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INFORMATION CIRCULAR NO. 93

**EARTHQUAKES AND SEISMIC HISTORY
OF FLORIDA**

By
Ed Lane

Published for the
**BUREAU OF GEOLOGY
DIVISION OF RESOURCE MANAGEMENT
FLORIDA DEPARTMENT OF NATURAL RESOURCES**

**TALLAHASSEE
1983**

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BUREAU OF GEOLOGY
TALLAHASSEE
July 30, 1983

Governor Bob Graham, Chairman
Florida Department of Natural Resources
Tallahassee, Florida 32301

Dear Governor Graham:

The Bureau of Geology, Division of Resource Management, Department of Natural Resources, is publishing as Information Circular No. 93, "Earthquakes and Seismic History of Florida," prepared by Ed Lane, a staff geologist with the Bureau.

This report presents the history of earthquakes felt in Florida and discusses how they occur and how they are detected and measured. This aspect of Florida's natural history is of interest to the general public, government officials, and teachers. This information should help to allay the fears that arise whenever earthquakes or rumors of earthquakes occur.

Respectfully yours,

Charles W. Hendry, Jr., Chief
Bureau of Geology

Staff of Issuing Agency

October 1984

**Printed for the
Florida Department of Natural Resources
Division of Resource Management
Bureau of Geology**

**Tallahassee
1983**

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EARTHQUAKES

AND SEISMIC HISTORY OF FLORIDA

Earthquakes in Florida? Not likely—that's true—but their effects have been felt in the historical past. With respect to earthquakes, Florida is in a region that is classified as **stable**, that is, earthquakes are not probable. However, this is a restless earth and no area is truly stable, in the strictest sense of the word. While earthquakes can and do occur in stable areas, they are generally much milder than the catastrophic ones, such as the Alaskan Good Friday earthquake of 1964.

Scientists and news media report earthquakes with terminology that is useful for comparative purposes. The more common terms are given here in bold type, with their definitions. An **earthquake** is the oscillatory, and sometimes violent movement of the earth's surface that follows the release of energy somewhere within the earth's crust. This energy can be generated by a volcanic eruption, a sudden dislocation or movements of segments of the crust along faults, by manmade explosions, and even by the great weight of water impounded behind dams. Usually, though, most destructive earthquakes are caused by movements of the crust along a fault.

Faults are zones in the earth's crust where there has been movement, such as the famous San Andreas fault zone in California. A fault occurs when internal forces cause rocks in the earth's crust to rupture and move against one another. These sudden ruptures and grinding movements release the energy that causes the ground-shaking, which we call an earthquake. Geologists have found that earthquakes tend to concentrate and recur along faults, and the fact that a fault zone has recently experienced an earthquake offers no assurance that the internal crustal stresses have been relieved enough to prevent another earthquake. Faults in Florida have been found during the exploratory drilling for oil in the panhandle. These faults are associated with the deeper parts of the Apalachicola Embayment and with the Foshee Fault system which extends northward into the state of Alabama. Some other faults have been postulated along the eastern seaboard, based on tenuous evidence.

The location of an earthquake is described by the geographic position of its focal depth, as shown on Figure 1. The **focal depth** of an earthquake is the depth below the earth's surface to the region (**focus**) where the earthquake's energy originates. The **epicenter** of an earthquake is the point on the earth's surface directly above the focus.

The energy released by an earthquake at its focus travels as seismic waves through the earth and along the surface. The first indication of an earthquake will often be a sharply felt thud, which signals the arrival of the seismic waves that travel through the earth. This will be followed by the ground roll or shaking caused by the seismic waves that travel along

the earth's surface. Waves, similar to ocean waves, have been observed to travel across the ground in response to the surface seismic waves, literally flipping people and animals off their feet.

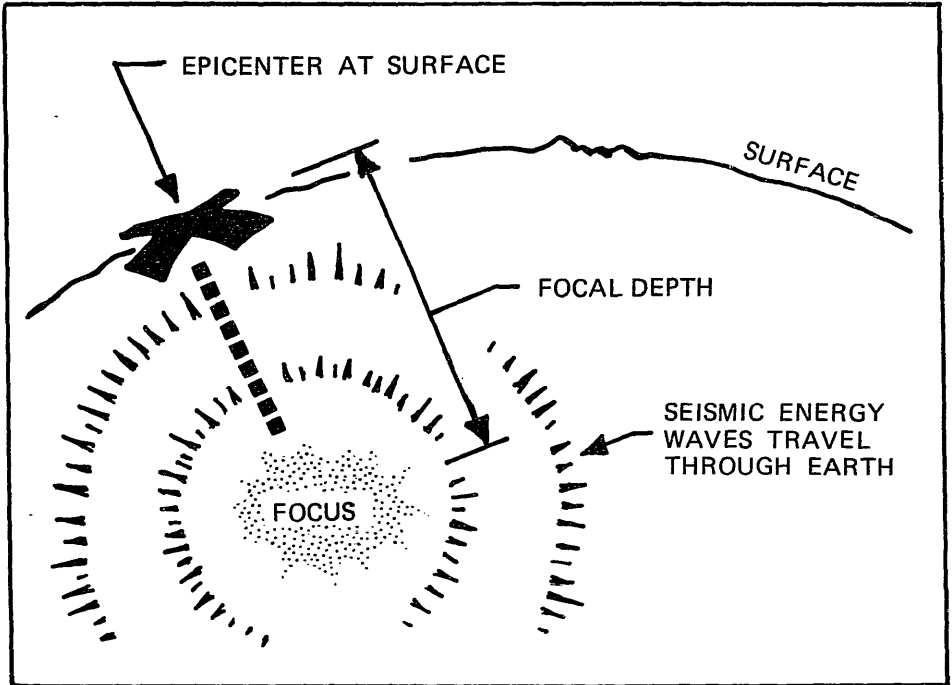


Figure 1. Cross section of earth showing how the release of energy at an earthquake's focus generates seismic waves, which propagate through the earth. The point on the earth's surface directly over the focus is called the epicenter.

Vibrations caused by earthquakes are detected, recorded, and measured by instruments called **seismographs**. Seismographs have their frames securely anchored into bedrock and are very sensitive to earth movements. The zigzag line recorded by a seismograph, called a **seismogram**, reflects the variations in movement of the rock beneath the instrument. From data compiled from seismograms recorded at several different locations, the time of occurrence, the epicenter, the focal depth, and estimates of the amount of energy released can be determined for each earthquake.

A water level recorder installed in a water well can act as a seismograph, because the seismic energy waves cause the water level to fluctuate in the well's casing. As the water level is recorded, a record is preserved of the earthquake, as on a seismogram. The Florida Bureau of Geology has such a sensitive and instrumented well; it has recorded many of the world's major earthquakes. Figures 2 and 3 show the fluctuations of the water level in the Bureau's well for two large earthquakes. Figure 4 shows the effect the great Alaskan earthquake had on another

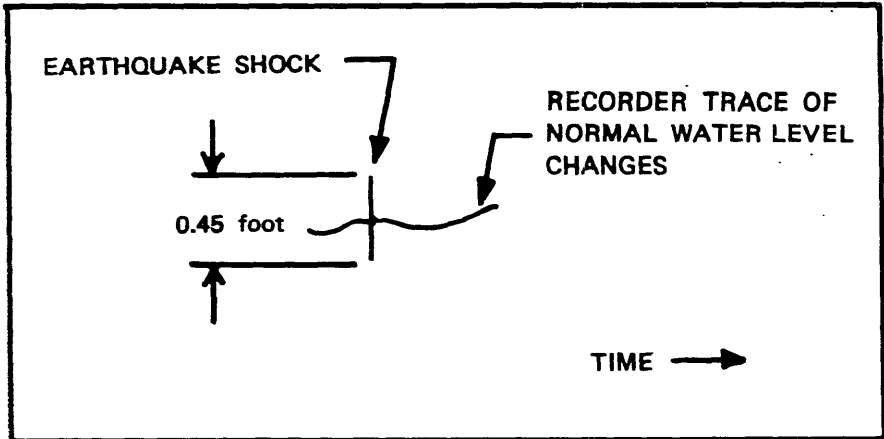


Figure 2. Largest earthquake in the world during 1978, Richter magnitude 7.8, struck November 29 about 300 miles southeast of Mexico City, causing at least 8 deaths. This earthquake caused the water level to fluctuate 0.45 foot in the Bureau of Geology's well.

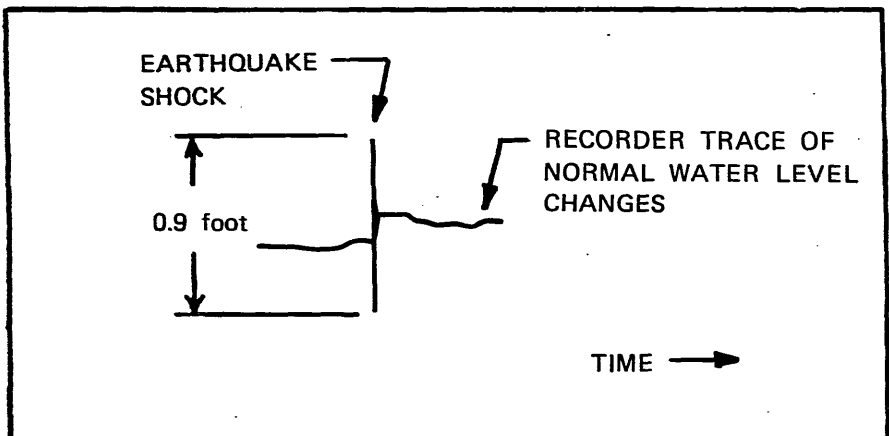


Figure 3. The Colombian earthquake of December 12, 1979, Richter magnitude 7.9 killed at least 600 people. It caused the water level to fluctuate 0.9 foot in the Bureau of Geology's well.

well located north of Lake Butler, Union County, Florida.

The severity of an earthquake can be expressed in several ways. The **magnitude** of an earthquake, as expressed on the **Richter Scale**, is a measure of the amplitude of the seismic waves and is related to the amount of energy released, an amount that can be estimated from seismograms. Magnitudes on the Richter Scale are expressed as whole numbers and decimals; for example, the Alaskan earthquake of March 27, 1964, was Richter magnitude 8.5. However, this scale is logarithmic, so that each increase in whole number represents a force 10 times larger than measured by the previous whole number. For example, a

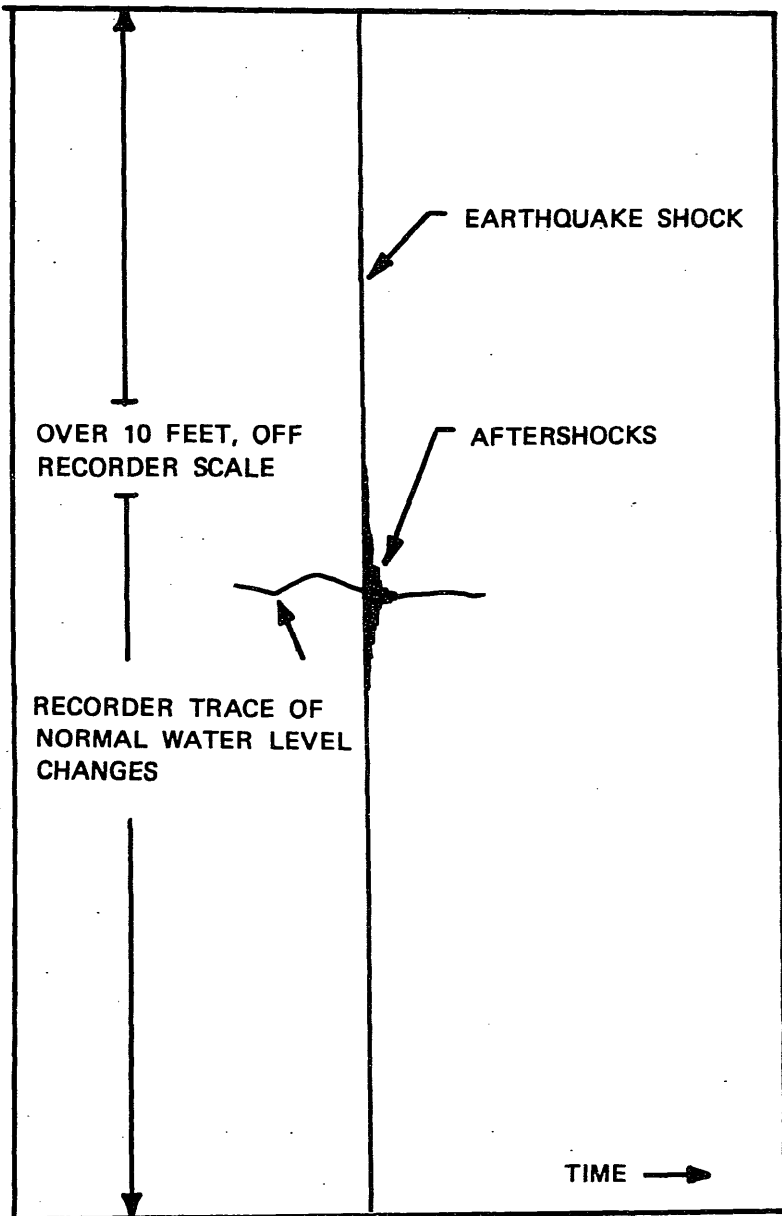


Figure 4. The Good Friday earthquake that struck Alaska on March 27, 1964, registered 8.5 on the Richter scale, and was the largest instrumentally recorded earthquake ever to strike the North American continent. It caused this water level recorder to go *off scale* in both directions—a *water level fluctuation of over 10 feet*. The major shock and the aftershocks caused the water level to fluctuate for more than two hours. Water well located north of Lake Butler, Union County, Florida.

recording of 3.0 is 10 times as large as 2.0 and 4.0 is 100 times as large as 2.0, and so on. An earthquake of magnitude 2.0 is the smallest normally felt by humans, while earthquakes with magnitudes of 6.0 or larger are considered to be major earthquakes.

The **intensity** of an earthquake, as expressed by the **Modified Mercalli Scale**, written as MM, is much more meaningful to laymen than the Richter Scale since it is based on actual human observations of earthquake effects at specific locations. Modified Mercalli Scale values of shock intensities are given as Roman numerals and range from MM I to MM XII; "*MM I—not felt except by very few people favorably situated,*" to "*MM XII—damage total, lines of sight disturbed, objects are thrown in the air.*" The maximum intensity experienced in the Alaskan earthquake of 1964 was MM X; in the San Francisco earthquake of 1906 it was estimated at MM XI.

Official records and newspaper accounts document the occurrences of many earthquakes since 1727 whose epicenters were in or near Florida. These earthquakes are listed in Table 1 with estimates of their epicentral locations and intensities. Several are grouped together, since they are aftershocks which commonly occur hours, days, or even weeks after major shocks. Of the earthquakes felt in Florida, only six are considered to have had epicenters in Florida, and even some of these possibly were tremors from earthquakes outside Florida. Most of the earthquakes felt in Florida had estimated local intensities of MM IV to MM VI. Generally, a tremor of intensity MM IV is: *felt indoors by many, outdoors by few. May awaken light sleepers. Vibrations similar to the passing of heavy trucks. Dishes, windows rattle; glassware clinks; houses may creak.* Intensity MM VI is: *felt by everyone, indoors and outdoors. Awakens all sleepers. Frightens many people; creates general excitement. Persons move unsteadily. Trees shake slightly. Liquids move strongly. Damage to some buildings. Church bells ring. Windows break; pictures and books fall; furniture overturns.*

Other natural or man-made phenomena causes rumblings or shaking of the ground which are sometimes mistaken for earthquakes. Such things as the sudden collapse of a sinkhole or the energy waves from an explosion have been mistaken by local residents as earthquakes.

Figure 5 shows zones of estimated risk of damage in Florida. It should be pointed out that, if it had not been for the effects of the great 1886 earthquake at Charleston, South Carolina, all of Florida probably would be in Zone 0.

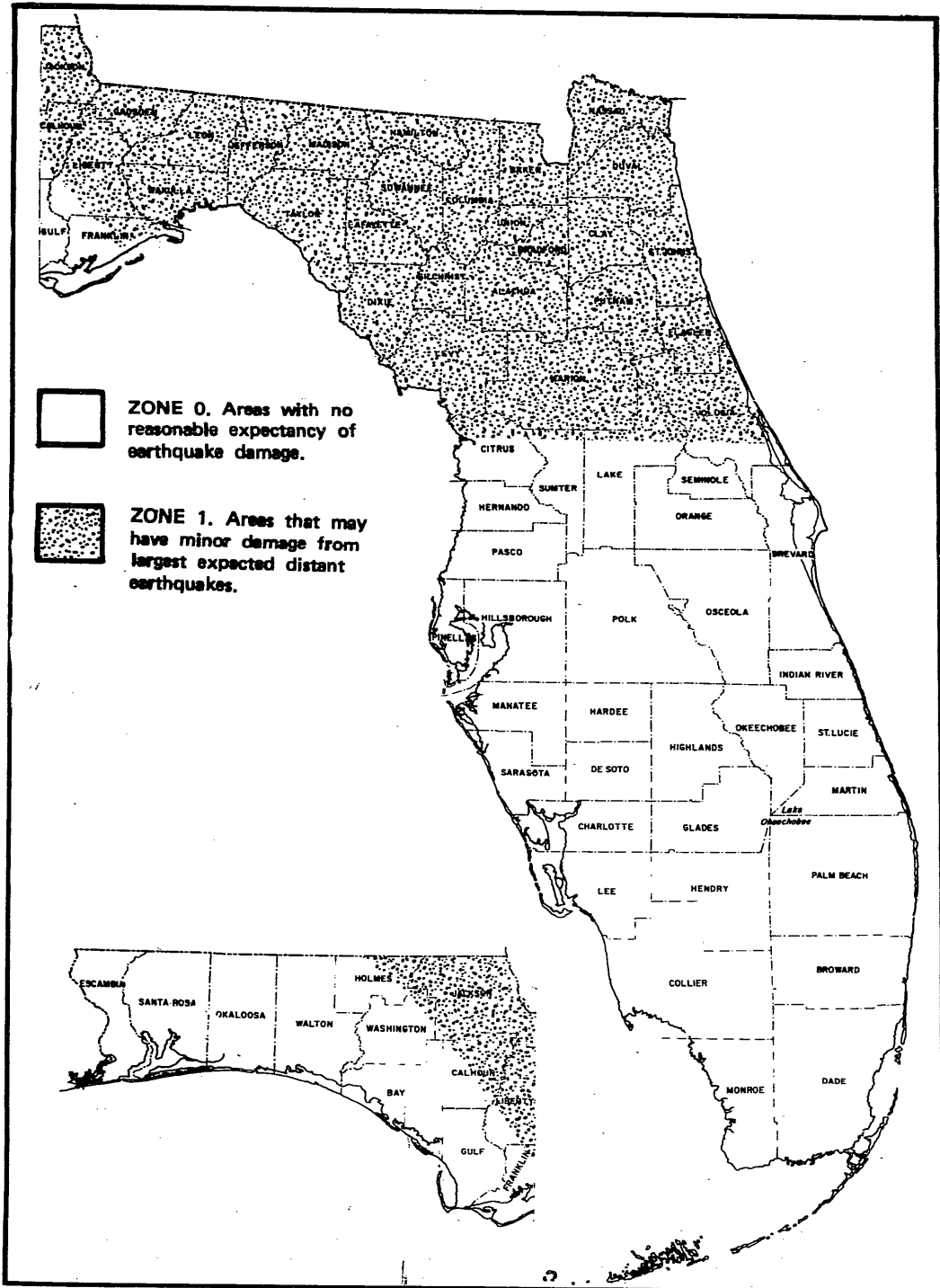


Figure 5. Seismic risk map of Florida. (Modified from *Seismic Risk Map of U. S.*, in *Earthquake Information Bulletin*, Nov.-Dec. 1974, U. S. Geological Survey).

Table 1. List of known earthquakes felt in Florida, from 1727 through 1982, with estimated epicenters and intensities. Compiled from Campbell (1943) and accounts from local newspapers.

October 29, 1727: Unofficial sources reported a severe quake, MM VI, in St. Augustine, but the original record has not been located. New England had a severe shock about 10:40 a.m. on this date, and a quake was reported on the island of Martinique on the same day.

February 6, 1780: Pensacola felt a tremor described as "mild."

May 8, 1781: Pensacola suffered a "severe" tremor that shook ammunition racks from barrack walls, levelled houses, but no fatalities.

February 8, 1843: Earthquake in West Indies, felt in United States, intensity unknown.

January 12, 1879: Earthquake felt through north and central Florida bounded by a line drawn from Fort Myers to Daytona on the south, to a line drawn from Tallahassee to Savannah on the north, an area of about 25,000 square miles. Intensity MM VI near Gainesville.

January 22 and 23, 1880: Earthquake in Cuba of intensity MM VII, about 120 miles east of Havana. Felt in Florida.

January 27, 1880: Several shocks of intensity MM VII to MM VIII were felt in Key West resulting from a disastrous earthquake at Vuelta Abajo, about 80 miles west of Havana, Cuba.

August 31, 1886: The great earthquake in Charleston, South Carolina, MM X. Felt all over north Florida, with an estimated intensity of MM V-MM VI. Bells rang in St. Augustine, and severe shocks were felt along the east coast. Quake effects felt in Tampa.

September 1, 3, 5, 8, 9, 1886: Jacksonville felt more aftershocks of intensity about MM IV from the Charleston quake.

November 5, 1886: Jacksonville felt another aftershock from the Charleston quake.

June 20, 1893: Jacksonville felt a tremor at 10:07 p.m. Estimated MM IV.

October 31, 1900: U. S. Coast & Geodetic Survey recorded a local shock of MM V at Jacksonville.

January 23, 1903: Shock of intensity MM VI was felt at Savannah. Effects felt in north Florida.

June 12, 1912: Strong shock felt at Savannah. Intensity unknown. Felt in Florida.

June 20, 1912: Shock of MM V felt at Savannah; probably associated with the above quake of June 12. Felt in north Florida.

1930 (exact date not known): An earth tremor was felt over a wide area in central Florida near LaBelle, Fort Myers and Marco Island. Thought to be from an earthquake, but some persons believed it was tremendous explosions, though no explosions were known to have been detonated. Estimated intensity at Marco Island was MM V.

November 13, 1935: Two short tremors were felt at Palatka in the early morning. The second shock was felt at St. Augustine and on nearby Anastasia Island. Estimated intensity at Palatka was MM IV or MM V.

January 19, 1942: Several shocks felt on south coast of Florida, with some shocks felt near Lake Okeechobee and in the Fort Myers area. Estimated intensity was about MM IV.

January 5, 1945: About 10:00 a.m. windows shook violently in the De Land Courthouse, Volusia County.

December 22, 1945: Shock felt in the Miami Beach-Hollywood area at 11:25 a.m. Intensity MM I to MM III.

November 8, 1948: A sudden jar, accompanied by sounds like distant explosions, rattled doors and windows on Captiva Island, west of Fort Myers.

November 18, 1952: Windows and doors were rattled by a slight tremor at Quincy, about 20 miles northwest of Tallahassee.

March 26, 1953: Two shocks estimated as MM IV were felt in the Orlando vicinity.

October 27, 1973: Shock felt in central east coastal area of Seminole, Volusia, Orange, and Brevard counties, at 1:21 a.m., maximum intensity MM V.

December 4, 1975: Shock felt in Daytona and Orlando areas, 6:57 a.m., maximum intensity MM IV.

January 13, 1978: Two shocks reported by residents in eastern part of Polk County south of Haines City. Tremors were about one minute apart and each lasted about 15 seconds, shaking doors and rattling windows. The tremors occurred between 4:10 and 4:20 p.m. No injuries or damages.

November 13, 1978: Tremor felt in parts of northwest Florida near Lake City. Seismic station at Americus, Georgia, estimated it originated in the Atlantic Ocean.

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