Jump to Navigation

Quaternary Fault and Fold Database of the United States

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Teton fault, central section (Class A) No. 768c

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Synopsis	**General:** The Teton fault is a major range-bounding fault along the eastern margin of the Teton Range. Spectacular post-glacial (<15 ka) scarps are present along 60 km of the fault trace and can be seen from the valley floor owing to their large height. Post-glacial offset is as much as 30 m along the middle part of the range, but diminishes to the north and south, mimicking the overall height of the range. Although quite active in the latest Quaternary, the fault has been seismically quiet in historic time. **Sections:** This fault has 6 sections. Three sections have been defined for main range front, but we add a more northerly section and two associated subsidiary faults (herein sections) that are within the range.
Name comments	**General:** Referred to as the Teton fault by Love and Reed (1968 #3796). This fault bounds the eastern margin of the Teton Range and Steamboat Mountain (north of Jackson Lake), and extends from Steamboat Mountain on the north to Phillips Creek on the south. The original location of the fault trace was compiled on and digitized from a 1:62,500-scale base map

	of Grand Teton National Park; the location was refined based on publicly available LiDAR data. Gilbert and others (1983 #1338) and Wong and others (2000 #4484) considered the inferred projection of the Hermitage Point fault to be a possible splay or continuation of the Teton fault, but it is not included herein owing to lack of associated scarps and equivocal evidence that it has been active in Quaternary time (Wong and others, 2000 #4484). **Section:** This part of the fault is commonly referred to as the central segment or section of the main range-bounding Teton fault; it extends between Moran Bay (on Jackson Lake) and Taggart Lake.
County(s) and State(s)	TETON COUNTY, WYOMING
Physiographic province(s)	MIDDLE ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:24,000 scale. *Comments:* Originally compiled from Smith and others (sheet 1, 1993 #2294). Location of scarps further constrained by LiDAR data (http://opentopo.sdsc.edu/gridsphere/gridsphere?cid=standarddems) and topography at scale of 1:24,000.
Geologic setting	The Teton fault is a major range-bounding fault that forms the eastern margin of the Teton Range. Initial movement on the fault is commonly associated with the arrival of the Yellowstone hotspot in this part of northwestern Wyoming; however, there is no consensus regarding the total amount of offset and age of initiation of faulting. Reported total displacement is 2.5–3.5 km (Byrd and others, 1994 #2263), 6–9 km (Smith and others 1993 #2294), and 10 km (Love, 1977 #3796). Faulting may have begun about 5 to 6 m.y. ago (Pierce and Morgan, 1992 #2297) or during the Miocene (5–13 Ma, Smith and others, 1993 #2294). Gravity models, the about 10° westward tilting of the approximately 2-Ma Huckleberry Ridge Tuff, and the absence of basement-sourced Precambrian clasts in Jackson Hole sediments all suggest that the displacement on the Teton fault was small prior to about 5 Ma and that the majority of the offset has accrued since about 2 Ma (Foster and others, 2010 #7045).
Length (km)	This section is 20 km of a total fault length of 59 km.
Average strike	N6°E (for section) versus N19°E (for whole fault)

Sense of movement	Normal, Left lateral *Comments:* The Teton fault is a normal fault; however locally, such as near south end of this section (south of Avalanche Canyon), the western splay of fault left laterally offsets a lateral moraine 9 m and has 8 m of vertical (normal) offset (Smith and others, 1993 #2294). K.L. Pierce and J.D. Good (field notes, 1986) measured 9.8±2 m of left-lateral offset and 7 m of vertical surface offset for a net oblique offset of about 12±1.7 m at this site. Ostenaa and Gilbert (1988 #7046) suggest that left-lateral offsets are consistent with localized east-striking extension of the fault and is not necessarily indicative of fault segmentation or partitioned slip.
Dip	>45° E. *Comments:* There is no data to constrain fault dip. Recorded earthquakes are too few and too poorly located to clearly define the dip of the fault, but their spatial distribution is consistent with a dip of less than 50° (O'Connell and others, 2003 #7040). The nearly linear strike of the fault trace along topography of the mountain front, however, suggests the fault dip is steep. Gravity models suggest a low (33°) dip (Behrendt and others, 1968 #3798), but the gravity data maybe imaging older, basin-bounding structure(s) rather than the dip of the late Quaternary seismogenic fault (O'Connell and others, 2003 #7040). Byrd and others (1994 #2263) used kinematic models to suggest the fault dips between 45 and 70°.
Paleoseismology studies	Site 768-3. Although no trenches have been excavated along this section of the fault, a study of submerged shorelines in southwestern Jackson Lake by Pierce and Good (1992 #2291) suggested about 10 post-glacial (since 15 ka) earthquake submergence events (strong earthquakes) in the past 15 k.y.
Geomorphic expression	Nearly continuous scarps on glacial moraines and Pleistocene (?) and Holocene colluvium.
Age of faulted surficial deposits	Pinedale-age (latest Pleistocene) glacial moraines, and Pinedale and Holocene colluvium and alluvium.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Latest Pleistocene glacial deposits are offset as much as 30 m

	(Byrd and others, 1994 #2263) suggesting multiple faulting events in the past 15 k.y.
Recurrence interval	1.5 k.y. (<15 ka) *Comments:* Submerged shorelines in southwestern Jackson Lake suggest 10 earthquake submergence events (strong earthquakes) in the past 15 k.y., for an average recurrence interval of 1,500 yr. Two other comparable recurrence intervals are reported for this section: (1) 700–2,000 yr with an average about 1,400 yr (Gilbert and others, 1983 #1338) and (2) 800–1,800 yr with an average about 1,650 yr (Doser and Smith, 1983 #460; Smith and others, 1993 #2294).
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Maximum vertical rate for late Quaternary displacement on the Teton fault clearly occurs on this section of the fault (west and south of Jackson Lake) and is likely about 1–2 mm/yr (Gilbert and others, 1983 #1338), but net slip rates (resolved to the dipping fault plane) could be as high as 5 mm/yr if the fault dip is low (O'Connell and others, 2003 #7040) suggest. Deposits estimated to be 15,000 yr old are offset as much as 30 m (Byrd and others, 1994 #2263), suggesting rates of vertical displacement that fall within the assigned category, as does 12 m of net (oblique) slip of a lateral moraine in the past 15 k.y. at Avalanche Canyon. Gilbert and others (1983 #1338) estimated an average vertical displacement rate of 1.3 mm/yr, whereas Smith and others (1993 #2294) estimated an average displacement rate of 1.0–1.4 mm/yr for the past 2 Ma. However, O'Connell and others (2003 #7040) caution that the highest slip rate estimates are all from scarp profiles on moraine crests and these types of sites are potentially susceptible to secondary deformation that could enhance the size of the scarps. Even though most of assessments of rate are 1-5 mm/yr, they appear to vary considerably depending on the time interval considered. Figure 10 of White and others (2009 #7042) suggests that the slip rate inferred for 14–8 k.y. is an order-of-magnitude higher than the mid- to late Holocene displacement rate. Hampel and others (2007 #7043) agree and conclude that approximately 70 percent of the postglacial displacement on the Teton fault occurred before 8 ka based on three-dimensional finite-element modeling of melting of the Yellowstone ice cap. In their model, rate increased by a factor of 4?7 with respect to the "steady-state rate" and was 2.33 mm/yr along this part of the fault during removal of the ice load (16±14 ka), Other studies define slip rates for seismic hazard modeling. Wong and others (2000 #4484) used fault slip rates ranging from 0.5–4.0 mm/yr, each with separate assigned weights. These reported slip rates are the same for all three main fault

	sections, are model dependent and do not represent actual measured values. Seventy percent weight was placed on 1.5–2.2 mm/yr values. O'Connell and others (2003 #7040) indicate that this part of the fault can be characterized by a rate of 1–2 mm/yr.
Date and Compiler(s)	2011 Kenneth L. Pierce, U.S. Geological Survey, Emeritus Kathleen M. Haller, U.S. Geological Survey
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