, OREGON KLAMATH COUNTY, OREGON
Physiographic province(s)	COLUMBIA PLATEAU CASCADE-SIERRA MOUNTAINS
Reliability of location	Good Compiled at 1:100,000 scale. *Comments:* Location of fault from ORActiveFaults (http://www.oregongeology.org/arcgis/rest/services/Public/ORActiveFaults/MapS downloaded 06/02/2016). Fault traces are based on 1:250,000-scale mapping of MacLeod and Sherrod (1992 #3566), 1:100,000-scale mapping of Weldon and otl (2002 #5648), 1:500,000-scale mapping of Pezzopane (1993 #3544), and Sherroc Smith (2000 #5165), and 1:350,000-scale mapping of Ake and others (2001 #503 The trace of the Dilman Meadows fault is from approximately 1:67,000-scale ma of Lyon (2001 #5061).
Geologic setting	These structures are a group of normal faults located in the La Pine graben or bas central Oregon. The basin is filled with Quaternary sediments which bury a comp graben structure bisected by a north-trending horst block coincident with a chain aligned volcanic vents (Gilchrist, Wampus, and Pringle Buttes). The subsurface structure is inferred from regional gravity data (Pitts and Couch, 1978 #5038; Co and Foote, 1985 #3772). The horst block divides the basin into two subbasins; the western subbasin is referred to as the Shukash basin and the eastern subbasin is referred to as the La Pine basin (Couch and Foote, 1985 #3772; Ake and others, 2 #5035). Structural relief is 600–800 m across the composite graben (MacLeod an Sherrod, 1992 #3566). Four possible faults that may bound the basin margins are inferred from gravity but have no topographic expression and no demonstrated of in Quaternary deposits (Ake and others, 2001 #5035). In contrast, numerous trace

	the Wampus fault zone offset Plio-Pleistocene volcanic rocks of the horst block (Hawkins and others, 1989 #2947; Walker and MacLeod, 1991 #3646; MacLeod Sherrod, 1992 #3566; Scott and Gardner, 1992 #3569; Sherrod and Smith, 2000 # Sherrod and others, 2002 #5169), and appear to offset Quaternary sediments in at one location. The distributed fault pattern and association with young volcanic ro may indicate some of these faults are volcanic in origin (Couch and Foote, 1985 #3772; Ake and others, 2001 #5035; Hemphill-Haley, 2001 #5036). Lyon (2001 #5061) inferred possible temporal association of displacement on the Dilman Me fault with emplacement of the Mount Bachelor volcanic chain (Scott and Gardne 1992 #3569).
Length (km)	40 km.
Average strike	N0°E
Sense of movement	Normal *Comments:* These faults are mapped as normal or high-angle faults by Hawkins a others (1989 #2947), Walker and MacLeod (1991 #3646), MacLeod and Sherrod #3566), Scott and Gardner (1992 #3569), Pezzopane (1993 #3544), Sherrod and S (2000 #5165), Ake and others (2001 #5035), and Lyon (2001 #5061).
Dip Direction	W; E *Comments:* Ake and others (2001 #5035) report a dip of 68° on an exposure of th Dilman Meadows fault of the Wampus Butte fault zone. Sherrod and Pickthorn (1 #3599) estimated dips of 60° on the La Pine graben faults, and Geomatrix Consul Inc. (1995 #3593) used an estimated dip of 70° in their modeling of earthquake potential of faults in the La Pine graben.
Paleoseismology studies	One trench (location 838-1) and one natural stream exposure (location 838-2) of t Dilman Meadows fault were described by Lyon (2001 #5061). The following descriptions are from Lyon (2001 #5061). Site 838-1. A nine-meter-long, 2-m-deep trench (trench TT-00-1 of Lyon (2001 #. was excavated in Pleistocene glacial outwash deposits across a 4-m-high fault sca about 50 m north of the Deschutes River exposure described at site 838-2. The so wall of the trench exposed Pleistocene lacustrine silt overlain by glacial outwash in the footwall, faulted against glacial outwash gravel, overlain by a root-stirred deposit of Mazama ash with bedded ash at its base. The north wall showed simila relations, with the bedded Mazama ash clearly faulted about 60 cm against the lacustrine deposits in the footwall. Site 838-2. A fifty-meter-long, 12-m-high exposure of the Dilman Meadows fault along the north bank of the Deschutes River was described by Lyon (2001 #5061

	cutbank exposed a thick sequence of lacustrine silt, overlain by glacial outwash g and a mantle of Mazama ash in the footwall. The lacustrine silt contains a 30-cm- bed of the Pringle Falls D tephra, which has been argon/argon dated nearby at 21 ka (Herrero-Bervera and others, 1994 #5040). The footwall deposits are faulted a lacustrine silt in the hanging wall that does not contain the Pringle Falls D tephra deposits in turn are overlain by two packages of outwash gravel and a mantle of Mazama ash. The exposure records several faulting events, only a few of which a recorded as colluvial wedges, interspersed with fluvial (glacial outwash) events th planed off some of the hanging wall and footwall deposits.
Geomorphic expression	This fault zone consists of numerous 1- to 6-km-long fault strands with both east west dips. The most conspicuous structure in this group of faults, the Wampus fau expressed as a 6-km-long, 5- to 25-m-high scarp on Miocene (?) (Hawkins and ot 1989 #2947) or early to middle Pleistocene basaltic andesites (Walker and MacLe 1991 #3646; MacLeod and Sherrod, 1992 #3566; Scott and Gardner, 1992 #3569 Sherrod and Smith, 2000 #5165; Ake and others, 2001 #5035; Sherrod and others 2002 #5169). Other scarps with both east and west dips offset similar volcanic ro the north in the Round Mountain/Lookout Mountain area, and to the south on Gil Butte; none of these faults are mapped in adjacent Quaternary sediments. The Dil Meadows fault is the only strand of the Wampus fault zone that demonstrably off Quaternary sediments (Ake and others, 2001 #5035; Lyon, 2001 #5061). This fau exposed in a cutbank of the Deschutes River, which exposed faulted middle and l Quaternary alluvial and lacustrine deposits; the fault is difficult to trace in the for terrain, but apparently is marked by a 3-km-long, 1- to 4.6-m-high scarp on midd late Quaternary lacustrine and fluvial sediments and terraces, the youngest of whi contains the Mazama ash (Lyon, 2001 #5061). The graben margin faults inferred the gravity data by Ake and others (2001 #5035) have no topographic expression demonstrated offset in Quaternary deposits.
Age of faulted surficial deposits	Hawkins and others (1989 #2947) obtained several late Miocene K/Ar ages on th volcanic rocks offset by these faults; however, they acknowledge that low potassi contents make dating these rocks difficult, and others agree that these ages are too (Sherrod and others, 2002 #5169). The youngest offset bedrock is mapped as Plio Pleistocene by Walker and MacLeod (1991 #3646) and MacLeod and Sherrod (19 #3566), and as lower to upper Pleistocene by Scott and Gardner (1992 #3569). Th faulted shield volcano of Gilchrist Butte, near the southern end of the fault zone, yielded a K/Ar age of 0.61±0.05 Ma (MacLeod and Sherrod, 1992 #3566). No fau scarps are mapped on Quaternary sediments (Hawkins and others, 1989 #2947; W and MacLeod, 1991 #3646; MacLeod and Sherrod, 1992 #3566; Scott and Gardn 1992 #3569; Sherrod and Smith, 2000 #5165), except the two faults near the sout end of the basin mapped by Pezzopane (1993 #3544) and Weldon and others (200 #5648). The newly discovered Dilman Meadows fault offsets middle Pleistocene lacustrine deposits that contain a distinctive lapilli tephra that has been correlated

	the Pringle Falls tephra layer (Ake and others, 2001 #5035; Lyon, 2001 #5061), v has been argon/argon dated nearby at 218±10 ka (Herrero-Bervera and others, 19 #5040). The Dilman Meadows fault also offsets last-glacial-maximum outwash deposits, several younger fluvial (outwash ?) terraces, and deposits containing the ka Mazama ash (Lyon, 2001 #5061). The middle Pleistocene sediments containin Pringle Falls tephra may also be uplifted in the Pringle Butte-Gilchrist Butte hors block (Sherrod and others, 2002 #5169).
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* Pezzopane (1993 #3544) and subsequent compilations (Geomatrix Consultants Inc., 1995 #3593; Madin and Mabey, 1996 #3575) classified these fa middle and late (<700–780 ka) Quaternary, based primarily on offset of the 0.61 I shield volcano of Gilchrist Butte. Hawkins and others (1989 #2947) found no evi of late Quaternary displacement on faults near Wampus Butte. Ake and others (2(#5035) describe evidence of offset of middle and late Quaternary alluvial and lacustrine deposits along the newly discovered Dilman Meadows fault. In a more detailed study, Lyon (2001 #5061) inferred Holocene movement on the Dilman Meadows fault, based on offset of deposits containing the Mazama ash. Weldon a others (2002 #5648) mapped most of these faults, including the inferred basin ma faults, as active in the late Quaternary (<120 ka), but do not discuss the evidence this age assignment; they also mapped several previously unmapped faults to the and west as active in the middle and late Quaternary (<780 ka). The graben marg faults inferred from the gravity data by Ake and others (2001 #5035) have no topographic expression or demonstrated offset in Quaternary deposits; although t probably began forming the La Pine and Shukash subbasins in the Pliocene or ea Pleistocene (Sherrod and others, 2002 #5169) and are herein mapped as Quaterna (<1.6 Ma) until further studies are conducted.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Geomatrix Consultants, Inc. (1995 #3593) used estimated slip rates o 0.01–0.3 mm/yr in their analysis of earthquake hazards associated with the La Pi graben faults. Pezzopane (1993 #3544) inferred an average deformation rate of ab 0.5–1 mm/yr across the La Pine graben, presumably distributed across several fau Ake and others (2001 #5035) estimated a preferred slip rate of 0.04 mm/yr on the Wampus fault zone in their analysis of earthquake hazards in the vicinity of Wick Dam. Lyon (2001 #5061) inferred vertical deformation rates of 0.04–0.31 mm/yr the Dilman Meadows fault for various intervals from about 140 ka to the late

	Holocene. However, the best documented slip data suggest long-term slip rates o Dilman Meadows fault of <0.2 mm/yr.
Date and Compiler(s)	2002 Stephen F. Personius, U.S. Geological Survey
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