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, San Pedro Mesa section (Class A) No. 2017a

Last Review Date: 2015-06-23

Compiled in cooperation with the Colorado Geological Survey and the New Mexico Bureau of Geology & Mineral Resources

citation for this record: **Kelson, K.I., Kirkham, R.M., Machette, M.N., and Koning, D.J., compilers, 2015, Fault number 2017a, Southern Sangre de Cristo fault, San Pedro Mesa 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:** The San Pedro Mesa section of the Southern Sangre de

	Cristo fault is essentially the same structure as fault 109 of Kirkham and Rogers (1981 #792) and is the northernmost of the 5 sections delineated along the southern Sangre de Cristo fault for the purpose of this compilation. The southern end of the fault is located near Costilla Creek in New Mexico and extends north along the west side of San Pedro Mesa. It terminates or is covered by younger deposits along Culebra Creek, west of San Luis, Colorado. **Fault ID:** Segment 3 of Menges (1988 #1120; 1990 #1116; 1990 #1387).
County(s) and State(s)	TAOS COUNTY, NEW MEXICO COSTILLA COUNTY, COLORADO
Physiographic province(s)	SOUTHERN ROCKY MOUNTAINS
Reliability of location	Good Compiled at 1:250,000 scale. *Comments:* The trace of this section of the fault is based on two sources. Most of the trace is from Colman and others (1985 #1954) at a scale of 1:125,000. Most of this section of the fault is concealed by landslide deposits and is poorly mapped. The splays that extend to the northwest off the northern end of the fault are mapped by Thompson and Machette (1989 #1382) at 1:50,000 scale, and are better located. The fault is also mapped at 1:250,000 scale by Colton (1976 #1136), at 1:500,000 by Kirkham and Rogers (1981 #792), and at 1:1,000,000 by Tweto (1978 #1956).
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 24 km of a total fault length of 96 km.
Average strike	N8°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) interpreted the same data set which was processed for deeper resolution, and concludes that the fault dips about 60° to at least 26–28 km depth, which is probably below the brittle-ductile transition zone.
Paleoseismology studies	
Geomorphic expression	The San Pedro Mesa section is generally buried by Quaternary landslide deposits along most of its length. Discontinuous scarps are seen among and between landslide deposits, typically during early morning sunlight. The splays that extend to the northwest off the northern end of the main fault are mapped by Thompson and Machette (1989 #1382) and have subtle scarps associated with them.
Age of faulted surficial deposits	Thompson and Machette (1989 #1382) indicated middle Pleistocene alluvium (unit Qa) is offset by this fault.
Historic earthquake	
Most recent prehistoric deformation	late Quaternary (<130 ka) *Comments:* The exact timing of the latest paleoevent on this section is unknown. A late Quaternary age is postulated for this

	fault because it offsets middle Pleistocene alluvium; however, the trace is mostly concealed by undifferentiated Quaternary landslide deposits (Thompson and Machette, 1989 #1382).
Recurrence interval	
Slip-rate category	Less than 0.2 mm/yr *Comments:* Burroughs (1978 #1381) reported that the Servilleta Formation is offset 600 m by the fault near the Colorado-New Mexico line. Thompson and Machette (1989 #1382) reported dates ranging from 3.6 to 4.5 Ma for the Servilleta basalts, suggesting a low long-term slip rate. Using the same datum Ruleman and Machette (2007 #7252) suggest vertical displacement rates that range from 0.075 to 0.1 mm/yr.
Date and Compiler(s)	2015 Keith I. Kelson, William Lettis & Associates, Inc. Robert M. Kirkham, Colorado Geological Survey Michael N. Machette, U.S. Geological Survey, Retired Daniel J. Koning, New Mexico Bureau of Geology & Mineral Resources
References	#1381 Burroughs, R.L., 1978, Northern rift guide 2, Alamosa, Colorado-Santa Fe, New Mexico—Alamosa to Antonito, Colorado, *in* Hawley, J.W., ed., Guidebook to Rio Grande rift in New Mexico and Colorado: New Mexico Bureau of Mines and Mineral Resources Circular 163, p. 33-36. #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. #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. #1954 Colman, S.M., McCalpin, J.P., Ostenaa, D.A., and Kirkham, R.M., 1985, Map showing upper Cenozoic rocks and deposits and Quaternary faults, Rio Grande Rift, south-central Colorado: U.S. Geological Survey Miscellaneous Geologic Investigations I-1594, 2 sheets.

#1136 Colton, R.B., 1976, Map showing landslide deposits and late Tertiary and Quaternary faulting in the Fort Garland-San Luis area, Colorado-New Mexico: U.S. Geological Survey Open-File Report 76-185, 1 sheet, scale 1:250,000.

#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.

#7790 Ingersoll, R.V., 2001, Structural and stratigraphic evolution of the Rio Grande Rift, northern New Mexico and southern Colorado: International Geology Review, v. 43, p. 687–891, doi:10.1080/00206810109465053.

#792 Kirkham, R.M., and Rogers, W.P., 1981, Earthquake potential in Colorado: Colorado Geological Survey Bulletin 43, 171 p., 3 pls.

#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.

#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.

#7253 Ruleman, C.A., Thompson, R.A., Shroba, R.R., Anderson, M., Drenth, B.J., Rotzien, J., and Lyon, J., 2013, Late Miocene–Pleistocene evolution of a Rio Grande rift subbasin, Sunshine Valley–Costilla Plain, San Luis Basin, New Mexico and Colorado, *in* Hudson, M.R., and Grauch, V.J.S., eds., New perspectives on Rio Grande rift basins—From tectonics to groundwater: Geological Society of America Special Paper 494, p. 47–73, doi:10.1130/2013.2494(03)

#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.

#1382 Thompson, R.A., and Machette, M.N., 1989, Geologic map of the San Luis Hills area, Conejos and Costilla Counties, Colorado: U.S. Geological Survey Miscellaneous Investigations Map I-1906, 1 sheet, scale 1:50,000.

#1956 Tweto, O., 1978, Northern rift guide 1, Denver-Alamosa, Colorado, *in* Hawley, J.W., ed., Guidebook to Rio Grande rift in New Mexico and Colorado: New Mexico Bureau of Mines and Mineral Resources Circular 163, p. 13-27.

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