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Quaternary Fault and Fold Database of the United States

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Williams Fork Mountains fault (Class A) No. 2301

Last Review Date: 2015-03-14

Compiled in cooperation with the Colorado Geological Survey

citation for this record: **Widmann, B.L., and Haller, K.M., compilers, 2015, Fault number 2301, Williams Fork Mountains fault, 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 03:00 PM.**

Synopsis	The Williams Fork Valley graben is the northernmost extensional of the Rio Grande rift in north-central Colorado. The graben and is filled with Neogene sediments eroded from adjacent uplifts. The Williams Fork Mountains fault is a northwest-trending, east-dipping, normal fault along the foot of the Williams Fork Mountains and bounds the western margin of the graben. Latest Quaternary movement is indicated by the presence of discontinuous scarps on alluvial deposits. Conclusive evidence of late Quaternary activity on the southern end of the Williams Fork Mountains fault and on the Neogene fault that forms the eastern margin of the graben has not been demonstrated, and

	thus these faults are not included herein. Interpretation of post-glacial deformation rates varies considerably.
Name comments	Unruh and others (1993 #2777) referred to western graben-bounding fault as the Williams Fork Mountains fault. It includes three northwest-trending faults on the east flank of the Williams Fork Mountains southeast of Kremmling, Colo. The faults are parallel to and northeast of the Laramide Williams Range thrust fault and are in the hanging wall of the thrust. **Fault ID:** Fault 53 in Kirkham and Rogers (1981 #792), fault 186 in Witkind (1976 #2792), and fault number Q50 of Widman and others (1998 #3441).
County(s) and State(s)	GRAND COUNTY, COLORADO
Physiographic province(s)	SOUTHERN ROCKY MOUNTAINS
Reliability of location	Poor Compiled at 1:250,000 scale. *Comments:* These faults were mapped at a scale of 1:62,500 by Tweto (1973 #2771) and Tweto and Reed (1973 #2763) and at a scale of 1:250,000 by Tweto and others (1978 #2770) and Unruh and others (1993 #2777). Kirkham (2004 #7056) illustrates the fault in figure 4 based on the earlier mapping.
Geologic setting	The Williams Fork Mountains fault form the western margin of the Neogene Williams Fork Valley graben (Kirkham and Rogers, 1981 #792). The faults are assumed to be high-angle normal and down to the northeast. The faults are parallel to the southwest-verging Laramide Williams Range thrust fault to the west and developed during Neogene extension in the hanging wall of the thrust (Unruh and others, 1993 #2777).
Length (km)	38 km.
Average strike	N40°W
Sense of movement	Normal *Comments:* Normal movement on these faults was reported by Witkind (1976 #2792), Kirkham and Rogers (1981 #792), Unruh and others (1993 #2777), and Kirkham (2004 #7056).

Dip Direction	NE; SW
Paleoseismology studies	
Geomorphic expression	Kirkham (2004 #7056) documents the most exhaustive study of the fault to date. Prominent scarps are present in all of the valleys for a distance of about 18 km, but some scarps are suspected to result from non-tectonic processes; photogeologic evidence of young fault activity was not observed south of Lost Creek. Scarps that align with Neogene bedrock faults found on drainage interfluves likely have a tectonic origin; Kirkham (2004 #7056) presents scarp-morphology data combined with soil studies to estimate the age of faulted deposits. Detailed studies from eight drainages show that surface offset of Qa1 (inferred to be Holocene) range from 1.1–2.1 m, surface offset of Qa2 (inferred to be late Pleistocene, 12–35 ka) range from 2.0–6.6 m, and the largest observed surface offset is 4.0 m on Qa3 (Bull-Lake ? equivalent). Pinedale fan deposits (10–40 ka) are offset about 13 m across the fault according to Unruh and others (1993 #2777).
Age of faulted surficial deposits	Latest Quaternary deposits are faulted (Kirkham, 2004 #7056). Tweto (1973 #2771), Tweto and Reed (1973 #2763), and Tweto and others (1978 #2770) showed rocks of the Miocene Troublesome Formation as faulted against Precambrian bedrock.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Kirkham (2004 #7056) shows that the most recent surface rupture on the northern 18 km of this fault is latest Quaternary as evidenced by the assumed age of offset deposits and steep maximum slope angles of the fault scarps. Similar evidence of latest Quaternary surface faulting is not evident along the southern 18 km of the fault or the eastern margin of the graben. Earlier, Unruh and others (1993 #2777) reported scarps on Pinedale-age alluvial-fan deposits. Howard and others (1978 #312) conservatively suggested that the most recent paleoevent on this fault occurred during the Quaternary.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr

	Comments: Interpretation of post-glacial deformation rates varies considerably. The most rigorous evaluation of vertical-displacement rate for this fault comes from Kirkham (2004 #7056). However, Kirkham warns that some rates reported may be derived from single event scarps, and we have intentionally excluded them from this comment. Kirkham (2004 #7056) calculated vertical displacement rates of about 0.1 mm/yr for the eight sites. Vertical displacement rates range from 0.017 mm/yr at the Skylark Creek site to 0.78 mm/yr at the McQueary Gulch site. Most vertical displacement rate estimates at sites that lack soil pits to constrain the age of the faulted deposit range from about 0.10–0.30 mm/yr, which agrees with estimates from sites with soils data. Unruh and others (1993 #2777) suggest vertical-displacement rates of 0.3–1.3 mm/yr based on two episodes of faulting that produced a total of about 13 m of vertical offset in Pinedale age (10–40 ka) fan deposits. Kirkham's (2004 #7056) study shows that at nearly all sites, calculated vertical-displacement rates are less than 0.3 mm/yr, except at Middle Creek where he reports 0.12–0.36 mm/yr and 0.10–0.28 mm/yr. Kirkham (2004 #7056) also presents an alternative rate (0.11–0.13 mm/yr) for the location that he believes Unruh and others (1993 #2777) studied. We consider the more recent study of Kirkham (2004 #7056) to better constrain the likely range in slip rates, and the assigned slip-rate category is based on the mean value of the data of about 0.2 mm/yr. Surface velocities from continuous measurements of GPS sites that span the northern part of the Rio Grande rift show extensional deformation is not concentrated in a narrow zone centered on the Rio Grande rift (let alone confined to the Williams Fork Mountains fault) but is broadly distributed from the western edge of the Colorado Plateau into the western Great Plains (Berglund and others, 2012 #7270).
Date and Compiler(s)	2015 Beth L. Widmann, Colorado Geological Survey Kathleen M. Haller, U.S. Geological Survey
References	#312 Howard, K.A., Aaron, J.M., Brabb, E.E., Brock, M.R., Gower, H.D., Hunt, S.J., Milton, D.J., Muehlberger, W.R., Nakata, J.K., Plafker, G., Prowell, D.C., Wallace, R.E., and Witkind, I.J., 1978, Preliminary map of young faults in the United States as a guide to possible fault activity: U.S. Geological Survey Miscellaneous Field Studies Map MF-916, 2 sheets, scale 1:5,000,000. #7056 Kirkham, R.M., 2004, Quaternary faulting in the Williams Fork valley graben, north-central Colorado, and comparison with late Quaternary deformation near Spinney Mountain, central Colorado: Technical report to U.S. Geological Survey, Reston, Virginia, under

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#2763 Tweto, O., 1973, Reconnaissance geologic map of the Mount Powell 15-minute quadrangle, Grand, Summit, and Eagle Counties, Colorado: U.S. Geological Survey Open-File Report 73-286.

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#2792 Witkind, I.J., 1976, Preliminary map showing known and suspected active faults in Colorado: U.S. Geological Survey Open-File Report 76-154.

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