

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](#).

Gulf-margin normal faults, Louisiana and Arkansas (Class B) No. 1022

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Compiled in cooperation with the Louisiana Geological Survey

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Synopsis

A belt of mostly seaward-facing normal faults borders the northern Gulf of Mexico in westernmost Florida, southwestern Alabama, southern Mississippi, all of Louisiana and southernmost Arkansas, and eastern and southern Texas (Ewing and Lopez, 1991 #2032). For the purposes of his compilation, the Gulf Coast faults are divided in four large groups because they number in the hundreds. To reflect regional differences in the characteristics of the faults, those in Florida and Alabama are evaluated together in a single group, as are those in Mississippi, those in Louisiana and Arkansas (described here), and those in Texas. Because numerous

	<p>individual faults are combined into a single group for this compilation, it is not possible to provide to provide digital information about the azimuth, length, and dip of each individual fault. The gulf-margin normal faults in Louisiana and Arkansas are assigned as Class B structures because their low seismicity and because they may be decoupled from underlying crust, making it unclear if they can generate significant seismic ruptures that could cause damaging ground motion.</p>
Name comments	
County(s) and State(s)	<p>ALL COUNTIES, LOUISIANA ASHLEY COUNTY, ARKANSAS BRADLEY COUNTY, ARKANSAS CALHOUN COUNTY, ARKANSAS CHICOT COUNTY, ARKANSAS COLUMBIA COUNTY, ARKANSAS HEMPSTEAD COUNTY, ARKANSAS LAFAYETTE COUNTY, ARKANSAS MILLER COUNTY, ARKANSAS NEVADA COUNTY, ARKANSAS OUACHITA COUNTY, ARKANSAS UNION COUNTY, ARKANSAS</p>
Physiographic province(s)	COASTAL PLAIN
Reliability of location	<p>Poor Compiled at 1:2,500,000 scale.</p> <p><i>Comments:</i> Most of the area was evaluated with regional maps at scales of 1:2,500,000 because no individual faults have sufficient evidence of seismic slip to justify singling it out for attention here at a larger map scale. Faults in areas having abundant drill-hole data may be better located in the subsurface than at the surface.</p>
Geologic setting	<p>A belt of mostly seaward-facing normal faults borders the northern Gulf of Mexico. These gulf-margin faults face southwest in westernmost Florida, southwestern Alabama, and southern Mississippi; south in Louisiana and southernmost Arkansas; and southeast in eastern and southern Texas (Ewing and Lopez, 1991 #2032). In early to middle Mesozoic time, the opening of the Gulf of Mexico formed a south-facing, rifted, passive margin at the southern edge of North America (DuBar and others, 1991 #2010;</p>

Salvador, 1991 #2019; Salvador, 1991 #2020). Subsequently, the rifted margin was buried beneath the thick, Middle Jurassic, Louann Salt and an overlying, carbonate and clastic, marine sequence that continues to accumulate today. This post-rift sequence thickens seaward (Salvador, 1991 #2020). It is at least 2 km thick everywhere in the belt of gulf-margin normal faults. At the coastline, the sequence is at least 10 km thick west of the Mississippi River and at least 5 km thick farther to the east. Thicknesses exceed 12 km under coastal Texas and southern Louisiana and perhaps 16 km offshore Louisiana.

Rapid deposition and the resulting enormous thickness of the post-rift sediments caused them to collapse and spread seaward. Salt flowed southward and pierced upward, and the overlying sediments extended on listric, normal, growth faults that flatten downward into detachments in the salt and in overpressured shales (Ewing, 1991 #1994; Nelson, 1991 #1995). These listric normal faults, their splays, and their antithetic and transfer faults make up the belt of gulf-margin normal faults described here.

Regional fluctuations in the overall deposition rate divide the belt of gulf-margin faults into two parts with different main ages of faulting and different degrees of Quaternary faulting. (1) The Interior zone of Ewing (1991 #1994) includes the entire belt except southern Louisiana, coastal Texas, and their offshore extensions. Triassic-Jurassic rifting and sedimentation, including deposition of the Louann Salt, led to Mesozoic growth faulting and salt tectonism. A line of large grabens approximates the landward limit of Jurassic salt, and Cenozoic faulting is sparse in the Interior zone (Ewing, 1991 #1994; Salvador, 1991 #2019; Ewing and Lopez, 1991 #2032). (2) The Coastal zone of Ewing (1991 #1994) covers southern Louisiana, coastal Texas, and their offshore extensions, and is separated from the Interior zone by the Early Cretaceous shelf edge (Ewing, 1991 #1994; Ewing and Lopez, 1991 #2032). Late Cretaceous and especially Cenozoic clastic sediments prograded southward led to abundant Cenozoic and continuing growth faulting and salt tectonism (for example DuBar and others, 1991 #2010, p. 584-585; Salvador, 1991 #2019). The post-rift sequence as a whole is at least 9-11 km thick throughout the Coastal zone (Salvador, 1991 #2020). Calculations show that the crustal load from rapid Quaternary sedimentation may aid Quaternary normal faulting and reactivate Tertiary faults of the Coastal zone by imposing extensional bending stresses on the post-rift sequence; older extensional stresses imposed by the

Mesozoic sediment load have had time to relax (Nunn, 1985 #2215).

Epicenter maps show only sparse, low-magnitude seismicity within the fault belt (Engdahl, 1988 #1959; Stover and Coffman, 1993 #1986). The only damaging earthquakes reported through 1989 in this huge tract of land are four MMI VI earthquakes in westernmost Florida (1780), southern Louisiana (1930), and eastern Texas (1891, 1932) (Stover and Coffman, 1993 #1986). This level of seismicity is even less than that of sparsely seismic North and South Dakota, which together cover approximately the same area as the belt of gulf-margin faults and which had seven earthquakes of MMI VI since 1909 (Stover and Coffman, 1993 #1986). Furthermore, some of the sparse seismicity in the normal-fault belt may be artificially induced. Earthquakes of mbLg 3.4 and 3.9 and M of 4.0 and 4.7 in southeastern Texas and M 4.9 in southwestern Alabama may have been induced by extraction of oil and gas or injection of fluids for secondary recovery (Pennington and others, 1986 #1876; Chang and others, 1998 #1806; Gomberg and others, 1998 #1828; Gomberg and Wolf, 1999 #3440). Therefore, the natural seismicity rate in the normal-fault belt might be even less than the recent historical record would indicate.

The post-rift sequence and its belt of gulf-margin normal faults may be mechanically decoupled from the underlying crust. The stress field is extensional throughout the post-rift sequence in both the Interior and Coastal zones of the normal-fault belt, as determined mostly from drill-hole data that demonstrate fault slips and well-bore breakouts (Zoback and Zoback, 1991 #2006). The orientations of S_{hmin} are radial to the Gulf of Mexico, in contrast to the east-northeast trends of S_{Hmax} that characterize most of North America east of the Rocky Mountains; the stress field in the crust beneath the thick post-rift sequence is unknown (Zoback and Zoback, 1991 #2006). Consistent with the stress field in the post-rift sequence, the normal-faulting focal mechanism of the 1997, M 4.9 earthquake in southwestern Alabama indicated south-southwest extension (Chang and others, 1998 #1806). The presence of the normal faults throughout the post-rift sequence from westernmost Florida to southern Texas (Ewing and Lopez, 1991 #2032) demonstrates that the sequence is sliding and extending seaward on detachments in weak salt and overpressured shales.

	In summary, the belt of gulf-margin normal faults in from Florida through Texas has strikingly low historical seismicity; the stress field and seismogenic potential of the underlying crust are unknown; and, therefore, the ability of the fault belt to generate significant seismic ruptures that could cause damaging ground motion is unclear. Accordingly, the fault belt is assigned to class B.
Length (km)	km.
Average strike	
Sense of movement	Normal <i>Comments:</i> In addition to the normal faults, a few strike-slip faults might form transtensional links between the normal faults.
Dip Direction	S; N <i>Comments:</i> Dips vary, but faults are generally steeper in their upper parts and they flatten downward. Dips are dominantly south in southern Louisiana, with southerly and northerly dips paired in grabens in northern Louisiana and southern Arkansas.
Paleoseismology studies	
Geomorphic expression	Scarps and drainage, topographic, and tonal lineaments (DuBar and others, 1991 #2010), particularly in southern Louisiana.
Age of faulted surficial deposits	Eocene to Holocene (Saucier and Snead, 1991 #2021; Haley and others, 1993 #1932).
Historic earthquake	
Most recent prehistoric deformation	undifferentiated Quaternary (<1.6 Ma) <i>Comments:</i> A belt of mostly seaward-facing normal faults borders the northern Gulf of Mexico (Ewing and Lopez, 1991 #2032). Ewing (1991 #1994) and Ewing and Lopez (1991 #2032) divided the faults into an Interior zone and a Coastal zone, which are separated by a boundary that begins in southeastern Louisiana and runs westward across Louisiana and Texas approximately 100 km inland from the coast. In the Interior zone, which includes central

and northern Louisiana and southernmost Arkansas, Quaternary slip is not reported (figure 3, DuBar and others, 1991 #2010). In contrast, the Coastal zone contains more abundant evidence of Quaternary slip (Hanor, 1982 #2200; Heinrich, 1988 #2201; McCulloh, 1991 #2210; McCulloh and Autin, 1991 #2253; McCulloh, 1996 #2211; Heinrich, 1997 #2202). Quaternary and historical faulting have been demonstrated in southern Louisiana, along the Tepehate and Baton Rouge fault systems and related faults (Durham and Peeples, 1956 #3829; Hanor, 1982 #2200; Heinrich, 1988 #2201; McCulloh, 1991 #2210; McCulloh and Autin, 1991 #2253; McCulloh, 1996 #2211; Heinrich, 1997 #2202). Together, these active faults cross the State from Beauregard and Calcasieu Parishes in the west to St. Tammany and St. Bernard Parishes in the east, between approximately latitudes 30° and 30°30'N. Geologic mapping and analyses of drill-hole logs, soil surveys, topographic maps, and aerial photographs documented Quaternary scarps on active and reactivated normal faults in the Coastal zone of Ewing (1991 #1994). However, as explained in "Geologic setting" above, it is unclear whether such slip was seismic or is likely to occur aseismically.

Recurrence interval

Comments: Estimates of recurrence interval are premature because it is not yet clear whether these faults can generate significant tectonic earthquakes.

Slip-rate category

Less than 0.2 mm/yr

Comments: The slip rate is unknown. However, a slip rate of 0.2 mm/yr would produce 320 m of slip during the 1,600,000 years of the Quaternary. It is unlikely that any single fault in the gulf-margin belt of normal faults has such a large Quaternary offset. Therefore, probably the long-term rate is less than 0.2 mm/yr.

Date and Compiler(s)

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