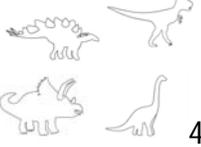
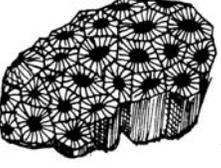
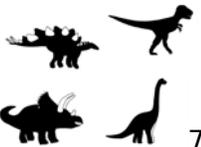
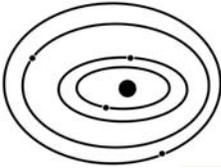
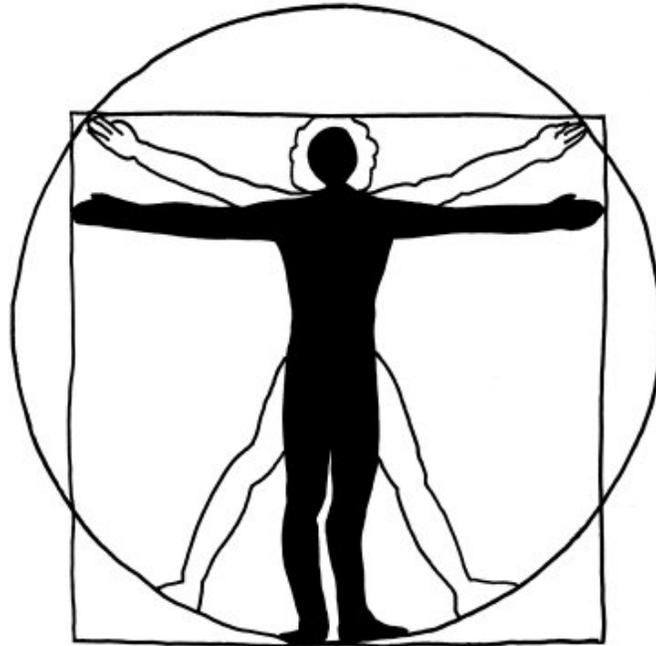


Click on an icon to find out more about it

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100,000



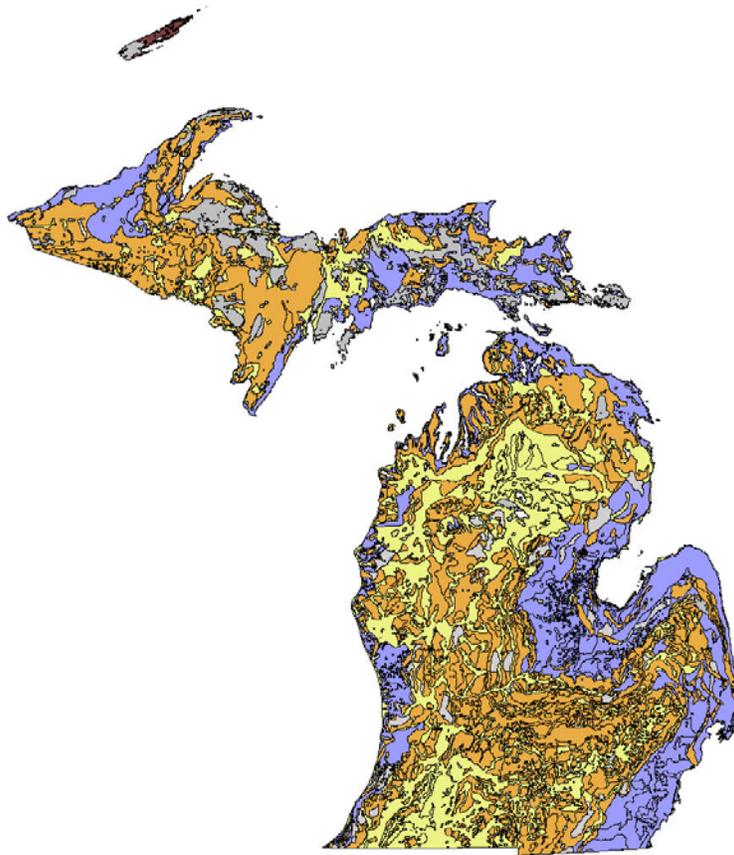
1 Modern humans

Modern humans are scientifically referred to as, *Homo sapiens*.

The term Holocene is used to denote the last 10,000 years when humans began to domesticate animals and cultivate plants. Humans have developed and use tools from stones to computers.

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1,800,000



2 Pleistocene GLACIAL deposits

During the Pleistocene Epoch great continental ice sheets, at least two kilometers (~1.25 mi.) thick, advanced and retreated over most of the northern hemisphere at least four different times. As the ice advanced, some animals were driven to warmer climates while others adapted to the cold by developing thick, furry hides. Fossils from this time include mammoths, mastodons, musk oxen and giant beavers. The mastodon is Michigan's State Fossil. This is only the most recent glacial episode. There have been other worldwide glaciations during Permian, Ordovician and Precambrian time.

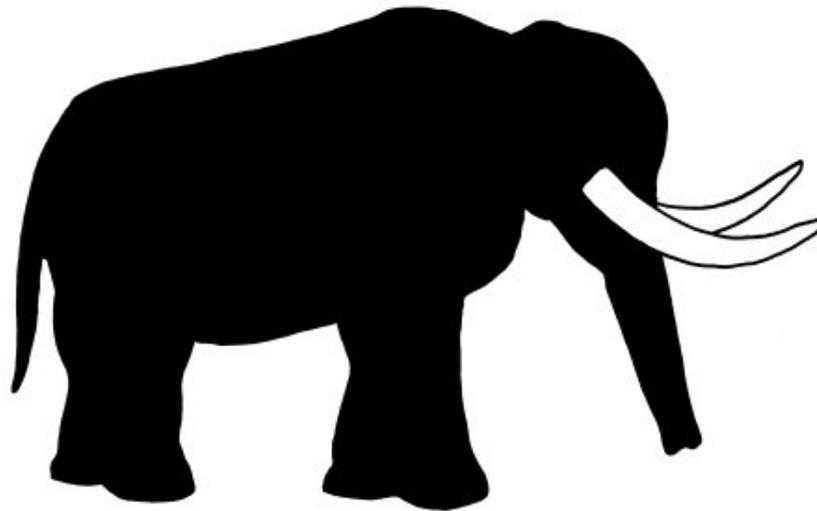
Outcrops: Numerous locations - these are the glacial deposits that cover 99 percent (or more) of Michigan.

Primary non-renewable resources: clay, sand, gravel, peat and marl. Great Lakes formed containing 20 percent of the fresh water on earth.

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37,000,000



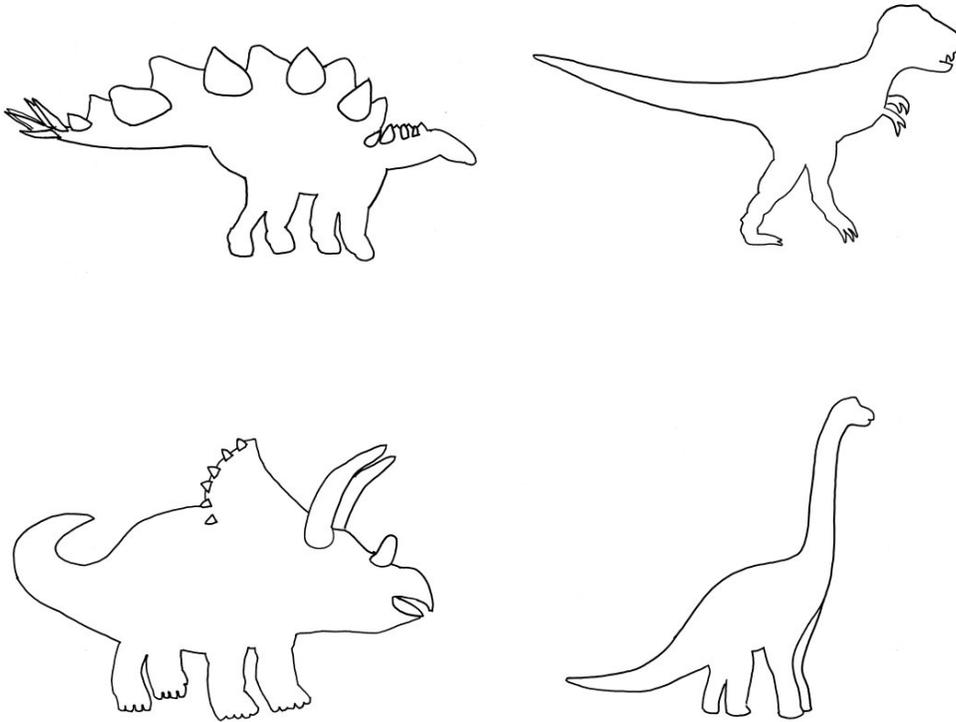
3 MASTODONS

The Mastodon, *Mammot americanum*, is the Michigan State Fossil. This extinct vertebrate has been found in the southern part of the Southern Peninsula. The Mastodon is easily differentiated from its larger and much younger 'cousin' the mammoth by the shape and definition of their teeth. Mastodons and many other large vertebrates went extinct about 10,000 years ago.

If you should find a vertebrate fossil contact a local museum or university. Proper excavation, documentation and management requires specialized, expensive resources and expertise.

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65,000,000

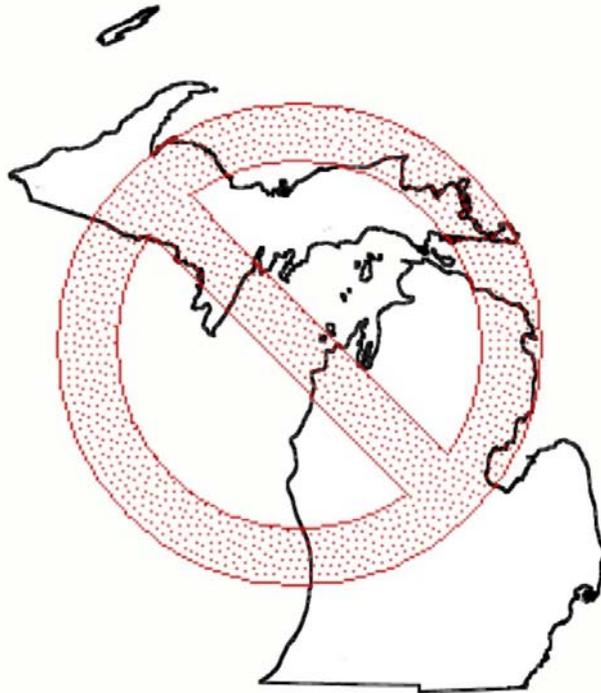


4 DINOSAURS become EXTINCT

Geologists believe there is a meteor impact site in the Yucatan Peninsula of Mexico near the town of Chixalub. This impact was likely a major contributor to a combination of circumstances that led to the extinction of dinosaurs. Depending on your opinion about the genetic relationship between birds and dinosaurs, not all dinosaurs are extinct.

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144,000,000



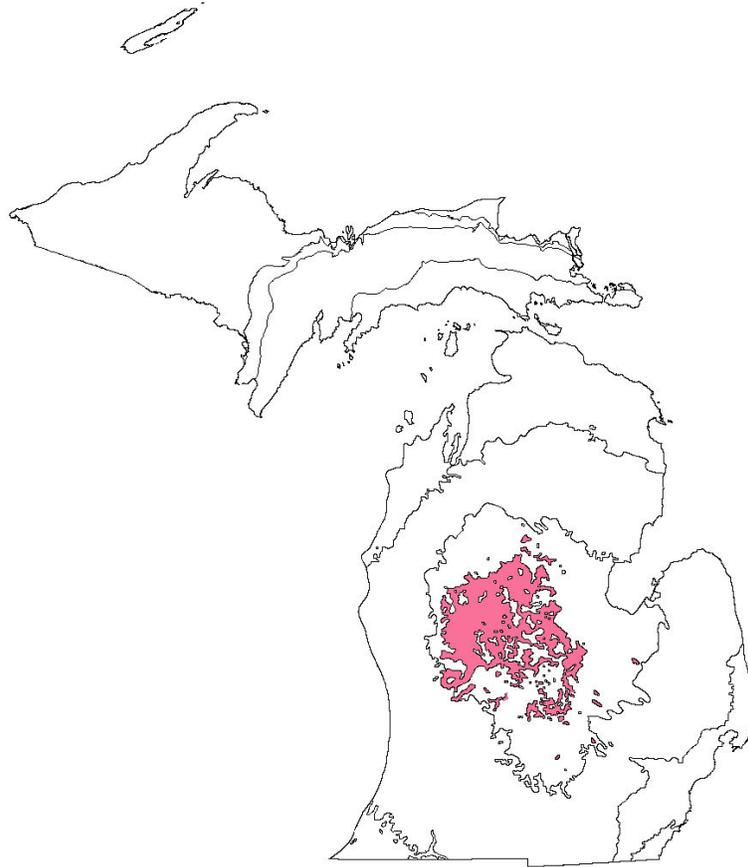
5 CRETACEOUS period

The Cretaceous period is marked by the last major submergence of what is now North America causing shallow seas to spread. The climate was still mild, favoring the development of the first flowering plants and insects that pollinate them. The evolution and diversity of dinosaurs and other reptiles peaked during the Early Cretaceous but declined swiftly at its end. This last period of the Mesozoic Era ended with major uplifts forming the Rocky Mountains and volcanic activity through most of what is now North America. As Pangea continued to breakup, the resulting new continents drifted apart and assumed more familiar shapes. The resulting catastrophic changes in the climate contributed to the extinction of dinosaurs, marine and flying reptiles, ammonoid and belemnoid cephalopods, as well as of two-thirds of the other marine invertebrates.

Outcrops: not known in Michigan

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206,000,000



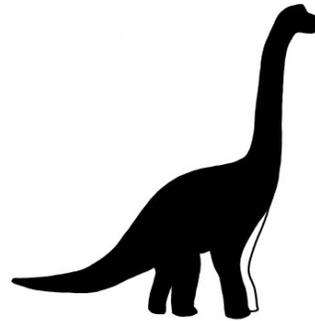
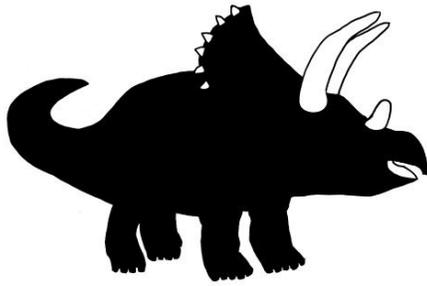
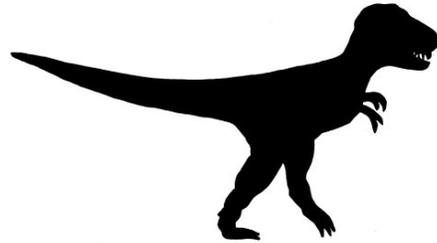
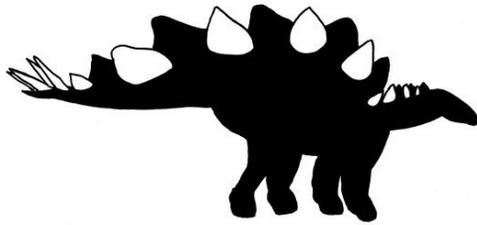
6 JURASSIC bedrock

The seas in Jurassic times covered only limited portions of what is now North America and the climate was mild and humid. On land, the dinosaurs continued to dominate while conifers, cycads, ferns and ginkgoes thrived. The first mammals and birds appear. In the seas, reef-building corals, mollusks, ammonites and sea urchins flourished. Pangea begins to break up and at the close of the Jurassic the extensive uplifting and volcanic activity in what is now western North America created the Sierra Nevada range.

Outcrops: not found in Michigan, samples are known from oil and gas drilling samples that contain fossil spores and pollen of Jurassic age

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245,000,000



7 DINOSAURS

Dinosaurs are well known. The name is Greek and means “terrible lizard”. These animals were a dominate life form for more than 200 million years. When did they first appear? When did they become extinct? How does that compare with the length of time that humans have been around?

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245,000,000

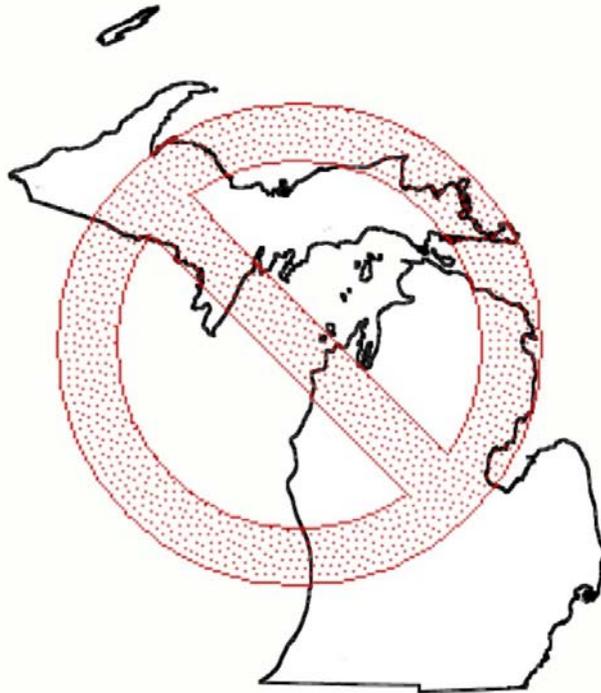


8 MAMMALS

Early mammals got started about the same time that dinosaurs did. However, early mammals were small, about the size of shrews and were a minor component of the environment. After the extinction of dinosaurs mammals expanded and diversified.

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248,000,000



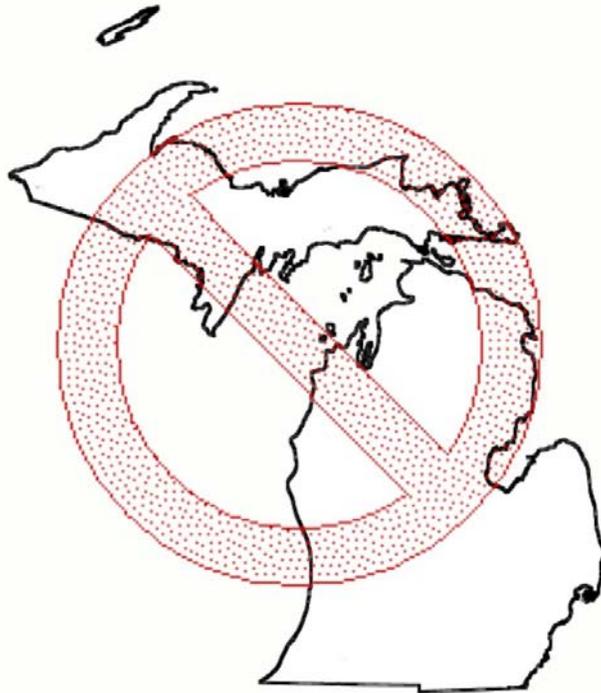
9 TRIASSIC period

The formation of Pangea, which began in the Mississippian Period, was completed by the end of the Triassic and now included all the continents we now know. During the Triassic, there was considerable volcanic activity in what is now eastern North America. In the shallow seas to the west, ammonites, gastropods and pelecypods flourished. While brachiopods, crinoids and nautiloid cephalopods declined. Reptiles established their dominance on the land, giving rise to the "Age of Dinosaurs".

Outcrops: not known in Michigan

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290,000,000



10 PERMIAN period

The continental uplift causes seas to shrink even further. Giant scale trees, conifers and insects dominated the land. Climatic and geographic changes at the end of the Permian, combined with extensive mountain building, resulted in the extinction of over 90 percent of all animal species, including ALL trilobites, blastoids and rugose corals. Reptiles then developed, as well as the first reptile with mammal-like features, Dimetrodon.

Outcrops: not known in Michigan

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320,000,000

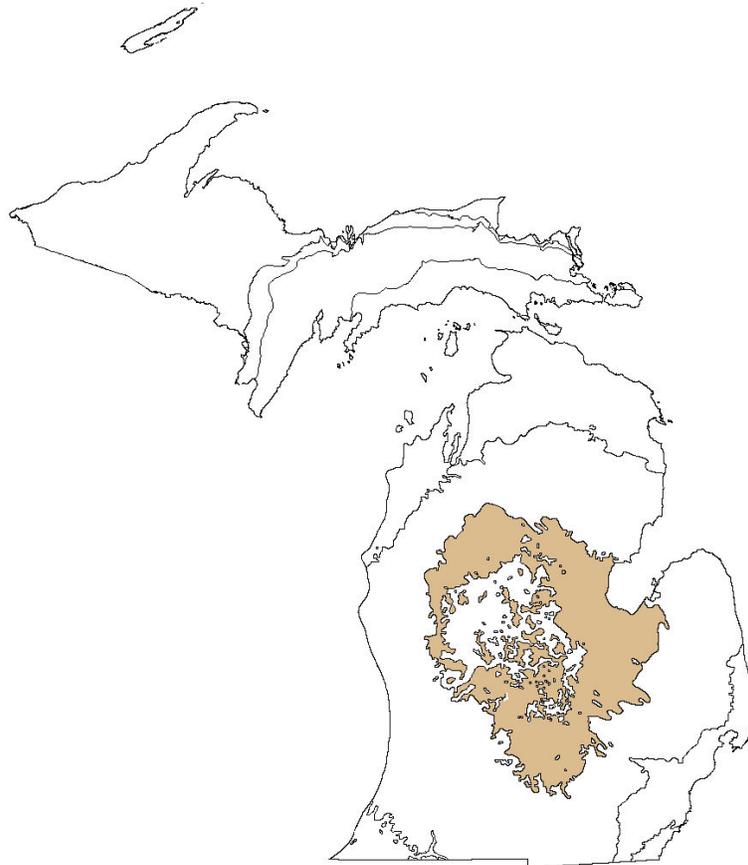


11 REPTILES

Early reptiles were lizard or crocodile-like. Reptiles did well on land because they did not have to lay their eggs in the water and their scales kept evaporation down. They adapted to many different niches. Over time reptiles gave rise to dinosaurs, birds and mammals. Where can you see turtles, snakes and other reptiles today? The silhouette of an iguana was used because it is one of the animals that captured the interest of a passenger on a ship called the "Beagle" in 1832. Who was this person?

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323,000,000



12 PENNSYLVANIAN bedrock

The retreating seas left extensive deltas. Increased temperatures and rainfall, combined with poor drainage, turned the deltas into swamplands. Plants became so abundant in these swampy areas that their decayed remains formed thick deposits of peat. Over geologic time these peat beds were converted to coal, an important resource the 1900's. Some leaves, stems and roots were preserved in the mud which turned to shale. In the seas, shallow water animals such as trilobites and crinoids declined, while deeper-water animals such as sharks and cephalopods continued to flourish.

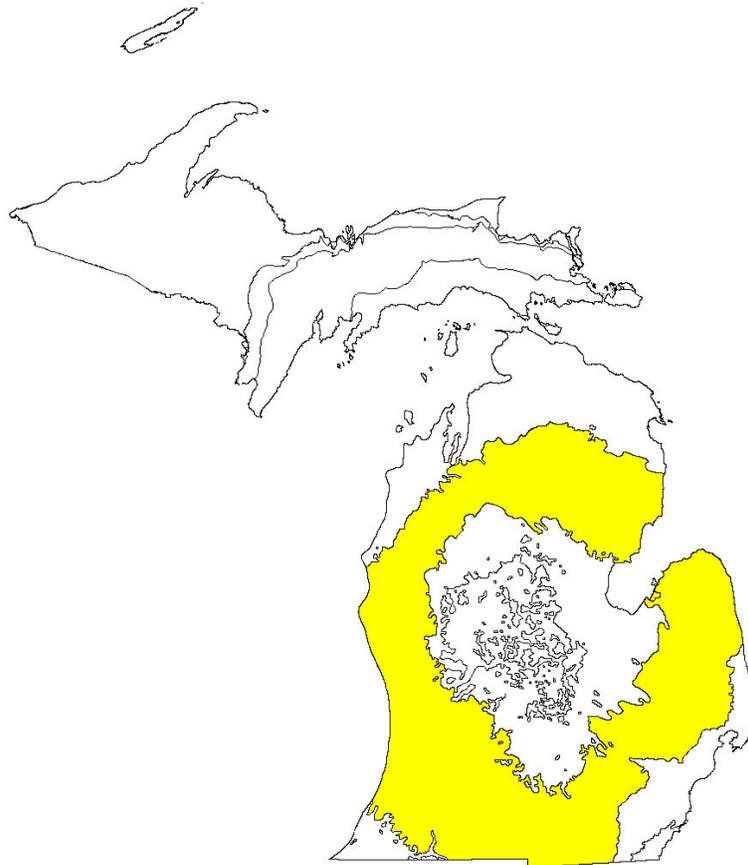
Outcrops: Arenac, Branch, Calhoun, Clinton, Eaton, Huron, Ingham, Ionia, Jackson, Ottawa Saginaw and Shiawassee counties

Primary non-renewable resources: Limestone, sandstone, coal and an important source of fresh water

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354,000,000



13 MISSISSIPPIAN bedrock

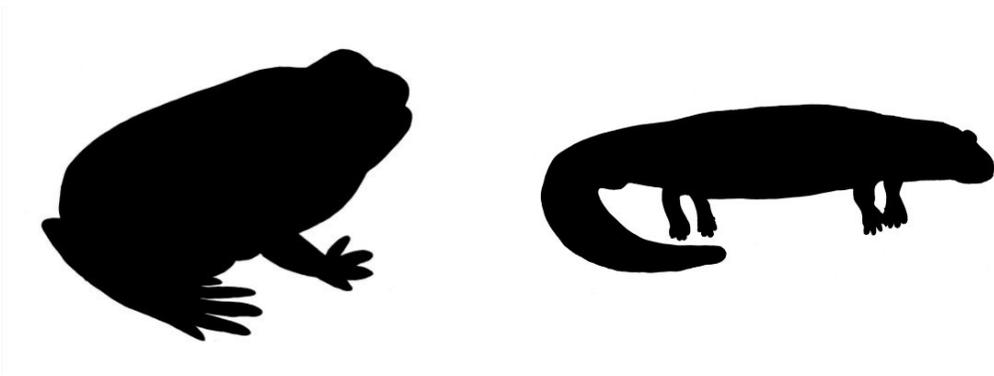
Warm, shallow seas covered most of the central portion of what is now North America, providing the perfect habitat for the proliferation of echinoderms, especially the crinoids and blastoids. However, conditions in the Michigan area were more arid, resulting in the deposition of extensive gypsum beds. By the end of the Mississippian Period the retreat of the seas caused a restriction of the marine environment, resulting in reduced invertebrate populations. In particular the trilobites were decimated both in numbers and species diversity. Pangea, which stretched from the North Pole to the South Pole, was forming as most of the continents drifted together.

Outcrops: Antrim, Arenac, Branch, Calhoun, Charlevoix, Clinton, Eaton, Hillsdale, Huron, Iosco, Ingham, Jackson, Kent, Ogemaw, Sanilac, Saginaw, Shiawassee and Tuscola counties

Primary non-renewable resources: Limestone, sandstone, gypsum and an important source of fresh water

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400,000,000



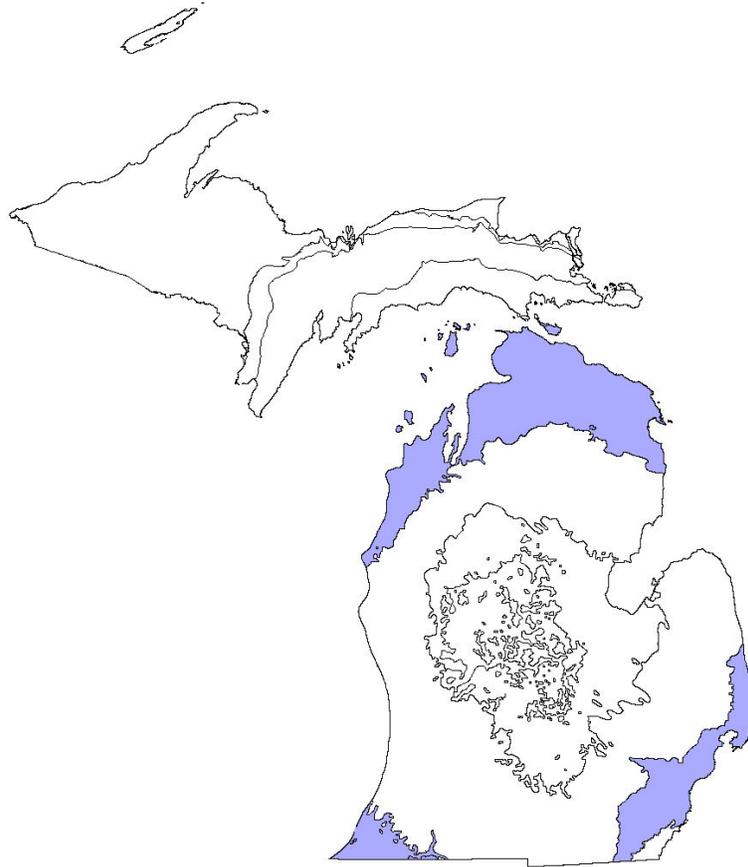
14 AMPHIBIANS

Amphibians were the first vertebrates to move into the terrestrial environment. However they have to return to water to lay their eggs. Amphibians spend most of their early lives in water because they cannot breathe air. Ancestral amphibians probably looked something like salamanders.

How many frogs and salamanders have you seen or heard? How are amphibians similar or different from other vertebrates like fish, reptiles and mammals?

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417,000,000



15 DEVONIAN bedrock

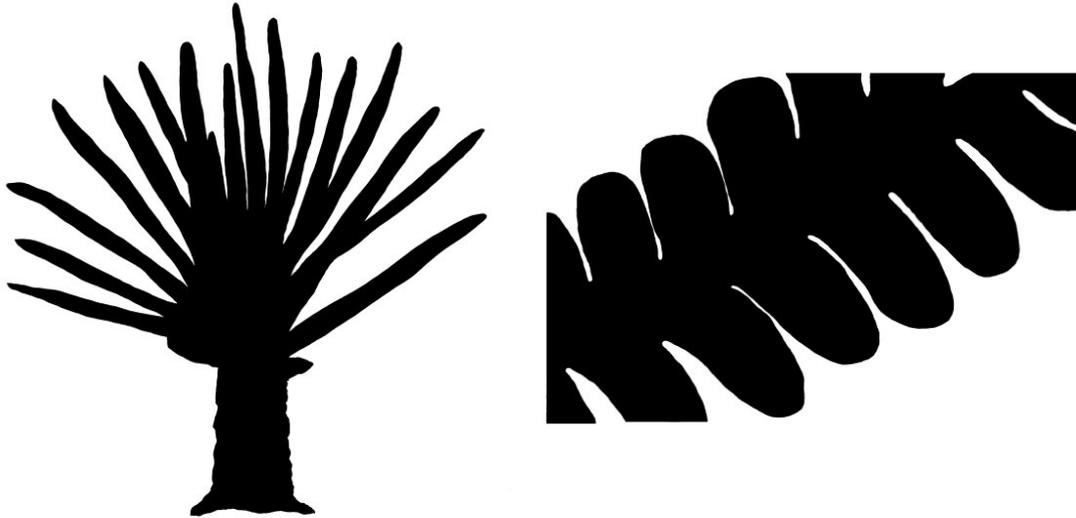
The Devonian sediments were laid down during a period of fluctuating sea levels. These deposits are the most fossiliferous outcrops in Michigan. Fish underwent great evolutionary development during the Devonian, with specialized forms such as the placoderms (fish with hard bony plates covering their skin) reaching lengths of 9 meters (~30 ft.). Other sea life included the corals, bryozoans, mollusks, arthropods and echinoderms. This was also the time of forests of trees and ferns.

Outcrops: Alcona, Alpena, Antrim, Charlevoix, Cheboygan, Emmet, Leelanau, Monroe, Presque Isle, St. Clair, Washtenaw and Wayne counties

Primary non-renewable resources: Limestone, shale, oil and gas

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435,000,000



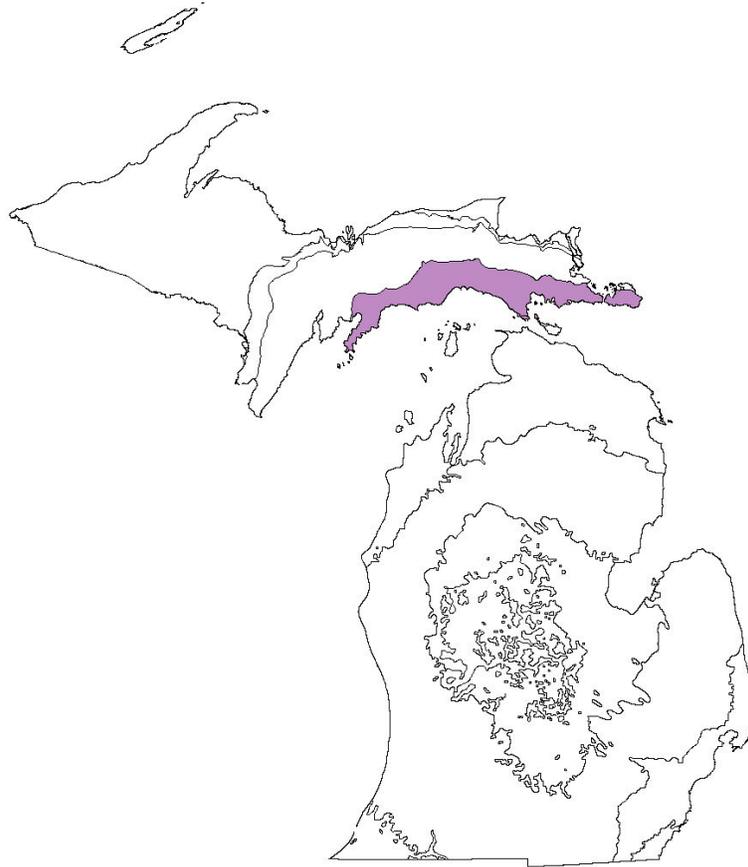
16 LAND PLANTS

Early land plants looked different from what we see today. They were small, had branching stems with little spore-filled pods on the top of each stem. They did not have leaves. Until plants moved onto the land there was no soil, only rock fragments. Plant growth and decay is needed for soil to form. Natural selection likely favored living on land because land plants were not eaten by those pesky aquatic animals. Early plants survived and evolved into different species that filled the new niches.

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443,000,000



17 SILURIAN bedrock

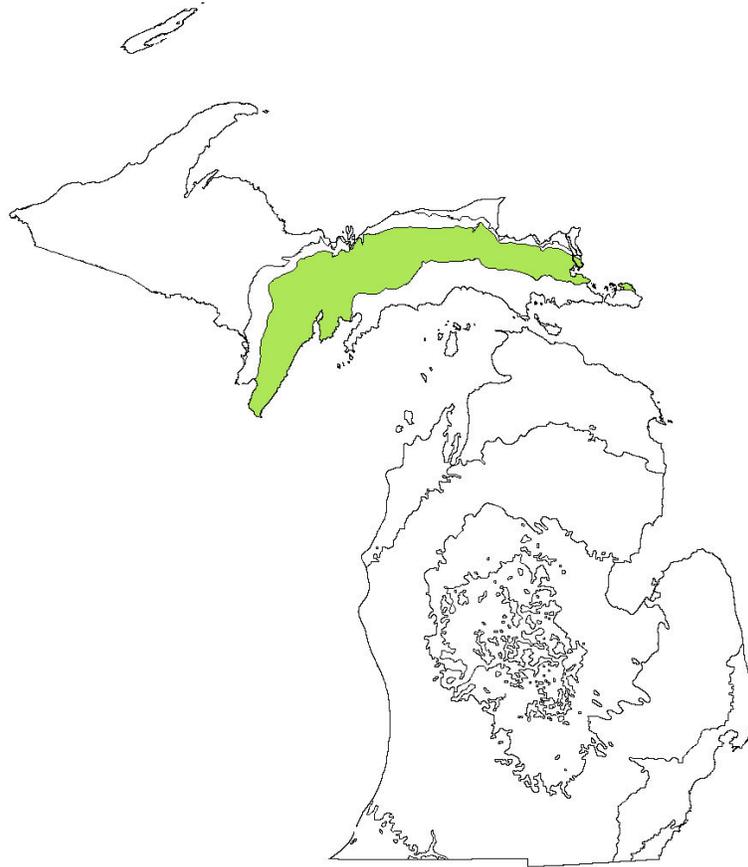
An isolated, shallow sea across parts of New York, Pennsylvania, Ontario and Michigan evaporated, leaving massive salt deposits. The seas abounded with reef- building corals, crinoids with root systems attached to the sea floor, mollusks and other marine life. While on land the first plants emerged. Seas receded during the later part of this period due to uplift and mountain building.

Outcrops: Chippewa, Delta, Houghton, Luce, Mackinac Monroe and Schoolcraft counties

Primary non-renewable resources: salt, limestone and dolomite, oil and gas

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490,000,000



18 ORDOVICIAN bedrock

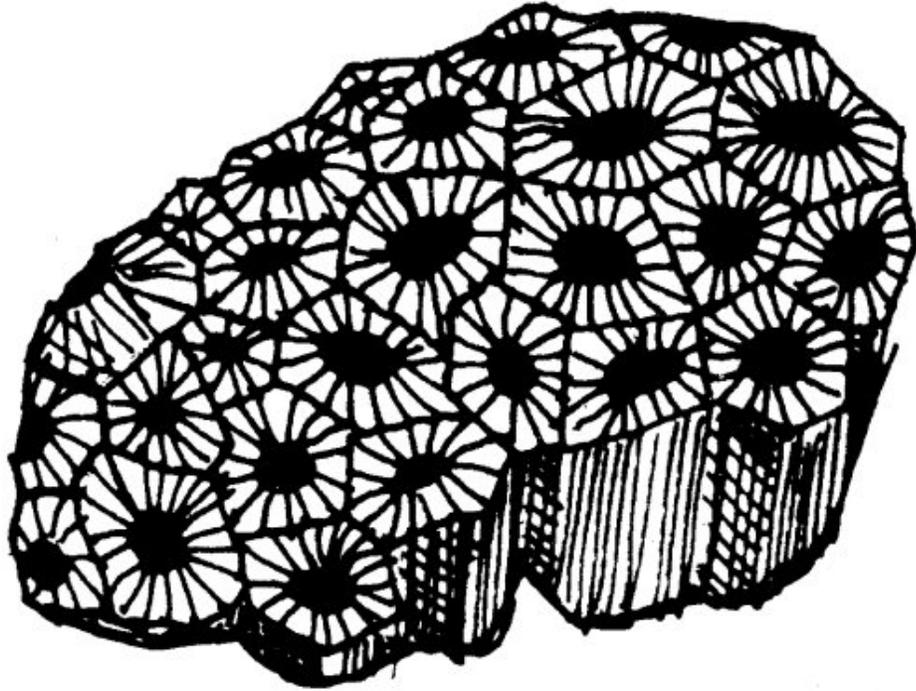
During the Ordovician Period, 70 percent of what is now North America was under water. The warm uniform temperatures resulted in expansion and greater diversification of marine invertebrates. Nautiloid cephalopods were the largest life forms, sometimes reaching a length of 5 meters (~16 ft). These, with other mollusks, bryozoans and articulate brachiopods were the most abundant animals of the period. Plant life consisted almost completely of seaweed and algae.

Outcrops: Alger, Chippewa, Delta, Marquette and Menominee counties

Primary non-renewable resources: limestone and dolomite; oil & gas

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505,000,000



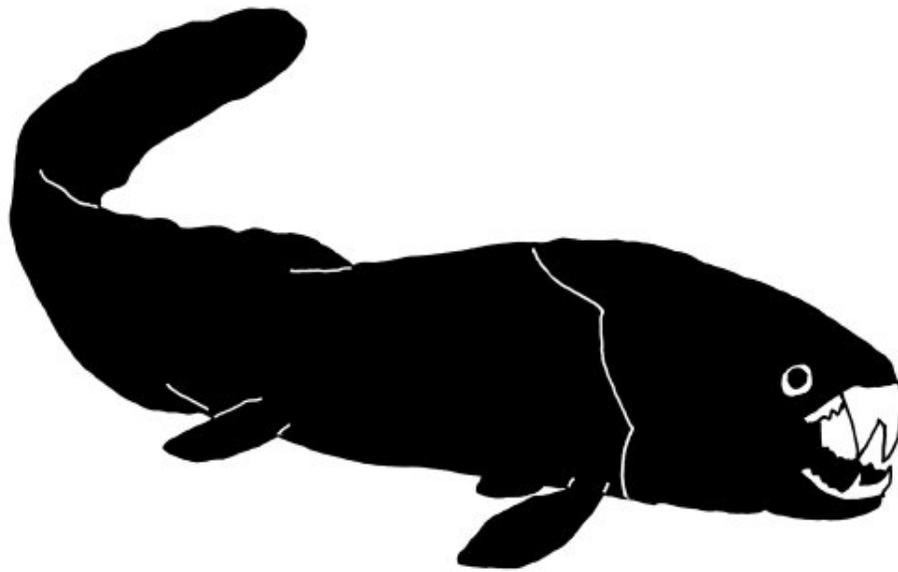
19 CORALS

The earliest corals might have looked something like this, with each compartment housing a single animal called a polyp. Corals were one of the important reef building animals. The coral seen here is the Petoskey stone, the State Stone of Michigan. It was used here because it is easily recognized. Where do corals grow today? Why do we find them in Michigan? What geologic resources are corals associated with?

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505,000,000

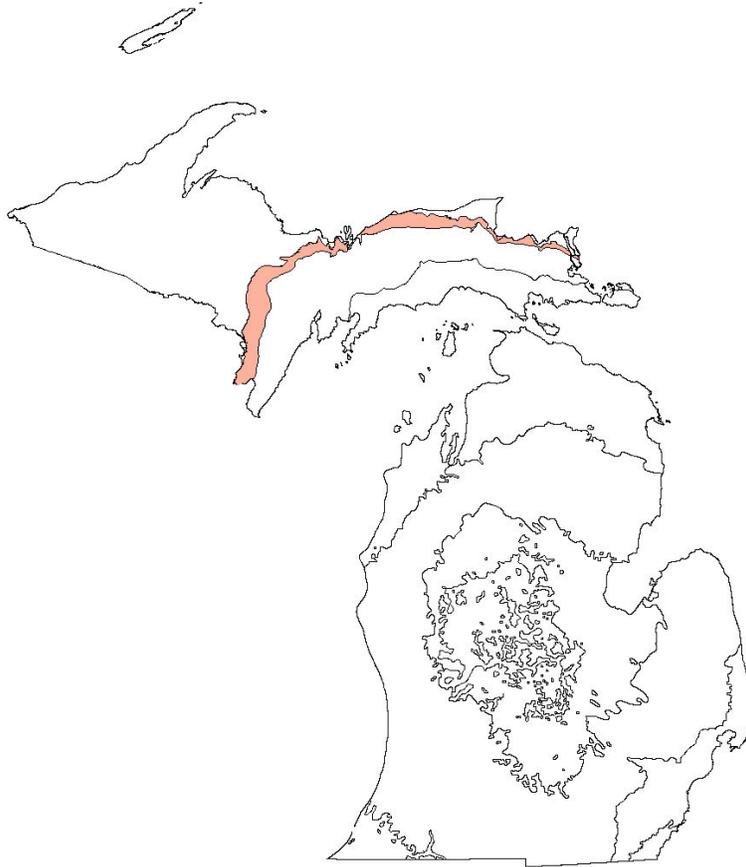


20 FISH

The fish seen here is one found in Devonian age rocks and is called a placoderm. It had several boney plates around the head area. The rest of the body was covered with scales. They were like the *T. rex* of the ocean. It could grow to 9 meters (~30 ft.) in length with plates up to 4 centimeters (~1.5 in.) thick. The teeth were arranged like the blades of self sharpening scissors. What did these fish eat? Anything they wanted to. Amazing as these creatures were, they are extinct, while sharks, which evolved at about the same time, are still around.

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543,000,000



21 CAMBRIAN bedrock

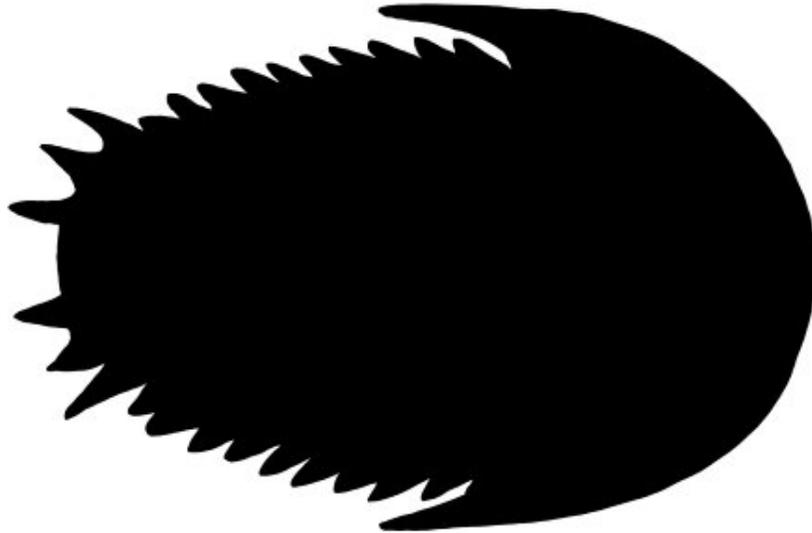
The beginning of the Cambrian is marked by the formation of low lying continental platforms that combined to form the huge land mass called Gondwanaland. Much of the margins were covered in part by shallow seas that were hospitable to life. Massive algal stromatolites were abundant. An explosion of trilobites and other arthropods led to their becoming the dominant animal during this period, yet they declined in both type and number toward the close of the Cambrian, due in part to shrinking seas.

Outcrops: Dickinson, Baraga, Chippewa, Gogebic, Houghton, Iron, Keweenaw, Luce, Marquette and Ontonagon counties

Primary non-renewable resources: sandstone

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570,000,000



22 TRILOBITES

Trilobites may well be the quintessential fossil. They are at once mysterious yet friendly, common yet rare, attractive yet repulsive, you get the idea. These extinct relatives of shrimp and horseshoe crabs have helped geologists organize out geologic time. They are among the animals that mark 'the beginning' of the fossil record known as the Cambrian explosion. Because they are unique and changed rapidly over time, they have served well as index or guide fossils.

Trilobite is pronounced try-lo-bite or try-lob-ite (not tril-o-bite). The name is derived from the arrangement of the body into three (tri) lobes running from the head (cephalon) to the tail (pygidium).

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1,060,000,000



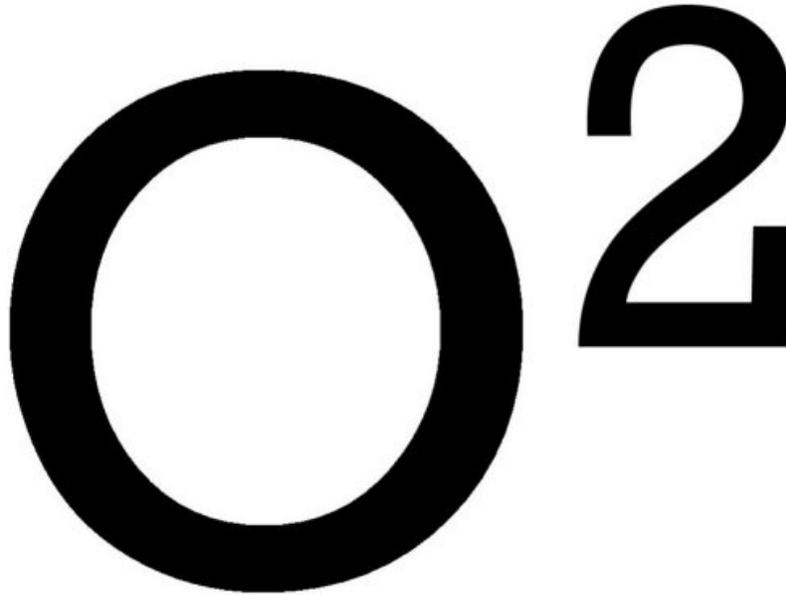
23 COPPER emplaced in the Keweenaw Peninsula

Extensive amounts of native or elemental copper were emplaced in the Keweenawan age rocks in the Northern Peninsula. These rich copper deposits played an important role in settling and developing Michigan shortly after it became the twenty-sixth state. In 1842 Michigan was the site of the first mineral rush in the United States. Copper was mined for 153 years during which, 7,297,679 TONS were produced. The copper that was mined in Michigan meant more economically to the state and nation than the 'gold rush' in California.

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2,000,000,000

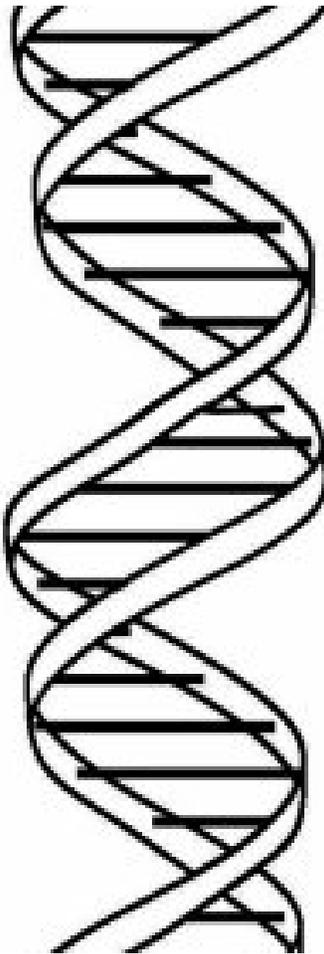


**24 OXYGEN atmosphere,
OZONE layer and
BANDED IRON ores Deposited**

Oxygen is the most abundant element in the crust of the earth. However oxygen easily combines with other elements. Free oxygen formed in the atmosphere and in the oceans due to photosynthetic activities of early life forms like *Grypania*. This was the first occurrence of significant amounts of free oxygen (O₂) and the beginnings of ozone (O₃). Prior to this time there was little or no free oxygen in the atmosphere. As a result life forms that require oxygen could now evolve. Dissolved iron (Fe) could combine with oxygen to form Banded Iron Formations found in many locations around the world including the western Northern Peninsula of Michigan.

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3,800,000,000



**25 OCEANS and ATMOSPHERE form
Oldest evidence of LIFE**

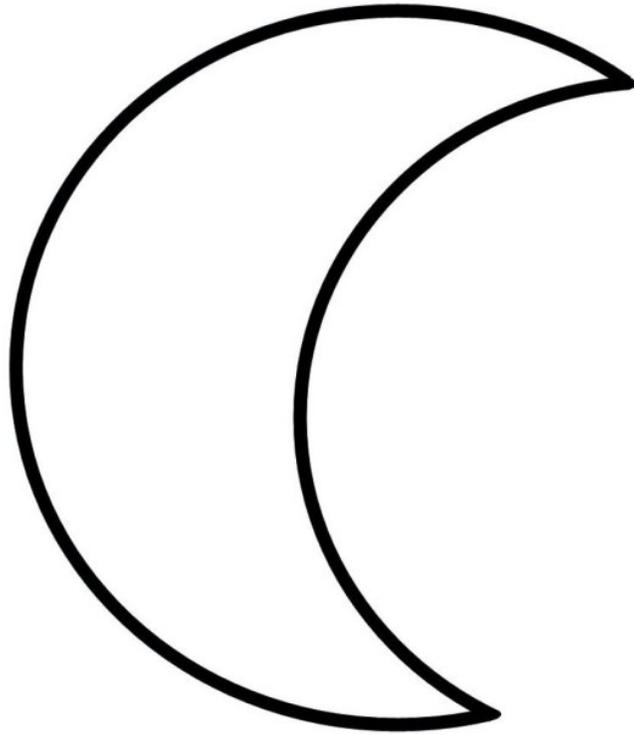
All life, as we know it, is based on the double helix of DNA (deoxyribonucleic acid). DNA molecules carry the genetic information necessary for the organization and functioning of most living cells and control the inheritance of characteristics. It took a considerable period of time for the earth to cool, sizable oceans to form and life to start.

Early life forms were small simple entities. These life forms, although they were primitive, were able to withstand and even thrive in conditions that we would consider unpleasant, hostile or dangerous.

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4,500,000,000



26 MOON forms

The formation and existence of the Moon has been very important to life on Earth. The moon has helped to control the rate of rotation or spin of the earth on its axis. It controls and maintains a limited tilt and variation of the tilt of the axis that causes the seasons. The moon causes tides which are also important to the many coastal life forms. It may have acted as a shield or magnet for some of the meteorites that were headed for Earth. It also gives us something to rhyme with June and soon.

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4,600,000,000



27 Precambrian bedrock

The Precambrian contains 88 percent of earth's history. The effects of heat and pressure from widespread mountain building caused considerable alteration of rock layers during the Proterozoic, or Precambrian, Era. This was followed by extensive erosion, especially in Canada and the northeastern United States. All life was in the sea. The first evidence of life is of single celled, bacteria-like algae; the preserved forms of some colonies of these microorganisms are known as stromatolites. These algal life forms increased the amount of oxygen in the atmosphere, leading to early animal life forms. Although highly developed most Precambrian life forms were soft bodied and not well preserved as fossils.

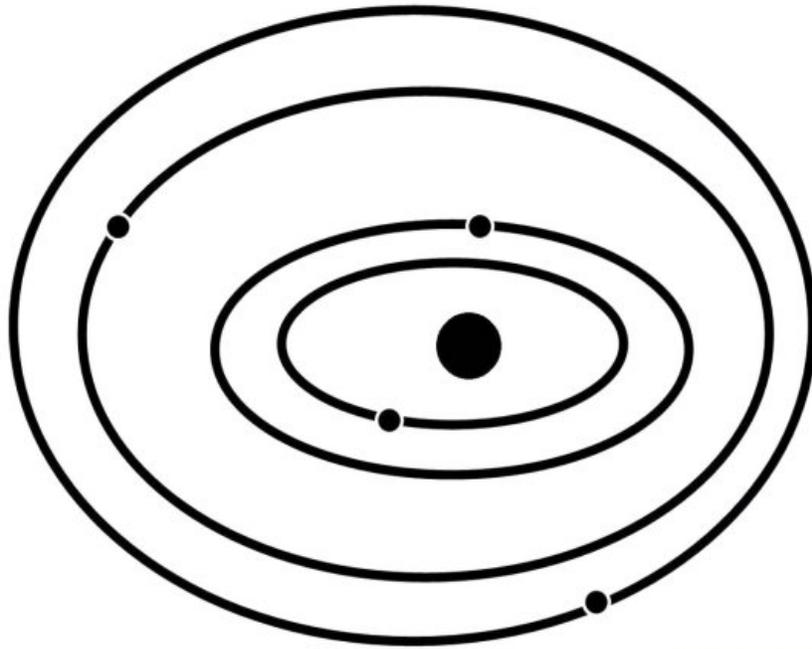
Outcrops: Baraga, Dickinson, Houghton, Gogebic, Iron, Keweenaw, Ontonagon and Marquette counties

Primary non-renewable resources: Iron ore, copper, gold, nickel, silver, dimension stone

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4,600,000,000



28 EARTH forms

No one was there when this happened. No one knows for sure how or why it happened, but by studying galaxies far, far away we might better understand how the earth could have formed. For one, I am glad it is here. Let's do what we can to take care of it and show it the respect it deserves.

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