

**Click on a thumbnail map to find out more about  
Geology in Michigan**



Pleistocene glacial deposits



Mississippian bedrock



Ordovician bedrock



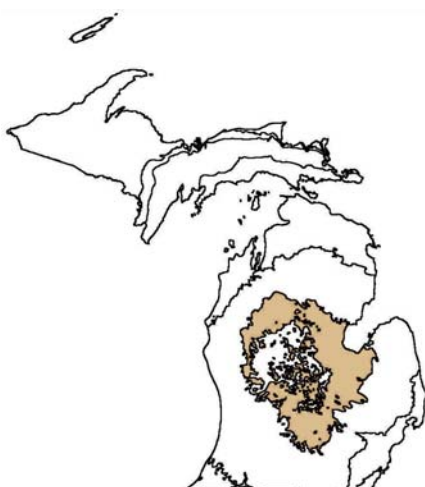
Jurassic bedrock



Devonian bedrock



Cambrian bedrock



Pennsylvanian bedrock



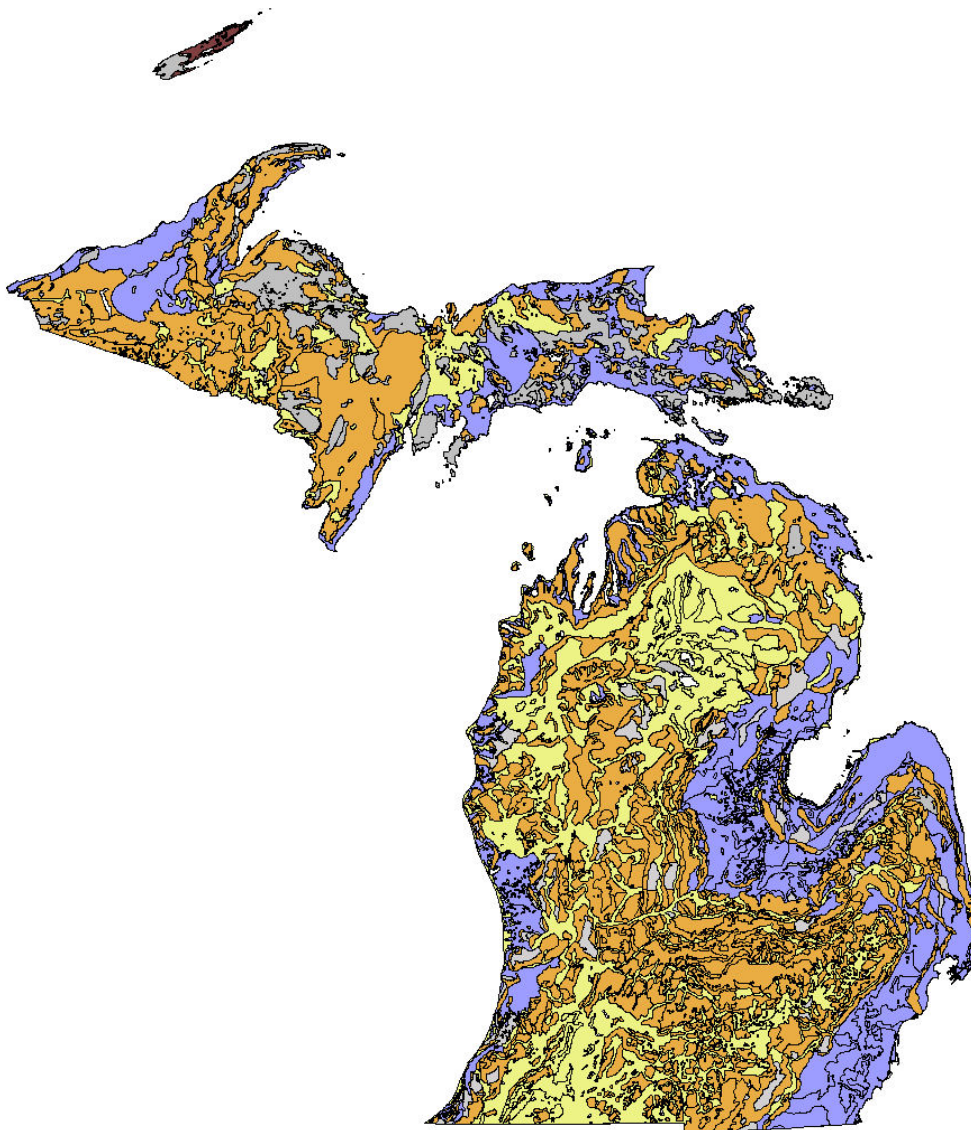
Silurian bedrock



Precambrian bedrock

# 1,800,000 to 10,000

1,800,000  
Pleistocene



206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

Geology Map

## 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.

Thumbnail maps

# 206,000,000 to 144,000,000

1,800,000  
Pleistocene

206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

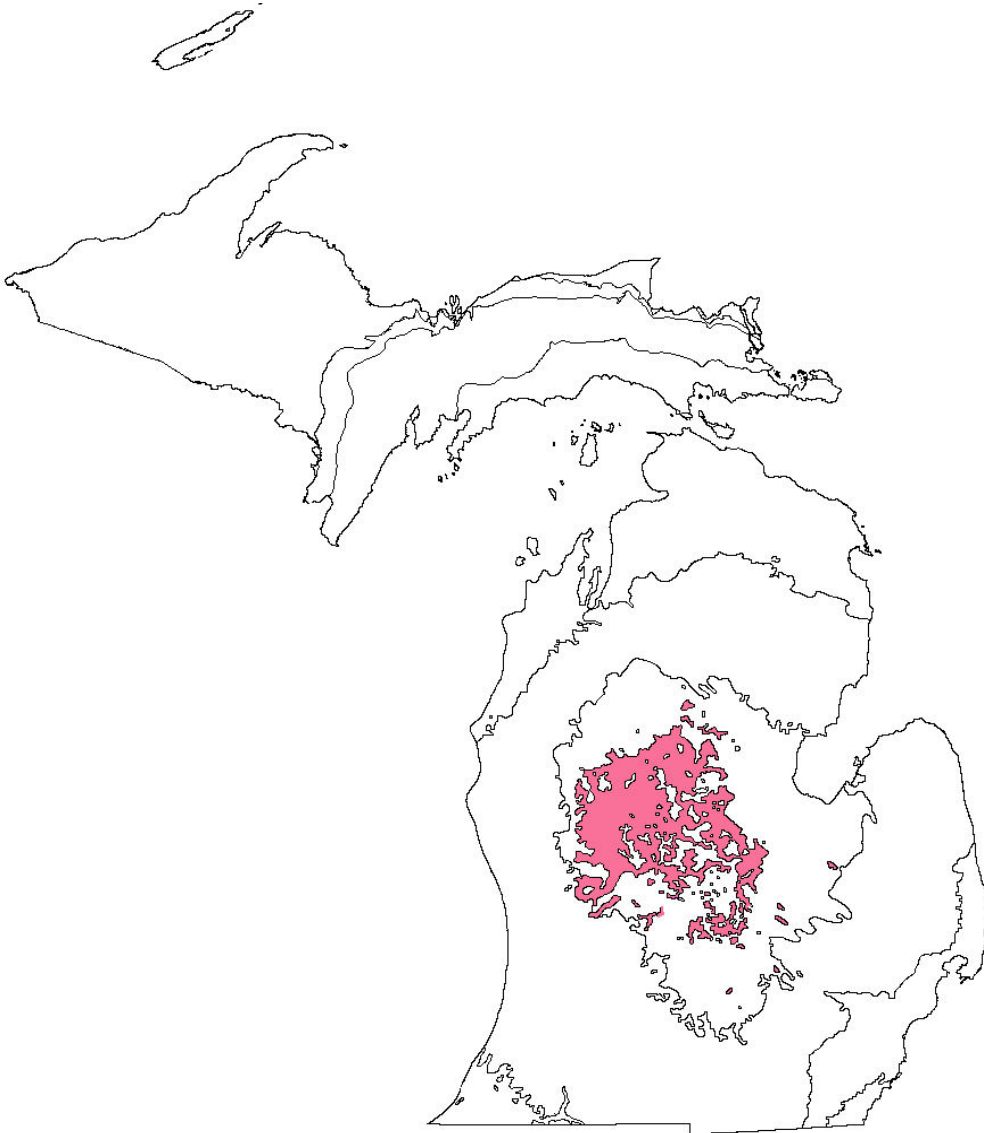
144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

Geology Map

Thumbnail maps

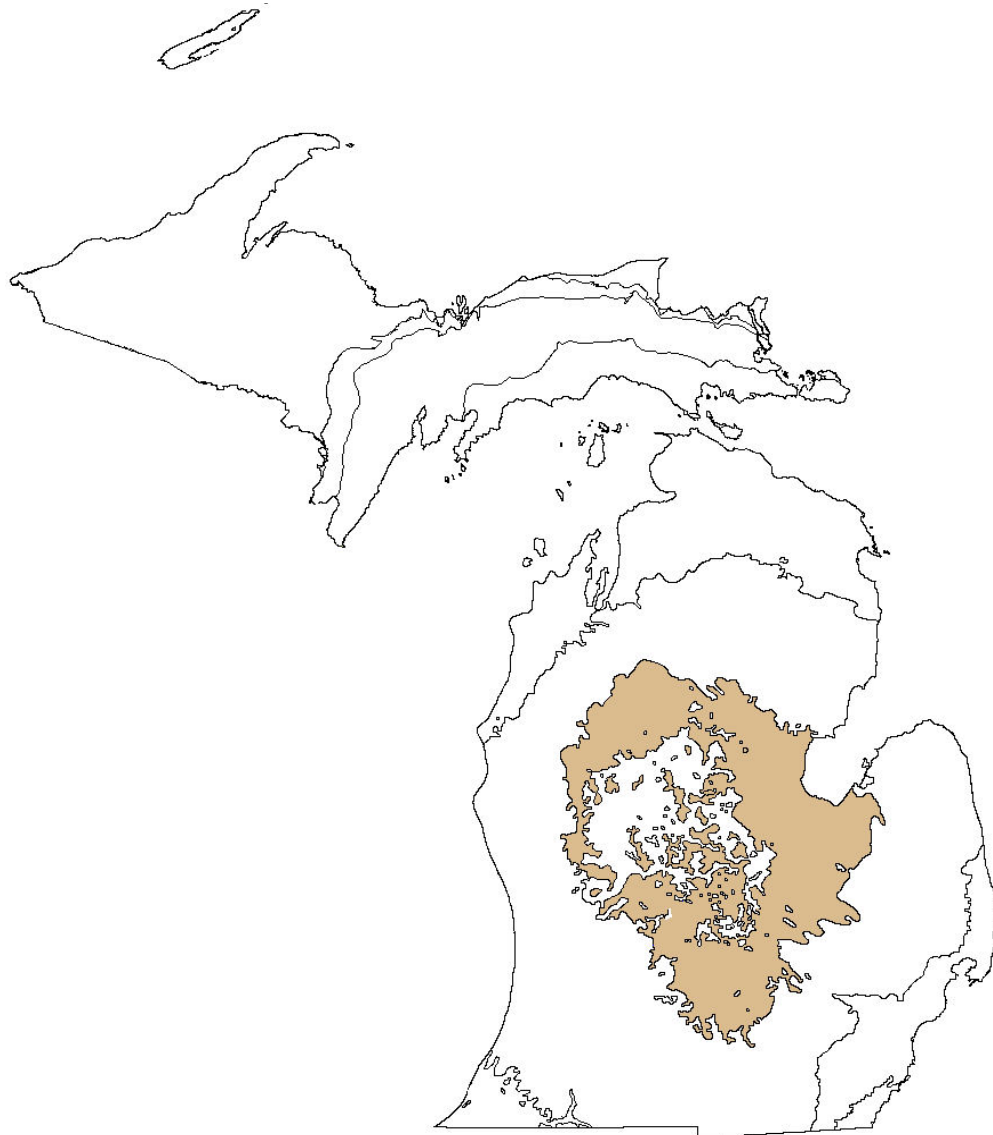


## JURASSIC bedrock

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

# 323,000,000 to 290,000,000



1,800,000  
Pleistocene

206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

Geology Map

## 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.

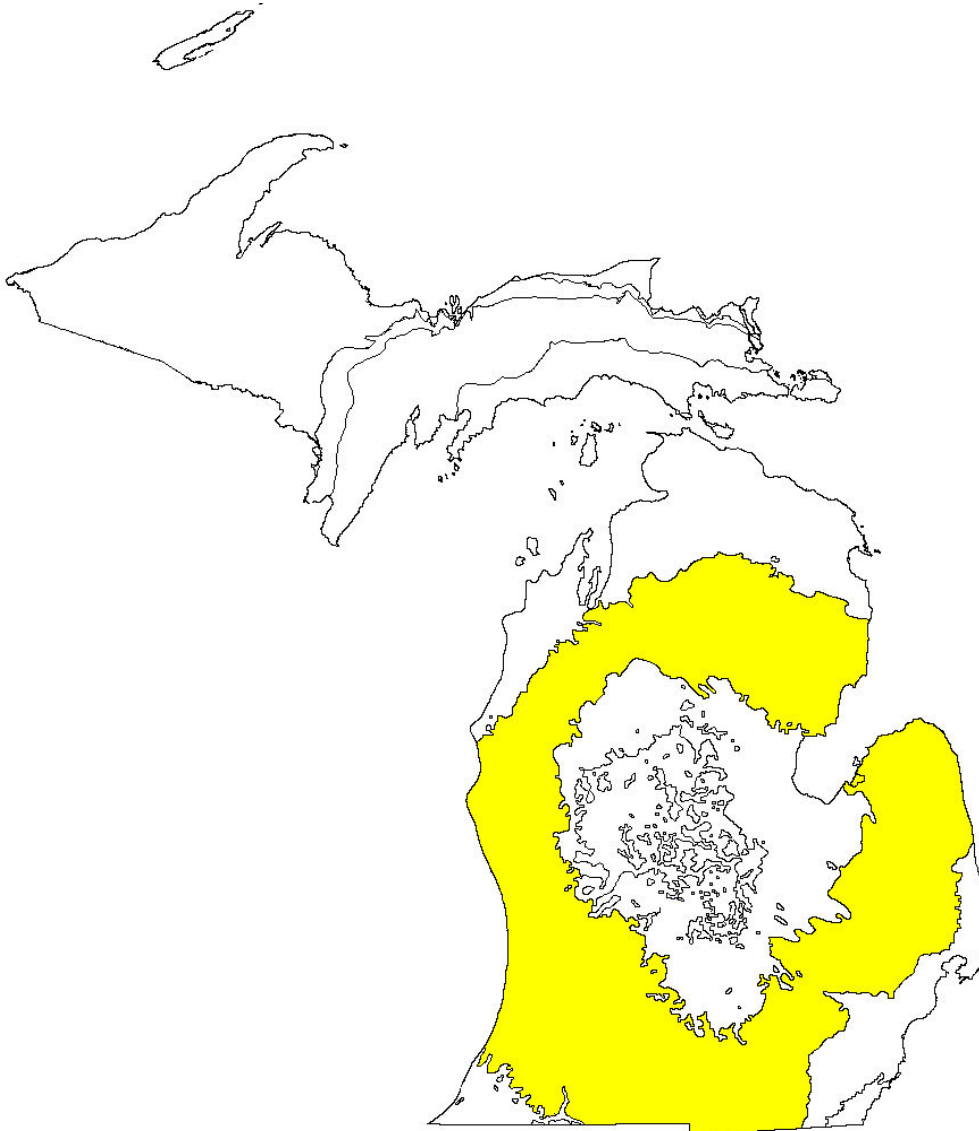
**Outcrops:** Arenac, Branch, Calhoun, Clinton, Eaton, Huron, Ingham, Ionia, Jackson, Ottawa Saginaw and Shiawassee counties

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

Thumbnail maps



# 354,000,000 to 323,000,000



1,800,000  
Pleistocene

206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

[Geology Map](#)

[Thumbnail maps](#)

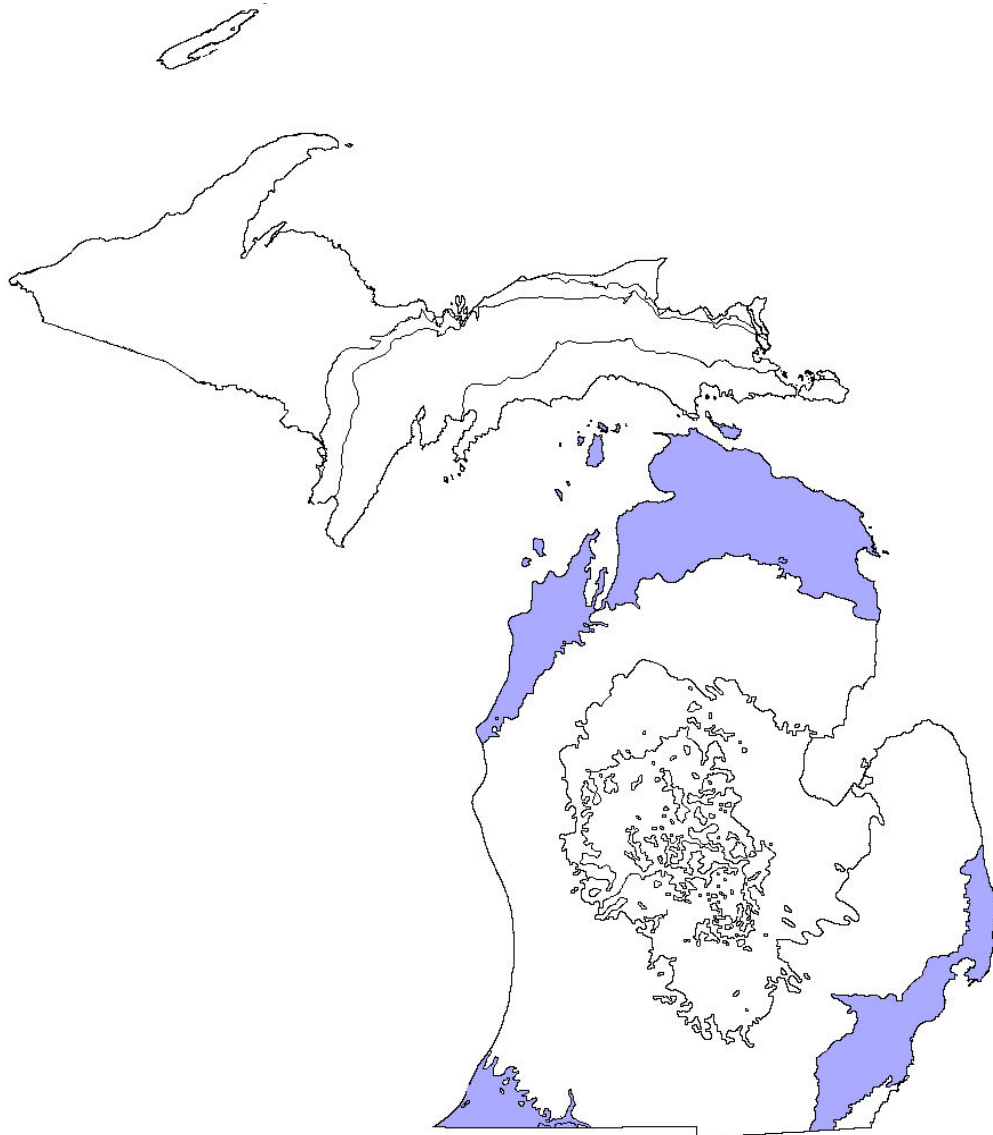
## MISSISSIPPIAN bedrock

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

# 417,000,000 to 354,000,000



1,800,000  
Pleistocene

206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

Geology Map

## DEVONIAN bedrock

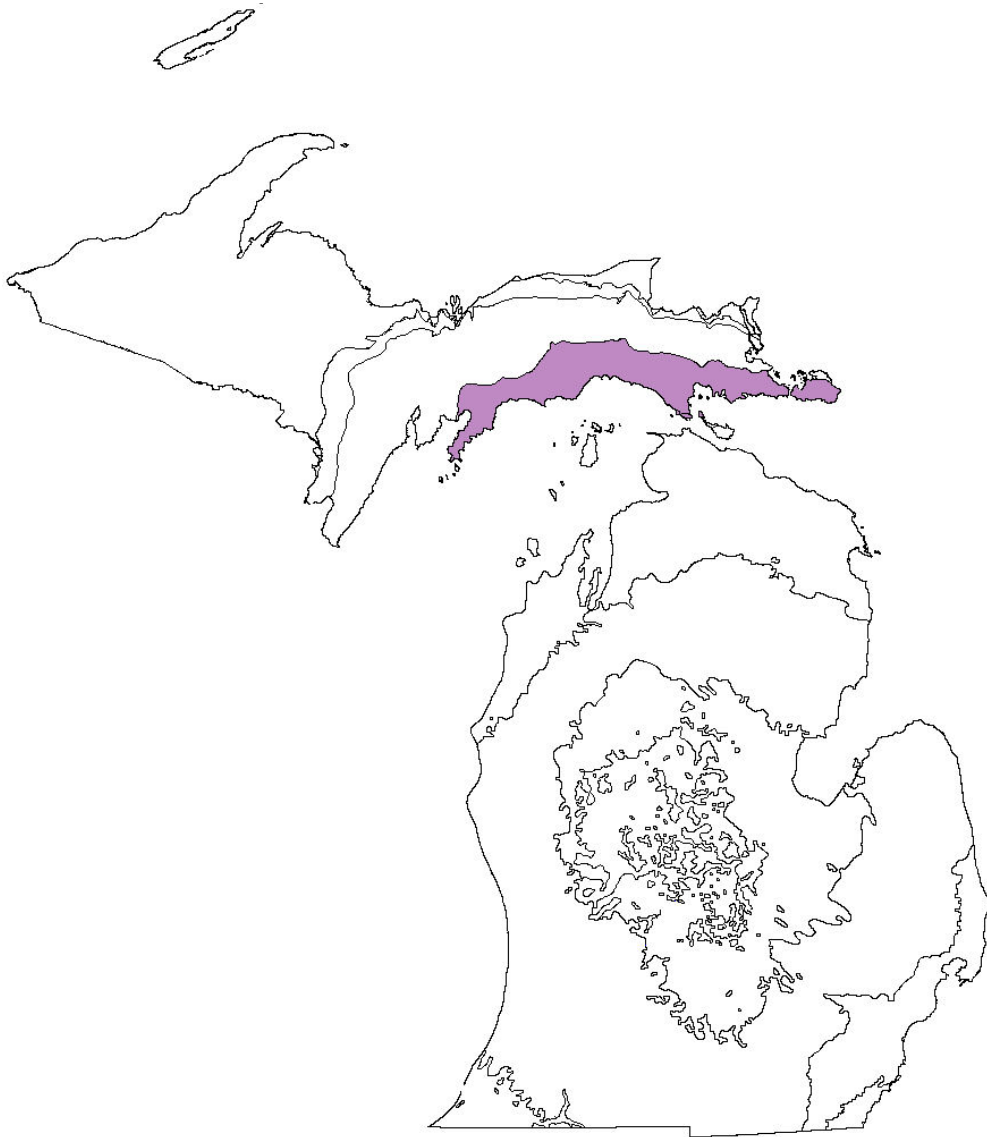
The Devonian sediments were laid down during a period of fluctuating sea levels. These deposits are the most fossiliferous outcrops in Michigan. Fish underwent great evolutionary development during the Devonian, with specialized forms such as the placoderms (fish with hard bony plates covering their 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

Thumbnail maps

**443,000,000 to 417,000,000**



1,800,000  
Pleistocene

206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

Geology Map

### **SILURIAN bedrock**

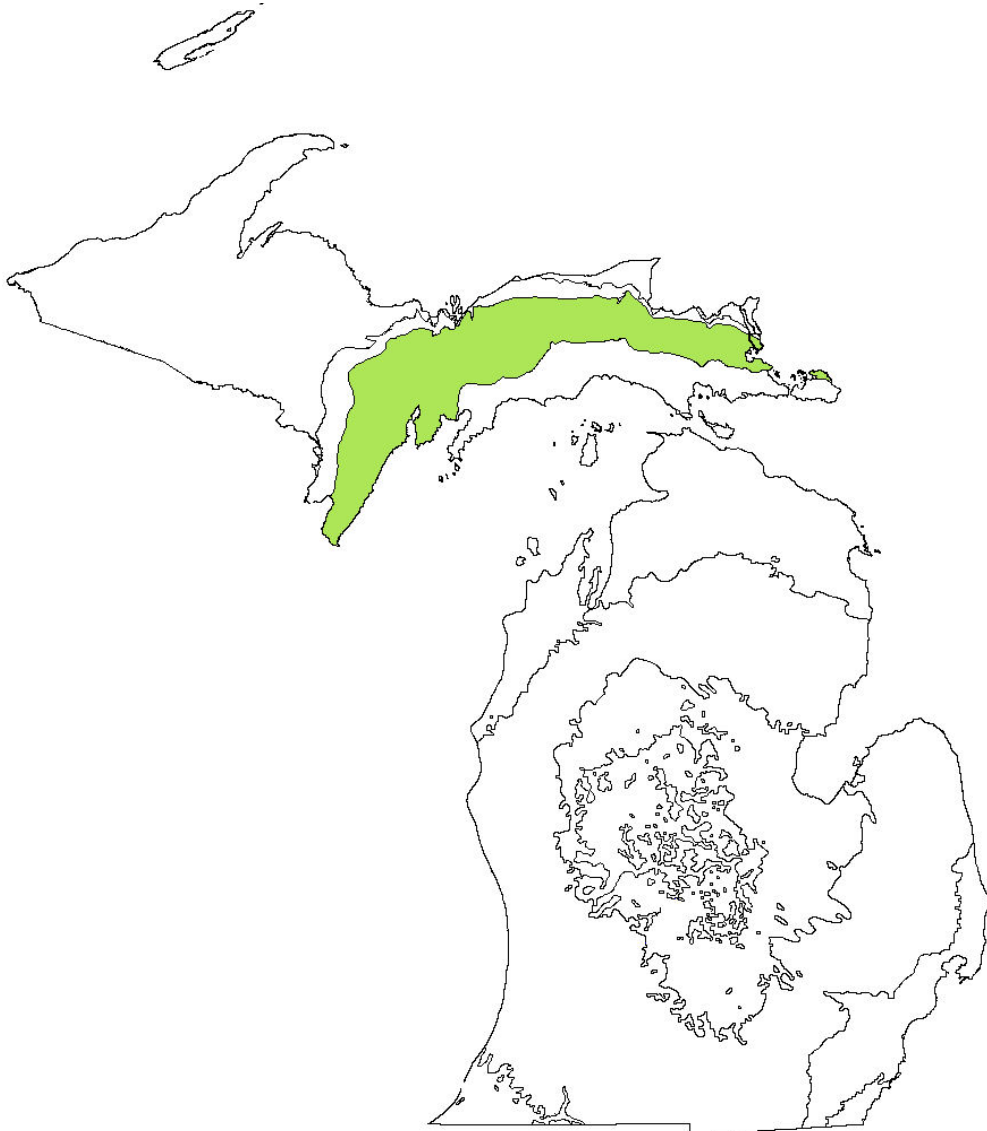
An isolated, shallow sea across parts of New York, Pennsylvania, Ontario and Michigan evaporated, leaving massive salt deposits. The seas abounded with reef- building corals, crinoids with root systems attached to the sea floor, mollusks and other marine life. While on land the first plants emerged.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

Thumbnail maps

**490,000,000 to 443,000,000,**



- 1,800,000  
Pleistocene
- 206,000,000  
JURASSIC
- 323,000,000  
PENNSYLVANIAN
- 354,000,000  
MISSISSIPPIAN
- 417,000,000  
DEVONIAN
- 443,000,000  
SILURIAN
- 490,000,000  
ORDOVICIAN
- 543,000,000  
CAMBRIAN
- 4,600,000,000  
Precambrian
- Not known  
in MI
- 144,000,000  
CRETACEOUS

**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

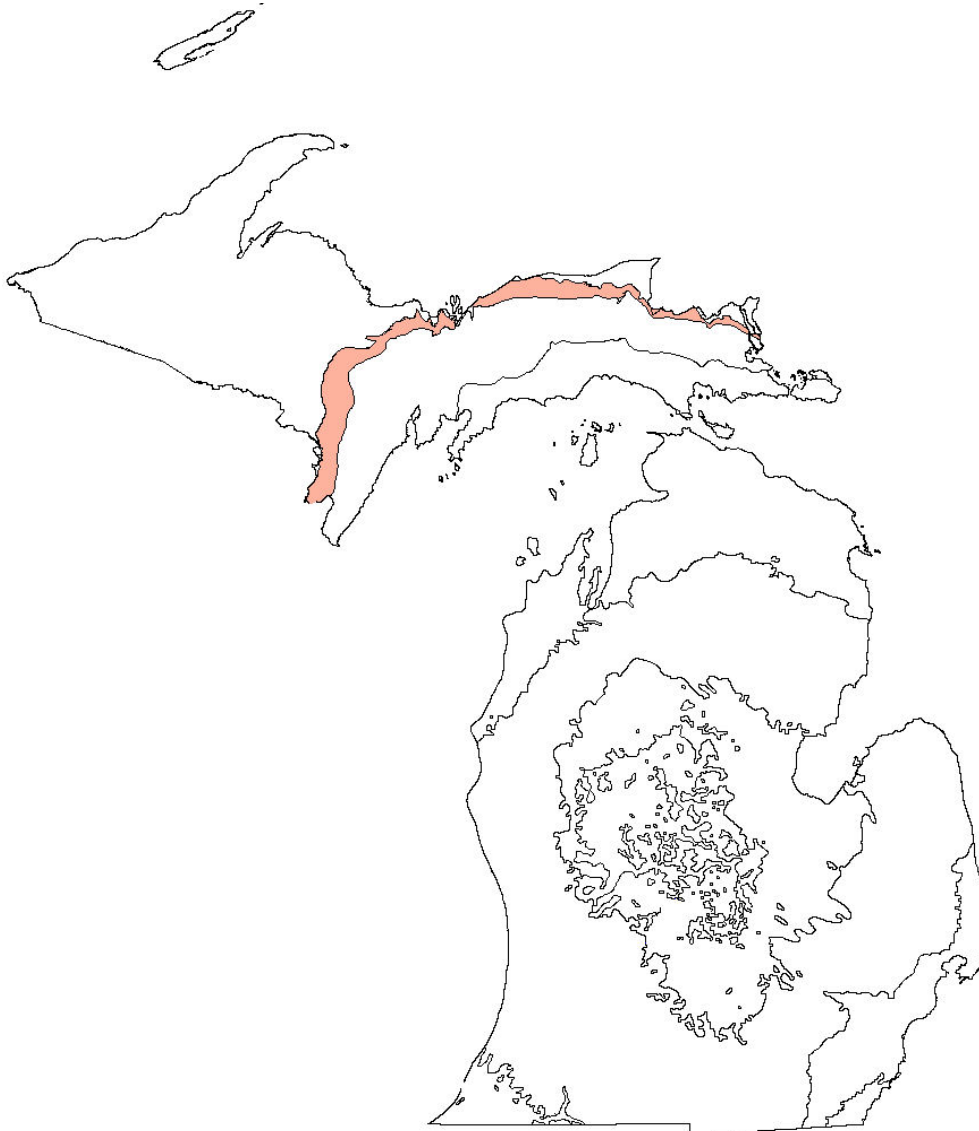
**Primary non-renewable resources:** limestone and dolomite; oil & gas

- 248,000,000  
TRIASSIC
- 290,000,000  
PERMIAN
- Geology Map

Thumbnail maps



# 543,000,000 to 490,000,000



- 1,800,000  
Pleistocene
- 206,000,000  
JURASSIC
- 323,000,000  
PENNSYLVANIAN
- 354,000,000  
MISSISSIPPIAN
- 417,000,000  
DEVONIAN
- 443,000,000  
SILURIAN
- 490,000,000  
ORDOVICIAN
- 543,000,000  
CAMBRIAN**
- 4,600,000,000  
Precambrian
- Not known  
in MI
- 144,000,000  
CRETACEOUS

## 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

- 248,000,000  
TRIASSIC
- 290,000,000  
PERMIAN
- Geology Map
- Thumbnail maps

**4,600,000,000 to 543,000,000**



1,800,000  
Pleistocene

206,000,000  
JURASSIC

323,000,000  
PENNSYLVANIAN

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

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543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

144,000,000  
CRETACEOUS

248,000,000  
TRIASSIC

290,000,000  
PERMIAN

[Geology Map](#)

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### **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

# Not known in MIchigan

1,800,000  
Pleistocene

206,000,000  
JURASSIC

## 144,000,000 to 65,000,000 - CRETACEOUS period

323,000,000  
PENNSYLVANIAN

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.

354,000,000  
MISSISSIPPIAN

417,000,000  
DEVONIAN

443,000,000  
SILURIAN

490,000,000  
ORDOVICIAN

## 248,000,000 to 206,000,000 - 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".

543,000,000  
CAMBRIAN

4,600,000,000  
Precambrian

Not known  
in MI

## 290,000,000 to 248,000,000 - PERMIAN period

144,000,000  
CRETACEOUS

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.

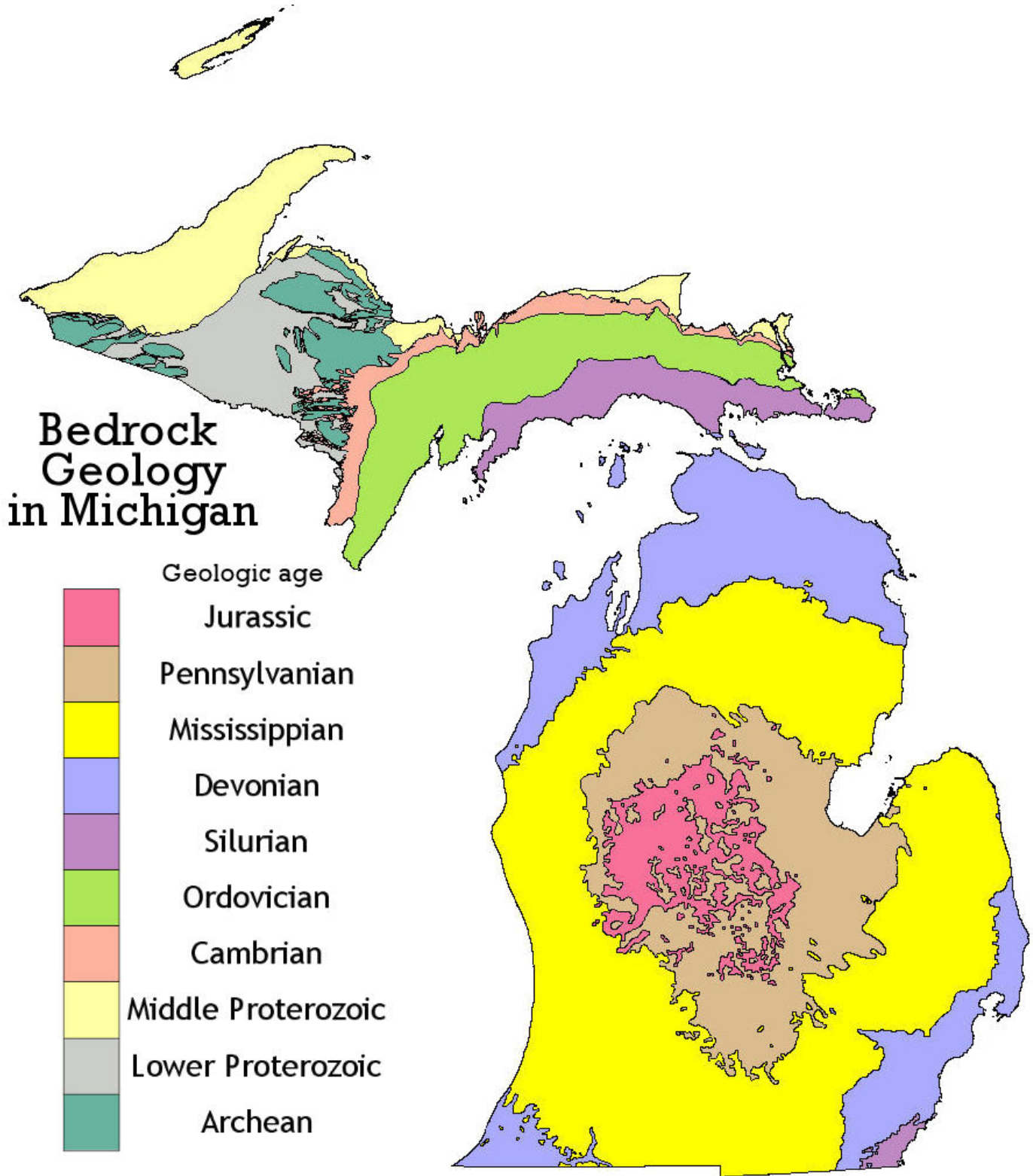
248,000,000  
TRIASSIC

290,000,000  
PERMIAN

[Geology Map](#)

[Thumbnail maps](#)

# Generalized Bedrock Geology in Michigan



Proterozoic and Archean bedrock have been combined as Precambrian bedrock on the previous maps. Each time period represented by a bedrock map is made up of multiple components often referred to as formations. Additional information about Geology in Michigan maps is available on-line at [www.michigan.gov/deqgeologyinmichigan](http://www.michigan.gov/deqgeologyinmichigan) (deq geology in michigan - all lowercase - no spaces)

Go to the Thumbnail maps