The Geology of Mississippi

Intended for Grade: Eighth

Subject: Science

Description:

This project is a PowerPoint presentation on the geology of Mississippi. The different geologic regions of Mississippi are also discussed, including the role the Mississippi River has played in shaping the state's geology.

Objective:

The students will be able to identify the major geographical regions of the state and describe characteristics specific to that region. In addition, the student will be able to list some of the fossils found in the state, and describe general characteristics of the Mississippi River System.

Mississippi State Frameworks addressed:

Science Framework 6a: Identify the components/stages of a geological timetable and discuss how the environment (including animals and landforms) has changed in each period.

Science Framework 6b: Describe methods and tools used in dating rocks and fossils.

Science Framework 6c: Discuss Mississippi's geological areas

National Frameworks addressed:

Content Standards D: Earth and Space Science, and science as inquiry

Materials:

- PowerPoint Presentation
- Projector

Background:

Extensive background is provided in two attached papers.

Evaluation:

The students will be asked to take notes and to question the speaker. The students will also be tested by the teacher at a later date.

Extended Activities:

Electric circuit boards that test the student's knowledge of events in each of the different geologic periods have also been created and are used as supplementary reinforcements.

Prepared by:

Matt Aufman and Meredith Carnley
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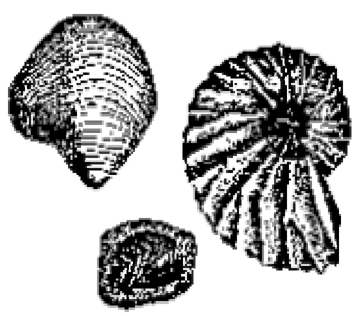
University of Mississippi

Background Information on the Geologic Timescale and Fossils



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1.0 Geologic Timescale

The geologic timescale is based on the different fossils that have been found in the rock strata. The first 5/6th of the earth's time contained no fossils so it has been dated using rocks. This time period is called Pre-Cambrian or Cryptozoic (hidden life) and is split into two separate time divisions, the Archean and Proterozoic eons.

The Phanerozoic (obvious life) eon is divided into 3 eras, which furthermore are divided in periods and epochs. Smaller units called systems, series and stages are used but not considered here.

1.1 Divisions of the Geologic Timescale:

Eon is the largest division of the geologic timescale. In order of oldest to most recent, the first three eons of the geologic timescale are the Hadean, Archean, and the Proterozoic. The Hadean refers to the period of time for which we have no rock record, which began with the origin of the planet about 4.6 billion years ago. The Archean corresponds approximately to the ages of the oldest known rocks on Earth. The Proterozoic Eon refers to the time interval from 2500 to 570 million years ago. The remainder of geologic time is included in the Phanerozoic Eon, which is the fourth eon. The Phanerozoic is divided into three major subdivisions, termed **eras**. The oldest era is the Paleozoic Era, followed by the Mesozoic Era, then the Cenozoic Era in which we are now living.

The eras are divided into shorter time units called **periods** and periods can be divided into **epochs**.

Figure 1 shows the Geologic Timescale. This timescale describes the changes in life and landforms.

Geologic Timescale

EON	ERA	PERIOD	EPOCH
P H A N E R O Z O I	**CENOZOIC** -"recent life" - 65 million years ago to present -Age of mammals -Woolly	**Quaternary** Humans appear	**Holocene** 10.000 yrs ago till present Humans start to dominate the world. Sea levels rise after end of ice age drowning large areas of land.
			Pleistocene 1.7 million -10,000 years ago First primitive humans appear. 1/4th of land covered by ice.
		Tertiary	**Pliocene** 5 - 1.7 million years ago

C	mammoths, saber-toothed cats and giant sloths lived during this time but are now extinct	Mammals become the dominant larger animals	Human-like apes make appearance. Climate cools as Ice Age nears. Galapagos islands rise from the sea. Panama land bridge emerges connecting North and South America.
			Miocene 23 - 5 million years ago Camel, cat, horse, raccoon, weasel and rhinoceros dominate.
			Oligocene 35 - 23 million years ago True Primates make first appearance. Horses and tapir in America.
			Eocene 57 - 35 million years ago Mammals adapt to marine life.
			Paleocene 65 - 57 million years ago Marsupials, carnivores. Modern continents start to form.
	MESOZOIC -“middle life” -248-65 million years ago -Age of Reptiles -Birds and small mammals began to evolve late in this era -By the end of the Mesozoic about 50% of all species on earth became extinct	**Cretaceous** 145 - 65 million years ago 65 million years ago, mass extinction of dinosaurs. Flowering plants and modern trees appear.	
		Jurassic 210 - 145 million years ago Birds make appearance, reptiles dominate sea and land. South America breaks away from Africa	
		Triassic 245 - 210 million years ago Dinosaurs and first true primitive mammals appear. Evergreen trees dominate. Breakup of Pangaea into 2 super continents.	
	PALEOZOIC -”old life” -540-248	**Permian** 290 - 245 million years ago Great mass extinction as trilobites, many fishes and corals dies out because of environmental changes.	

<table>
<tr><td rowspan="6"></td><td rowspan="6">million years ago

-1st era well represented by fossils

-@ the beginning there were no land organisms, but towards the middle, plants appeared on land

-@ the end amphibians were living partially on land and insects were abundant

-a mass extinction at the end of this era wiped out 90% of all species.</td><td>Cycad like plants and true conifers appear in the north.
Land masses drift together to form Pangaea.</td></tr>
<tr><td>Carboniferous
360 – 290 million years ago
Amphibians venture out of the sea and on to land.
Lush forests in swamplands turned into today’s coal and oil deposits.</td></tr>
<tr><td>Devonian
410 - 360 million years ago
Age of fish making appearance.
Land covered with giant ferns.</td></tr>
<tr><td>Silurian
440 - 410 million years ago
Later a scorpion became first air-breathing animal.
Oceans with vertebrate, jawed fish and corals.
Vascular plants venture on land as first terrestrial life.</td></tr>
<tr><td>Ordovician
510 - 440 million years ago
Trilobites are still abundant and vertebrate fish and corals make first appearance.</td></tr>
<tr><td>Cambrian
570 - 510 million years ago
Marine invertebrates, especially trilobites are prevalent in sea, but there are no land animals.
Seaweed in the oceans and lichens on land.
Formation of Gondwanaland super continent.</td></tr>
<tr><td colspan="3">PROTEROZOIC
2.5 billion - 570 million years ago
Soft-bodied marine invertebrates emerge 900 million years ago.
Eukaryotic cells and algae are in oceans.</td></tr>
<tr><td colspan="3">ARCHEAN
3.8 - 2.5 billion years ago
Prokaryotic cells only, bacteria and blue-green algae in the oceans
Algae in the oceans begin producing oxygen, which settled in the atmosphere and was necessary for the later evolution of higher animals.
Consolidation of earth's crust and first sign of life.</td></tr>
<tr><td colspan="3">FORMATION OF EARTH
4.6 billion years ago</td></tr>
<tr><td colspan="3">FORMATION OF UNIVERSE
20-7 billions of years ago</td></tr>
</table>

Figure 1. Geologic timescale

1.2 Discussion: Geologic Time

Objective: The objective of this activity is to help the students understand just how huge geologic time is and to compare it to the human life span.

Discussion: A time line is a way of picturing some period of time. The time scale of the earth starts at the beginning of the universe to the present which is about 15 billion (15,000 million) years. Here are some ways to understand this enormous period of time. How big is one billion?

- One billion earths still wouldn't equal the mass of the sun.
- One billion minutes is 1,903 years.
- One billion atoms make up the period at the end of the sentence.

How big is one million?

- If a person lived for one million days, he or she would be 2,740 years old

1.2 Activity: Making a Geologic Time Line for Your Classroom

Objective: The objective of this activity is for students to gain an understanding of the earth's 4.6 billion years of history. Students will also become familiar with events in the Earth's history and how they relate to one another.

Materials Needed:

Adding machine tape
Tape
Markers
Ruler

Procedure:

1. Using the adding machine tape, prepare a timeline using a scale of 1"=5 million years. Remember the earth is 4.6 billion years old.
2. Using index cards, prepare event cards with the following information on them (without the ages). Select various events in the earth's history- one for each student or team of students.

Bacteria	3 bya
Green Algae	1 bya
Jellyfish	600 mya
Trilobites	550 mya
First Vertebrate	480 mya
Sharks	400 mya

Spiders	400 mya
Ferns	350 mya
Earthworms	300 mya
Greatest Extinction	250 mya
Pangaea Forms	240 mya
First mammal	210 mya
Archaeopteryx	140 mya
First Flowering Plant	120 mya
Ants	100 mya
Triceratops	65 mya
Camel	35 mya
Grass	20 mya
“Lucy”	4 mya

3. Hang the timeline around the room and discuss what it is. See if students can name any of the time periods. Identify the Pre-Cambrian, Paleozoic, Mesozoic and Cenozoic.
4. Ask each student or team of students to pick one Event Card. Explain that each card represents the first evidence of an organism in the fossil record or the occurrence of a particular event during the Earth’s history.
5. Have students arrange themselves in sequence according to their event-the oldest event first and the most recent last.
6. There will be some errors. Most students are surprised that grass is so recent and spiders are so old! Allow discussion as you place them in the correct sequence.
7. Now that the proper sequence of events has been determined, ask students to stand in front of the timeline at the place that represents the correct age of the event. Students are surprised to see that for very long periods of early history, very little happened.

Extensions:
1. Students can find other events to research and add to the timeline.
2. Students can make their own timelines.

2.0 Methods and Tools Used to Date Rocks and Fossils

2.1 Dating Fossils

Paleontologists use many ways of dating individual fossils in geologic time.

1. The oldest method is stratigraphy, studying how deeply a fossil is buried. Fossils are usually found in sedimentary rock. Sedimentary rock layers are formed episodically as earth is deposited horizontally over time. Newer layers are formed on top of older layers, pressurizing them into rocks. Paleontologists can estimate the amount of time that has passed since the stratum containing the fossil was formed. Generally, deeper rocks and fossils are older than those found above them.

2. Observations of the fluctuations of the Earth's magnetic field, which leaves different magnetic fields in rocks from different geological eras.

3. Dating a fossil in terms of approximately how many years old it is can be possible using radioisotope-dating of igneous rocks found near the fossil. Unstable radioactive isotopes of elements, such as Uranium-235, decay at constant, known rates over time (its half-life, which is over 700 million years). An accurate estimate of the rock's age can be determined by examining the ratios of the remaining radioactive element and its daughters. For example, when lava cools, it has no lead content but it does contain some radioactive Uranium (U-235). Over time, the unstable radioactive Uranium decays into its daughter, Lead-207, at a constant, known rate (its half-life). By comparing the relative proportion of Uranium-235 and Lead-207, the age of the igneous rock can be determined. Potassuim-40 (which decays to argon-40) is also used to date fossils. The half-life of carbon-14 is 5,568 years. That means that half of the C-14 decays (into nitrogen-14) in 5,568 years. Half of the remaining C-14 decays in the next 5,568 years, etc. This is too short a half-life to date dinosaurs; C-14 is useful for dating items up to about 50,000-60,000 years ago (useful for dating organisms like Neanderthal man and ice age animals).

   Radioisotope dating cannot be used directly on fossils since they don't contain the unstable radioactive isotopes used in the dating process. To determine a fossil's age, igneous layers (volcanic rock) beneath the fossil (predating the fossil) and above it (representing a time after the dinosaur's existence) are dated, resulting in a time-range for the dinosaur's life. Thus, dinosaurs are dated with respect to volcanic eruptions.

4. Looking for index fossils- Certain common fossils are important in determining ancient biological history. These fossil are widely distributed around the Earth but limited in time span. Examples of index fossils include brachiopods (which appeared in the Cambrian period), trilobites (which probably originated in the pre-Cambrian or early Paleozoic and are common throughout the Paleozoic layer-about half of Paleozoic fossils are trilobites), ammonites (form the Triassic and Jurassic periods, and went extinct during the K-T extinction), many nanofossils (microscopic fossils from various eras which are widely distributed, abundant, and time-specific), etc.

2.2 Dating Rocks
Most rocks can be given an approximate age, in 4.5 Ba Earth history using actual ages and relative ages.

Actual ages - come from radiometric dating of some rocks.

1. Radiometric dating is based on observation of amount or parent and daughter elements in radioactive decay (this was discussed in above).

Relative ages - found by inference, from observations of geometry, composition, etc. Before radiometric dating was discovered, the general structure of geological time had been inferred. The inference was based on a small number of key principles, in turn based on observation.

1. Principle of Uniformitarianism – this principal is based on the fact that “the present is the key to the past". The processes we see shaping the Earth now operate the same way throughout geological time.

2. Principle of Original Horizontality-This principle is based on the fact that "Sediments are deposited as essentially horizontal beds”. This is a direct application of the Uniformity principle: sediments deposited today form horizontal layers the same way they have in the past.

3. Principle of Superposition – This principal is based on the fact that "Younger rocks were laid down on top of older rocks ".

4. Principle of Faunal Succession- This principal is based on the fact that "Fossil species succeed one another in a definite and recognizable order". For example fossils at the base of a thick

sequence of sediments are less like present-day species than those near the top. Also a fossil species which is observed to occur above a second fossil species in one location will always occur above that second species, wherever it is found.

3.0 Types of Fossils

3.1 Four Types of Fossils:

1. Mold fossils -a fossilized impression made in the substrate (a negative image of the organism)
2. Cast fossils**-** formed when a mold is filled in
3. Trace fossils or ichnofossils **-** fossilized nests, gastroliths, burrows, footprints, etc.
4. True form fossils - fossils of the actual animal or animal part

3.2 Body Fossils vs. Trace Fossils

Fossils can be divided into two categories, fossilized body parts or body fossils (bones, claws, teeth, skin, embryos, etc.) and fossilized traces, called ichnofossils (which are footprints, nests, dung, toothmarks, etc.), that record the movements and behaviors.

3.2.1 Body Fossils

The most common body fossils found are from the hard parts of the actual animal or plant, including bones, claws, teeth, shells and leaves. More rarely, fossils have been found of softer body tissues. Body fossils include:

A. Unaltered Remains--This category includes those fossils which have undergone little or not change in structure and composition. As a general rule an organism which lived fairly recently has a greater probability of being unaltered than a more ancient one.

Original Skeletal Material--Organisms which have hard parts are preserved as the original material. This includes many invertebrate shells composed of calcium carbonate, silica, chitin, or vertebrate bones of calcium phosphate.

Encrustations--In many caves, ground water seeps and drips constantly; the high concentration of dissolved minerals in such water is left behind when the water drips, and forms a thin crust on the interior surface of the cave and whatever lies in it. This will coat and preserve any organism which dies here.

Tar Impregnation--Tar pits are excellent sites for fossilization. The famous Rancho La Brea tar pits in southern California have yielded particularly rich collections of vertebrate bones, wood, etc. Smaller pits have yielded perfectly preserved insects and even insect larvae.

Amber Entombment--Certain cone-bearing trees, such as spruce, pine and fir, contain a sticky resinous "pitch" which comes from wounds in the tree. Small insects and other minute organism may become trapped in this resin, which after burial may harden into amber. Certain parts of the Baltic Sea coast and some of the islands in the West Indies are well known for occurrences of insects preserved in amber.

Refrigeration--During the Pleistocene glaciation, when ice sheets covered much of the Northern Hemisphere, some animals (mammoths, for example) fell into crevasses in frozen terrain or became trapped in permanently frozen soil. Some of these animals have been discovered perfectly preserved.

Mummification--In very arid regions, animals may dry out quickly and be preserved, soft parts and all.

B. Altered Remains--As sediments become compressed by the weight of overlying sediments, they slowly undergo the process of lithification. Common cementing materials in the groundwater are carbonate, silica, and iron oxides. Often the groundwater and their minerals may affect the fossilization process.

Permineralization -- Many bones, shells, and plant stems have porous internal structures. These pores may become filled with mineral deposits. In the process of permineralization, the actual chemical composition of the original hard parts of the organism may not change.

Dissolution/Replacement -- Groundwater (especially acidic groundwater) may act to dissolve a hard structure in an organism trapped in sediments and may, simultaneously deposit a mineral in its place--molecule by molecule. Replication of tree trunks, including their internal microscopic cellular structure, by silica in the process of forming Petrified wood is a classic example of this type of fossilization.

Recrystallization -- conversion, essentially in the solid state, of the mineralogy of the fossil usually to a new mineral or to coarser crystals of the original mineral.

Carbonization -- When organisms become mashed into the sediment, their volatile (liquid or gaseous) components may be forced out, leaving only a film of carbon. If additional organic matter remains when, for example, plants are entombed, the result is coal.

3.2.2 Trace Fossils

Trace fossils (ichnofossils) give us proof of animal life from the past. Trace fossils include things like foot prints, burrows, and fossilized poop. They record the movements and behaviors of the dinosaurs and other creatures. Even the lack of trace fossils can yield information; the lack of tail-furrow fossils indicates an erect tail stance for dinosaurs that were previously believed to have dragged their tails.

Mold--Any reproduction of the anatomical features of the internal or external surface of an organism. Animal tracks preserved in rocks may be termed external molds. Internal molds, particularly of shells, are sometimes called Steinkerns. An impression is actually and external mold.

Fossil footprints of dinosaurs have yielded information about:

- speed and length of stride
- whether they walked on two or four legs
- the bone structure of the foot
- stalking behavior (a carnivore hunting a herd of herbivores)
- the existence of dinosaur herds and stampedes
- how the tail is carried (few tail tracks have been found, so tails were probably held above the ground)

Unfortunately, linking a set of tracks with a particular species is often virtually impossible.

Although there were many more plant-eating dinosaurs (sauropods and ornithopods) than meat-eating dinosaurs (theropods), many more footprints of meat-eaters have been found. This may be because the meat-eaters walked in muddy areas (where footprints are more likely to leave a good impression and fossilize) more frequently than the plant-eaters).

Cast--This is, in general, a duplication of the original. Casts are formed when original parts are dissolved away and the resulting space becomes filled either with sediment or mineral matter.

Compression--In general, this refers to the deformation of a structure as a result of pressure from overlying sediments. This term has been used also for casts and/or molds of leaves.

Borings and Burrows--Certain worms and clams and many other invertebrates burrow into rocks, wood, shells, and all types of sediment. These burrows are frequently preserved, especially in fine-grained rocks. Fossils of dinosaur and other creatures' burrows and nests can reveal a lot about their behavior.

Coprolites--Fossil excrement can be sometimes give definitive knowledge about the diet of the animal concerned.

Gastroliths--These are smooth, polished stones that are often found in the abdominal cavities of the skeletons of dinosaurs. They are thought to have helped those huge animals grind up vegetable matter in their stomachs (modern birds do this also). They are usually smooth, polished, and rounded (and hard to distinguish from river rocks).

Gnawings--Rodents and other animals chew on bones for the calcium content and did so in the past. Gnawed bones are frequently preserved as fossils.

3.3 Activity/Demonstration of how land animals can be buried in river beds

Facts and Ideas

The great majority of fossils are found in sediments that were deposited under water. More than half come from sediments deposited on the bottoms of ancient shallow seas and lakes. Land animals sometimes buried in river beds and on river floodplains or in swamps are less commonly preserved as fossils.

Activity

A box of sand and a stream of water offer good materials with which to demonstrate how organisms may be buried by sand and water. Dig a shallow spot in the sand and drop a bone, shell or some other object into the depression. Direct a fine stream of water over the sand that surrounds the cavity. Observe how the objects become covered as the sand washes over them.

3.4 Activity to Demonstrate Preservation by Burial in Sand or Volcanic Ash

Facts and Ideas

A few organisms are covered by wind-blown sand on deserts or beaches, or covered by falls of ash from volcanic eruptions and subsequently preserved a fossils.

Activity

It is possible to cover flowers with powder-like material and dry them so they will retain their shape and color. (Fine clean sand, borax or baking soda may be used.) Cover the bottom of a box with two inches of fine-grained clean sand. Arrange fresh flowers on this sand so that the flower parts are in a good natural position. Carefully sprinkle sand between all the parts and cover to a depth of several inches. Allow at least three weeks for the drying process. If carefully removed, the specimens will have the appearance of freshly cut flowers. Brushing with a soft brush may be necessary to remove sand that may cling to the petals and stems.

Pressed flowers will also retain their color if they are treated as follows. Sprinkle borax on a blotter or piece of newspaper, arrange the flowers attractively, cover with borax, and then with a blotter or piece of newspaper. Put into a press and dry as quickly as possible.

3.4 Activity: Making molds and casts fossils

Objective: The objective of this activity is to demonstrate how mold and cast fossils are formed.

Materials: Shells
Milk bones
Sand

Bowls
Play dough
Plaster of Paris
Fresh leaves

Procedure:

1. Mix up some plaster of paris (two parts plaster of paris powder to one part water.)
2. Distribute bowls, shells and milk bones to each student.
3. Have students put about 1.5 inches of sand in their bowls.
4. Tell students to push the sea shell and mild bone into the sand (just enough to make and imprint). The imprints act as the molds.
5. Pour plaster of paris in the molds and let dry (may take about 30 minutes). When the plaster is dry, students can remove the casts from the sand. They have just created a cast fossils of a sea shell and a bone.

**The same type of activity can be done using play dough. Instead of shells, green leaves can be picked and used to make the mold. Plaster can then be poured into the mold to create the cast.

Questions

1. Name the eons.
2. What are the divisions of geologic time?
3. What Eon, Era, Period and Epoch do we live in?
4. How many eras are in the Phanerozoic? List them.
5. Which two geologic time intervals did two major extinctions occur? When did these intervals end?
6. Which era is known as "recent life"?
7. What period did humans appear?
8. During which period did the dinosaurs go extinct?
9. During which period did the land masses drift together to form Pangaea?
10. How long ago was the Earth formed?
11. Which era is known as "old life"?
12. Which era is known as "middle life"?
13. Which epoch did the last ice age occur?
14. During which period did birds first appear?

4.0 References

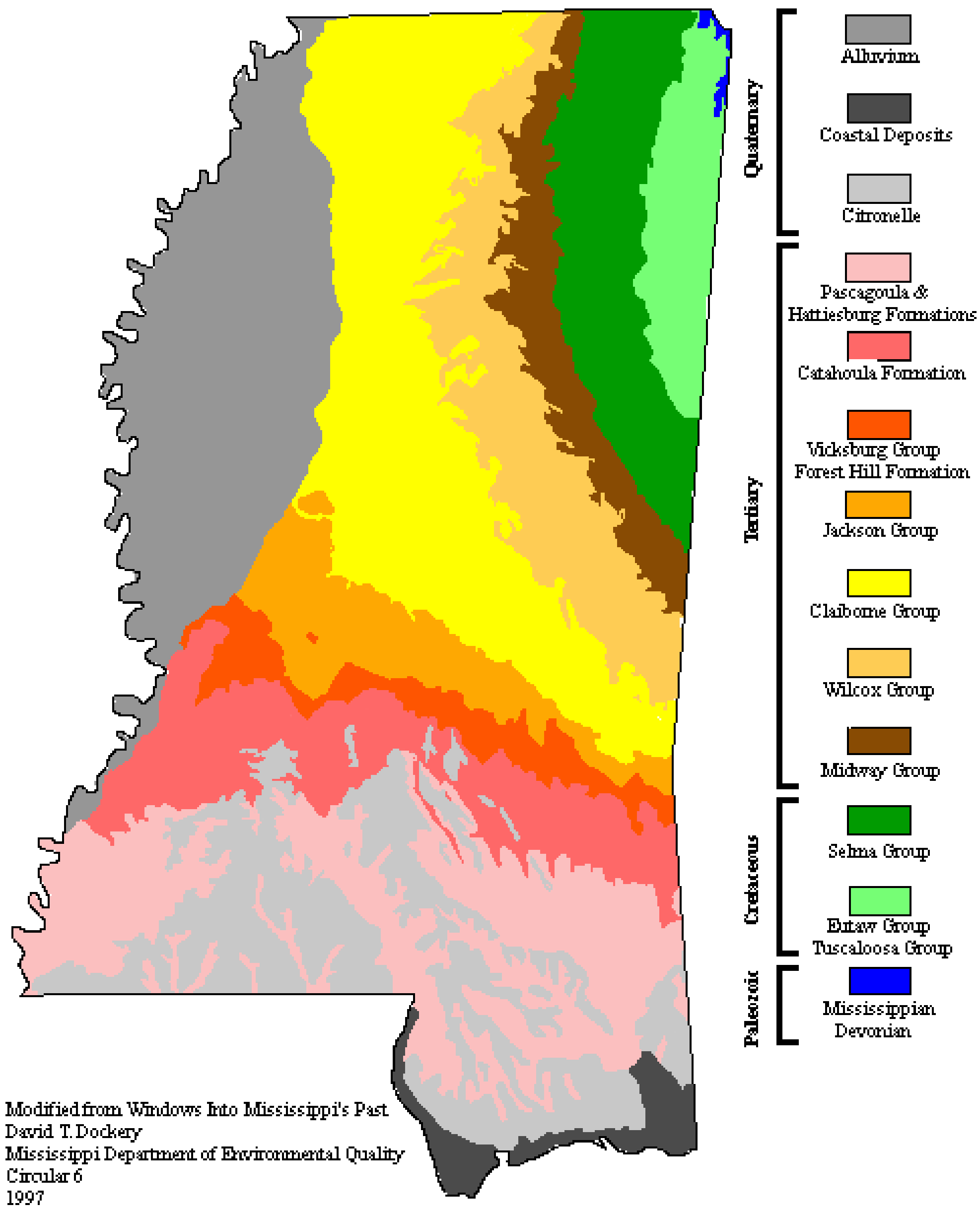
http://www.enchantedlearning.com/subjects/dinosaurs/index.html, 3-16-2003

http://web.ask.com/redir?bpg=http%3a%2f%2fweb.ask.com%2fweb%3fq%3dwhat%2bare%2bthe%2btypes%2bof%2bfossils%26o%3d0&q=what+are+the+types+of+fossils&u=http%3a%2f%2fmuseum.gov.ns.ca%2fmnh%2fnature%2ftracefossils%2fenglish%2fsections%2ftypes.html&s=a, 3-16-2003

http://www.geobop.com/paleozoo.World/NA/US/MS/, 3-5-2003

American Geological Institute. 1962. Geology and Earth Sciences Sourcebook for Elementary & Secondary Schools, Holt, Rinehart and Winston, Inc., New York

Background of the Geological Features of Mississippi



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1.0 Introduction to Mississippi

Let's start out with a little bit of information about the state of Mississippi. Mississippi was named after the Mississippi River. The Mississippi River, which means "large river", was named by the Chippewa Indians. Mississippi is located in the South, and is the central Gulf Coast state. Mississippi is bordered by Tennessee on the north, Alabama on the east, the Gulf of Mexico on the south, and the Mississippi River on the west. Mississippi is the 32^{nd} biggest state and contains 47,695 square miles. Woodall Mountain in Tishomingo County reaches 806 feet above sea level, and is the highest elevation in Mississippi. The Gulf of Mexico is the point of lowest elevation.

2.0 Fossils of Mississippi

Mississippi's official state fossil is the Zygorhiza kochii. This is a small prehistoric whale that grew to about 16 feet. On March 12, 1981, the Mississippi State Legislature passed, *Senate Concurrent Resolution No. 557* designating the prehistoric whale as the official fossil of the State of Mississippi.

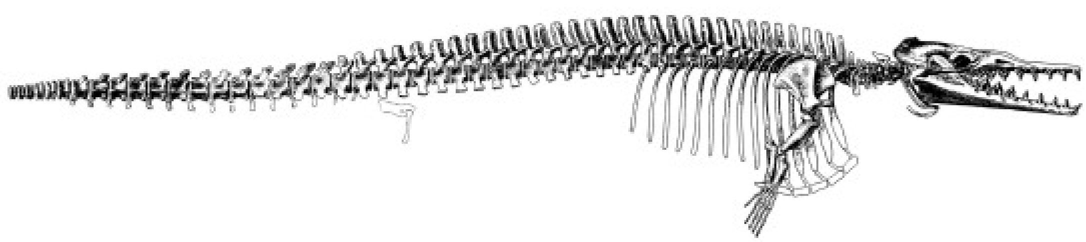


Figure 1. Mississippi's State Fossil Zygorhiza kochii, a prehistoric whale

A whale (Zygorhiza kochii) was discovered in a sand and gravel deposits in Thompson Creek by members of the Mississippi Gem and Mineral Society in 1971. The members were looking for semi precious stones that can be found in these sand and gravel deposits, when they came across the fossil.

This fossil is one of the most complete fossils of its kind and is nicknamed Ziggy. It was the first fossil vertebrate from Mississippi that has been completely reconstructed and is probably the most complete one of its kind in the world. This whale had been dead for around 38 million years (since the late Eocene Epoch). The sand and gravel deposits (presently Yazoo County, Mississippi) that this whale was found in, was the floor of a shallow tropical sea 38 million years ago. This sea was the Gulf of Mexico and back then it covered most of Florida and parts of Georgia, Alabama, Mississippi, Louisiana, and Texas. Ziggy can now be seen in the Mississippi Museum of Natural Science in Jackson.

Other partial skeletons of Zygorhiza kochii have been found is the same formation of sand in Jackson.

There are more fossils that have been found in Mississippi. About 10 miles northeast of Yazoo City, Sylvester Q. Breard, Jr. discovered about 20 species of vertebrates (animals with backbones). He has found sharks, fish, more remains of Zygorhiza kochi, and eagle rays (Myliobatis, Figure 2). He has also found a scapula and two teeth of another whale, Basilosaurus cetoides (Alabama's state fossil). The Basilosaurus cetoides (Figure 3) were huge; they had a four-foot head, a ten-foot body, and a forty-foot tail.

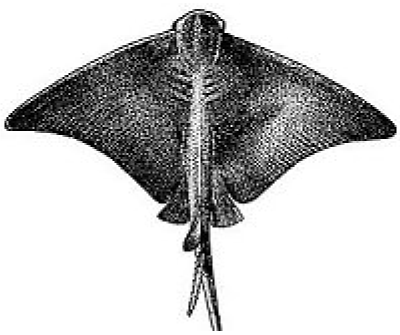


Figure 2. Myliobatis

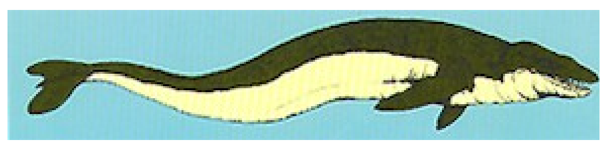


Figure 3. Basilosaurus cetoides

Teeth of giant shark (Carcharodon auriculatus, Figure 4) have been found about 11 miles northeast of Vicksburg. These sharks were capable of growing thirty feet or more.

Figure 4. Carcharodon auriculatus tooth (Giant shark tooth).

The sea that these marine animals once lived in, was eventually filled in, the land was uplifted. This enables the remains of these fossils to be found where they are today.

In the loess deposits around Vicksburg, fossils of horse, tiger, bear, deer, and bison have been found. Mastodon remains were excavated in 1964 and 1984 at two sites in Vicksburg. The 1984 remains, shown in Figure 5 are being prepared for removal, and are displayed at the Mississippi Museum of Natural History in Jackson. Bones and a tusk from the 1964 excavation north of Vicksburg are on display in the Geotechnical Laboratory foyer at WES.

Figure 5. 1984 excavation site of the Mastedon.

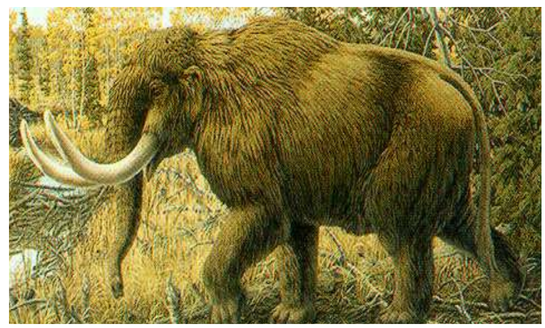


Figure 6. Picture of what the Mastedon was thought to looked like.

3.0 Mississippi State Stone

Mississippi's state stone is petrified wood. The best known site with petrified wood in Mississippi is the Mississippi Petrified Forest located in Flora Mississippi.

The Mississippi Petrified Forest is the only Petrified Forest in the eastern United States. The Petrified Forest has been known since the middle 1800's, but has only been developed and open for the public within the past three decades. In 1966 this forest was declared a Registered National Natural Landmark by the National Park Service, Department of the Interior as possessing exceptional value in illustrating the natural history of the Unites States.

The petrified wood found in Mississippi comes in several varieties: a nondescript type called "silicified wood," a denser type called "massive silicified wood," and a third type known as "petrified palm wood."

First of all what is petrified wood? Petrified wood is wood that has turned to stone over time. It is a fossil of a woody plant that is preserved through time by chemical and physical processes. Researchers have not been able to duplicate the process of petrification, so the process is not completely understood.

For petrification to occur there are certain conditions that need to exist. One is that oxygen would need to be kept away from the rotting plant material. This is because oxygen is used to breakdown (decay) these types of materials. With this in mind, the dead plant material may have been deprived of oxygen by burial with sediments settling in water covering the plants. Most of the petrified wood that is found today is a product of flood plain environments of ancient rivers.

After the woody material is buried, the wood reacts to percolating water. Three things may happen when this occurs. 1.) The log may disintegrate 2.) The log may be compressed and turned into coal or 3.) The log may be petrified. If the wood becomes petrified, the minerals from the percolating water are deposited in fluid-filled openings in the woody material (called premineralization). Sometimes minerals can replace the woody portion of the wood in a process called replacement. The final process to create petrified wood is time. This process can take millions of years.

4.0 Landforms of Mississippi

Figure 7. Map identifying major land areas of Mississippi

4.1 Mississippi Valley Alluvial Plain (Yellow on the map)

The Mississippi alluvial plain represents the valley of the Mississippi River and its tributaries from Cairo, IL to the Gulf Coast of Louisiana which is approximately 35,000 square miles of fertile lowlands. This area is known as the Delta and covers the entire western edge of the state. The Plain is narrow south of Vicksburg and gets wider farther north between the Yazoo, Tallahatchie and Coldwater rivers. This region is enriched with silt that is deposit from the flood waters of the Mississippi River. This fertile soil is famous for its large soybean and cotton crops.

4.2 Coastal Plain (Green on the map)

The Coastal Plain extends over all the State east of the Delta. This region is composed of mainly low, rolling, forested hills. This region also has prairies and lowlands.

4.2.1 Loess Hills

Yellowish-brown loess soil covers the region in the west. This area is commonly known as the Loess Hills.

Loess is silt or clay sized material that is picked up by the wind and carried until it is deposited. Loess can be carried hundreds of miles before being deposited in thick layers. One interesting fact about loess is that it can maintain vertical or nearly vertical slopes. One great place to observe these loess cliffs is Vicksburg along I-20. The loess deposits in Vicksburg are over 100 feet thick and are between 10,000 to possibly 100,000 years old. In these deposits are fossils of vertebrate animals including mastodon, horse, tiger, bear, deer, and bison.

Figure 8. Loess Bluff near Vicksburg

4.2.2 Tennessee River Hills

The Tennessee River Hills are located in the northeast part of the state and are part of the foothills of the Appalachian Mountains. They include the highest point in the State, Woodall Mountain (located in Tishomingo State Park), which is 806 feet above sea level. Tishomingo State Park contains rock formations dating to the Devonian (360-408 million years ago) and Mississippian (320-360 million years ago) epochs of the Paleozoic era.

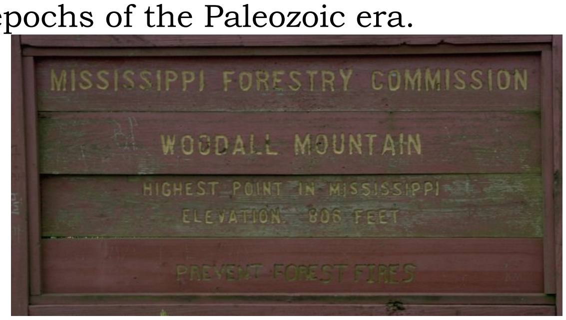


Figure 9. Sign showing the highest point in Mississippi

The Devonian age rocks consist of limestone, thin layers of sandstones with thick layers of shales. The Mississippian aged rocks in places consist of limestone, chert, shale and sandstone. Some fossils can be found in this area.

4.2.3 Pine Hills

The Pine Hills, often called the Piney Woods, rise in the southeastern part of the State. They are covered largely with longleaf, loblolly, and slash pine forests.

4.2.4 Black Belt or Blackland Prairies (Blue on the Map)

The main prairie areas are called the Black Belt or Blackland Prairies because their soils are largely black in color. This long narrow prairie lies in the northeast section of the State. The Black Belt stretches through 11 counties. Small prairies also lie in central Mississippi, east of Jackson.

4.2.5 Flatlands (Brown on the Map)

The flatlands, which lie along the Mississippi Sound, are lowlands that stretch inland over the southern portion of the region. In this region lies the coastline which is about 44 miles long. Along the coast is an extensive coastal estuary. It is one of the most extensive estuary systems in the United States. (Estuary-a broad river valley submerged by rising sea level or a sinking coast. They are shallow and have gently sloping beaches.) From this estuary, the land slopes inland for about 10-20 miles.

Also in the Flatlands lie the barrier islands of Ship Island, Horn Island, Cat Island and Deer Island, just to name a few. (Barrier islands- a long narrow, low-lying island that parallels the shoreline. It looks like a beach separated from the mainland by a lagoon.) These Barrier Islands lie some 10-20 miles offshore (Figure 10). They are only a half mile to a mile wide and several miles long. These islands provide a very important geologic function. They protect the mainland from the violent storms. For instance they take the brunt of the force exerted by the storms, namely hurricanes, before they hit the mainland.

Figure 10. Barrier islands of Mississippi

5.0 Mississippi River

The Mississippi River is probably the most fascinating geologic feature in Mississippi. It is the longest river in North America. The Mississippi-Missouri River system is the world's fourth longest river in the world. The Nile, Amazon and Yangtze Rivers are the only rivers that are longer. It flows 2,350 miles from its source at Lake Itasca, Minnesota, through the mid continental United States, to the Gulf of Mexico. The river basin, or watershed, is the third largest in the world extending from the Allegheny Mountains in the eastern United States to the Rocky Mountains. This includes all or parts of 31 states and 2 Canadian provinces. The river basin measures approximately 1,837,000 square miles (4.76 million sq. km) covering about 40% of the United States and about one-eighth of North America (Figure 11).

Figure 11. Showing the extent of the Mississippi River Basin

The Mississippi River is divided into three parts; 1.) Headwaters, 2.) Upper Mississippi River and 3.) Lower Mississippi River. The Headwaters is the section of the river from the source (Lake Itasca) downstream to St. Anthony Falls in Minneapolis, Minnesota. The Upper Mississippi River extends from St. Anthony Falls downstream to the mouth of the Ohio River at Cairo, Illinois. The portion of the Mississippi River that borders Mississippi is the Lower Mississippi River. It extends from Cairo, Illinois all the way to the Gulf of Mexico.

The Mississippi River is a meandering river system. Meandering rivers cut a channel into a flood plain and deposit sediments. Below is a figure of a typical meandering stream.

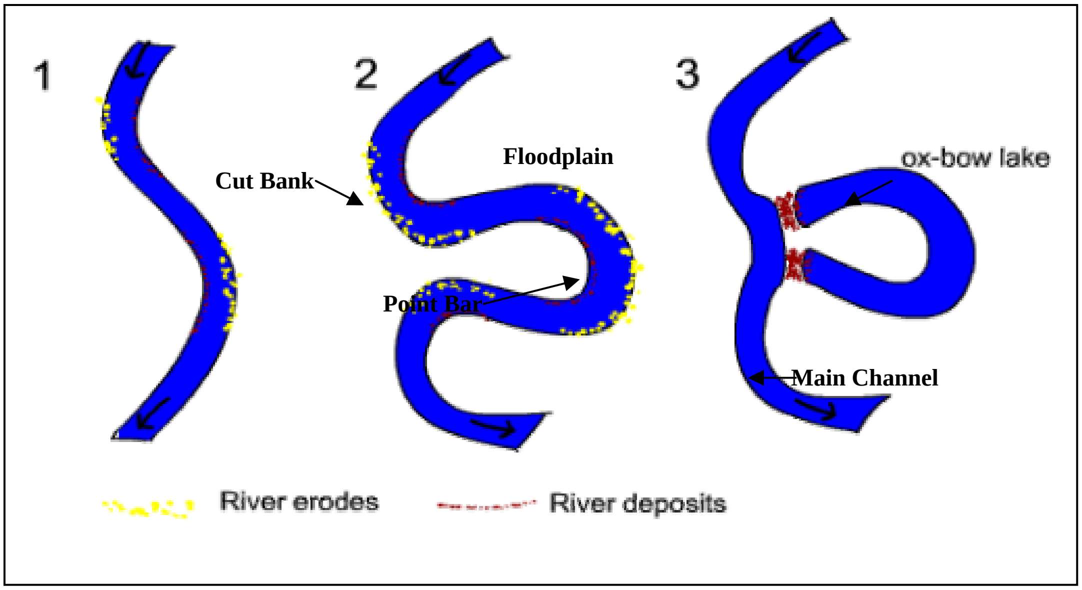


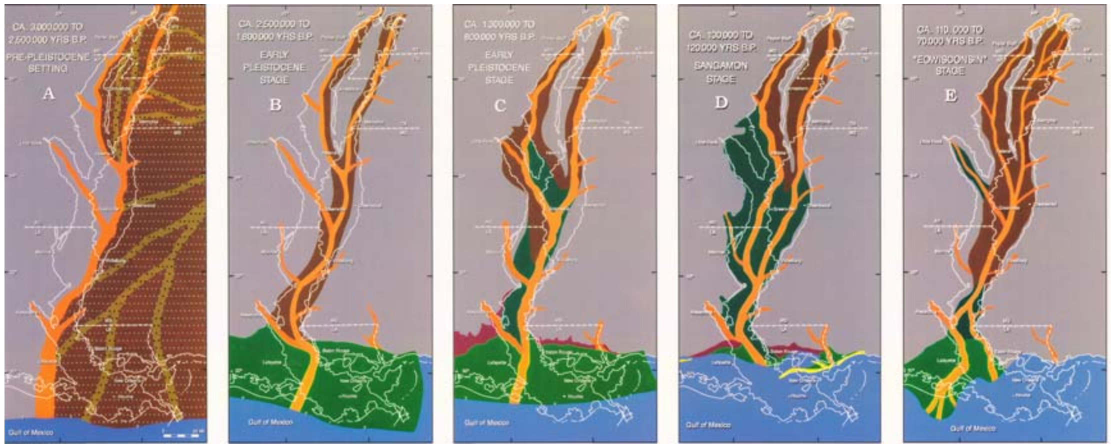
Figure 12. Schematic of a meandering river showing the process of creating an oxbow lake.

Meandering river systems contain certain different elements. These elements consist of the main channel, point bars, cut banks, floodplains, oxbow lakes and others but they will not be discussed here. The main channel is just like it sounds; it is the main channel in the system. The point bar is where the sediment carried by the river is deposited (on the edge of the river). Cut bank is the place where the river cuts the bank. Here the river erodes the bank of the river. Floodplains are located on the sides of the river. This is where the water goes in a flood situation. When the river floods it deposits fine sediment in the floodplains. The flood plain in Mississippi is just east of the river. Oxbow lakes are formed when the river keeps eroding and eventually cuts part of it off, thus creating an abandoned part of the river channel.

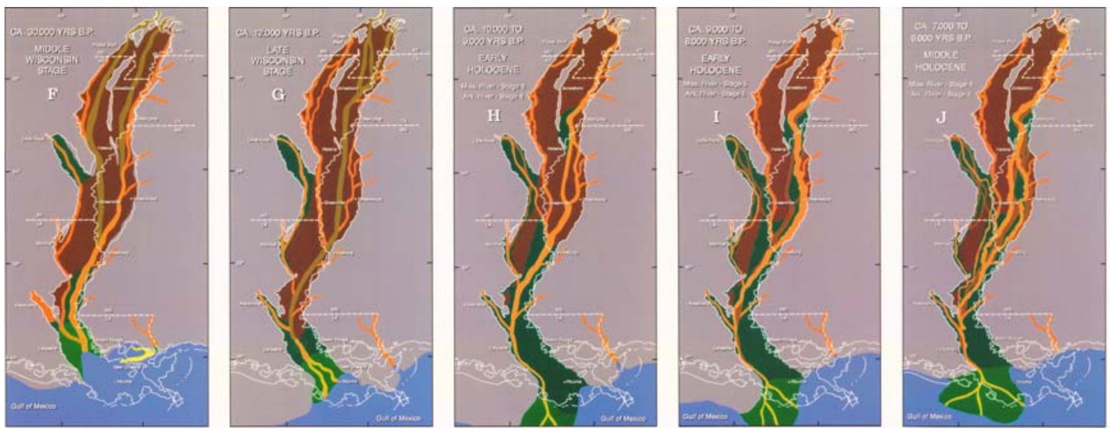
6.0 Mississippi Geology and Delta Formation

Almost all of our state's geology and topography is shaped by fluvial or marine activity. Glaciation and sea level changes were overwhelmingly responsible for changes to the geomorphology (surface landforms) during the Holocene. Ice sheets that swept across Illinois and Minnesota in the Pleistocene created the headwaters for the Mississippi River system**.** During the time from around 70,000 to 30,000 years ago, the lower Mississippi valley became filled with glacial outwash. The last glaciers that swept the state occurred around 10,000 years ago, and cleaned the outwash away, and turned the river channel from a braided stream into the meandering river that it is today. The drawing on the far left of Figure 13a is of what the river probably looked like approximately 3 million years ago, the age slightly before the Pleistocene began. The drawing on the far right of Figure 13a shows the river and delta right before Glaciation swept across the state 70,000 years ago. The river floodplain is very narrow here because of lowered sea levels. Notice that there is creation and destruction of the river channel over time, due to various risings and fallings of the sea. The drawing on the far left of Figure 13b shows the lower river system around 30,000 years ago. The third of Figure 13b drawing shows the approximate location of the river during the last glacial event, 10,000 years ago. Figure 13c is important because it shows the growth of the actual delta during the last 6,000 years, rather than simply the changing of the floodplain. The first drawing of Figure 13c is of 6,000 years ago, whereas the drawing on the far right of Figure 13c is of 1,000 years ago. Notice that the width and size of the floodplain do not change, only the size and aerial extent of the delta. This is because we have not had major sea level changes during the last 6,000 years. The delta has continually built outwards during this time.

Figure 13 A.


CA. 3,000,000 TO 2,500,000 YRS B.P.
PRE-PLEISTOCENE SETTING
A
CA. 2,500,000 TO 1,800,000 YRS B.P.
EARLY PLEISTOCENE STAGE
B
CA. 1,300,000 TO 600,000 YRS B.P.
EARLY PLEISTOCENE STAGE
C
CA. 130,000 TO 120,000 YRS B.P.
SANGAMON STAGE
D
CA. 110,000 TO 70,000 YRS B.P.
"EOWISCONSIN" STAGE
E
Gulf of Mexico

B


CA. 30,000 YRS B.P.
MIDDLE WISCONSIN STAGE
F
CA. 12,000 YRS B.P.
LATE WISCONSIN STAGE
G
CA. 10,000 TO 9,000 YRS B.P.
EARLY HOLOCENE
H
CA. 9,000 TO 8,000 YRS B.P.
EARLY HOLOCENE
I
CA. 7,000 TO 6,000 YRS B.P.
MIDDLE HOLOCENE
J
Gulf of Mexico

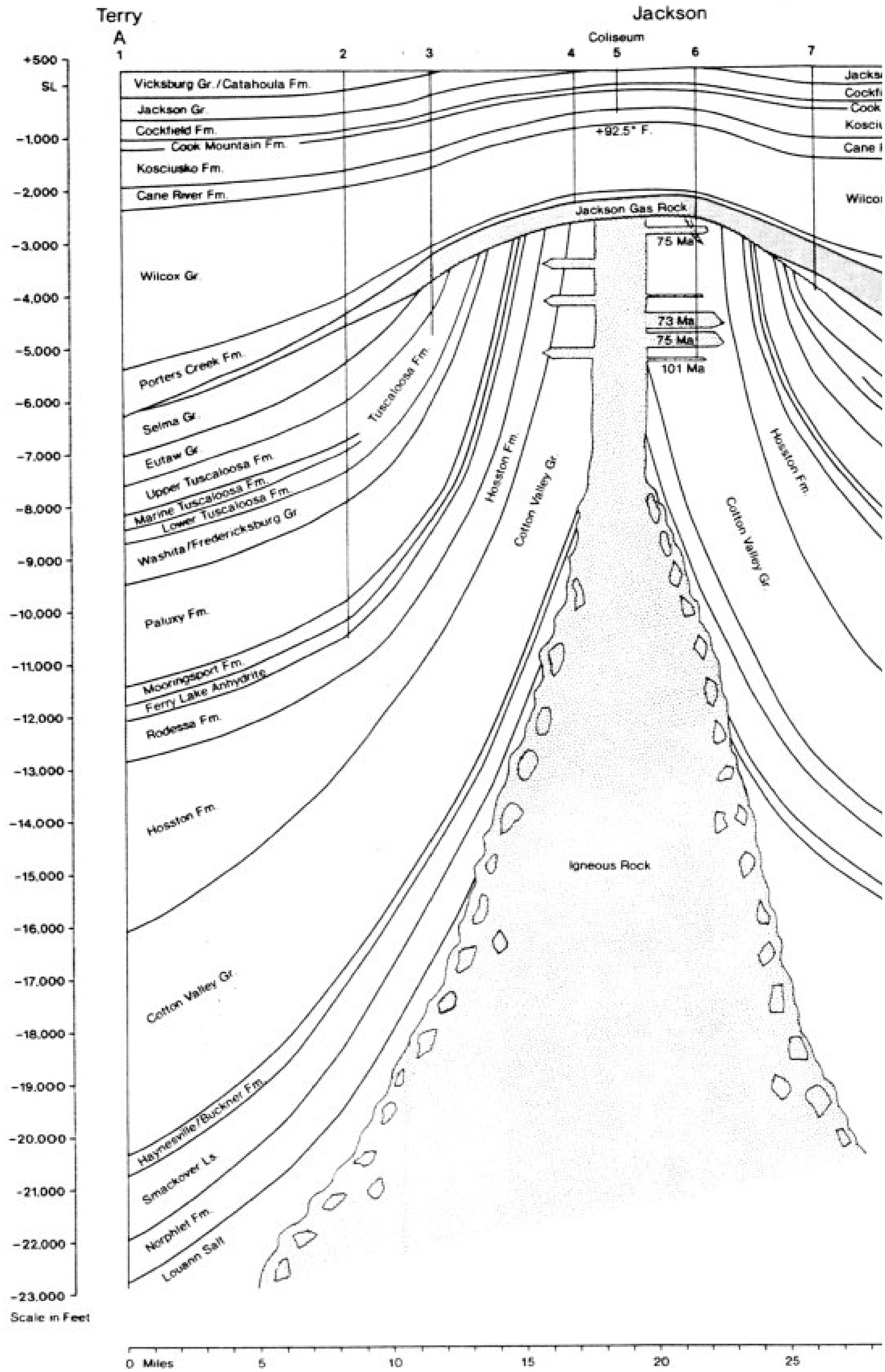
C.

7.0 The Jackson Volcano

I bet you didn't know that Mississippi had a volcano. This is another interesting geologic feature of Mississippi. The Jackson Volcano lies 2900 feet below the state's capital. The peak of the volcano is located below the coliseum on I-55. No other capital city or major population center is located above an extinct volcano. Mississippi also has a smaller volcano, the Midnight Volcano, which is located in Humphreys County. The Dense igneous rock below Jackson and Midnight increase the force of gravity slightly. With this in mind a person in Jackson or Midnight would be slightly heavier than elsewhere in the state.

Will this volcano erupt? Well, the answer is no. This volcano is not active nor it is not dormant, it is extinct. The volcanoes in the northern Gulf Province have been silent for about 65 million years or more. There is no reason to believe that any of them will ever erupt again.

Cross Section of the Jackson Volcano



8.0 Sources

3-3-2003 http://lupus.northern.edu:90/natsource/earth/Petrif1.htm
3-3-2330 http://www.mspetrifiedforest.com/
3-3-2003 http://www.statefossils.com/ms/msstone.html
3-3-2003 http://partners.fws.gov/pdfs/MS-needs.pdf
3-4-2003 http://biology.usgs.gov/s+t/SNT/noframe/ms137.htm

Dockery, D.T. and Others, Mississippi Geology, v. 18, no. 3
Saucier, Roger T. "Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley." United States Army Corp of Engineers, Vicksburg, MS, December 1994.

3-23-2003 http://geoscience.wes.army.mil/FS_VicksburgGeology.html
3-5-2003 http://www.earthfoot.org/loess/loess.html
3-5-2003 http://www.geobop.com/paleozoo/World/NA/US/MS/
4-3-2003
http://geology.about.com/library/bl/maps/blmissippimap.htm