

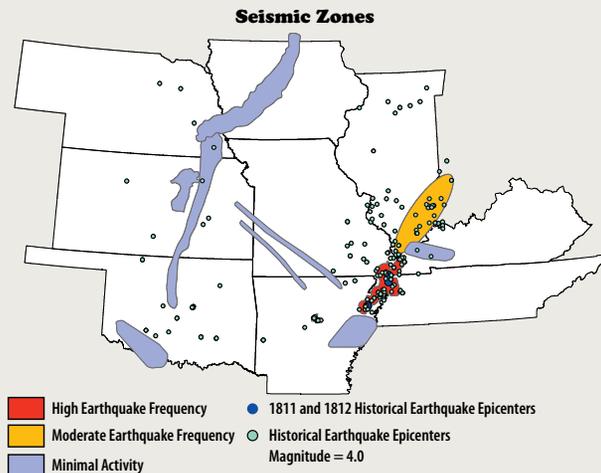
## Earthquakes

Most Missourians are familiar with the large 1811-1812 earthquakes that occurred in the New Madrid Seismic Zone (NMSZ) in southeast Missouri. However, Missouri experiences small earthquakes nearly every day. These earthquakes typically are too small to be felt but are recorded on seismographs, devices that measure the earth's movement. While these earthquakes are more frequent in the NMSZ in southeast Missouri, they also occur on other faults located in Missouri and surrounding states.

Earthquakes occur when pressure builds up on two sides of a fault. The fault sides slip against one another, shifting the rock and sending waves of motion through the earth. Movement along a fault can occur thousands of feet below ground surface, often with no visible signs of the fault at the surface.

It is impossible to predict when or where an earthquake might occur in Missouri or elsewhere. Based on the history of past earthquakes, U.S. Geological Survey seismologists (earthquake researchers) suggested in 2009 the chance of having a magnitude 7.0 - 8.0 earthquake in the NMSZ in the next 50 years is about 7 to 10 percent. Smaller earthquakes have a greater chance of occurring.

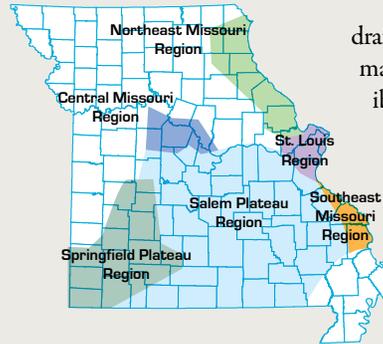
Knowledge and preparation are crucial to earthquake preparedness. Information related to earthquakes and disaster preparedness is available at [dnr.mo.gov/geology/geosrv/earthquakes.htm](http://dnr.mo.gov/geology/geosrv/earthquakes.htm).



## Sinkholes

Sinkholes are collapsed areas formed by the dissolution of carbonate bedrock or collapse of underlying caves. They range in size from several square yards to hundreds of acres and may be very shallow or hundreds of feet deep. Often, sinkholes are visible from the ground surface as circular

### Primary Sinkhole Regions of Missouri



depressions or areas of internal drainage. Other sinkholes may not be readily visible from the ground surface because they are plugged or capped with soil or thin layers of rock.

Development in areas prone to sinkhole formation can be very dangerous. Collapse of the plug or cap can open the underground void to the surface. Sinkholes may start as a small hole in the ground that slowly grows to full size or may form in a sudden catastrophic collapse that occurs with no warning. Collapsed sinkholes generally are steep-sided and very unstable. They often experience continued slumping and collapse along their edges; therefore, activities near sinkholes should be undertaken with great caution.

When sinkholes form, they can act as conduits for rapid surface water infiltration, often resulting in groundwater contamination. Managing storm water runoff and waste disposal in sinkhole-prone areas is important to maintaining good groundwater quality.

Anyone living in a sinkhole-prone area of the state who notices a collapse or hole opening should first block off all access to the area, decide if there is an immediate safety threat and, if so, contact their local emergency management personnel. For more information about sinkhole collapse and remediation, contact the Missouri Geological Survey's Geologic Investigations Unit by calling 573-368-2100 or visit the division's website at

[dnr.mo.gov/geology/geosrv/geoes/geohazhp.htm](http://dnr.mo.gov/geology/geosrv/geoes/geohazhp.htm).

## Landslides

Landslides, slumps and rockfalls are potential geologic hazards throughout Missouri and can occur where there are bluffs or steep slopes. They often can be triggered when surficial materials are moved or modified by man. In general, the higher and steeper the slope, the farther and faster the slide will travel.

Landslides and slumps generally occur where there are steep slopes of unconsolidated material or thick soils. Slopes with shale are also susceptible to landslides. Slumps appear as curved scars along the slope and an uneven or unusually flat surface at the base of slopes. Slope stability often is reduced by change in water tables or when heavy rains oversaturate soils, by the removal of vegetation or by increased human activity. Modification of a slope, such as cutting a road in a hillside, can cause problems, even on slopes that appear stable. Care should be taken when modifying slopes or changing water's natural drainage course.

Rockfalls are common hazards in areas that have bluffs or extremely steep hillsides. The most hazardous are bluffs that contain thick beds of sandstone or carbonate rock underlain by shale. The shale will often become soft and weather out, leaving large pieces of balanced rock. Bluffs of highly fractured rock are also at great risk for rockfalls. As with landslides and slumps, rockfalls are also more likely to occur during times of heavy rains.



Landslide along a Missouri roadway.

## Abandoned Mines

Abandoned mines are found throughout Missouri. They include both surface pits and underground mines. These mines produced a variety of economic, industrial and energy minerals and provided raw materials that helped build Missouri and the nation. Some abandoned mines date back to the original French settlers in the 1700s and are a major part of Missouri's history.

Older mines typically were abandoned and seldom reclaimed or closed. These mines operated long before permitting laws established requirements for reclamation and closure. Today, these pits, voids, open adits and shafts can pose a public safety hazard.

Abandoned mine sites appear attractive to explore, but are unsafe to walk, climb or ride in. What appears to be solid ground may only have a thin veneer of cover hiding an abandoned shaft, which could collapse under the weight of a person walking. Embankments or high walls may be unstable or not visible behind piled material. High walls that appear to be stable can collapse. Piles of waste material called "tailings" or "slime" may be unstable and can slide and bury someone climbing on them. Abandoned quarries or other surface mines often are appealing swimming holes. However, from the surface it is impossible to tell how deep the mine is or if shallow ledges left from mining remain but cannot be seen.

Abandoned underground mines can have poor air quality. Active underground mines are ventilated to bring fresh air to miners. Abandoned mines, however, may have dangerous levels of carbon monoxide or methane.

The Missouri Geological Survey maintains the official Missouri Mine Map Repository and the Inventory of Mines, Occurrences and Prospects (IMOP). The Repository houses more than 2,000 maps of underground mines while the IMOP database contains locations of more than 27,000 surface and underground mines. Learn more at [dnr.mo.gov/geology/geosrv/geores/minemaps.htm](http://dnr.mo.gov/geology/geosrv/geores/minemaps.htm).

## Publications

Geologic maps and other geologic and hydrologic publications are available from the Missouri Geology Store by visiting this website [missourigeologystore.com](http://missourigeologystore.com).



Abandoned mine shaft in southwest Missouri.

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# GEOLOGIC HAZARDS

in Missouri



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Sinkholes  
Landslides  
Abandoned Mines