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# Quaternary Fault and Fold Database of the United States

**As of January 12, 2017, the USGS maintains a limited number of metadata fields that characterize the Quaternary faults and folds of the United States. For the most up-to-date information, please refer to the interactive fault map.**

## Helena valley fault, piedmont section (Class A) No. 678b

**Last Review Date: 2006-06-13**

## Compiled in cooperation with the Montana Bureau of Mines and Geology

***citation for this record:*** **Machette, M.N., compiler, 2006, Fault number 678b, Helena valley fault, piedmont section, 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 02:04 PM.**

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| **Synopsis** | **General:** This fault has been mapped as a bedrock structure for more than 20 years, but considerable doubt has existed about its sense and recency of movement. Stickney (1987 #251) was the first to find offset Quaternary deposits along two short parts of the fault, although the majority of its mapped trace seems to be represented by a fault-line scarp.<br><br>**Sections:** This fault has 2 sections. The informally named sections consist of the (1) main range-bounding trace of the Helena valley fault and (2) the minor section containing two 1- |

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| | km-long scarps that are on the piedmont south of the range. The piedmont scarps are clearly related to young movement, which may be associated with the main fault at depth. |
| **Name comments** | **General:** According to Schmidt (1986 #533), this fault was first mapped by Bregmen and Robinson (no reference given). The first name applied to the structure appears to be St. Mary's fault (Witkind, 1975 #317), which was a previously mapped fault to the northwest of Helena (Schmidt, 1986 #533). The name Helena valley fault, which is now preferred in the literature, has been applied to combinations of various faults in the Helena valley. However, recent mapping by Schmidt (1986 #533) and Stickney (1987 #251) support restricting the name to the range-bounding fault along the northern margin of the Helena valley. The part of the fault having demonstrable or suspected Quaternary movement extends from 5 km west of Interstate Highway 15 at the bedrock divide with Silver Valley to 3 km east of the southeastern shore of Lake Helena.<br><br>**Section:** This informally named section includes the Thorton Ranch scarp and the East of I-15 scarp of Stickney and Bartholomew (1987 #85). The scarps are parallel to and slightly basinward (south) of the range-bounding section of the Helen valley fault [678a].<br><br>**Fault ID:** Refers to fault 50 (St. Mary's fault) of Witkind (1975 #317), fault 121 (Helena Valley fault) of Johns and others (1982 #259), fault 20 (Helena valley fault) of Stickney (1987 #251) and Stickney and Bartholomew (1987 #85) (written commun. 1992 #556), and Thorton Ranch and East of I-15 segments of Helena valley fault of Stickney and Bartholomew (written commun. 1992 #556). |
| **County(s) and State(s)** | LEWIS AND CLARK COUNTY, MONTANA |
| **Physiographic province(s)** | NORTHERN ROCKY MOUNTAINS |
| **Reliability of location** | Good<br>Compiled at 1:250,000 scale.<br><br>*Comments:* Based on 1:50,000-scale map of Stickney (1987 #251). |
| **Geologic setting** | High-angle, down-to-the-southwest, normal (?) fault along |

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| | northern margin of the Helena valley (as restricted from previous usage). The fault extends from the bedrock divide with Silver Valley eastward to Lake Helena. Witkind (1975 #317) extended the fault farther west to Canyon Creek, and both Witkind (1975 #317) and Johns and others (1982 #259) extended the fault southeastward along the base of the Spokane Hills. Schmidt (1986 #533) mapped the fault (inferred trace) eastward into the Townsend Valley, although Stickney (1987 #251) found no evidence for Quaternary movement in the low divide between Lake Helena and Hauser Lake. The zone formed by the St. Marys fault, Helena valley fault, and its extension to the east are considered to be the northern boundary of the Lewis and Clark line, which is thought to be a Tertiary dextral-slip fault zone (Reynolds, 1979 #223). Reynolds (1979 #223) and Schmidt (1986 #533) reported several kilometers of Tertiary dextral movement on the Helena valley fault, although this amount of offset is not well documented. |
| **Length (km)** | This section is 5 km of a total fault length of 20 km. |
| **Average strike** | N76°W (for section) versus N65°W (for whole fault) |
| **Sense of movement** | Normal |
| **Dip Direction** | S |
| **Paleoseismology studies** | |
| **Geomorphic expression** | This section consists of two 1-km-long fault scarps on alluvial-fan deposits. The scarps are about 1 m high, have a gentle slope (angle not specified), and appear to be highly degraded (Stickney, 1987 #251). They have been incised by streams and are buried in part by upper Quaternary deposits. |
| **Age of faulted surficial deposits** | |
| **Historic earthquake** | |
| **Most recent prehistoric deformation** | middle and late Quaternary (<750 ka)<br><br>*Comments:* Based on age estimates of Stickney and Bartholomew (1987 #85) and supported by the implied high degree of |

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| | degradation of the fault scarps. |
| **Recurrence interval** | |
| **Slip-rate category** | Less than 0.2 mm/yr<br><br>*Comments:* Inferred low slip rate based on absence of scarps on upper Quaternary deposits. Anderson and LaForge (2003 #6897) suggest this fault is similar to other nearby faults (Spokane Hills [679], Regulating Reservoir [680], and Spokane Bench [681] faults) and can be characterized by slip rates of less than 0.01 to 0.1 mm/yr. |
| **Date and Compiler(s)** | 2006<br>Michael N. Machette, U.S. Geological Survey, Retired |
| **References** | #6897 Anderson, L.W., and LaForge, R., 2003, Seismotectonic study for Canyon Ferry Dam, Missouri River Basin Project, Montana: U.S. Bureau of Reclamation Seismotectonic Report 2003-1, 70 p.<br><br>#259 Johns, W.M., Straw, W.T., Bergantino, R.N., Dresser, H.W., Hendrix, T.E., McClernan, H.G., Palmquist, J.C., and Schmidt, C.J., 1982, Neotectonic features of southern Montana east of 112°30' west longitude: Montana Bureau of Mines and Geology Open-File Report 91, 79 p., 2 sheets.<br><br>#223 Reynolds, M.W., 1979, Character and extent of Basin-Range faulting, western Montana and east-central Idaho, *in* Newman, G.W., and Goode, H.D., eds., Basin and Range symposium and Great Basin field conference: Rocky Mountain Association of Geologists and Utah Geological Association, p. 41-54.<br><br>#533 Schmidt, R.G., 1986, Geology, earthquake hazards, and land use in the Helena area, Montana—A review: U.S. Geological Survey Professional Paper 1316, 64 p., 3 pls., scale 1:48,000 and 1:25,000.<br><br>#251 Stickney, M.C., 1987, Quaternary geologic map of the Helena valley, Montana: Montana Bureau of Mines and Geology Geologic Map 46, 1 pl., scale 1:50,000.<br><br>#85 Stickney, M.C., and Bartholomew, M.J., 1987, Seismicity and late Quaternary faulting of the northern Basin and Range |

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| | province, Montana and Idaho: Bulletin of the Seismological Society of America, v. 77, p. 1602-1625.<br><br>#556 Stickney, M.C., and Bartholomew, M.J., 1992 written commun., Preliminary map of late Quaternary faults in western Montana (digital data): Montana Bureau of Mines and Geology (digital version of MBMG Open-File Report 186), 1 pl., scale 1:500,000.<br><br>#317 Witkind, I.J., 1975, Preliminary map showing known and suspected active faults in western Montana: U.S. Geological Survey Open-File Report 75-285, 36 p. pamphlet, 1 sheet, scale 1:500,000. |