Jump to Navigation

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.

Southern Sangre de Cristo fault, Cañon section (Class A) No. 2017e

Last Review Date: 2015-06-23

Compiled in cooperation with the New Mexico Bureau of Geology & Mineral Resources

citation for this record: **Kelson, K.I., Haller, K.M., Koning, D.J., Kirkham, R.M., and Machette, M.N., compilers, 2015, Fault number 2017e, Southern Sangre de Cristo fault, Cañon 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 02:23 PM.**

Synopsis	**General:** The Southern Sangre de Cristo fault is a west-dipping fault that in New Mexico forms the border between the Sangre de Cristo Mountains and the San Luis basin. In Colorado, the fault forms the border between San Pedro Mesa to the east and San Luis Valley to the west. At an embayment in the Sangre de Cristo Range, at the New Mexico/Colorado border, faulting steps eastward to the Northern Sangre de Cristo fault [2321]. The Southern Sangre de Crist fault has subdued geomorphic expression compared to the Northern Sangre de Cristo fault.

	Sections: This fault has 5 sections. The four sections in New Mexico are better exposed and have been studied in more detail than the single section in Colorado. Menges (1988 #1120; 1990 #1116; 1990 #1387) defined 4 geometric segments and 13 subsegments of the Southern Sangre de Cristo fault in New Mexico on the basis of physiographic and geomorphic expression of the fault zone and the morphology of the Sangre de Cristo range front in New Mexico, but did not investigate the part of the fault that extends north into Colorado. The trace of the fault in Colorado is mainly buried by Quaternary landslide debris. On the basis of fault scarp geomorphic expression, morphometric analyses of scarps, and surficial mapping, Ruleman and Machette (2007 #7252) suggest combining the Urraca and Questa sections into the Latir Peaks section of the fault. The original sectioning of the fault is retained in this update because of the lack of robust understanding of the timing of the most recent event, vertical-displacement rates, and recurrence intervals along the fault.
Name comments	**General:** The Sangre de Cristo fault system borders the eastern margin of the San Luis basin, which extends from Poncha Pass, Colorado, to near Taos, New Mexico. This description addresses only the southern part of the fault system, which extends from the north end of San Pedro Mesa Creek south to its intersection with the Embudo fault at TalpaRancho, about 8 km south of Taos. Upson (1939 #1142) first mapped the fault in Colorado and northern New Mexico. The Southern Sangre de Cristo fault, as used by Menges (1988 #1120; 1990 #1116; 1990 #1387) and herein, includes the Sangre de Cristo fault zone of Lipman and Mehnert (1975 #1955), the Taos fault of Dungan and others (1984 #1181), and the Cedros Canyon, Urraca Ranch, Taos Pueblo, and Cañon faults of Machette and Personius (1984 #1113) and Personius and Machette (1984 #1124). Ruleman and Machette (2007 #7252) suggest the Sangre de Cristo fault system (including the Northern Sangre de Cristo [2321] and the Southern Sangre de Cristo, herein) is more appropriately divided into northern, central, and southern based on tectonic activity that has shifted from the southern and northern parts of the fault system to the central part during the late Quaternary. The southern fault zone of Ruleman and Machette (2007 #7252) coincides with what we call the Southern Sangre de Cristo fault. **Section:** This section corresponds to segment 4 of Menges (1988 #1120; 1990 #1116; 1990 #1387), but a new name is used to avoid numerical section designations. This section includes the

	Taos Pueblo and Cañon faults of Machette and Personius (1984 #1113) and Personius and Machette (1984 #1124). The northern termination of the section is at Rio Pueblo de Taos, about 7 km northeast of the town of Taos, which coincides with a large re-entrant in the Sangre de Cristo range front. The southern end of the section lies at Rio Grande del Rancho, about 1 km south of the village of Talpa. This boundary coincides with a large bend in the range front and is the southern boundary of segment 4 of Menges (1988 #1120; 1990 #1116; 1990 #1387). This boundary marks the intersection of the Sangre de Cristo fault with the Embudo fault (Kelson and others, 1997 #1374). **Fault ID:** Segment 3 of Menges (1988 #1120; 1990 #1116; 1990 #1387).
County(s) and State(s)	TAOS COUNTY, NEW MEXICO
Physiographic province(s)	SOUTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:250,000 scale. *Comments:* Menges (1988 #1120) mapped fault traces from aerial photography at scales of 1:15,780 to 1:70,000, and presents mapping at a scale of about 1:400,000. Machette and Personius (1984 #1113) mapped fault traces at a scale of 1:250,000.
Geologic setting	The Southern Sangre de Cristo fault is part of a major rift-margin structure of Neogene age that borders the eastern margin of the Rio Grande rift in south-central Colorado and north-central New Mexico. The entire Sangre de Cristo fault system generally forms the boundary between the San Luis basin to the west, a narrow (10–25 km wide), east-tilted, asymmetrical half-graben on the west, and the Sangre de Cristo Mountains to the east. There is 7–8 km of structural relief on Precambrian basement rock across the Sangre de Cristo fault zone (Lipman and Mehnert, 1975 #1955). The western margin of the San Luis basin has comparatively little displacement, and no evidence of late Quaternary displacement. The southern end of the fault merges with or intersects the north-down, sinistral Pilar section of the Embudo fault [2007a] near the village of Talpa, New Mexico; geologic mapping shows there is not a distinct boundary between the Embudo and the Southern Sangre de Cristo faults (Bauer and Kelson, 2004 #7250). Wong

	and others (1995 #1155) note that a few well-located earthquakes appear to have occurred near the fault in New Mexico.
Length (km)	This section is 14 km of a total fault length of 96 km.
Average strike	N29°E (for section) versus N6°W (for whole fault)
Sense of movement	Normal
Dip	60° W *Comments:* Deep seismic reflection data and two-dimensional modeling of gravity data near Alamosa, Colorado, suggest that the most likely dip of the Northern Sangre de Cristo fault [2321] is 60° (Kluth and Schaftenaar, 1994 #1183). Tandon (1992 #1390; cited in Chapin and Cather, 1994 #1180) interprets the same data set processed for deeper resolution, and concludes that the fault dips about 60° to at least 26 to 28 km, which is probably below the brittle-ductile transition zone. In the near surface, individual fault planes dip steeply west to northwest with slickenlines plunging moderately to steeply westward (Bauer and Kelson, 2004 #7250). Bauer and Kelson (2004 #7250) further note that near-surface dips are consistently steeper than estimated using geophysical data.
Paleoseismology studies	Site 2017-1 Taos Pueblo site (Kelson and others, 2004 #7269). Trench exposed the main fault strand near the base of the topographic scarp. The Sangre de Cristo fault zone likely consists of at least three fault strands in the vicinity of the trench; therefore, the record of total displacement and possibly event chronology is incomplete. Trench T-1 crosses the most prominent strand of the fault at the site with about 3 m of net vertical tectonic displacement. Stratigraphic relations exposed by the trench suggest the occurrence of two surface ruptures since the formation of the alluvial-fan surface, each with about 1.5 m of vertical displacement. No numerical or correlative age estimates are available. Startigraphic and soils relations in Trench T-1 suggests that the most-recent surface-rupturing earthquake on the Southern Sangre de Cristo fault occurred 10– 30 k.y. ago (Kelson and others, 2004 #7269).
Geomorphic expression	Prominent west-facing fault scarps are present on late Pleistocene and possibly Holocene alluvial fans derived from the Sangre de Cristo Mountains. Menges (1988 #1120; 1990 #1116; 1990

	#1387) documents the presence of truncated ridge spurs and triangular facets along the Sangre de Cristo range front, and interprets these as products of long-term displacement. Mapping shows that the Cañon section is complexly faulted and as much as 2 km wide (Bauer and Kelson, 2004 #7250).
Age of faulted surficial deposits	Machette and Personius (1984 #1113) and Personius and Machette (1984 #1124) indicate late Pleistocene and late Pleistocene to Holocene deposits are displaced along the fault. Kelson (1986 #1109) mapped late Quaternary deposits and some fault strands along this section, and shows faulted Pleistocene alluvial-fan deposits. Menges (1990 #1116; 1990 #1387) did not map surficial deposits along the fault, but concludes that this fault section has experienced late Pleistocene and early Holocene to latest Pleistocene movement. At Trench T-1, the degree of soil development on buried fault scarp colluvium in the hanging wall suggests an age of 10-30 ka (Kelson and others (2004 #7269). This implies a late Pleistocene age for the pre-faulted geomorphic surface and underlying sediment.
Historic earthquake	
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* The timing of the most recent surface rupture is unconstrained; no numerical or correlative age estimates are available. Early geomorphic investigation of the fault by, Machette and Personius (1984 #1113) and Personius and Machette (1984 #1124) suggest a late Pleistocene age for the most recent movement based on scarp profile data. Menges (1988 #1120; 1990 #1116; 1990 #1387) conducted a more exhaustive study of fault-related landforms, and suggests the possibility of late to middle Holocene movement along part of the Urraca section. Interpretation of geologic relations in the only trench across the fault suggests that the most-recent large earthquake on the southern Sangre de Cristo fault occurred 10– 30 k.y. ago (Kelson and others, 2004 #7269).
Recurrence interval	10 to 50 k.y. *Comments:* Menges (1988 #1120; 1990 #1116; 1990 #1387) estimated recurrence at a given site along the southern Sangre de Cristo fault as 10,000 years and stated that this is compatible with data from the northern part of the Sangre de Cristo fault system

	(10 to 50 k.y.) given by McCalpin (1982 #791). Furthermore, no data exist from the trench site to constrain recurrence intervals (Kelson and others, 2004 #7269).
Slip-rate category	Less than 0.2 mm/yr *Comments:* Menges (1988 #1120; 1990 #1116; 1990 #1387) estimated two vertical-displacement rates for the southern Sangre de Cristo fault on the basis of fault scarp data: (1) a post-middle Pleistocene (post-Bull Lake age) rate of 0.03–0.06 mm/yr, and (2) a post-Pliocene (post-4 Ma) rate of 0.12–0.23 mm/yr.
Date and Compiler(s)	2015 Keith I. Kelson, William Lettis & Associates, Inc. Kathleen M. Haller, U.S. Geological Survey Daniel J. Koning, New Mexico Bureau of Geology & Mineral Resources Robert M. Kirkham, Colorado Geological Survey Michael N. Machette, U.S. Geological Survey, Retired
References	#7250 Bauer, P.W., and Kelson, K.I., 2004, Fault geometry and Cenozoic kinematic history of the southeastern San Luis Basin near Taos, New Mexico: New Mexico Bureau of Geology and Mineral Resources Bulletin 160, p. 79–95. #1180 Chapin, C.E., and Cather, S.M., 1994, Tectonic setting of the axial basins of the northern and central Rio Grande rift, *in* Keller, G.R., and Cather, S.M., eds., Basins of the Rio Grande rift—Structure, stratigraphy, and tectonic setting: Geological Society of America Special Paper 291, p. 5-25. #1181 Dungan, M.A., Muehlberger, W.R., Leininger, L., Peterson, C., McMillan, N.J., Gunn, G., Lindstrom, M., and Haskin, L., 1984, Volcanic and sedimentary stratigraphy of the Rio Grande gorge and the late Cenozoic geologic evolution of the southern San Luis Valley, *in* Baldridge, W.S., Dickerson, P.W., Riecker, R.E., and Zidek, J., eds., Rio Grande rift—Northern New Mexico: New Mexico Geological Society, 35th Field Conference, October 11-13, 1984, Guidebook, p. 157-170. #1109 Kelson, K.I., 1986, Long-term tributary adjustments to base-level lowering in northern Rio Grande rift, New Mexico: Albuquerque, University of New Mexico, unpublished M.S. thesis, 210 p. #7269 Kelson, K.I., Bauer, P.W., Love, D., Connell, S.D.,

Mansell, M., and Rawling, G., 2004, Initial paleoseismic and hydrologic assessment of the Southern Sangre de Cristo fault at the Taos Pueblo site, Taos New Mexico: New Mexico Bureau of Geology and Mineral Resources Open-File Report 476, 46 p

#1374 Kelson, K.I., Unruh, J.R., and Bott, J.D.J., 1997, Field characterization, kinematic analysis, and initial paleoseismologic assessment of the Embudo fault, northern New Mexico: Technical report to U.S. Geological Survey, Reston, Virginia, under Contract 1434-96-G-02739, July 1997, 48 p.

#1183 Kluth, C.F., and Schaftenaar, C.H., 1994, Depth and geometry of the northern Rio Grande rift in the San Luis Basin, south-central Colorado, *in* Keller, G.R., and Cather, S.M., eds., Basins of the Rio Grande rift—Structure, stratigraphy, and tectonic setting: Geological Society of America Special Paper 291, p. 27-37.

#1955 Lipman, P.W., and Mehnert, H.H., 1975, Late Cenozoic basaltic volcanism and development of the Rio Grande depression in the southern Rocky Mountains, *in* Curtis, B.F., ed., Cenozoic history of the southern Rocky Mountains: Geological Society of America Memoir 144, p. 119-154.

#1113 Machette, M.N., and Personius, S.F., 1984, Map of Quaternary and Pliocene faults in the eastern part of the Aztec 1° by 2° quadrangle and the western part of the Raton 1° by 2° quadrangle, northern New Mexico: U.S. Geological Survey Miscellaneous Field Studies Map MF-1465-B, 1 sheet, scale 1:250,000.

#791 McCalpin, J.P., 1982, Quaternary geology and neotectonics of the west flank of the northern Sangre de Cristo Mountains, south-central Colorado: Colorado School of Mines Quarterly, v. 77, no. 3, p. 1-97.

#1120 Menges, C.M., 1988, The tectonic geomorphology of mountain-front landforms in the northern Rio Grande rift near Taos, New Mexico: Albuquerque, University of New Mexico, unpublished Ph.D. dissertation, 339 p.

#1116 Menges, C.M., 1990, Late Cenozoic rift tectonics and mountain-front landforms of the Sangre de Cristo Mountains near Taos, New Mexico, *in* Bauer, P.W., Lucas, S.G., Mawer, C.K., and

McIntosh, W.C., eds., Tectonic development of the southern Sangre de Cristo Mountains, New Mexico: New Mexico Geological Society, 41st Field Conference, September 12-15, 1990, Guidebook, p. 113-122.

#1387 Menges, C.M., 1990, Late Quaternary fault scarps, mountain-front landforms, and Pliocene-Quaternary segmentation on the range-bounding fault zone, Sangre de Cristo Mountains, New Mexico, *in* Krinitzsky, E.L., and Slemmons, D.B., eds., Neotectonics in earthquake evaluation: Geological Society of America Reviews in Engineering Geology, v. 8, p. 131-156.

#1124 Personius, S.F., and Machette, M.N., 1984, Quaternary and Pliocene faulting in the Taos Plateau region, northern New Mexico, *in* Baldridge, W.S., Dickerson, P.W., Riecker, R.E., and Zidek, J., eds., Rio Grande rift—Northern New Mexico: New Mexico Geological Society, 35th Field Conference, October 11-13, 1984, Guidebook, p. 83–90.

#7252 Ruleman, C., and Machette, M., 2007, An overview of the Sangre de Cristo fault system and new insights to interactions between Quaternary faults in the northern Rio Grande rift, in Machette, M.N., Coates, M.M., and Johnson, M.L., eds., 2007 Rocky Mountain Section Friends of the Pleistocene field trip—Quaternary geology of the San Luis Basin of Colorado and New Mexico, September 7–9, 2007: U.S. Geological Survey Open-File Report 2007-1193, p. 187–197.

#1390 Tandon, K., 1992, Deep structure beneath the San Luis basin in Colorado from reprocessing of an industry reflection survey: Ithaca, New York, Cornell University, unpublished Ph.D. dissertation, 285 p.

#1142 Upson, J.E., 1939, Physiographic subdivisions of the San Luis Valley, southern Colorado: Journal of Geology, v. 47, p. 721-736.

#1155 Wong, I., Kelson, K., Olig, S., Kolbe, T., Hemphill-Haley, M., Bott, J., Green, R., Kanakari, H., Sawyer, J., Silva, W., Stark, C., Haraden, C., Fenton, C., Unruh, J., Gardner, J., Reneau, S., and House, L., 1995, Seismic hazards evaluation of the Los Alamos National Laboratory: Technical report to Los Alamos National Laboratory, Los Alamos, New Mexico, February 24, 1995, 3 volumes, 12 pls., 16 appen.