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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.

Western Boundary fault (Class A) No. 2313

Last Review Date: 1997-09-29

Compiled in cooperation with the Colorado Geological Survey

citation for this record: **Widmann, B.L., compiler, 1997, Fault number 2313, Western Boundary 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 Western Boundary fault forms the western rim of the Tertiary Bonanza Caldera. The fault originated as a reverse fault in the early to middle Oligocene with the collapse of the Bonanza Caldera, but has post-Oligocene movement associated with continued collapse and perhaps growth of the Rio Grande rift. The fault is marked by a prominent fault scarp, cold springs, fault gouge, and anomalous drainages and topography. Oligocene to Miocene volcanics are clearly offset by the fault, whereas offset of Pleistocene alluvium is less definitive. The most recent movement on this fault is herein considered to have occurred during the Quaternary.

Name comments	The Western Boundary fault is a curvilinear north-south oriented fault that begins north of Starvation Creek and ends near Kerber Creek, midway between Brewer Creek and Little Kerber Creek. The fault is on the east flank of Sheep and Flagstaff Mountains in the southern Sawatch Range and on the west side of the San Luis Valley near the Bonanza Caldera. **Fault ID:** Fault 119 in Kirkham and Rogers (1981 #792) and fault number Q61 of Widman and others (1998 #3441).
County(s) and State(s)	SAGUACHE COUNTY, COLORADO
Physiographic province(s)	SOUTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:250,000 scale. *Comments:* The fault was mapped at a scale of 1:20,000 by Marrs (1973 #2721), at 1:62,500 by Knepper (1974 #2714), and at 1:250,000 by Tweto and others (1976 #2774). The trace used herein is from Tweto and others (1976 #2774).
Geologic setting	The Bonanza Caldera is located along the western margin of the north end of the San Luis Valley. The Western Boundary fault is a high-angle normal, listric fault that is down to the northeast and east. The fault lies within a pattern of concentric faults and defines the western rim of the Bonanza Caldera. The fault probably originated during the early to middle Oligocene as a reverse fault in response to doming of the Bonanza Caldera. Normal movement on the fault is related to collapse of the magma chamber and subsequent local readjustment (Marrs, 1973 #2721).
Length (km)	20 km.
Average strike	N16°W
Sense of movement	Normal *Comments:* The fault originated as a reverse fault in the early to middle Oligocene but has experienced subsequent normal reactivation associated with the collapse of the Bonanza Caldera (Marrs, 1973 #2721).
Dip Direction	NE; E

	Comments: Marrs (1973 #2721) descibed the Western Boundary fault as a high-angle, concentric fault that dips northeast and east towards the Bonanza Caldera.
Paleoseismology studies	
Geomorphic expression	The Western boundary fault is characterized by a prominent cliff that appears to be a fault-line scarp; the fault itself is marked by bouldery fault gouge. Cold water springs are present along the fault trace. Stream beds that cross the fault trace have an anomalous character, topography on the downthrown side of the fault is hummocky, and drainage patterns are not well developed (Marrs, 1973 #2721).
Age of faulted surficial deposits	Oligocene volcanic flows associated with the Bonanza Caldera are offset by the fault (Marrs, 1973 #2721; Knepper, 1974 #2714). Knepper (1974 #2714) mapped Quaternary deposits as concealing the fault. Tweto and others (1976 #2774) mapped offset of mid-Tertiary intrusive rocks of Oligocene to Miocene age. Lettis and others (1996) indicated that the fault offsets early to middle Pleistocene alluvium. The fault is almost entirely in Tertiary volcanic rocks with Precambrian bedrock exposed only at the north end of the fault on the upthrown side.
Historic earthquake	
Most recent prehistoric deformation	undifferentiated Quaternary (<1.6 Ma) *Comments:* Teritary movement on the fault is clearly documented by offset of Oligocene to Miocene volcanics. More recent movement on the fault is less definitive. Marrs (1973 #2721) suggested youthful fault movement based on stream bed anomalies, topography and drainage patterns. He observed evidence for increased stream energy and steepened profiles in stream beds that cross the fault trace, which seemed to indicate recent flooding. However, he found no evidence for flooding in other drainages and no historical documentation of flooding in the area. He concluded that the apparent flood indicators could be related instead to youthful faulting. Further, topography on the downthrown side of the fault is hummocky with poorly defined drainage patterns. Marrs (1973 #2721) ackowledged that there is no definitive evidence for youthful faulting, but suggested that

	these anomalies may in fact be indicators for Quaternary fault activity. Kirkham and Rogers (1981 #792) classified this fault as a possible Quaternary fault. Colman (1985 #1953) and Lettis and others (1996) indicated that this fault offsets early to middle Pleistocene alluvium.
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Widmann and others (1998 #3441) placed this fault in the <0.2 mm/yr slip-rate category.
Date and Compiler(s)	1997 Beth L. Widmann, Colorado Geological Survey
References	#1953 Colman, S.M., 1985, Map showing tectonic features of late Cenozoic origin in Colorado: U.S. Geological Survey Miscellaneous Geologic Investigations I-1566, 1 sheet, scale 1:1,000,000. #792 Kirkham, R.M., and Rogers, W.P., 1981, Earthquake potential in Colorado: Colorado Geological Survey Bulletin 43, 171 p., 3 pls. #2714 Knepper, D.H., Jr., 1974, Tectonic analysis of the Rio Grande Rift zone, central Colorado: Golden, Colorado School of Mines, Ph.D. dissertation T-1593, 237 p. #4453 Lettis, W., Noller, J., Wong, I., Ake, J., Vetter, U., and LaForge, R., 1996, Draft report, Seismotectonic evaluation of Colorado River storage project-Crystal, Morrow Point, Blue Mesa dams, Smith Fork project-Crawford dam, west-central Colorado: Technical report to U.S. Bureau of Reclamation, Denver, Colorado, 177 p. #2721 Marrs, R.W., 1973, Application of remote-sensing techniques to the geology of the Bonanza volcanic center: Golden, Colorado School of Mines, Ph.D. dissertation T-1531, 281 p. #2774 Tweto, O., Steven, T.A., Hail, W.J., Jr., and Moench, R.H., 1976, Preliminary geologic map of the Montrose 1° x 2° quadrangle, southwestern Colorado: U.S. Geological Survey

	Miscellaneous Field Studies Map MF-761. #3441 Widmann, B.L., Kirkham, R.M., and Rogers, W.P., 1998, Preliminary Quaternary fault and fold map and database of Colorado: Colorado Geological Survey Open-File Report 98-8, 331 p., 1 pl., scale 1:500,000.