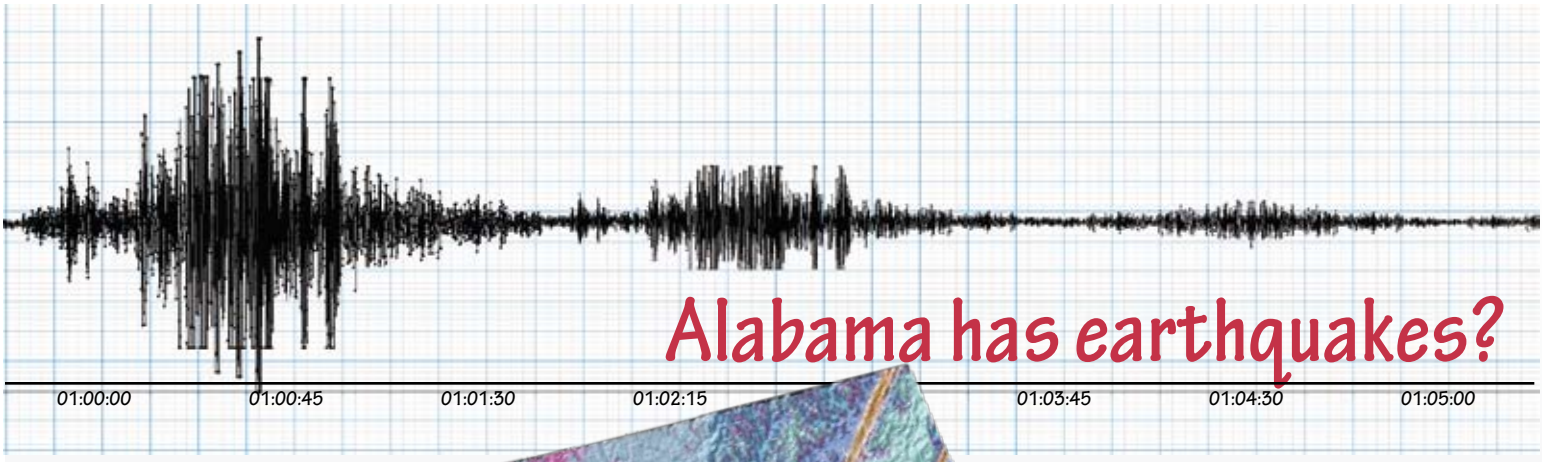
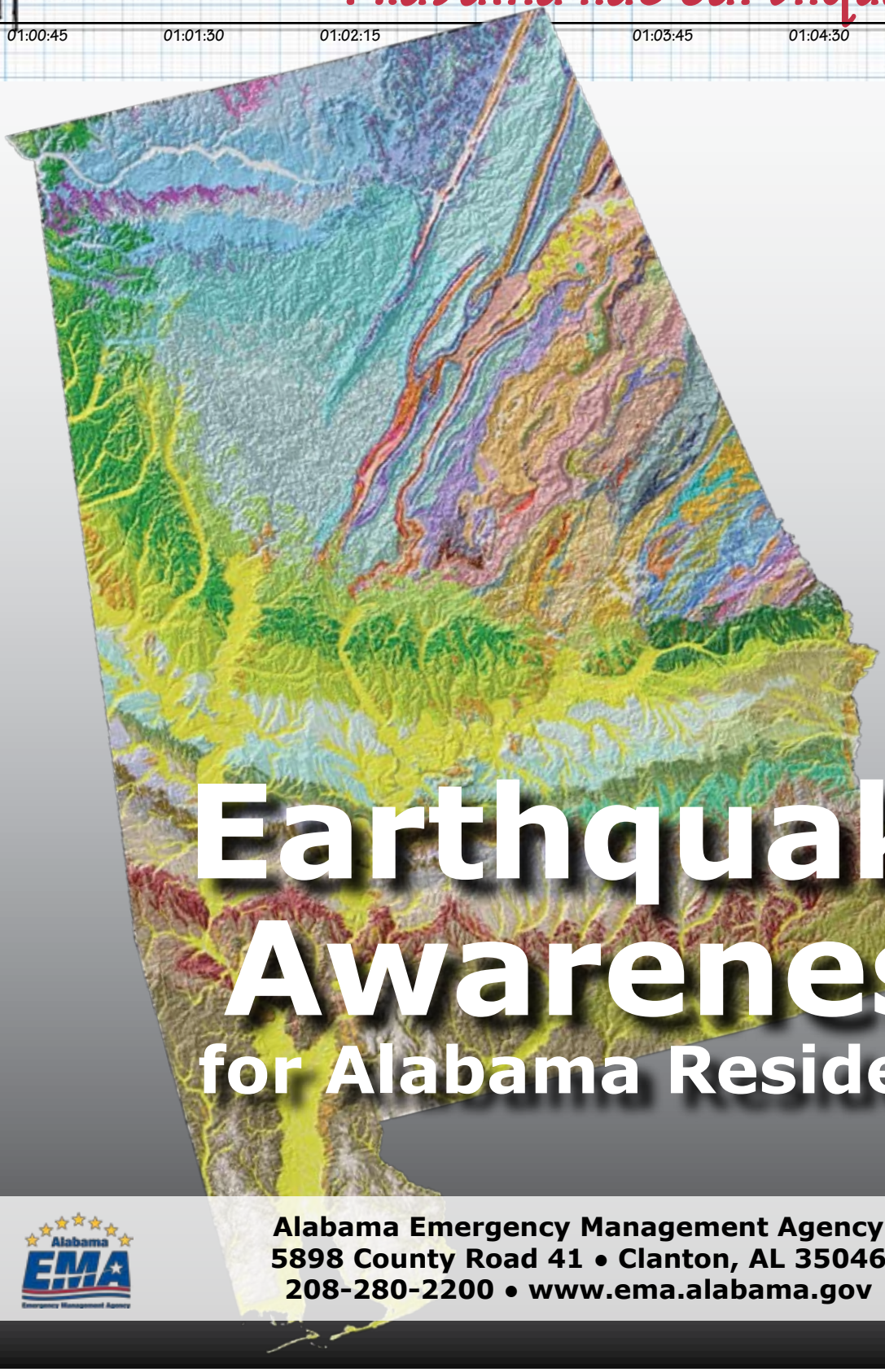


Alabama has earthquakes?



Earthquake Awareness

for Alabama Residents

Alabama Emergency Management Agency
5898 County Road 41 • Clanton, AL 35046
208-280-2200 • www.ema.alabama.gov

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Purpose of this publication

We know disasters occur in Alabama. We also know that:

- few households have disaster plans
- few households have disaster supply kits
- few households have disaster resistant housing
- few households are adequately insured

A household that is prepared for one type of disaster will be better able to cope with any type of disaster.

We want <u>you and your family</u> to be prepared.

As information

Thanks for inspiration and contents from the Geological Survey of Alabama (GSA), South Carolina Emergency Management Department, Central United States Earthquake Consortium and the United States Geological Survey.

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Disclaimer: The suggestions and illustrations included in this document are intended to improve earthquake awarenss and preparedness. However, they do not guarantee the safety of an individual or a structure. The writers, contributors, and sponsors of this handbook do not assume liability for any injury, death, property damage or other effect of an earthquake.

What is an earthquake?

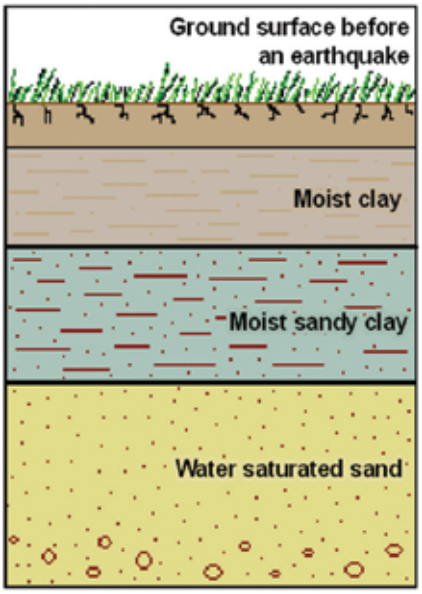
An earthquake is the sudden, sometimes violent, ground shaking from the release of energy in the earth's crust. Earthquakes typically occur with little or no warning.

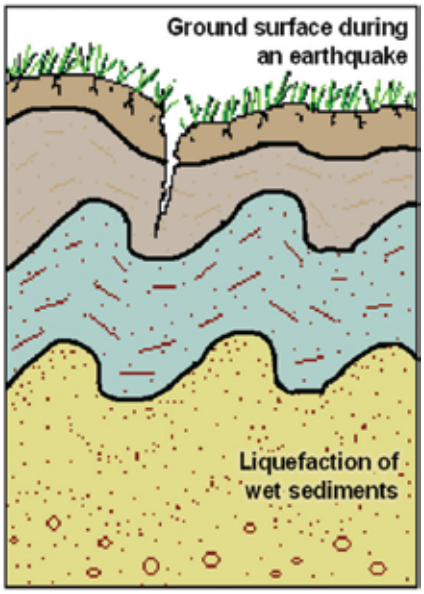
The risks that earthquakes pose to society, including death, injury, and economic loss, can be greatly reduced by better planning, construction, and mitigation practices before earthquakes happen, and providing critical and timely information to improve response after they occur.

Although earthquakes can occur anywhere on earth, the majority of earthquakes worldwide occur at plate boundaries. These earthquakes are known as **interplate earthquakes**.

Alabama is located within the interior of the North American plate, far from any plate boundary. Earthquakes occuring within a plate are **intraplate earthquakes**. Little is known as to why intraplate earthquakes occur. The most widely accepted model is that several geologically old fault systems of varying orientation within the subsurface are being reactivated while being subjected to stress, possibly due to the plate tectonics. For hundreds of millions of years, the forces of continental drift have reshaped the earth. Continental drift is based on the concept that the continents bumped into, and slid over and under each other and at some later time broke apart.

Different geologic materials (soils, sediments, and rocks) react differently to seismic waves generated by earthquakes. When shaking intensities are very strong, soft sediments can actually undergo liquefaction, a phenomenon that occurs when wet sediments amplify seismic waves, causing the sediment to shake intensely. Liquefaction can occur in areas underlain by unconsolidated material or in water-saturated soils such as those that are found on river floodplains where recent (Quaternary) soft sediments are saturated by the high water table. The geologic figure (right) shows some of these areas in yellow.





Earthquake Terminology

Crust–Earth's outermost layer consisting of rigid oceanic and continental tectonic plates.

Epicenter–The point on the Earth's surface above the point at depth in the Earth's crust where an earthquake begins.

Focus–The point at which the earthquake rupture begins, usually deep within the earth on a fault.

Fault–A fracture or crack along which two blocks of rock slide past one another. This movement may occur rapidly, in the form of an earthquake, or slowly, in the form of creep.

Foreshock–An earthquake that precedes the largest quake ("mainshock") of an earthquake sequence. Foreshocks may occur seconds to weeks before the mainshock. Not all mainshocks are preceded by foreshocks.

Intensity–A measure of the strength of ground shaking at a particular place, and varies by location, proximity to the source of the earthquake, and type of material underlying the site. The intensity scale ranges from low (I) to high (XII).

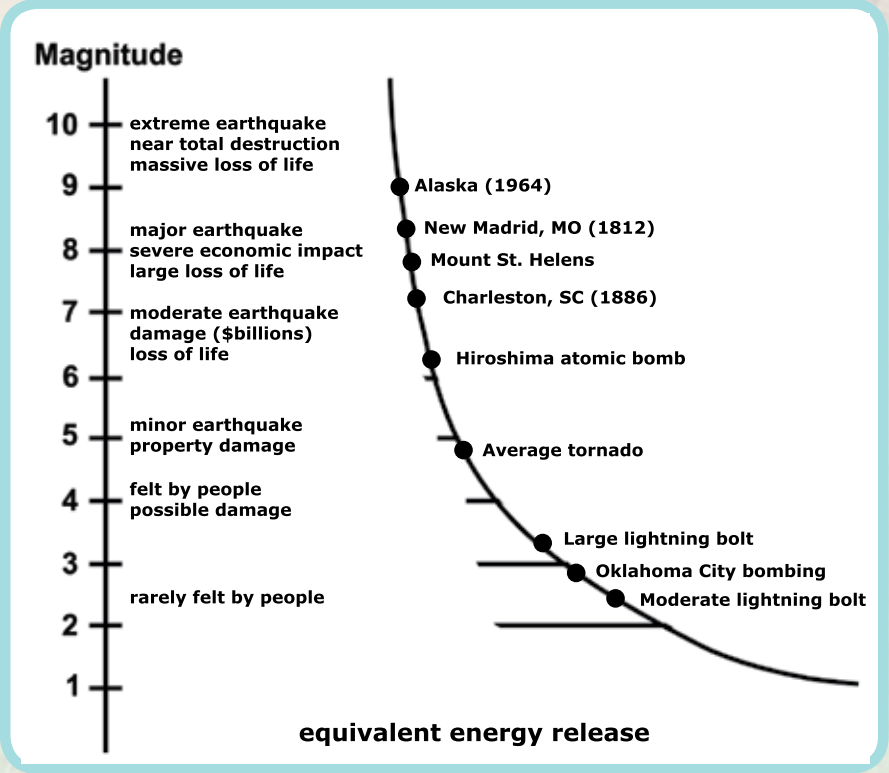
Landslide–A mass movement of soil, mud, and (or) rock down a slope.

Liquefaction–The process that occurs when an earthquake shakes wet sandy soil until it behaves like a liquid, allowing sand to "boil up" to the surface, buildings to sink, or sloping ground to move.

Magnitude–A measure of the energy released in an earthquake—a single value that depends on the area of fault rupture and amount of slip. The figure to the right illustrates how different magnitudes might be perceived.

Mainshock–The largest quake of an earthquake sequence, possibly preceded by smaller foreshocks and commonly followed by aftershocks.

Mantle–The layer of heated viscous rock between Earth's crust and core.



Earthquake Terminology

Modified Mercalli Scale

I.	Not felt.
II.	Felt by persons at rest, on upper floors, or favorably placed.
III.	Felt indoors. Vibration like passing of light trucks.
IV.	Vibration like passing of heavy trucks.
V.	Felt outdoors. Small unstable objects displaced or upset.
VI.	Felt by all. Furniture moved. Weak plaster/masonry cracks.
VII.	Difficult to stand. Damage to masonry and chimneys.
VIII.	Partial collapse of masonry. Frame houses moved.
IX.	Masonry seriously damaged or destroyed.
X.	Many buildings and bridges destroyed.
XI.	Rails bent greatly. Pipelines severely damaged.
XII.	Damage nearly total.

Modified Mercalli Intensity (MMI) Scale–The Modified Mercalli Intensity Scale is commonly used in the United States by seismologists seeking information on the severity of earthquake effects.

Seiches–These are waves "sloshing" in a lake as a result of earthquake ground shaking. Seiches and seiche-related phenomena have been observed on lakes, reservoirs, swimming pools, bays, and seas. Waves caused by landsliding into a reservoir or displacement of the lake bed are termed a **surge**.

Seismic hazard–The potential for damaging effects caused by earthquakes. The level of hazard depends on the magnitude and frequency of likely quakes, the distance from the fault that could cause quakes, and geologic conditions at a site.

Seismic risk–The chance of injury, damage, or loss resulting from seismic hazards. There is no risk, even in a region of high seismic hazard, if there are no people or property that could be injured or damaged by a quake.

Seismologists–Scientists who study earthquakes and their causes and results.

Seismogram–The record made by a seismograph.

Seismographs–Instruments that make an automatic record of the time, duration, direction, and intensity of earthquakes.

Surface faulting (surface fault rupture)–Propagation of an earthquake-generating fault rupture to the surface, displacing the surface and forming a fault scarp.

Tectonic plate–Earth's outer shell is composed of large, relatively strong "plates" that move relative to one another. Movements on the faults that define plate boundaries produce most earthquakes.

Tectonic subsidence–Downdropping and tilting of a basin floor on the downdropped side.

Theory of Plate Tectonics–States that the earth's crust is divided into a number of relatively rigid plates that collide with, separate from, and translate past one another at their boundaries, this disruption commonly results in earthquakes.

Tsunami–This is a series of water waves caused by the displacement of a large volume of a body of water, such as an ocean. Due to the immense volumes of water and energy involved, tsunamis can cause extreme damage when it strikes land.

What kind of damage can occur?

Most Earthquake Damage is Caused by Shaking

The intensity of shaking that a building or structure will experience during an earthquake is highly variable, but generally depends on three main factors:

The magnitude of the earthquake—in general, the larger the quake, the stronger the shaking and the larger the area affected.

The distance from the earthquake—the closer to the source of the earthquake, the greater the shaking.

The type of ground material beneath the structure—soils may amplify or deamplify the shaking relative to hard bedrock.

The variables above will also affect the kind of damage done. Below is a list of various kinds of damage that may occur.

Chimney and foundation damage from Ft. Payne, Alabama, 4.9 earthquake which occurred on April 29, 2003.

Roads buckle

Building damage

Damage amount is affected by local building/construction codes and is particularly dangerous in unreinforced masonry buildings.

Electric lines and gas mains can snap

Large areas of ground can shift position

Movement in large bodies of water

Dam failures

Surface fault ruptures

Landslides/Rock falls

These occur in hilly/mountainous regions. The damage caused can range from blocked roads to possibly huge property damage and many deaths.

Soil Liquefaction

This occurs when shaking during an earthquake causes saturated granular material to lose its strength and act like a liquid. This allows heavy structures to become very unstable and sink into the ground. Areas susceptible to liquefaction include low lying areas in water-saturated, loose, sandy soils and poorly compacted artificial fill.

Fires

Earthquakes can easily cause fires. Ground movements can lead to gas and fuel leaks in pipes, cutting of electrical cables, etc. The destruction of water pipes makes it harder to fight such fires should they occur.

Release of hazardous materials

If tanks or other structures containing these materials are damaged the chances of a release are increased.

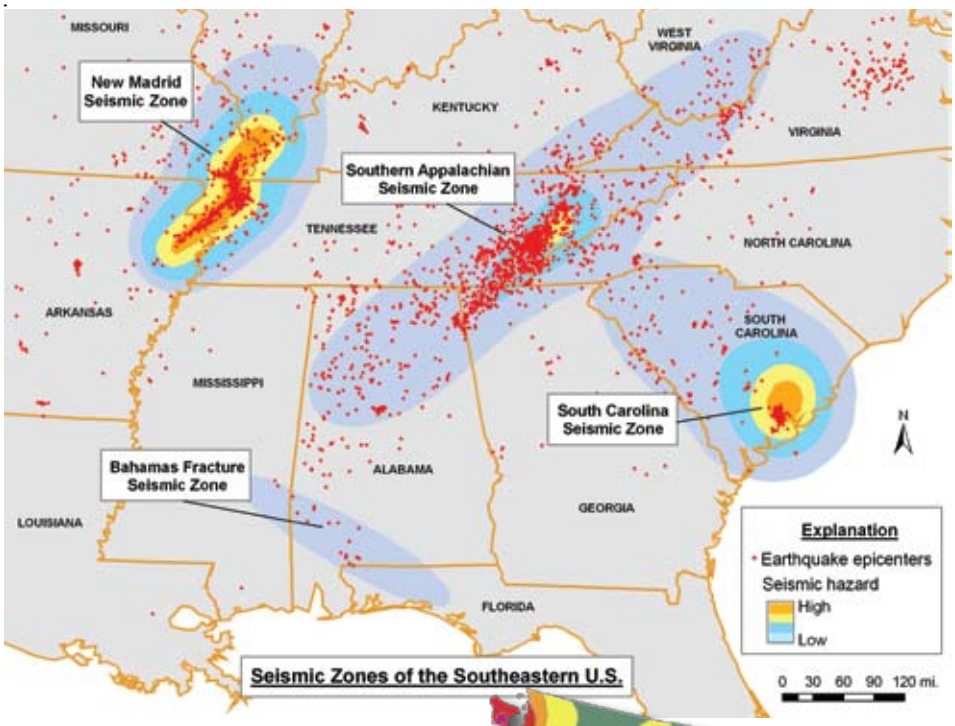
How likely is an earthquake?

The probability of a large earthquake occurring in any specific area within a given time frame is based on several variables including recorded historical seismic activity and geologic setting. Given the geologic settings in Alabama and the Southeast, strong magnitude earthquakes are a possibility. Scientists researching the seismic setting in the Southern Appalachians have estimated probabilities of a large magnitude quake occurring with variations in their estimates. According to previous research:

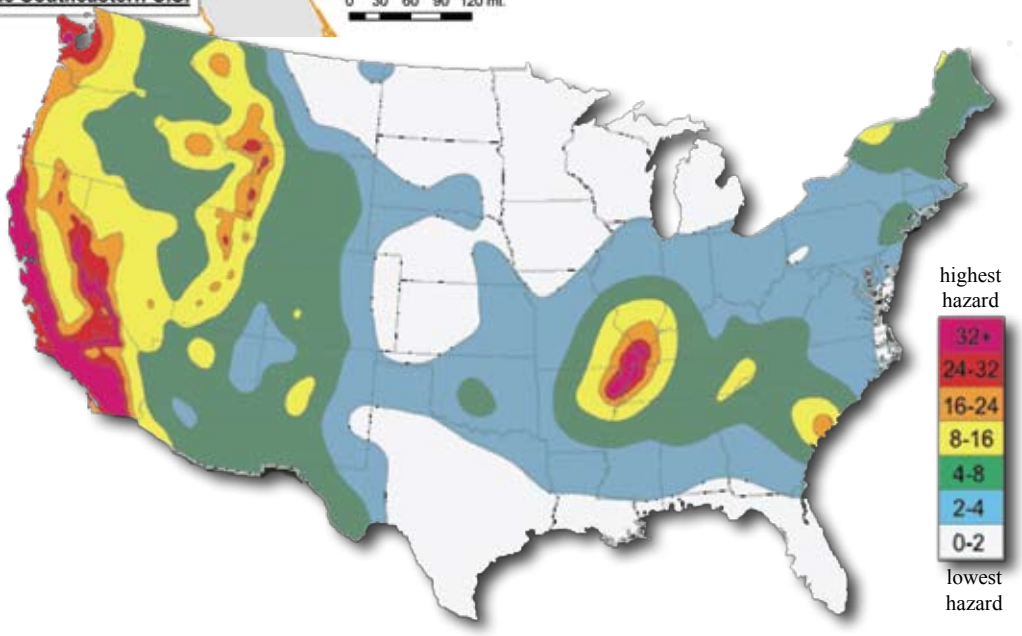
USGS states the **East Tennessee Seismic Zone (southern Appalachians)** is capable of a 7.5 magnitude event (Wheeler and Frankel, 2000). Recurrence of a 5 – 6 magnitude event has been estimated at once every 200-300 yrs (Bollinger et al., 1989; Chapman, 2000)

For the **New Madrid Seismic Zone, according to USGS Fact Sheet 131-02:**
It is generally accepted that earthquakes can be expected in the future as frequently as in the recent past. Given this assumption, and interpretations of research collected over the past 15 years, USGS* estimates that for the next 50 year period:

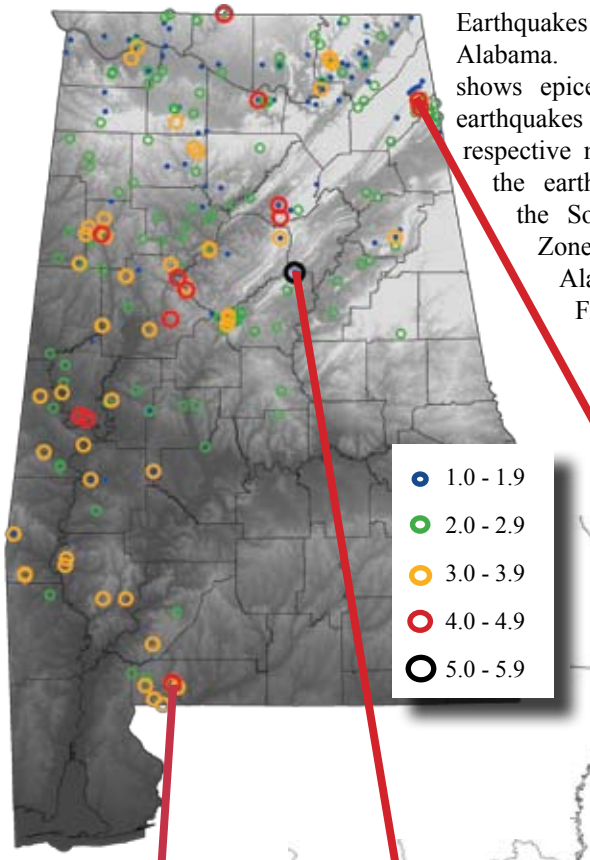
- The probability of a repeat of the 1811-1812 earthquakes is 7-10%
- The probability of a magnitude 6.0 or greater is 25-40%



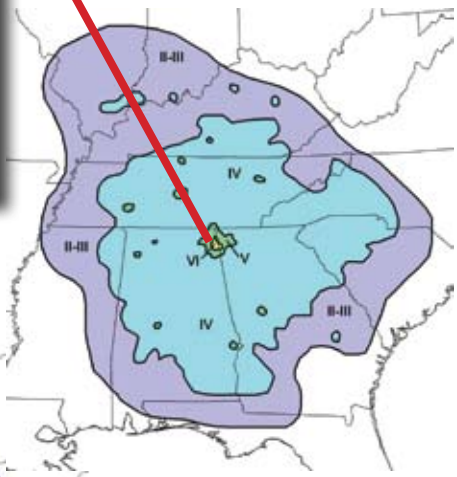
The **National Hazards Map** (right from 2002) is based on earthquake occurrences in areas and on shaking extent relative to the epicenter. Colors show levels of horizontal shaking that have a 1-in-10 chance of being exceeded in a 50-year period. Four zones of frequent earthquake activity affect Alabama (above). They are the **New Madrid Seismic Zone, the Southern Appalachian Seismic Zone, the South Carolina Seismic Zone and the Bahamas Fracture Seismic Zone.**



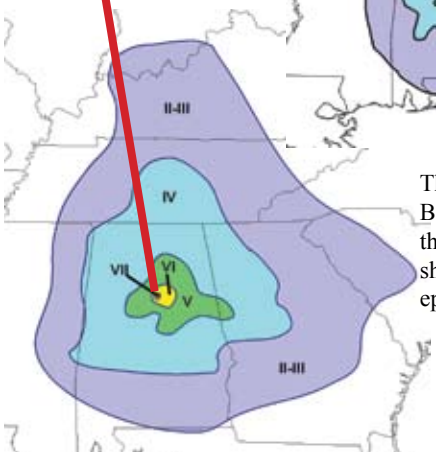
Historical Alabama Earthquakes



Earthquakes are not uncommon in Alabama. The illustration to the left shows epicenters of historical Alabama earthquakes from 1886 to 2007 and their respective magnitudes. The majority of the earthquakes are associated with the Southern Appalachian Seismic Zone (SASZ in northern and central Alabama) and the Bahamas Fracture Seismic Zone (BFSZ in southern Alabama). The largest earthquake on record (black circle) occurred in 1916 near Birmingham.



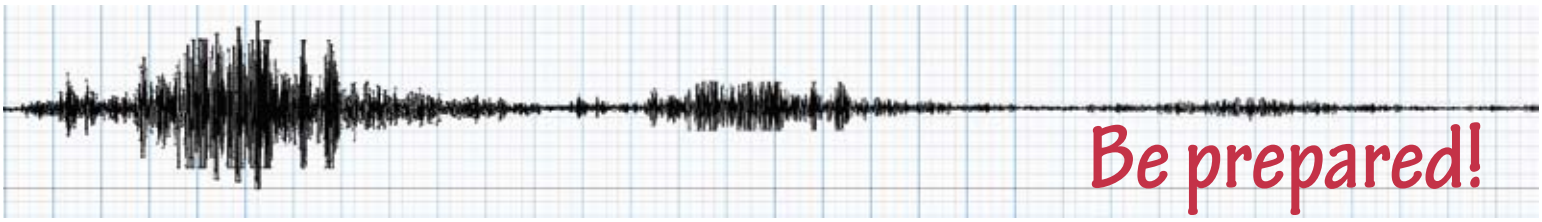
On Tuesday morning, April 29, 2003, a 4.9 magnitude earthquake occurred in DeKalb County, Alabama, 10 miles northeast of Fort Payne, Alabama. The quake was felt in 13 states. The earthquake was deep enough to suppress significant damage in Fort Payne, the closest city, although the event did damage weaker chimneys and formed cracks in some structures. Pictures of some of the damage is on page 6.



The largest known earthquake in Alabama occurred in the SASZ, near Birmingham, in 1916. Although no seismographs existed in the state at that time, the magnitude of the earthquake (estimated from the reported shaking intensities) was calculated to be approximately 5.1, and the epicenter was located in the Irondale area.

There have been an increasing number of recorded earthquakes in southwest Alabama. One of these was a 4.9 magnitude event on October 24, 1997, in Escambia County. This was the largest quake at that time recorded by seismographs in Alabama and the largest in the Southeast in the preceeding 30 years. Historically, the southwestern part of Alabama has had minimal seismic activity, but this quake indicates activity on the BFSZ, an ancient basement fault zone that underlies the area.

Damage photos to right: 1. Area along a creek suffered large cracks. Many of these cracks are over a foot deep. 2. A large crane was parked between a house and a clump of pine trees that grew on the edge of a sand pit. The quake caused the slope beneath the crane to slump, moving the crane and trees downward into the pit.



Seven Steps to Earthquake Safety

BEFORE A QUAKE

1. Identify potential hazards in your home and fix them.
2. Create a disaster-preparedness plan.
3. Prepare disaster supply kit.
4. Identify your building's potential weaknesses and begin to fix them.

DURING A QUAKE

5. Protect yourself during earthquake shaking.

AFTER THE QUAKE

6. Check for injuries and damage.
7. When safe, continue to follow your disaster-preparedness plan.

Life could change. You need to have a plan.

Where will your family be?
children at school, day care or other activities
family members at work or commuting
pets may run away or be injured

Will you have medical services?
the 911 system may be overloaded
emergency rooms and trauma centers may be overwhelmed or damaged
assisted living, critical care and other health services such as dialysis may not be operational

Will you be able to get home or to work?
road damage and closures may restrict your ability to travel by car
public transportation may experience interruptions in service

Will you be able to stay in your home?
amount of damage
kind of damage

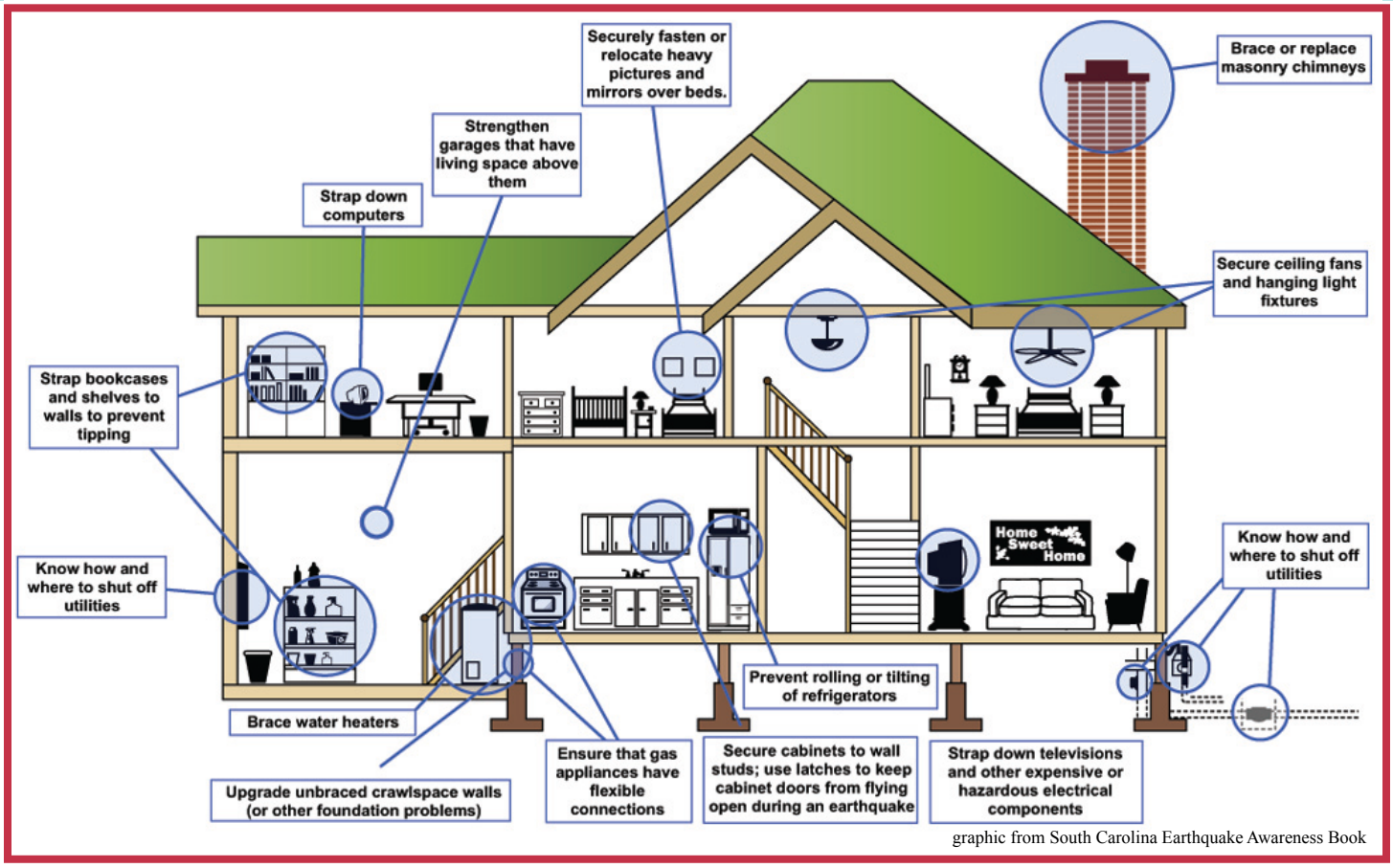
Can you live without the services you rely on?
utilities
communication
bank, grocery, drug and other services

How will your job be affected?
workplace closed due to damage
Continuity of Operations Place in place

Will your insurance cover your losses?
coverage details
costs covered

Home Hazard Hunt

How can you reduce hazards in your home?



graphic from South Carolina Earthquake Awareness Book

Good steps to take to keep occupants of your home safe on a day-to-day basis.

Secure any items in your home or storage areas that are:

1. heavy enough to hurt you if they fall on you
2. fragile and/or expensive enough to be a significant loss if they fall

Examples:

Secure cabinet doors with child-proof latches, hook and eye latches or positive catch latches designed for boats.

Move furniture such as bookcases away from beds, sofas, or other places where people sit or sleep.

Secure bookcases, refrigerators, hot water heaters and other major appliances to walls using earthquake appliance straps. Be sure to anchor to the stud, and not just to the drywall.

Secure electronics, TVs, stereos, computers and microwaves and other electronics to surfaces with flexible nylon straps and buckles for easy removal and relocation.

Use either hook and loop fasteners on the table and object, or non-damaging adhesives such as earthquake putty, clear quake gel, or microcrystalline wax to secure breakables on surfaces.

Place heavy items and breakables on lower shelves.

Mirrors, framed pictures, and other objects should be hung from closed hooks so that they can't bounce off the walls.

Only soft art such as tapestries should be placed over beds or sofas.

Secure your water heater with two straps around it that are screwed into the studs or masonry of the wall.

Move heavy objects to lower shelves.

Be prepared!

Plan to be self-sufficient for at least three days. Have basic supplies on hand and make sure everyone in your family knows how to pull them together quickly. The checklist below can help you develop a supply kit.

- Battery-operated radio
- Flashlight
- Extra Batteries
- First Aid Kit
- 3 gallons per person, minimum, in a food-grade, plastic container
- Additional water for sanitation
- Minimum 3-day supply of non-perishable food that requires no refrigeration or preparation and little or no water
- Non-electric can opener
- Mess kits, or paper cups, plates and plastic utensils
- Disinfectant
- Soap, liquid detergent
- Toilet paper, towelettes, paper towels
- Personal hygiene items
- Plastic bucket with tight lid
- Plastic garbage bags, ties (for personal sanitation use)
- Sturdy shoes or work boots
- Blankets or sleeping bags
- Complete change of clothing and footwear per person
- Special items for babies or other family members with special needs
- Matches in a waterproof container
- Basic hand tools
- Cash, traveler's checks, change
- Map of the area
- Tape, duct tape and plumber's tape or strap iron
- Patch kit and can of seal-in-air for tires
- Shut off wrench, to turn off household gas & water
- Pet supplies such as food, water, leash, harness or carrier, records of vaccinations, picture of you and your pet together
- Sanitation supplies (litter, newspapers, trash bags, disinfectant)
- Important Documents in a waterproof container that can be transported quickly
  - Important telephone numbers
  - Record of bank account numbers
  - Family records (birth, marriage, death certificates)
  - Inventory of household valuables
  - Copy of will, insurance policies, contracts, deeds, stock and bonds
  - Records of credit card account numbers and companies
  - Copy of passport, social security cards, and immunization records

Earthquake Insurance

No standard insurance policy, including the homeowner's policy, covers catastrophic damage that is caused by an earthquake. For an additional premium, companies offer an earthquake endorsement with your homeowner's policy that will protect you in case your home suffers earthquake damage. This coverage is typically inexpensive and should be considered. The Alabama Department of Insurance website is www.aldoi.gov.

Special Preparations

Citizens with Disabilities and Special Needs

Unlike some disasters, normally there is no time for evacuation and citizens should shelter-in-place. Planning ahead is the key. Identifying potential hazards ahead of time can reduce the dangers of serious injury or loss of life.

Don't be afraid to ask for help if you think you will need it.

Prepare in advance with neighbors, family or caregivers. Your community may have a way to register with your local emergency management agency so they are aware of your special needs.

Develop an emergency communications plan. Ask an out-of-state relative or friend to serve as the "family contact". Make sure everyone in the family knows the name, address and phone number of the contact.

Make sure that you have a supplies kit and that it is maintained to meet your special requirements.

Expect aftershocks.

Stay informed about what is happening and what public officials are asking citizens to do.

Be prepared to follow their instructions.

Pets

Know in advance where sheltering will be available before sheltering is required. Have a plan which covers the same issues as the plan for your family. Make sure you have special items in an emergency kit for your pet.

Emergency Kit for Pets

- Pet food
- Water to supply your pet for three days
- Medicine and medical records
- Collar with ID tag and a leash
- Crate or other pet carrier
- Sanitation supplies (litter, newspapers, trash bags, disinfectant)
- Picture of you and your pet together
- Familiar items to comfort your pet

Information will be available through television and radio stations and on the AEMA website if animal sheltering becomes necessary, but it is best if you make plans before a disaster occurs.

While things are shaking...

DROP down on the floor:

Take **COVER** under a sturdy desk, table or other furniture. If that is not possible, seek cover against an **interior wall** and protect your head and neck with your arms. Avoid danger spots near windows, hanging objects, mirrors, or tall furniture.

If you take cover under a sturdy piece of furniture, **HOLD** on to it and be prepared to move with it. Hold the position until the ground stops shaking and it is safe to move.

WHAT IF YOU ARE NOT AT HOME?

Know your workplace's earthquake safety plan and put it into action. When safe, move to a specified meeting location.

When **OUTDOORS**, move to a clear area away from trees, signs, buildings, or downed electrical wires and poles. Windows, facades, and architectural details are often the first parts of a building to collapse.

When on a **SIDEWALK NEAR BUILDINGS**, duck into a doorway to protect yourself from falling bricks, glass, plaster and other debris.

When in a **HIGH-RISE BUILDING**, move against an interior wall if you are not near a desk or table. Protect your head and neck with your arms. Do not use the elevators.

When in a **CROWDED STORE OR OTHER PUBLIC PLACE**, move away from display shelves containing objects that could fall. Do not rush for the exit.

When in a **STADIUM OR THEATER**, stay in your seat, get below the level of the back of the seat and cover your head and neck with your arms. Don't try to leave until the shaking is over. Then walk out slowly, watching for fallen debris or anything that could fall on you in aftershocks. Move to a clear area if you can do so safely; avoid buildings, power lines, trees, and other hazards. Always assume fallen power lines are live.

When **DRIVING**, pull over to the side of the road and stop. Avoid overpasses and power lines. Stay inside your vehicle until the shaking stops. If a power line falls on the vehicle, stay inside until a trained person removes the hazard.

Aftershocks

Aftershocks are earthquakes themselves that occur because the fault that ruptured in the original temblor is still readjusting itself. They are smaller than the mainshock and can last for weeks to months. The bigger the quake, the larger the aftershock zone and the longer aftershocks will continue. It is important to remember that there may be continuing danger from additional shaking.

Once the earthquake is over...

You could be on your own for three days. Be prepared to take care of your family until help arrives.

Check on the status of your family's physical health.

Check yourself for serious injuries before helping others.
Do not move seriously injured persons, unless they are in immediate danger of further harm.

Check on the safety of your home and neighborhood.

Andrea Booher, FEMA News Photo

If possible, put out small fires in your home or neighborhood immediately. Call for help, but don't wait for the fire department.

Turn off the gas only if you suspect a leak because of broken pipes or detect the odor or sound of leaking natural gas. Use a manual gas shut-off wrench to close your main gas valve by turning it counterclockwise.

Don't turn gas back on by yourself.

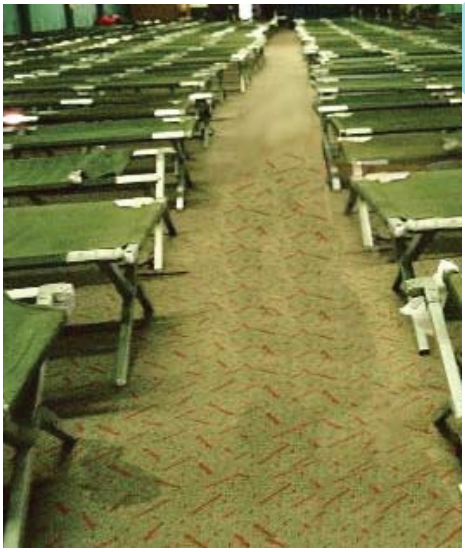
Shut off power at the main breaker switch if there is any damage to your home wiring. Leave the power off until the damage is repaired!

If you see downed power lines, consider them energized and keep yourself and others well away from them. Never touch downed power lines or any objects in contact with them!

Beware of heavy items tumbling off shelves when you open closet and cupboard doors.

Spilled medicines, drugs, or other relatively non-toxic substances can be cleaned up. Potentially harmful materials, such as bleach, lye, garden chemicals, paint, and gasoline or other flammable liquids should be isolated or covered with an absorbent material, such as dirt or cat litter.

Stay away from brick chimneys and walls. They may be weakened and could topple during aftershocks. Don't use a fireplace with a damaged chimney, as this could start a fire or trap toxic gases in your home.



If your home is structurally unsafe or threatened by a fire or other secondary disaster, you need to evacuate.

Shelters may be overcrowded and initially lack basic services, so **do not leave home just because utilities are out of service** or your home and its contents have suffered moderate damage.

If you evacuate, inform your family point-of-contact where you are going.

Once the earthquake is over...

Take the following, if possible, when you evacuate:

- **Identification for adult family members.**
- Bottled water (at least one bottle for each family member including pets)
- Dry snacks
- One complete change of clothing and footwear per person
- Cash, traveler's checks and/or Credit cards, enough for food, gas and lodging.
- Important documents
- Medications and any special items required by family members
- Maps (evacuation routes and shelters)
- For Baby: formula, diapers, bottles, medication and powdered milk
- Travel games or books for the kids

Take one step at a time and pay attention to the mental health of your family.

A Final Note

Alabamians should always be aware of conditions around them. If a damaging earthquake occurs your local emergency management agency would provide information through area media.

Regular preparedness steps are always important. Know what the risks are in your community. Have a family emergency kit and a communication plan in place at all times. Practice your plan and update your kit periodically to make sure you are ready.

You may get information on all these topics from the Alabama Emergency Management Agency website.

Use the Risk Analysis tool (pictured at the right) which is available on the AEMA website. Click on the Risk Analysis Tool Icon to learn the risks for your community.

Additional resources:

For Everyone

Alabama Emergency Management Agency
www.ema.alabama.gov

Alabama Geological Survey
http://www.gsa.state.al.us/gsa/geologichazards/earthquakes/

United States Geological Survey
www.usgs.gov

Central United States Earthquake Consortium
www.CUSEC.org

Center for Earthquake Research and Information
www.ceri.memphis.edu

Citizen Corps: emergency and disaster preparedness information for adults
http://www.citizencorps.gov/

Red Cross emergency and disaster preparedness information
http://www.redcross.org/

For Parents and Children

Emergency and disaster preparedness for children
http://www.ready.gov/kids/

United States Geological Survey–Earthquakes for Kids
http://earthquake.usgs.gov/learn/kids/

For Teachers

Unites States Geological Survey–Educational Resources
http://earthquake.usgs.gov/learn/classroom.php

CUSEC publica la información del terremoto para los residentes hispánicos de los Estados Unidos. Está disponible en este Web site: http://www.cusec.org/publications/publicaciones-en-espanol.html